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Towards a Decision Support Tool to Prescribe Recreation for Older Adults in Social Isolation (RxOSI)

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***Abstract*—Social isolation is the objective lack of social connection. Social isolation in older adults was an issue before the COVID-19 pandemic hit and the issue only got exacerbated during this period. Today, loneliness is a bigger public health problem than obesity, and often isolated older adults are lonely too. Recreation activities such as participation in physical activity, arts, music and other such social activities offer physical, mental, social and cognitive benefits to older adults, including reduction of social isolation and loneliness. Social prescription has gained momentum in countries like the United Kingdom and Canada. Social prescriptions usually include a diverse range of non-clinical interventions, such as educational classes, arts and culture engagement, peer-run social groups, and nature-based activities. The present state-of-art literature recommends multiple interventions for social isolation and loneliness, however the literature falls short of explaining the basis of these recommendations. Decision support tools have been extensively used in clinical medicine and they help standardize the quality of care and improve physician workflow. In the field of knowledge engineering, qualitative methods have a significant contribution to convert domain knowledge into decision support tools. This paper describes a thesis on a qualitative study that will iteratively build and validate a decision support tool (RxOSI) recommending recreational activities to older adults for reducing social isolation. The paper provides a brief overview on the state-of-art, challenges, proposed solution, methodology, contributions and work-in-progress.**

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

I. Introduction and Background

Close to one in five Canadians (18.5%) are now aged 65 and older [36]. The number of centenarians rose by 1,100 year over year to 12,822 [36]. By 2036, the population aged 65+ is expected to increase to between 23 and 25 percent [19]. 1 billion people are aged over 60 years as of 2020 [27]. By 2050, two-thirds of the world's population over 60 years will live in low- and middle-income countries [27]. The number of persons aged 80 years or older is expected to triple between 2020 and 2050 to reach 426 million [27]. Annually Medicare (US) loses 6.7 billion dollars due to social isolation in older adults [24].

In this context where aging and related socio-technical challenges are increasingly relevant and important [22], several key definitions must be provided.

- *Older* adults or *seniors* or *elderly*: The World Health Organization defines individuals above 60 years of age as senior citizens or older adults or elderly [27]. In industrialized Western countries, the cutoff is 65 years and above. I have used 55+ as the definition of seniors, which is consistent with the most commonly used in academic research for older adults [42].
- *Loneliness*: the perception of social isolation or the subjective feeling of being lonely [26].
- *Social isolation*: The objective lack of (or limited) social contact with others [26].
- *Recreation*: Activity done for enjoyment when one is not working [29].

II. Motivation

Social prescribing (SP) is a popular practice in the UK through which General Practitioners (GP) prescribe nonclinical interventions that are within a patient's community and help improve a patient's social determinants of health. SP is an important component of universal personalised care in the UK [7]. SP has been used mainly for community-based management of complex chronic health issues such as diabetes, hypertension and heart failure, but also social isolation and loneliness. [7]. Social prescribing has no fixed definition, but the Social Prescribing Network defines it as "enabling healthcare professionals to refer patients to a link worker, to co-design a nonclinical social prescription to improve their health and well-being" [10], [35]. Since the problem of social isolation has become a problem of scale, there is a shortage of social prescribers. As the solutions are usually non-clinical, it is possible to meet some of the demand through evidence-based consumer apps. I therefore plan to create a tool that can help doctors, families, caregivers and older adults themselves find activities suited to their abilities and interests, and thereby live a meaningful retirement with less isolation and, in turn, fewer visits to emergency units.

III. Research Questions

The main research question (**RQ**) is: How can we build an effective decision support tool to prescribe recreational activities to older adults in social isolation? RQ can further be broken down into the following sub-questions:

- **RQ1**: (a) Who are the users? (b) What answers are they looking for? (c) How can a decision support tool provide that answer?
- **RQ2**: What are the different recreational activities that can be beneficial to reduce social isolation?
- **RQ3**: How effective can a decision support tool be in helping older adults become less socially isolated?

From these research questions, many socio-technical challenges can be inferred:

- **C1**: Need for clear user requirements for social prescriptions (user goals and context preferences) and capabilities. Will the recreation activities satisfy these needs and goals?
- **C2**: Balancing the decision to recommend activities to a user with that of a prescriber. Social or recreation prescription involves multiple stakeholders.
- **C3**: Who should participate in validation for the decision support tool? The practitioner's perspectives may vary significantly from the end user's perspectives.
- **C4**: Measurement of outcomes. In a prescription, there is typically a dose response curve to the medication and it depends on the strength and frequency of the medication. In the case of social prescription, what would constitute the appropriate measurement? Intensity or frequency of the activity or engagement parameters such as enjoyment, finding meaning in the activity or the social components of the activity?

For C1 and C1, we are considering using goal-oriented modeling [17] as a mechanism to specify goals, preferences and contexts, and to measure user satisfaction.

IV. State of the Art

A. Systematic Literature Review

A systematic literature review was conducted using a single search query (((recreation* OR hobb* OR leisure) AND ("older adult*" OR elder* OR senior*) AND ("social isolation" OR loneliness))). The titles, abstracts and keywords of three wide-ranged and relevant databases (Scopus, CINAHL, Pubmed) were searched. Inclusion, exclusion and quality criteria were established to screen the papers. The inclusion criteria are 1) Age: 55+ years, 2) Intervention: recreation or leisure activities for social isolation, 3) Outcome: prevention or reduction of social isolation or loneliness, 4) Study Design: both qualitative and quantitative but with clear methodology, peer reviewed, reviews papers. The exclusion criteria are: 1) Papers not in English, 2) Papers from predatory journals, 3) Research protocols, letters. Covidence was used to screen the papers: (Step 1) title/abstract screening and (Step 2) full-text reading. The selected articles were analysed using a thematic analysis methodology. Constructivist and positivist lens and a deductive-abductive approach were used while performing the qualitative analysis of the literature.

The results (Scopus: 263, CINHAL:111, Pubmed: 93) were downloaded and imported into the Zotero reference manager, and then exported to Covidence, a systematic review tool by Cochrane. 143 duplicates were removed by Covidence, 324 unique studies were screened against title and abstract, and 207 studies were excluded in this step. Out of the 117 studies assessed for full-text eligibility, 81 studies were excluded (32 wrong intervention, 29 wrong outcomes, 15 wrong patient population, 3 wrong study design, 1 not in English, 1 wrong setting). This led to 36 included studies. Using a snowballing approach applied to these papers, 4 more articles were added. A total of 40 articles were reviewed. The major findings and limitations found in the review can be classified in the following themes: (1) trends, (2) an activity theory framework, and (3) requirements and decision methods.

B. Trends

Social prescribing started in the UK as early as the mid 1980s but it is only recently (2019) that it has become a part of the Universal Personal Care Plan in the UK [7]. There is an increasing trend in the number of publications on this topic, as show in Fig 1.

Four articles explicitly mentioned COVID-19 as a contextual factor, with three focused on virtual social activities [14], [28], [34] and one on outdoor physical activities [6]. These findings are consistent with the physical and social restrictions that were enforced during the pandemic, where there was an increase in outdoor and virtual recreation seen worldwide. Although there was one study reviewing the use of computers, internet and quality of life as early as 1999 [45], it is not until 2018 that we see virtual recreation for social connection in the literature [3]. Thirteen articles [6], [16], [20], [23], [30], [38], [39], [42] focused on loneliness, 9 articles [3], [8], [25], [31]–[33], [40], [41], [47] focused on social isolation and 8 articles [2], [5], [9], [14], [28], [34], [43], [45] focused both on loneliness and social isolation in older adults. Not all articles are cited here due to space constraints.

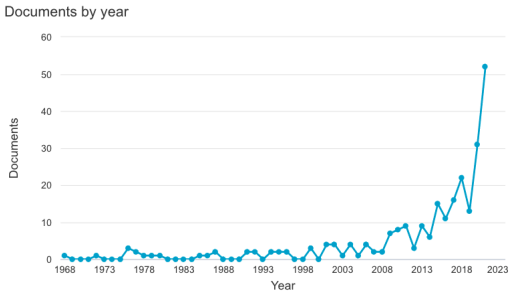

Fig. 1. Publication trends for the search query ran on Scopus.

C. Theory Framework

The purpose of many literature reviews and theses is to contribute to an existing theory or create a new one. In order

to effectively synthesize the existing state of the literature, I looked for theoretical frameworks within the literature. In the practice of social prescription, the key components of social prescribing at a glance are the client, the prescriber, the social prescribing navigator, the social prescription or non-clinical interventions and the data tracking pathway [10]. According to Stevenson [37], social prescribing is currently a popular but an atheoretical practice.

There are three main sociological theories of aging that are widely used: Activity Theory, Disengagement Theory and Continuity Theory. Of them, Activity Theory of Aging by Havighurst and Albrecht [15] seemed most relevant to this thesis. The original activity theory stated that remaining occupied and involved is necessary to satisfaction in later life but it did not explain how the types of activity were linked to life satisfaction, amongst various other shortcomings of the theories. It is only in 1972 that Lemon et al. [21] addressed the shortcomings of this theory and found direct relationship between being active and life satisfaction, observed that older adults viewed quality of activity to be more important than the quantity and suggested that informal activities, such as hobbies, are what most affect later life satisfaction.

Garcia-Martin et al. [13] verified that activities indeed improve life satisfaction, decreases depression and loneliness, and that the effect stays even three months after participation in the activities. They also focused on social support, loneliness, perceived control, social self-efficacy and self-perceived health as influencers, not just their related activities [13].

Perdana and Mokhtar [28] recently designed a study on the adoption of digital devices and virtual platforms in Singapore and used Social Exchange Theory by Wan and Antonucci [44] as their theoretical framework. The social exchange theory proposes that behavior 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 [44].

For my thesis, I have created a theoretical approach combining the practice of Social Prescribing and Social Exchange Theory. Therefore, while studying the literature documents, I organised the literature into user parameters, user context (both corresponding to the client's component), activity selected by whom (the prescriber or client), the list of activities with their details (the social prescription) and the outcomes measured (data tracking pathway). This approach helped me summarize the literature into classes, concepts and attributes of a recreation activity, which are summarized in Fig. 2.

Blusi, Nilsson and Lindgren [2], were the first ones to focus on the concept of co-creating meaningful individualized social activities. They classified activities into four types: outdoor activity, music event, visiting a friend and leisure activity. This approach of chunking activities into groups or types, can help organize the literature better and create stronger associations between similar types of interventions and outcomes. Bickerdike et al. [1] conducted a systematic review and found that although social prescribing is very popular, the study designs have serious methodological shortcomings and therefore pose a huge risk of bias. These findings were echoed by Quan et al. [30] and Veazie et al. [43], who had respectively conducted a systematic review of interventions for loneliness among older adults living in long-term care facilities and a rapid review on addressing social isolation to improve health of older adults respectively. In spite of the research methodology challenges, social prescribing is gaining popularity. In fact, for loneliness and isolation, recreation activities ranging from music, walks in nature, social activities are recommended and promoted at both community and clinical levels [30], [43].

D. Requirements and Decision Methods

A recent review by Husky and colleagues [18] suggested that social prescribing be viewed as a system and not as an intervention. This idea of thinking of social prescription as a system and not as an intervention helped me formulate a working model for the decision support, which is explained in Fig. 4. The idea of approaching social prescribing as a system, also made me take a close look at the context of the activities, which in turn influenced the criteria I considered in summarizing the decision methods.

The current literature offers a variety of interventions or recreational activities and not any decision methods to recommend those activities. The literature is focused primarily of the "effectiveness" or a certain recreational activity in meeting the desired recreation and social goal, but there is no clear decision support or decision tree spelled out in any of the 40 papers in review. However, the literature does help collate the different user parameters, context and life events, which were the inclusion criteria to recruit the study participants which are summarized in Fig. 3.

The problem of lack of clear decision methods to recommend activities can be solved by borrowing principles from Clinical Decision Support Systems (CDSS). Late John Fox had championed using qualitative methods to build CDSS [11]. Along with is colleagues, he refined the domino model into PROforma, a technology language for clinical decision support [12]. A domino describes a relationship between actions, decisions, beliefs, plans, problem goals and candidate solutions and the inference and processes linking them [12]. PROforma on the other hand takes rigorous engineering decisions and combines it with domino model and creates a solid foundation to make a framework for CDSS [11]. Fig 4 shows a modified domino model that helps conceptualize the different requirements of a decision support system. This diagram helps show the different components of a social prescription in relation to one another. The diagram also helps narrow the relevant data points form the literature review and shows the relationship between the different components of a Decision Support Tool (DST), called *Recreation for Older adults in Social Isolation (RxOSI)*, briefly described next.

E. Description of RxOSI

Three kinds of knowledge are required to build RxOSI: (1) user or older adult specific knowledge (personal details,

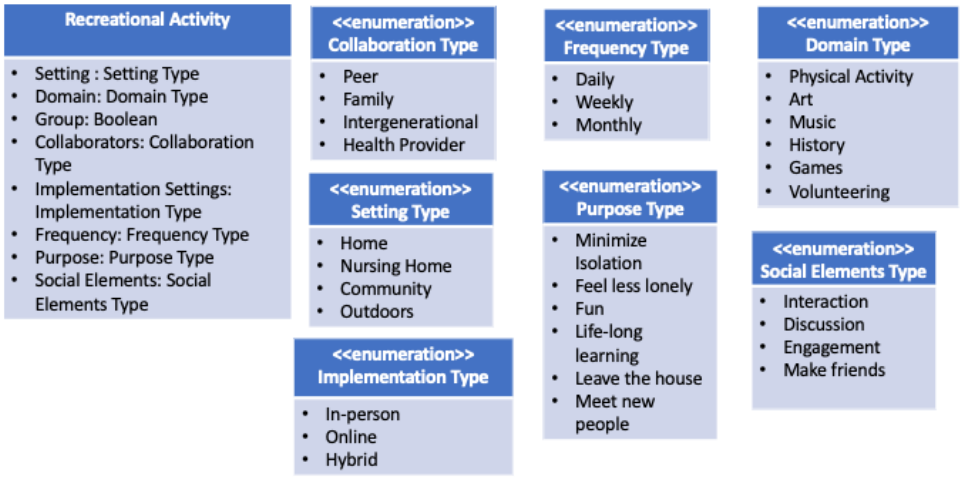

Fig. 2. Summary of classes, concepts and attributes of a recreation activity in the literature, using a theoretical framework combining Social Prescribing and Social Exchange Theory.

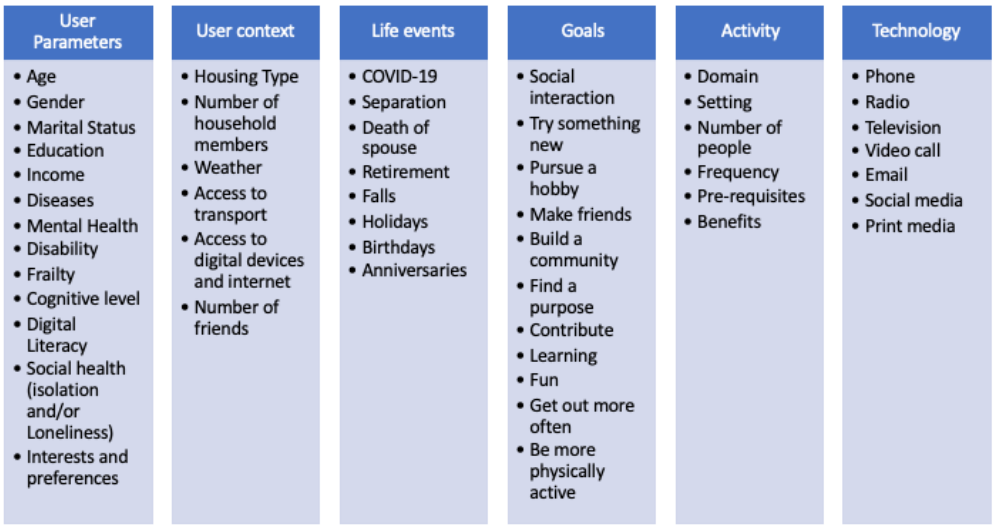

Fig. 3. Summary of the criteria for decision methods.

mobility capabilities, cognitive capabilities, digital capabilities; (2) general medical knowledge (social isolation and loneliness, related diseases, symptoms, tests); and (3) knowledge of recreation activities (what should be done when) [11]. RxOSI is primarily focused on the last type of knowledge; my intention is that it should be able to accommodate different medical knowledge models and specific user data models [11]. A rapid prototyping approach will be used to build RxOSI and the end product will be a web-based tool that can prescribe activities based on user inputs and context.

F. Current Contributions

- Systematic literature review of decision criteria and methods for RxOSI;
- Enumeration of concepts, classes, attributes for a database of activities in RxOSI;
- Modification of the clinical domino model suitable for social prescription.

G. Planned Contributions

- Recreational activity database for social isolation;
- Decision rules for RxOSI;
- A validated RxOSI prototype;

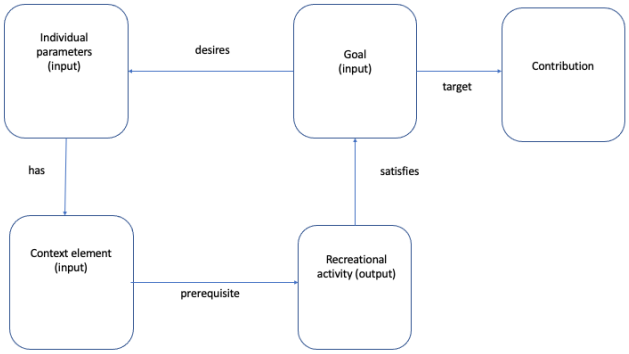

Fig. 4. Modified domino model of a social prescription process.

- Contribution towards theory of social exchange and social prescription.

V. Research Methods

The thesis will follow Design Science Research Methodology as described by Wieringa [46]. A four-stage qualitative analysis will be undertaken. The first stage was completed at the time of the literature review, which helped define the problem and generate initial classes, concepts and relationships needed to create the necessary theoretical framework for the decision support tool. The literature will also help create a database of activities, rules for decision trees. The prototype, activity database and rules engine will then be built further using abductive-deductive analysis of podcast transcript and reflexivity notes [4]. The 60+, one-hour podcasts I co-led with Prof. Paul Merkley contain interviews of industry, academia, recreation specialists, practitioners who have worked in the domain of social isolation in older adults. The third stage of thematic analysis will be be done to validate the decision support tool. Podcast guests who are also social prescribers will be interviewed individually and the data collected will be analysed using abductive-deductive reasoning. The fourth stage will include compiling the additional insights gained during the validation back into the theoretical framework as well as the decision support tool.

1) Thematic Analysis: There are various approaches to conducting thematic analysis and I will be considering the most common used methodology by Braun and Clarke [4]. The methodology follows a six-step process: data familiarization, coding, generating themes, reviewing themes, defining and naming themes, and writing up. NVivo will be used as the software to do the coding and theme generation.

2) Recruitment of Participants: The validation piece of the thesis will need recruitment of domain experts who have been social prescribers or are recreational experts and have experience in working with older adults. The participants will be recruited through a snowball technique, starting with identifying the relevant podcast guests and then using recommendations from their professional networks. A total of 15 participants will be interviewed for validating the decision support tool.

The participants will be asked to answer a predetermined set of questions and the interview will last 45 minutes to 60 minutes. The interview will be recorded over Zoom and informed consent will be taken before recording the interview. The participants will be asked to suggest a time as per their convenience for the recording and they will not be compensated for their time. There will be only one interview, however during the analysis phase, if any questions arise or clarifications are needed, the participants will be contacted again via email.

The literature review, podcast analysis and prototype validation will support triangulation of the views.

3) Assessment of Risks and Benefits: No risks to the participants are foreseen, as no personal question will be sought.

4) Privacy and Confidentiality: During the course of interviews, names and email addresses of the participants will be identified by me, but during the analysis phase they will be coded to prevent linking the data to the person. Only me and my supervisor will have access to any identifiable data. No other private or confidential data will be collected.

5) Best Practices for Data Safety: We will ensure all the physical and technical safeguards are undertaken, for collection and storage of the data, consistent with the best practices for data safety. The data will be stored five years post collection, and the retention period begins on the next day after the interview is undertaken.

6) Free and Informed Consent: The consent form will be prepared as per University of Ottawa guidelines and data collection will begin post approval from the Research Board (REB).

VI. Progress So Far

I have completed the systematic literature review and am writing the thesis proposal. The systematic review and an initial reading of the first ten podcast transcripts have enabled understanding the different concepts and challenges that need to be addressed in making a decision support tool, as summarized in Fig. 3. Revisiting the research questions, the review has also helped answering **RQ1** and has partially answered **RQ2**. **RQ2** will be further be answered by the iterative study design by performing qualitative analysis of podcasts, whereas the prototype design, validation and in-depth interviews will help answer **RQ3**. The contributions of this thesis are in line with the objectives of the REWBAH community (on Requirements Engineering for Well-being, Aging, and Health) as it uses multidisciplinary domain knowledge for requirements elicitation, involving multiple stakeholders (in an aging and well-being context), and with validation methodologies inspired from social sciences.

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