

Appendix A – Scoping Review Protocol

Paper: A Scoping Review on Human-Centered Design Approaches and Considerations in the Design of Technologies for Loneliness and Social Isolation in Older Adults

Aim	Aim is to summarize and discuss the human-centered design (HCD) and user-centered design (UCD) approaches, the user and stakeholder needs, and contextual influences in the design of technologies to address loneliness and social isolation in older adults. This informs about current design considerations and about insights and potential gaps in the application of HCD and UCD methods in this context.
Question	How have UCD and HCD methods been applied in developing technologies to address loneliness and social isolation in older adults? What stakeholder and user needs have the designers of these technologies identified as important? What contextual influences have been identified that may affect the functioning of these technologies?
Objective	The search focuses on technologies designed to address loneliness and social isolation for older adults. It is expected that there are already relevant user, stakeholder, and contextual considerations that are important to inform future designs. Moreover, we also analyze how UCD and HCD have been applied for learnings, gaps, and future recommendations.
Protocol	The protocol including the aims, research questions, objectives, search strategy, and inclusion criteria were presented and discussed in the research team.
Search strategy	The search focused on publications after 2014 in the data bases Scopus, Web of Science, and Association of Computing Machinery (ACM) with the keywords (loneliness OR “social isolation”), older adults (elderly OR “old age” OR “older adults” OR “older people” OR geriatric OR senior), and technology (technolog* OR design OR system OR service OR innovat* OR wearable OR smart OR sensors OR monitoring OR internet) in the abstract.
Process of selecting articles	The search string was entered in the databases and records were retrieved. Duplicates, review papers, protocols, and unrelated papers based on title and abstract were removed in an initial step. The remaining records were included or excluded based on the title, abstract, and full paper where uncertain and the inclusion and exclusion criteria. Part of the articles were revised independently by a second author. Discrepancies were resolved in discussion.
Inclusion and exclusion criteria	The inclusion and exclusion criteria were developed by a preceding search of literature on the topic. The aim was to understand current technologies particularly designed to address loneliness and social isolation in older adults, the requirements that need to be considered in the design, and the design approach. Therefore, one criterion was to find papers on technological interventions or evaluations of new interventions. We excluded papers that were not focused on the development of a technology, but that only discussed the effect of existing technologies (such as social media usage). We also excluded those papers that did not propose a technological intervention but alternative therapies that might have applied existing technological means (such as a physical training activity delivered by a videocall). Few papers had to be excluded, because their technology did not address loneliness, social isolation, or older people. Furthermore, we only included work in English.
Process of extraction of	We applied a qualitative content analysis using NVivo, which is a software for qualitative data analysis. Initially, categories and descriptions were developed based on the analysis of part of the material (such as ‘accessibility’, ‘control’,

relevant information	‘health conditions’). In addition, the categories for UCD and HCD approaches were also informed by previous literature on the methodological approach (Göttgens and Oertelt-Prigione, 2021). Afterwards the complete material was analyzed and assigned to the developed categories. In the paper, the categories were summarized where similar or overlapping (for example ‘safety and privacy’, ‘control and independence’).
Results and data synthesis	The results consist of descriptions how HCD and UCD have been applied, how they are defined, what methods were used, and found challenges. We also present a list of the contextual influences, user, and stakeholder needs and examples how they are applied to the diverse technologies.
Discussion	We compare our work to previous research on the application of HCD and UCD methods in the context of healthcare technologies. To discuss the special needs in the specific research context, we compare the results to previous systematic reviews that investigated related technologies and user groups.
References	The protocol is based on: Pyykkö, H., Suoheimo, M. and Walter, S. (2021) ‘Approaching Sustainability Transition in Supply Chains as a Wicked Problem: Systematic Literature Review in Light of the Evolved Double Diamond Design Process Model’, <i>Processes</i> , 9(12), 2135, pp. 1-23. The analysis on the methods of HCD and UCD was informed by: Göttgens, I. and Oertelt-Prigione, S. (2021) ‘The Application of Human-Centered Design Approaches in Health Research and Innovation: A Narrative Review of Current Practices’, <i>JMIR mHealth and uHealth</i> , 9(12), p. 24. A list of all references included in the systematic review are found in Appendix B.