A Prototype for Decision Support Targeting Recreation Prescriptions for Older Adults in Social Isolation (ℛOSI)

Namrata Bagaria ⓘ and Daniel Amyot ⓘ, *Senior Member, IEEE*
Faculty of Engineering and LIFE Research Institute
University of Ottawa
Ottawa, Canada
nbaga065@uottawa.ca, damyot@uottawa.ca

Abstract—*Background*: Social isolation is a lack of regular social contacts that often negatively impacts well-being. The literature on recreational activities for addressing social isolation in older adults offers a variety of activities with different effectiveness levels, but it does so without concrete goals or decision methods to recommend them. *Goal:* This paper proposes a prototype for ℛOSI, a web-based decision support tool that aims to support independent living staff in identifying, assessing, evaluating, and recommending (prescribing) activities to improve the social engagement of residents. *Methodology*: The Design Science Research Methodology is used for the prototype development, and qualitative methods from social sciences were adapted for requirements elicitation. Data from 20 podcasts on preventing social isolation in older adults was analyzed using Braun and Clarke's thematic analysis. The results were used to complement the information extracted from a literature review to develop input questions, underlying logic, and outputs. *Results*: ℛOSI is built on Social Exchange Theory and the prototype was developed using open-source software (Pencil). ℛOSI is designed for independent living in North America. ℛOSI's input questions cover important aspects related to demographics, social engagement levels, interests, and accommodation needs. ℛOSI's outputs cover (1) baseline classification of an individual based on engagement levels, (2) confirmation of the user goal, (3) recommended recreational activities, benefits, steps, frequencies, and preparation checklists, and (4) reminders for individuals who use assistive technologies so that they can be prepared for their recreational activities. The underlying logic for recommending recreational activities aims to increase social engagement in an incremental manner. *Future Directions*: This is a work in progress and the prototype will be tested with older adults and experts in the field.

Index Terms—Decision support tool, goals, older adults, recreation, requirements, social isolation.

I. Background

Social isolation is defined as the objective lack of (or limited) social contact with others whereas loneliness is defined as the subjective lack of meaningful social contacts [1]. Social isolation was already a problem for the elderly and the COVID-19 pandemic exacerbated this problem even further [2]. Statistics suggest that more than a quarter of seniors in the US and Canada are isolated and almost half of them feel lonely [3].

Social isolation is harmful to the physical and mental health of an older adult and worsens hypertension, increases cholesterol, elevates stress hormones, weakens the immune system, increases chronic inflammation, and increases the risk of dementia [1]. Mental health and well-being, especially regarding issues such as loneliness, boredom, depression, cognitive decline, anxiety, and substance use, are also negatively impacted by social isolation [1].

Another major impact of COVID-19 has been the increased turnover of staff in all sectors, including independent living [4]. In this paper, we defined *independent living* as a range of housing and lifestyle options for aging persons adapted to the challenges of health issues associated with aging, such as limited mobility and susceptibility to illness [5]. Such options may include living in a retirement community or an age-restricted community but here do not include living in a nursing home or long-term care [5]. *Residents* are seniors who live in independent living. This is coupled with the caregiving crisis in Western countries where adults aged 35-55 are juggling between work, raising children, and caring for their parents, leading to burnout [6].

Recreational activities are known to have benefits on the health and well-being of older adults and also prevent and/or reduce social isolation and loneliness [7]–[9]. Seniors centers, independent living, community clubs, and neighborhood activities are some of the ways older adults can access recreational activities and stay connected. Many of these recreational activities are often led by facilitators such as certified instructors, recreation professionals, volunteers, or peers [7]–[9].

Given human resource constraints in caring for the elderly, it becomes imperative that we leverage the use of technology to deliver solutions for social isolation and loneliness at scale. A practical use of technology for elderly well-being is for creating a decision support tool that can help recommend recreational activities for social isolation based on an individual's needs and preferences. Such tool can act as a bridge between elderly care practitioners and the elderly population.

This paper focuses on two of the research challenges identified for the Requirements Engineering for Well-Being, Aging, and Health community [10], namely: "Developing (Web) services and applications for the aging group and combining qualitative and quantitative methods for realizing system requirements", and "Supporting systems for health-related decision and error detection, and health knowledge transfer". The goal of this paper is to describe the prototype of a decision support tool called ṚOSI (pronounced *Rosie*), an acronym derived from "Recreation Prescription for Older Adults in Social Isolation" where "Recreation Prescription" is presented by the symbol ℞. This tool is designed using the principles laid out by Catwell & Sheikh [11], who emphasize that e-health interventions need to be "fit-for-purpose" in order for elderly care practitioners to adopt them. We derive requirements for ṚOSI not only from a literature review [12], but also from the thematic analysis of a set of podcasts related to social isolation.

This paper first provides a brief review of the literature (Sect. II), followed by a description of the design methodology (Sect. III), with a focus on podcast thematic analysis for requirements elicitation. Section IV gives an overview of the partial results, and goals/requirements and a prototype are then presented in Sect. V. Section VI concludes the paper and provides an overview of the next steps.

II. LITERATURE OVERVIEW

In the existing literature, various approaches to addressing social isolation and loneliness in older adults have been explored. These include reviewing effective activities [9], [13]–[15], developing web-based assessments [16], utilizing virtual engagement platforms [17], and implementing inter-generational virtual programming [18]. The meta-review by Paquet et al. [15] integrated scientific evidence and on-the-ground knowledge and found that group-based social activities, support groups, recreational activities, and the use of information and communication technologies were more effective than increasing social interactions, promoting well-being, and providing home-based care in improving the outcomes. Blusi et al. [19] introduced the concept of co-creating meaningful individualized social activities, categorizing them into four types, which improved literature organization and strengthened associations between similar interventions and outcomes. Teh et al. [7] highlighted the effectiveness of culturally significant activities such as playing mahjong in Chinese elderly communities as an intervention for reducing loneliness. The literature thus makes a strong case for group-based, meaningful, and culturally relevant recreational activities as effective interventions to meet the social and emotional needs of diverse older adult populations.

In our previous work, we identified the lack of concrete goals or decision methods to recommend activities for addressing social isolation and loneliness in older adults as a gap in the literature [12]. This means that although recreational activities for social isolation and their effectiveness are well documented, there is limited guidance on which specific activities

should be recommended to individuals based on their unique parameters, contexts, and life events. For example, physical activity is most effective in reducing social isolation in able-bodied older adults [9], but we do not know if physical activity would be an effective intervention for a wheelchair-bound older adult. We, therefore, summarized the existing literature into different decision-support criteria such as user parameters (e.g. health, disability), user context (e.g. living alone or in a retirement facility), life events (e.g. death of a spouse), and user goals (e.g. make new friends); and also created classes, concepts, and attributes for recreational activities [12]. We believe that in addition to the recreational activity being group-based, meaningful, and culturally relevant, it should also be personalized and contextually relevant.

Another gap in the literature is effectively identifying individuals at risk of social isolation. While the literature provides a comprehensive list of risk factors for social isolation and loneliness (such as hospitalizations [1], falls [1], loss of hearing [1], death of a spouse [1], and recently COVID-19 [18]), the existing scales to measure social isolation [20] and loneliness (UCLA Loneliness Scale [21], De Jong-Giervald Loneliness Scale [22]) are reactive rather than proactive. Also, the current scales only measure social isolation or loneliness but not both, and given that social isolation can worsen loneliness and vice-versa [23], it would be worthwhile to consider using both scales in combination. Furthermore, these scales fail to account for the temporal aspect of social isolation and loneliness. Although some of the scales like the 20-item UCLA loneliness scale also measure the levels of loneliness, they do not capture the changes in the frequency, intensity, duration, and patterns of isolation and loneliness.

Overall, the current literature offers valuable insights into addressing social isolation and loneliness in older adults, but there is a need to bridge the gaps in identifying at-risk individuals, adopting a preventive approach, and providing personalized recommendations based on individual parameters and contexts which are meaningful and culturally relevant.

III. METHODOLOGY

A. Methodology Overview

We have adapted the Design Science Methodology (DSM) for information systems and software engineering, described by Wieringa [24], to develop and validate the ṚOSI decision support tool. Our methodology has ten steps, including iterations:

1) Problem identification and motivation through a systematic literature review and gap analysis;
2) Definition of additional requirements for the decision support tool through a thematic analysis of relevant podcasts;
3) Development of a ṚOSI prototype based on the literature review and podcast-driven requirements;
4) Validation of requirements and prototype through semi-structured interviews with social prescribers and older adults;

5) Re-iteration of the problem and motivation;
6) First iteration of prototype refinement;
7) Usability Survey 1 to get feedback;
8) Second iteration of prototype refinement;
9) Usability Survey 2 to get further feedback;
10) Final iteration of the decision support tool.

Step 1 was already performed with a literature review, part of which was already published [12]. This paper focuses on Steps 2 and 3, with early results on the analysis of podcasts for extracting additional requirements, and on the development of a ROSI prototype.

B. Podcast Thematic Analysis

The objectives and additional requirements for the solution were deduced from analyzing the data from a collection of podcasts on preventing social isolation in older adults called *Seniors Junction Podcast*[1].

Qualitative methods from social sciences were adapted for requirements elicitation [25], [26]. Twenty, one-hour public podcasts[2], with transcripts generated using *PodscribeAI*, were analyzed for complementing the information extracted from the literature review. *Dedoose*[3] was used as the software to do the coding and theme generation.

There are various approaches to conducting thematic analysis and we used the methodology proposed by Braun and Clarke [27]. The methodology follows a six-step process: (1) data familiarization, (2) coding, (3) generating themes, (4) reviewing themes, (5) defining and naming themes, and (6) writing up. Only one coder (the first author) conducted the thematic analysis and hence intercoder agreement was not addressed and the time to code was not recorded either. This is a work in progress and reflexivity will be used to improve the validity and reliability of the findings.

C. Coding

Perdana and Mokhtar [17] used *Social Exchange Theory* from Wan and Antonucci's work [28] to build their virtual engagement platform for older adults, and our work uses their model as the underlying research to build our decision support tool. The Social Exchange Theory proposes that behaviour and interactions among individuals are a result of an exchange process and that the relationship between individuals is generated by the pursuit of rewards and benefits and the avoidance of costs and punishment [28]. This essentially means that for every interaction, whether with a person or an activity, human beings are making calculations in their minds about whether to engage or disengage based on perceived costs (efforts, skills, money) and perceived rewards (experience, engagement, relationships). For example, someone who is shy or has social anxiety has higher costs to do social activities, whereas someone who already has a large set of friends may attend the fitness class for the sake of fitness and not social

[1]https://seniorsjunction.com/podcast
[2]https://app.podscribe.ai/series/1784180?title=Seniors%20Junction%20Podcast
[3]https://www.dedoose.com/

reasons. So we may want to understand the social motivation of a person while onboarding them.

The root codes and their child codes based on Perdana and Mokhtar's model [17], Social Exchange Theory [28], and the first author's recreation domain knowledge are:

- Root Code: Sociodemographic factors
  Child Codes: Race, Culture, Age, Gender, Marital Status, Family
- Root Code: Psychosocial factors
  Child Codes: Personality, Mental Health, Attitude
- Root Code: Contextual factors
  Child Codes: Falls, Hospitalisation, Events, Seasons, COVID-19
- Root Code: Relationships
  Child Codes: Quality, Partners, Groups, Networks
- Root Code: Costs
  Child Codes: Time, Money, Effort
- Root Code: Rewards
  Child Codes: Acceptance, Enjoyment, Companionship, Satisfaction, Stability
- Root Code: Social Exchange
  Child Codes: Reciprocity, Social support, Consistency
- Root Code: Risks
  Child Codes: injury, social rejection, dissatisfaction

It is important to note that we added a few nodes and codes based on the literature review, outside of the Social Exchange Theory. They are:

- Root Code: Individual factors
  Child Codes: Interests, Diseases, Disability, Quality of Life
- Root Code: Social support
  Child Codes: Intangible, Tangible, Instrumental, Informational
- Root Code: Emotional Response
  Child Codes: Positive emotions, Negative emotions
- Root Code: Purpose
  Child Codes: Relaxation, Creativity, Fun, Disease prevention
- Root Code: Activities
  Child Codes: Benefits, Side-effects, Alternatives, Frequency
- Root Code: Facilitators
  Child Codes: People, Skills, Technology
- Root Code: Barriers
  Child Codes: Shyness, Language, Accessibility, Past Failures

D. Validation of Requirements

The validation of the requirements for this research is outlined in Section VI. The requirements validation involves semi-structured interviews with social prescribers and older adults. Data collection will involve recruiting social prescribers through snowballing and professional networks, and older adults through an independent living facility in Ottawa. The interviews will be conducted through video calls for social prescribers and in-person meetings or telephone calls for older adults, respectively. Thematic analysis will be applied to the collected data to triangulate and validate requirements.

IV. RESULTS

Each podcast session focused on five questions: (Q1) Tell us about yourself; (Q2) What is your observation/ experience about social isolation amongst seniors (give the main

points)? (Q3) What is your vision for solving this issue?; (Q4) What are the challenges and opportunities?; (Q5) What advice do you have for a startup like ours, which is focusing on tackling this issue? The first question was not coded and a total of 165 codes were applied to four questions asked in the podcast. The demographic information from the first question was used to identify the job description of the different stakeholders. Only the first 20 podcasts (out of 60) were coded.

Three academics (music, gerontology, interdisciplinary), one family physician, seven entrepreneurs (in age tech), two non-profit executives, three independent living industry executives, one fitness educator, one poet, one aging coach, and three older adults were interviewed in the first 20 episodes. The podcast provided an interdisciplinary perspective on social isolation with technology being the most frequent code (24) followed by activities (14). Barriers (9), COVID-19 (8), facilitators (8), network (8), and accessibility (7) were the other most frequent codes, and the word cloud in Fig. 1 shows these codes in sizes representing their frequencies.

Figure 2 shows the different codes used and their frequencies. There were many codes that were not utilized in the analysis of these 20 podcasts and they do not appear in the truncated version of the tables. Since this is work in progress, we believe that those codes will be used in the remaining 40 podcasts. We do not believe we have achieved saturation yet.
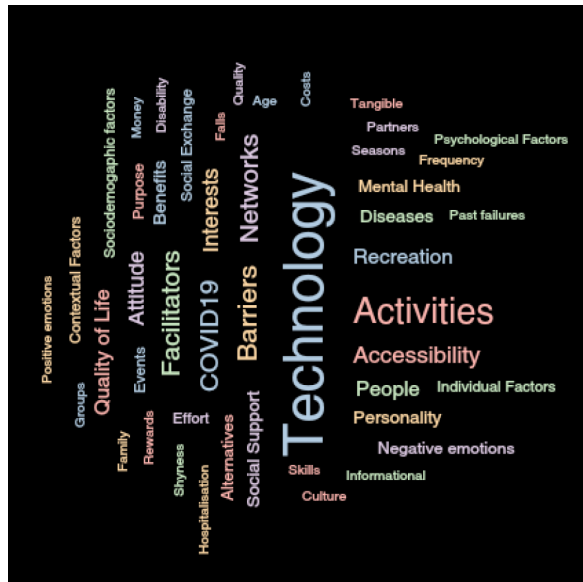

Fig. 1. Codes word cloud

V. REQUIREMENTS ELICITATION BASED ON EXCERPTS FROM THE PODCAST

A. ROSI Context

This system is designed for independent living facilities in North America. Its purpose is to assist them in identifying, assessing, evaluating, and recommending activities that can enhance the social engagement of independently living residents. The system can be used by both social prescribers (recreation or healthcare staff) or older adults themselves. In this paper, we only present one interface targeting older adults. However, we will add aggregated views and statistical report generation options for social prescribers before validation.

B. System Assumptions

We make several assumptions based on the thematic analysis of podcasts and the following are the results with important quotes.

- Assumption A1: People prefer recreational activities that are closer to their interests. Quote: *"And I asked him a very simple question. It was like (...) you know, 'do you want to do something?' You know, 'what, what do you want to do?' He was like 'well, there's nothing here for me to do'. It was like, they are doing bingo. They were doing some type of, you know, the classical drawings, classical music. I have no idea what that stuff. I don't have any, like any mariachi let's go to bring some tamales and make."*

- Assumption A2: Oftentimes, there is a mismatch between activities offered and resident interests, and sometimes family members can help communicate the preferences

	Barriers	Accessibility	Past failures	Shyness	Contextual Factors	COVID19	Events	Falls	Hospitalisation
Questions:	0	0	0	0	0	0	0	0	0
Questions:	7	3	1	0	1	3	0	0	0
Questions:	0	1	0	1	0	1	0	0	0
Questions:	2	3	0	0	1	4	2	1	1
Totals	9	7	1	1	2	8	2	1	1

Code frequency table 1/5

	Recreation	Activities	Alternatives	Benefits	Frequency	Groups	Networks	Partners	Quality	Rewards
	0	1	1	1	0	0	1	0	0	0
	0	3	0	0	0	0	2	1	0	0
	4	9	2	2	1	0	5	0	0	0
	1	1	0	1	0	1	0	0	1	1
	5	14	3	4	1	1	8	1	1	1

Code frequency table 2/5

	Individual Factors	Disability	Diseases	Interests	Quality of Life	Psychological Factors	Attitude	Mental Health	Personality	Purpose
	0	0	0	0	0	0	0	0	0	0
	2	0	0	0	1	0	2	1	0	1
	0	1	1	4	1	1	1	1	1	0
	0	0	3	2	3	0	3	1	3	1
	2	1	4	6	5	1	6	3	4	2

Code frequency table 3/5

	Seasons	Costs	Effort	Money	Negative emotions	Positive emotions	Facilitators	People	Skills	Technology
	0	0	0	0	0	0	0	2	0	9
	0	1	0	1	3	1	5	3	1	9
	1	0	1	0	0	0	1	2	0	6
	0	0	1	0	0	0	0	0	0	0
	1	1	2	1	3	1	8	5	1	24

Code frequency table 4/5

	Social Exchange	Social Support	Informational	Tangible	Sociodemographic factors	Age	Culture	Family	Totals
	0	0	0	1	0	0	0	0	16
	0	1	0	0	1	1	0	1	56
	2	0	0	0	0	0	0	0	50
	0	3	1	0	1	0	1	0	43
	2	4	1	1	2	1	1	1	0

Code frequency table 5/5

Fig. 2. Code frequency table (low , medium , high)

and interests of the residents to the independent living staff. Quote: *"It's more about people's interests: some people interested in art, some people interested in building new connections with other people, some people are interested in wellness and trying to maximize these exercises or whatever other programs that are available"*.

- Assumption A3: Different people have different levels of need to connect with others. Quote: *"You know, my dad was one of hundreds of older adults in this community, but when I saw him, he looked very lonely, very depressed, very isolated"*.

- Assumption A4: People's personalities play an important factor in their social engagement process. Quotes: *"She was thriving and able to interact with different people, but my dad just kept staying, staying in a room and not wanting to leave. So that experience of isolation is also, was also compounded by boredom. So, you know, it was up for like 14 hours a day. He was, you know, he can read, he can, you know, do crosswords or Sudoku puzzles or whatever, but he wouldn't engage with technology."*

- Assumption A5: Past injuries or negative experiences act as barriers to participating in recreational activities. Quote: *"Oh, I don't really want to go out and I'm embarrassed by walker"*. *"Well Mary, did you know, if you come to the fitness class, we can help you feel more confident, stand up a little taller with that walker"*.

- Assumption A6: People prefer doing activities with friends rather than strangers. Quote: *"One of the things is that, as people get out of the workforce and start to enter the senior part of their lifestyle to remain connected as much as possible to friends, family organizations."*

- Assumption A7: Engagement is a gradual process. *"Hey, these are your, you know, two closest seniors centers. This is what they do. Here's a way to get out and be with people. I think people, you know, also just tend to retract as they get older as is what I've seen too."*

- Assumption A8: Consistency is an important social exchange to improve engagement levels. Quote: *"So I think empowering these seniors to interact via technology will be a means to really address that social isolation and find them a consistent way any time they're feeling lonely to have someone to interact with is really through online platforms"*.

- Assumption A9: Social engagement is a spectrum and people can move between the categories multiple times in a year or lifespan. Quote: *"On the one hand I do, and I encourage people to consider senior housing, because it's not a hospital and it's not some place you go to die. It's the place where you can live the rest of your life in a good environment, surrounded by people when you want to be surrounded by people. And when you'd rather sit in your room, read a book, watch TV, watching Netflix. You're completely free to do that, but you have the choice of socializing when you choose."*

- Assumption A10: Life events such as the death of a spouse, falls, and hospitalizations can temporarily or permanently impact people's social engagement levels. Quote: *"So a lot of times we work with Seniors who have had a significant other, the other passed away, and now they're isolated. Right? And I think that it snowballs quicker than people think is going to. And so you're going from a social network, maybe that spouse or partner was the driver, and you're going from the social aspect to completely on your own isolated and everything in your life."*

- Assumption A11: Environment factors, such as COVID-19 restrictions of social distancing, can negatively influence social engagement. Quote: *"Like I said, slippery slope, you start retracting. And then all of a sudden, you know, your eating is, you know, gone down on your medication is getting messed up and, you know, all sorts of things come out of that."*

- Assumption A12: Recreation needs to be customized based on health and ability. Quote: *"And I think societies, depending on what the medical condition of the person is, it can be very helpful: heart and stroke foundation, cancer society, Alzheimer's society, United Way... All have excellent resources that can be utilized to help people who either are, or at risk of becoming isolated."*

C. System Goals

The main goal of this system is to aid the decision process involved in recommending recreational activities to residents living in independent living. In particular, the system will help the residents and social prescribers achieve several refined goals, which target specific assumptions ([Ax]):

- Goal G1 [A3,A4,A9]: Identify the levels of social engagement and classify a resident's social engagement levels. Quote: *"We definitely, due to the isolation. We have seen an enormous increase in cognitive deficits. So the folks that are staying at home that possibly were making a move last year, they were in a process to do so in that, decided to stay at home. Those seniors they are having a lot more cognitive issues, and people are just staying way too long at this point"*

- Goal G2 [A3-A6,A12]: Select a resident's goals for social engagement. Quote: *"..remain connected as much as possible to friends, family organizations, to take up things that they may not have tried before, belong to clubs, religious organizations, the library."*

- Goal G3 [A5]: Identify a resident's challenges. Quote: *"And I think there's a lot of stigma about getting older, right? As well. And they don't want to be seen as someone that, you know, it has balance issues or can't do the grocery shopping anywhere. So that it's, it's a pride thing as well."*

- Goal G4 [A1,A2]: Suggest social activities based on the interests of a resident. Quote: *"..I think that we want people to enjoy poetry, writing it and reading it."*

- Goal G5 [A10,A11]: Suggest alternative social activities for different events (COVID-19) or abilities. Quote: *"And*

I think we will have the way we have it set up each week, a different topic or a different sort of thing."

- Goal G6 [A7,A9]: Gradually increase the levels of social engagement. In the following quote, the older adult mentioned mainly spending their time watching television, and it will require sustained and gradual efforts to motivate them to leave the couch and engage in social activities. The initial step with individuals in this situation is to encourage them to get up from the couch and spend time outdoors even if its as simple as sitting on a park bench. Quote:*"And a lot of the seniors their families tell us you know, you know, as long as she's got a seat in her a room and a TV, she was good. And it's like, well, that's not awesome. Like it's, you know, it's not great."*
- Goal G7 [A8]: Ensure consistency. Consistency is used here as an import social exchange currency. The podcast quote from A8 is also applicable here.

D. Classifications and Definitions

From the literature review, it was clear that although there are many scales available to measure social isolation and loneliness [1], the choice of the scale depends on the context of use [29]. One of the common reasons to move into independent living is to get help with meal preparation and most independent living homes have shared social spaces and dining halls for residents to take their meals together. *"And of course, you know, one of the things, again in our senior housing sector that we like to talk about is the fact that when seniors move from home to a retirement home, they put on weight because when they were at home, when you're living alone for 10 years, you're not cooking meals, you're drinking tea and dunking biscuits this into your tea"*. Additionally, eating alone has detrimental effects on social isolation and loneliness, and eating meals together provides mental health benefits in the case of older adults [30].

In order to make ROSI proactive, we have created a preliminary classification that is non-clinical and based on social engagement rather than isolation or loneliness only. We call this classification the *ROSI classification for social engagement in older adults* and it is based on the frequency of eating meals together and attending recreational activities and is intended for community use by non-experts. At present, we did not factor in common geriatric issues such as depression, anxiety, and loneliness and since our process is iterative, we plan to incorporate inputs from the *De Jong-Giervald Loneliness Scale* in our subsequent iterations. The *ROSI classification for social engagement in older adults* is as follows:

- *Shut-in*: A person who does not leave their apartment or room for any activities for weeks. They may request for meals to be delivered to their apartments or rooms, do not talk to anyone, and are not interested in recreational activities in the independent living facilities.
- *Unengaged*: A person who may leave their apartment or room for activities of daily living like meals, but prefers to keep to themselves. They are aware of the recreational activities in the independent living facilities but do not

attend them. They are waiting for the right activity or event or person to pique their interest.
- *Passively engaged*: A person who eats most of their meals in common areas and infrequently attends recreational activities. They may have made a friend or two in the independent living facilities.
- *Actively engaged*: A person who eats most of their meals with friends in the dining hall or shared social spaces. They regularly attend recreational activities. They have many friends and acquaintances, and they may also volunteer in independent living facilities.

It is important to keep in mind that these categories are not static but dynamic, as a person may progress or regress in their social engagement levels due to their health, disabilities, or life events.

E. ROSI Components

ROSI consists of three main components (1) Inputs (Figs. 3, 4, 5, and 6); (2) Decision Support Rules (Tables I and II); and (3) Outputs (Figs. 7, 8, 9, and 10). A more complete version of this work-in-progress prototype is also available online[4]. The following sections describe the ROSI prototype in more detail.

1) Inputs: The inputs of ROSI will be gathered through a web-based application and the questions and reasons to ask them are summarized in our previous work [12]. One guideline considered while designing the input questions was to ask the minimum number of questions to get the maximum information needed to generate the outputs. The questions cover different inputs needed to run the underlying decision support logic and include: (1) social demographics (age, gender); (2) motivation to join recreational activities; (3) meal patterns (frequency of eating alone and with others); (4) loneliness levels (De Jong-Gierveld Loneliness Scale); (5) interests: music, arts, physical activity, sports, movies, watching TV, nature, etc.; (6) disabilities or challenges: visual, hearing, mobility, speaking, etc.; and (7) preferred group size (some people may be introverted or prefer smaller groups).

The interests list will be gathered based on the literature review and by reviewing the different activities and schedules of independent living by going through their websites. The rationale here is to offer a selection of recreational activities typically available at independent living. This strategy will also help prevent disappointment and loss of engagement resulting from suggesting recreational activities that may not be available in an independent living facility. When addressing the accessibility needs of the residents, the latter will be incorporated in the decision support logic to recommend activities and also provide reminders as an output. The purpose of the reminders is to help staff prepare the residents for the activities and ensure that small tasks do not become barriers to participation. For example, discharged batteries from hearing aids or insufficient space to park the walker in a room are common barriers to participation in recreational activities.

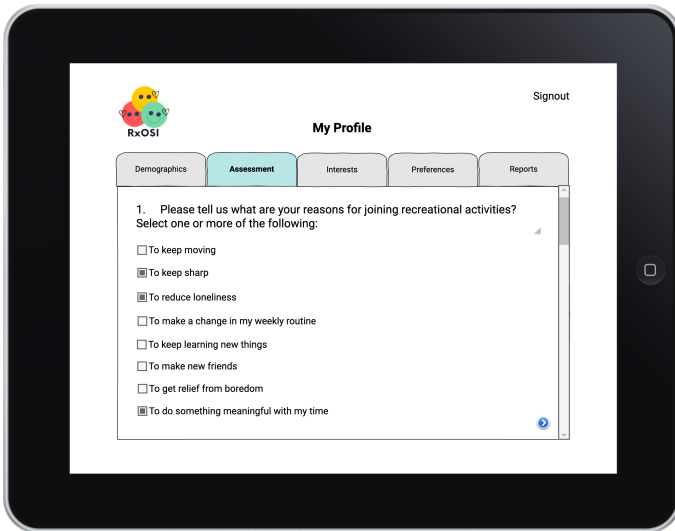[4]Full ROSI static prototype: https://bit.ly/3pnbO5i

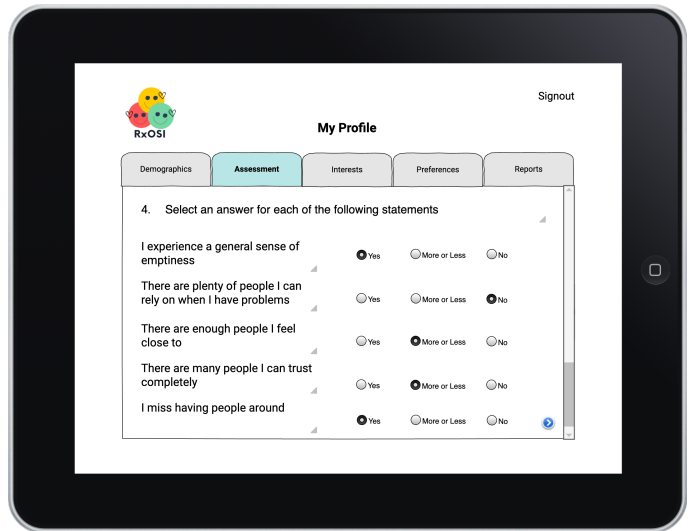Fig. 3. Input – User goals (Goal G1 [A4,A9])

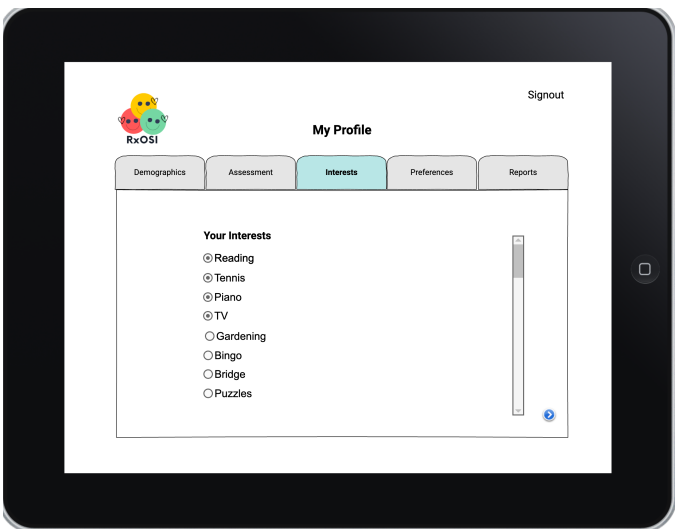Fig. 5. Input – De Jong-Gierveld Loneliness Scale (Goal G6 [A7,A9])

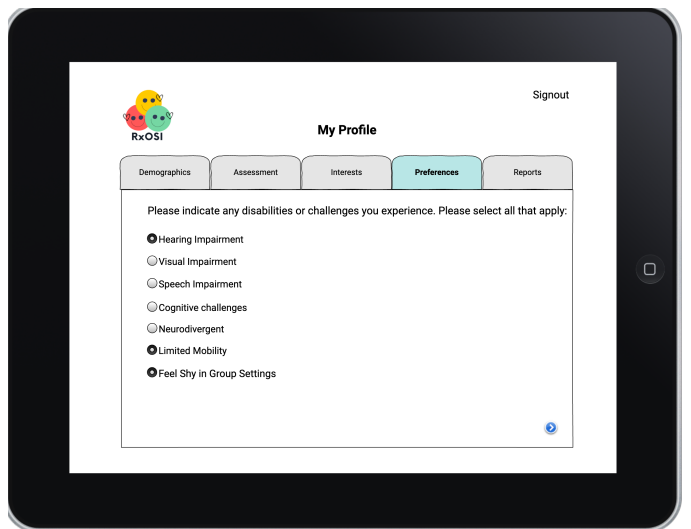Fig. 4. Input – User interests (Goal G4 [A1,A2])

Fig. 6. Input – Accessibility needs and challenges faced (Goal G3 [A5])

2) Decision Support Rules: The underlying logic for recommending recreational activities is to increase social engagement in an incremental manner (A7). This means that the system takes into account the assumption that different individuals are at different stages of their social engagement journey and what works for one individual may not work for another individual (A9). The logic is an attempt toward *personalization* of recreational activities (A1,2,12).

The underlying social exchange currency for the decision support rules in our system will be *consistency* (goal G7). Although Wan and Antonucci [28] did not identify consistency as a social exchange currency for aging, previous work by Meeker [31] identifies consistency as an element in social exchange. We have observed that in the list of recreational activities found on the monthly calendars of various independent living facilities, there are fewer explicit opportunities for

giving or receiving *social support* and *reciprocity* but plenty of obvious ones for consistency.

With regards to the selection and gradation of recreational activities based on individual interests (goal G6), a database will be created by gathering information from the websites of independent living facilities. This approach will ensure that the recreational activities recommended by RxOSI align with the offerings available at these facilities (goal G4,G5). The rationale for incorporating a range of activities stems not from literature or podcasts, but from observations made by the first author during visits to independent living communities. These observations revealed that some individuals prefer solitude and may simply enjoy sitting alone on park benches, while others may prefer engaging socially with a limited number of people, and a few others may prefer actively participating in activities such as volunteering. These observations serve as

a reminder that recommendations provided by RÓSI should prioritize incremental improvements in residents' quality of life within independent living rather than sudden changes or a one-size-fits-all approach (goal G6).

Tables I and II provide a summary of the underlying logic for decision support, which is based on Social Exchange Theory. Table I illustrates how the system will generate goals and recommendations for a user, taking into account their social engagement classification (goal G1). To assess a user's engagement levels, the system will analyze their current activity levels, meal patterns, and score on the standardized De Jong-Gierveld Loneliness Scale. The underlying logic recommends activities based on individuals' social engagement levels, even for individuals with similar recreational interests. The primary objective is to increase their social engagement from their baseline levels (goal G6). For instance, a shut-in individual with an interest in reading may be recommended to read a book on a park bench outside, with the goal of encouraging them to leave their apartment. An unengaged individual might be offered a ride to the library or asked to share their weekly reading with others in the facility. A passively engaged person could be suggested to join a book club at a nearby library, while an actively engaged person might be recommended to initiate a new activity such as starting a book club or providing book recommendations for an existing book club.

TABLE I
RECOMMENDATIONS BASED ON THE RÓSI CLASSIFICATION (GOAL G1) AND GRADUALLY INCREASING THE LEVEL OF SOCIAL ENGAGEMENT (GOAL G6)

Identifying Factors (Inputs)	Gradually Increasing Social Engagement Levels (Decision Support)	Classification (Output Goal G1)	Recommendations (Outputs for Goal G6)
(1) Eat in their rooms OR Eat alone, (2) Not interested in anyone, (3) Not aware of the activities that are going on in the facilities.	(1) Get them out of their room or apartment. (2) They can continue activities in solitude, but the key focus is to get them out of the room.	Shut-in	(1) Medical and psychological assessments and treatment. (2) Social visits by a social worker or a recreation team member.
(1) May leave their room for activities of daily living like meals, (2) Prefer to keep to themselves (3) Aware of the recreational activities but do not attend, (4) Waiting for the right activity, event, or person to pique their interest.	(1) Get them into shared social spaces and start attending activities.	Unengaged	(1) One-on-one visits by recreation teams to talk to them and get to know their interests. (2) Offer one event or activity suited to their interest to draw them in.
(1) Eat most of their meals in shared social spaces, (2) Infrequently attend recreational activities, (3) May have made a friend or two.	(1) Get them to attend activities more frequently.	Passively engaged	(1) Activate social support, (2) Buddy system may work the best
(1) Eat most of their meals with friends in shared social spaces, (2) Regularly attend recreational activities, (3) Have many friends and acquaintances, (4) May volunteer in the retirement facilities	(1) Give them opportunities to contribute and lead.	Actively Engaged	(1) Tokens of appreciation for their contribution.

Additionally, Table II illustrates the additional attributes that

TABLE II
SOCIAL EXCHANGE THEORY LOGIC FOR THE SYSTEM

Attributes	Parameters	Assumptions	Goals
Sociodemographic factors	Gender	A3	G2
Individual Factors	Health	A12	G2
Psychosocial Factors	Loneliness	A9, A7	G1, G6
Contextual Factors	Independent Living Resident	A2	G4
Relationships	Friendships	A3-6	G1,2
Costs	Time, Effort	A3-6	G2
Rewards	Enjoyment, Company, Pass time	A1	G4
Social Support	Informational	A3,4	G1
Social Exchange	Consistency	A8	G7
Emotional Response	Happy	A4,5	G2
Purpose	Fun	A3-5	G2
Activities	Fitness, Frequency	A1,2	G4, G6
Facilitators	Staff, Buddy resident	A10,11	G5
Barriers	Lack of accessibility	A5	G3
Risks	Social Rejection	A5	G3

require development to align the system with Social Exchange Theory. These attributes correspond to the codes used for thematic analysis and encompass sociodemographic factors, individual factors, contextual factors, relationships, costs, rewards, social support, social exchange, purpose, activities, facilitators, and barriers. For example, if an individual is shy to engage socially due to hearing loss, the system should be capable of identifying shyness as one of their barriers. It should provide suggestions such as reminders to charge their hearing aids and starting with small social interactions to overcome these barriers. It is important to note that this work is still in progress and subject to further refinement.

In terms of deployment, our primary focus is on developing a digital decision support tool. However, it is worth noting that this logic can also be implemented as paper-based decision tools for retirement homes that lack internet access or have not undergone digital transformation.

3) Output: The following statement captures the objective of the decision support tool in one sentence:

> **Who** (person) needs to do **what** (recreation activity and frequency) to achieve the **desired social engagement levels** (goal).

At the moment, RÓSI is designed to generate four main outputs: (1) classification of an individual's social engagement levels (Fig. 7); (2) confirmation of user goals; (3) recommendations for recreational activities based on user profile (Figs. 8 and 9); and (4) reminders for individuals who use assistive technologies so that they better prepare for their recreational activities. For example, discharged batteries from hearing aids or insufficient space to park the walker in a room are common barriers to participation in recreational activities. The rationale behind the reminders feature is that the tool proactively reduces barriers and thus perceived costs to participation since it is based on Social Exchange Theory.
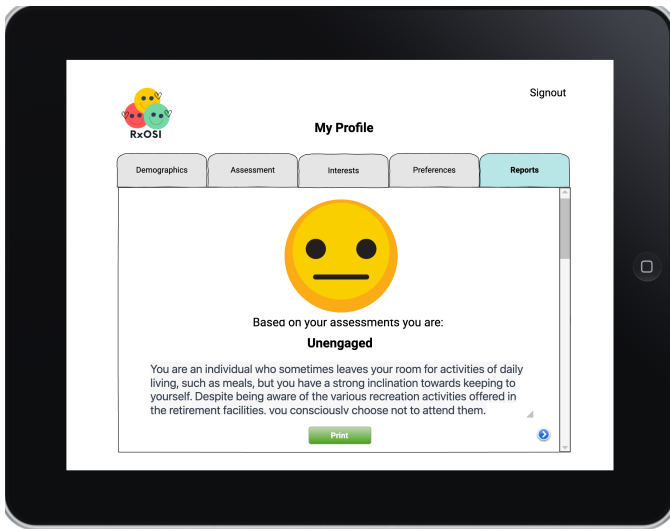
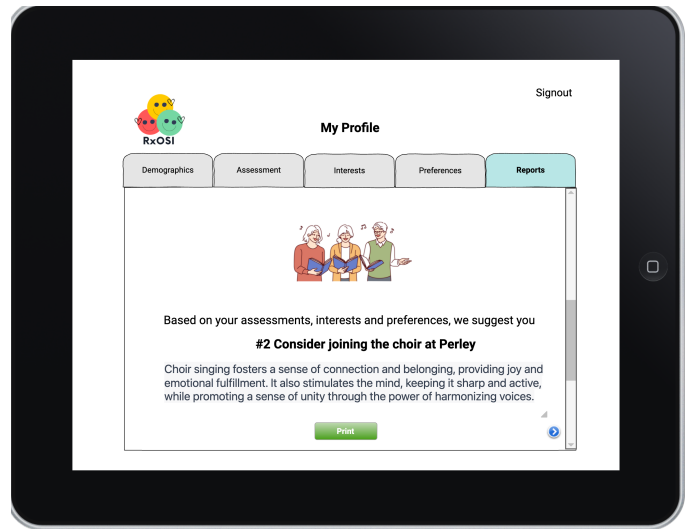Fig. 7. Output – Social engagement classification (Goal 1 [A3,A4,A9])

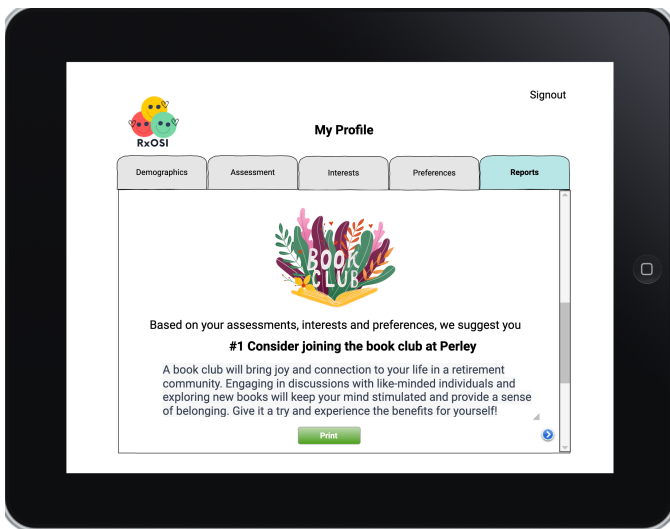Fig. 9. Output recreation recommendation 2 (Goal 4 [A1,A2])

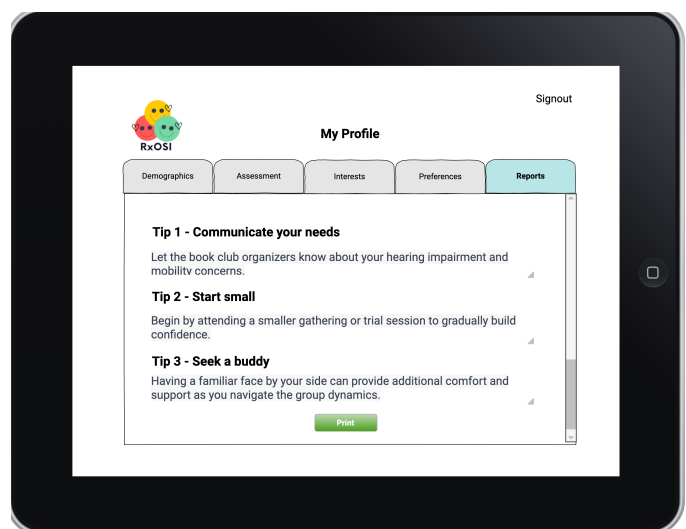Fig. 8. Output recreation recommendation 1 (Goal 4 [A1,A2])

Fig. 10. Output social skill tips (Goal 3 [A5])

In addition to these outputs, the system will also provide tips on socialization to assist or encourage individuals who may be shut-in, disengaged, or shy (Fig. 10).

VI. CONCLUSION AND NEXT STEPS

RxOSI is designed for independent living in North America to help identify, assess, evaluate, and recommend activities to improve the social engagement of the residents. We used a literature review and a thematic analysis of 20 public podcasts to gather requirements (including assumptions and goals) for RxOSI's design. The use of podcasts, although not new [32] is seldom seen for requirements elicitation. The availability of public podcasts that had the same structure and that targeted the same domain (social isolation in older adults) enabled the feasibility of this approach, and the successful elicitation of a collection of requirements (with frequencies based on coding,

which improves confidence) that would have been difficult to get from individual podcasts or interviews. This analysis is a work in progress and 40 more podcasts will be coded.

The tool's input questions cover different aspects needed in Social Exchange Theory (with a focus on consistency as social exchange currency) including (1) social demographics; (2) baseline social engagement levels; (3) interests; and (4) accessibility needs. The underlying logic for recommending recreational activities is to increase social engagement in an incremental manner through *personalization*. The outputs include: (1) classification of social engagement; (2) goal-based activities recommendations; (3) reminders; and (4) social skill tips. Future work will also include the frequency of the activity as an output. Special attention to safety and adequacy will also need to be paid when recommending social prescriptions.

The next steps for this research involve completing the

podcast analysis, and then validating the requirements and prototype (Step 4 in Section III-A). The requirements will be validated through a 29-item semi-structured interview, and the ethics application for this is in progress. There are separate interview guides and consent forms for social prescribers and older adults with a significant overlap in the questions. The semi-structured interview has four sections: (1) demographic information; (2) practices or observations used to identify an individual at-risk for isolation; (3) user preferences and training requirements for RxOSI; and (4) potential facilitators and barriers to RxOSI acceptance. Social prescribers will be recruited through snowballing techniques via research and industry professional networks, while older adults will be recruited from Perley Health, an independent living facility in Ottawa. Upon obtaining ethics approval, the interviews will be conducted through video calls for social prescribers and in-person or via phone calls with older adults. The collected data will be analyzed using thematic analysis and responses will be summarized to triangulate the requirements.

For refining and validating the prototype (Steps 5 to 10 in Section III-A), another instrument (a survey) will be developed and used for the two iterations, and a second ethics application will be sought.

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