2025

# Abstract book

Supporting Health by Technology
International Conference
14-5-2025

Centre for eHealth & Wellbeing Research
UNIVERSITY OF TWENTE.
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# Abstract book of Supporting Health By Technology XIV

## June 10th & 11th 2025, Enschede, The Netherlands

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# Preface

The Centre for eHealth & Wellbeing Research of the University of Twente, in collaboration with the University Medical Center Groningen, proudly offers the abstract book of the **14th edition - 2025** of the Supporting Health by Technology conference. Each year, this event brings together researchers, practitioners, designers, and entrepreneurs who contribute to shaping the future of digital health, and we are delighted to welcome you this year to the beautiful UParkhotel and the University of Twente campus.

This year, we received 92 submissions, and with them, we have a rich and varied program that addresses the most pressing issues and new directions of the field. The program includes 12 oral sessions, 5 symposia, 23 posters, 2 demonstrations, as well as a record number of 5 interactive workshops. Together, these contributions highlight developments in current themes such as the role of artificial intelligence in healthcare, implementation of digital health solutions in practice, and the ethical use of data in relation to privacy and bias.

We are particularly delighted to host two keynote talks delivered by prof. dr. Wijnand IJsselsteijn and Maarten Stevens, who will share their rich experience in digital health across the fields of design, academia, and entrepreneurship. In addition to the formal program, participants are invited to experience our unique green campus. A number of possibilities exist for touring the research facilities and discovering the artwork around campus: individually or while connecting with fellow attendees.

We thank all authors for sharing their work, and all reviewers for their thoughtful input in shaping this year's program. For detailed information about sessions, keynotes, and locations, please visit https://www.healthbytech.com/.

We look forward to welcoming you to Enschede and to an engaging and inspiring conference.

Tessa Dekkers, Sofia Bastoni, & Thomas Vaessen

Program Committee Supporting Health by Technology XIV 2025

# Keynotes

**WIJNAND IJSSELSTEIJN PROF. DR.**

## From Silver Bullet to Situated Practice: Rethinking AI as a Sociotechnical Innovation in Dementia Care

*Tuesday, June 10th at 10:45-11:45 in C1+C2*

Wijnand Ijsselsteijn has a background in AI and cognitive neuropsychology. Since 2012, he has been Professor of Cognition and Affect in Human-Technology Interaction at Eindhoven University of Technology (TU/e). He leads a research program on the impact of technology (e.g., VR/XR, personal informatics, and human-centered AI) on human mind and behavior, and on the use of psychology and ethics to improve technology design. His work focuses on enhancing human learning, communication, health, and well-being, as well as improving quality of life for people with dementia. His research is widely cited and applied in both academic and industrial contexts. Prof. IJsselsteijn is co-PI of the NWO Gravitation program "Ethics of Socially Disruptive Technologies," and PI of the NWO/ZonMW QoLEAD project, which explores the role of AI in improving quality of life for people with dementia. He is also the recipient of the Distinguished NIAS-Lorentz Fellowship for 2024/2025.

**Keynote Abstract:**

Artificial Intelligence is increasingly portrayed as a panacea for the challenges of long-term dementia care - offering smart, scalable solutions for a sector under growing pressure. But such visions often obscure the realities of care as a deeply relational, context-bound, and morally complex practice. This keynote critically reconsiders AI not as a silver bullet, but as a sociotechnical innovation embedded in the textures of lived experience. Drawing on co-design research and the Warm Technology approach, I examine how AI systems are not merely adopted, but appropriated—adapted, resisted, or reimagined by people with dementia, caregivers, and care professionals. In my talk, I will draw on examples from navigation support, social robotics, and home automation. Rather than aiming for technological replacement or efficiency alone, we need design practices that support human dignity, autonomy, and relational connectedness. This requires a shift from speculative futures to situated engagements - where technologies earn their place not through novelty or raw computational power, but through co-design, collaboration, and contextual fit.

## MAARTEN STEVENS

*Tuesday, June 11th at 15:00-16:00 in C1+C2*

Maarten Stevens is CEO of 8D | Research + Design = Impact and has worked in the innovation sector for over a decade, with a strong focus on healthcare. He began his career as a therapist at GGZ Friesland, where he applied creative, game-based methods to support clients in their mental health treatment. With a background in psychology and mental health care, Maarten brings deep expertise in human behavior. He combines this with a down-to-earth entrepreneurial mindset that steers clear of endless waffle and is defined by a getting-shit-done attitude. His mission is to bring knowledge to the people that need it the most, but are last in line to get it. His company 8D is an impact partner in many scientific projects where the aim is to create social change. 8D develops its tools and interventions in close collaboration with researchers to bridge the gap between science and real-world impact.

**Keynote Abstract:**

In this keynote, Maarten Stevens takes a critical look at how we approach impact in publicly funded research, and what needs to change. With over a decade of experience in national and EU-funded consortia, he reveals why so many projects get stuck at scientific impact and don’t reach societal impact. Expect honest reflections and real talk: promising prototypes that never come to market, failed partnerships, and the recurring mistake of treating companies as the enemy instead of an ally for impact.

The core problem? We’ve stopped applying the most basic principle of design thinking - *empathy* - to the way we collaborate. Researchers and businesses often fail to grasp each other’s needs, timelines, and constraints. Without that mutual understanding, we end up with disconnected efforts, missed opportunities, and an impact that exists only on paper. Okay, so this keynote is to get us depressed? No, no, no. Truth hurts, that's true. But growth comes after pain and acceptance. The keynote is about hope! The truth is, we need each other. Not just to build better projects, but to challenge a system that too often sets us up to fail. Change *is* possible - and already underway!

EU programmes are moving in the right direction and embed societal impact in their calls. We need to change if you want to get your research project granted. Maarten will present in his keynote what elements will help to get your call granted and also create a societal impact. This keynote is a call for impact that goes beyond empty words. The only limit to our impact is our imagination and commitment.

# Program – oral presentations, workshops & symposia

## Tuesday, June 10th

| 13:20-14:20 | | Presenting author |
|---|---|---|
| C3 | **Digital mental health for (caregivers of) young people** | |
| | Considerations in developing a suicide risk prediction algorithm for mental health care | Linda Hummel |
| | Insights from an evaluation study on room: a mobile tool designed to foster university students' wellbeing | Tajda Laure |
| | Students’ needs and requirements for a chatbot supporting student mental well-being: a student counsellors’ perspective | Valentina Bartali |
| | Supporting the mental health of parents of neurodivergent children through a mobile app: the cocreation of “adappt” | Kim Tönis |
| C2 | **Learning from patient data: (ai-based) predictive modelling** | |
| | Unsupervised change point detection for early complication identification in post-surgical oncology patients | Arlene John |
| | Automated detection of cardiac syncope causes in 12-lead ecgs using residual neural networks | Arlene John |
| | Promis-driven convalescence: clustering patient trajectories of physical functioning following surgery | Daan Toben |
| | AI in automatic recognition of palliative care demand | Richard Maria Hermanus Evering |
| C1 | **Workshop:** Time for a heart-to-heart. Practical ethics and the development of a soft-robotic artificial heart | Anne Bonvanie, Wouter Weijermars |
| C4 | **Symposium:** Empowering health by technology: tailored solutions for diverse populations | Janine Sikkens, Joan Dallinga, Hanneke Braakhuis, Diana Eijgermans, Sanne de Vries |
| **14:25-15:25** | | **Presenting author** |
| C3 | **Codesigning with diverse populations** | |
| | Co-design of digital mental health support for LGBTQI+ youth | Tessa Dekkers |
| | Co-designing implementation materials for the compassionate use of smartwatches in mental health care | Charlotte van Lotringen |
| | Initiating co-creation in COPD exacerbation management: patients’ and providers’ perspectives on remote patient monitoring | Atena Mahboubian |
| C2 | **Navigating data and regulation in (personalised) digital health** | |
| | Personalization in eHealth; urgent needed but how to come forward? A methodological framework based on literature and expert knowledge | Steven Lankheet |
| | Unlocking the potential of real-world data for dynamic evaluation in digital health | Annemiek Kwast |
| | Emerging technology to revolutionize healthcare | Lisette van Gemert-Pijnen |
| | A roadmap for certifying software as a medical device under the European medical device regulations (MDR) | Erwin Waas |

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| **C1** | **Workshop:** Understanding biases in healthcare technologies and envision alternative futures | Roberta Antognini, Francesca Toso, Cristina Zaga, Mascha Van der Voort |
| **C4** | **Symposium:** Advancing mobile mental health interventions for anxiety and depression | Felix Fiß, Jannis Kraiss, Chani Nuij, Alyssa Jongeneel |
| **16:40-17:40** | | **Presenting author** |
| **C3** | **Versatile applications of Virtual Reality** | |
| | The potential of HoloLens in addressing obstacles experienced by preceptors of nursing students during internships | Anouk Charlotte Jolijn Jansen |
| | Using technology to explore the link between the future self and goal achievement | Tiffany Tettero |
| | A first step towards implementing DEEP within (forensic) mental healthcare – a pilot study | Lisa Klein Haneveld |
| **C2** | **Digital health across the care ecosystem** | |
| | Cpthrive: development of an mhealth aide to facilitate evidence-based treatment choices for cerebral palsy | DanaKai Bradford |
| | Preliminary results and lessons learned from a stepwise eHealth intervention with the participatory approach | Hanneke Lettinga,<br>Trees Juurlink |
| | Advancing ehealth integration in mental health: a collaborative approach to treatment pathways | Maaike Meurs,<br>Merel van Hoogdalem |
| **C1** | **Workshop:** Unifying the status-quo: a comprehensive framework of tailoring strategies for eHealth interventions | Sandra Straková, Steven Lankheet, Anouk Middelweerd, Iris ten Klooster, Monique Tabak |
| **C4** | **Symposium:** Advancing equity in digital mental health: current research insights from the field of youth and women's mental health and future research priorities | Caroline Figueroa, Ruixuan Zhang, Nic Orchard, Kathleen W. Guan |

## Wednesday, June 11th

| 09:45-10:45 | | Presenting author |
|---|---|---|
| C3 | **AI in healthcare** | |
| | Explainable ai (xai) for arrhythmia detection in ECG | Joschka Beck |
| | Predicting psychological states using machine learning and digital biomarkers from wearable data | Arlene John |
| | Opportunities, challenges, and conditions for data-driven working and the use of (generative) ai in insurance medicine | Dominika Borowiec |
| | The impact of ai integration on clinical decision-making: a qualitative study of primary care physician workflows in simple and complex scenarios | Sormeh Mehri |
| C2 | **Regional, national, and international perspectives on implementation of digital health technology** | |
| | Doing good care with digital technologies: between being spontaneous and predictable | Artur Vlas Nikulkin |
| | State of digital care in the Netherlands in 2024 | Jelle Keuper |
| | Organisational eHealth readiness of top clinical hospitals in the Netherlands: a mixed-methods study. | George Garritsen |
| | Culture matters: a cross-country comparison of technology acceptance | Esther Metting |
| C1 | **Workshop:** Supporting health by design rationale; navigating and articulating design decisions in technology for health | Bard Wartena, Joanneke Weerdmeester |
| C4 | **Symposium:** Educating future-proof professionals: best practices and research in vocational education **[DUTCH]** | Lieke Brons, Diane Beerlage, Alfons Brink, Jolanda van Til, Wouter Keuning, Miranda van der Velde, Marike Hettinga, Marjolein den Ouden, Anne-Ruth Oosterbroek, Ingrid ten Haken, Femke Veld, Theo Olthuis, Marloes Postel, Rudie van den Heuvel, Jeltje Kok |
| 10:50-11:50 | | Presenting author |
| C3 | **Design and implementation of technology for older adults** | |
| | Identifying needs, motivations, and challenges for a multidomain digital intervention to promote brain health among older adults | Nikita Sharma |
| | Acceptability of an m-health application for individualized fall prevention in nursing homes | Jonathan Diener |
| | Designing technology for liminality and autonomy in dementia care | Bard Wartena |
| | Implementation of age tech via different Dutch markets: opportunities and challenges | Christian Wrede |

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| C2 | **Virtual agents for personalization and behaviour change** | |
| | Mapping behavior change techniques, health data integration, and delivery channels in virtual agents for chronic condition management: a systematic scoping review | Martha Kreuzberg |
| | Enhancing tele-monitoring with ai-enabled personalized coaching and real-time support | Govert de Vries |
| | A pilot usability study of smart virtual assistants to monitor medication adherence in chronic patients | Emanuele Tauro |
| | Evaluating perfect fit: a virtual coach-based mHealth intervention for smoking cessation and physical activity. | Milon H. M. van Vliet |
| C1 | **Workshop:** Nothing gets left behind: navigating legal, ethical, financial & technological eHealth implementation challenges through gaming | Britt Bente, Meyke Roosink, Nienke Beerlage-de Jong, Lisette van Gemert-Pijnen |
| C4 | **Symposium:** Developing an immersive learning tool to support change agents in sustainable health technology implementation | Miriam van Ittersum, Erik Soepenberg, Marianne van Dommelen, Gijs Terlouw, Lise Beumeler, Annemarie van der Wees, Kirsten Poelma-Tap |

| 12:45-13:45 | | **Presenting author** |
|---|---|---|
| C3 | **Use of wearables for (mental) health** | |
| | Reporting, representation and subgroup analysis in studies assessing consumer wearable validity: a scoping review | Rebecca Marie Schipper |
| | Exploring key values in the design of wearable stress management technology: a multi-method approach | Merel van den Berg |
| | 'Open doors' policy in nursing homes: using gps-trackers to monitor residents with psychogeriatric problems | Chiem Tuil |
| C2 | **Design, evaluation, and engagement with digital (lifestyle) interventions** | |
| | Exploring rehabilitation patients' perspectives on what matters for the adoption of home-based rehabilitation technology: a q-methodology study | Karlijn E. te Boekhorst |
| | Applicability of behavioral design methods in the metahealth project | Nymphaea Notschaele |
| | Results of the six-month health lifestyle intervention "diameter" for type 2 diabetes in secondary care | Chiara Lansink |
| | Predictors of engagement and adherence in blended eHealth cardiac rehabilitation | Isra Al-Dhahir |
| C1 | **Workshop:** The digital data divide: a festival experience to discuss the increasing impact of personal data | Sjors Groeneveld, Harmieke van Os-Medendorp, Lisette van Gemert-Pijnen, Ruud Verdaasdonk, Marjolein den Ouden |

# Program – posters & demonstrations

After the plenary poster and demo pitches on Tuesday, 10th of June, 11:45-12:15, all posters and demonstrations will be available throughout the conference in room C5. At the times specified below, authors will be present in this room to provide an additional presentation and discuss their work.

## Tuesday, June 10th

| Tuesday June 10th 11:45-12:15 | | Presenting author |
|---|---|---|
| C1+C2 | Plenary pitch of posters and demonstrations | All |
| Tuesday June 10th 15:40-16:40 | | |
| C5 | Posters & demonstrations Tour Day 1 | |
| | Does Engagement Behavior Predict Mental Health Outcomes in Digital Mental Health Interventions? An Individual-Level Approach. | Jonathan M. Faria da Silva Dias |
| | Unfolding the processes between user needs and health technology in the socio-technical transition of healthcare services | Vaitiare Mulderij-Jansen |
| | Do attitudes towards technology mediate engagement with digital mental health interventions? | Valentina Fietta |
| | A design framework for developing ai-powered and engaging digital interventions for disease prevention and management | Valentina Fietta |
| | Study protocol for the feasibility and effectiveness of vr intervention in supporting diabetic patients' health | Bingyan Lin |
| | Patients and healthcare providers' values in remote patient monitoring for copd exacerbation management: continuing co-creation | Atena Mahboubian |
| | Assisting caregivers in enhancing self-reliance in clients with autism: the impact of social robot "maatje" | Ellen Janssen |
| | Optimizing copd care: evaluating the virtual companion program (vcp) for patients and healthcare professionals | Stephanie Jansen - Kosterink |
| | Co-creating a service model and technology-supported ecosystem with end-users to enhance sub- acute stroke rehabilitation | Stephanie Jansen - Kosterink |
| | Self-management in reintegration: development of www.mijn-reintegratie.nl | S. Ten Hoeve |
| | Designing and disseminating digital lifestyle interventions for vulnerable young families: an interview study. | Ashley J.P. Smit |
| | A simulation-based training tool for child helpline counsellors [DEMO] | Mohammed Al Owayyed |
| Wednesday June 11th 13:45-14:45 | | |
| C5 | Posters & demonstrations Tour Day 2 | |
| | Happy again! social support app | Sanne Schoenmakers |
| | From relapse to resilience: the development of a technology-assisted self-management platform for people with severe mental illness. | Joyce Bierbooms |
| | Expanding horizons: brainstorming requirements for international deployment and additional health conditions for mHealth aides | Danakai Bradford |
| | The data infrastructure of rehablines databank: from data sources to data release | Bregje L. Seves |
| | Requirements for a personalized ehealth coaching tool for people with knee osteoarthritis | Elke Warmerdam |

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| | Bridging research and practice: identifying barriers to social robotics in ASD home therapy | Sabrina Saiko |
| | From crisis to continuity: longitudinal developments and socio-economic influences on digital health adoption in friesland | Inge Tuitert |
| | Mapping biases and misrepresentation of marginalized groups in healthcare technologies | Roberta Antognini |
| | Personalizing ehealth for metabolic syndrome: identifying key determinants for user-profiles | Hakan Kuru |
| | A multi-method approach to developing personalized text-messages for improving diet, physical activity and stress: a within-subject repeated randomization study | Iris ten Klooster |
| | Unlocking research anytime: A demonstration of the Twente Intervention and Interaction Machine and its latest developments [DEMO] | Iris ten Klooster |

# Oral presentations

## Considerations in Developing a Suicide Risk Prediction Algorithm for Mental Health Care

**Linda Hummel, Karin Lorenz-Artz, Joyce Bierbooms & Inge Bongers**

**Background:** Artificial intelligence (AI) offers potential solutions to address the challenges faced by a strained mental healthcare system, such as increasing demand for care, staff shortages and pressured accessibility. Concerning suicide incidents, AI is able to predict more accurately which individuals are at risk than traditional statistical methods. While developing AI-based tools for clinical practice is technically feasible and has the potential of producing real-world impact, only few are actually implemented into clinical practice. Implementation starts at the algorithm development phase, as this phase bridges theoretical innovation and practical application. The design and the way the AI tool is developed may either facilitate or hinder later implementation and use.

The objective of this qualitative study is to examine the challenges encountered by a development team in creating a suicide risk prediction algorithm using real-world electronic health record (EHR) data for clinical use. It explores how the team addressed these challenges and identifies key considerations for bridging technical and clinical needs in algorithm development. This work aims to contribute to the body of knowledge concerning the effective integration of AI into mental healthcare.

**Methods:** An exploratory, multimethod case study was conducted, employing a hybrid approach with both inductive and deductive analysis. Data were collected through desk research, reflective team meetings, and iterative feedback sessions with the development team. Thematic analysis was used to identify development challenges and the team’s responses, as well as to derive key considerations for future implementations.

**Findings:** Key challenges included defining, operationalizing, and measuring suicide incidents within EHRs due to issues such as missing data, underreporting, and differences between data sources. Predicting factors were identified by consulting clinical experts, however, psychosocial variables had to be constructed as they could not directly be extracted from EHR data. Risk of bias occurred when traditional suicide prevention questionnaires, unequally distributed across patients, were used as input. Analyzing unstructured data by Natural Language Processing (NLP) was challenging due to data noise but ultimately enabled successful sentiment analysis, which provided dynamic, clinically relevant information for the algorithm. A complex model (XGBoost) enhanced predictive accuracy but posed challenges regarding understandability, which was highly valued by clinicians.

**Discussion:** To advance mental healthcare as a data-driven field, several critical considerations must be addressed: ensuring robust data governance and quality, fostering cultural shifts in data documentation practices, establishing mechanisms for continuous monitoring of AI tool usage, mitigating risks of bias, balancing predictive performance with explainability, and maintaining a clinician "in-the-loop" approach. Future research should prioritize sociotechnical aspects related to the implementation and daily use of AI in mental healthcare practice.

## Insights from an Evaluation Study on ROOM: A Mobile Tool Designed to Foster University Students' Wellbeing

**Tajda Laure, Danielle Remmerswaal, Rutger Engels, Stefan Konigorski, Djameela Dulloo & Marilisa Boffo**

**Background:** The transition to university can be stressful and negatively impact mental health. However, it also provides an opportunity to lay the groundwork for positive life trajectories. Emotion regulation (ER), a key factor underlying various mental health issues, is crucial for students, a group particularly vulnerable to mental health problems. A mobile transdiagnostic ER intervention – ROOM to grow – has been developed following Center for eHealth research (CeHRes) Roadmap guiding its' development, evaluation and implementation efforts. ROOM's goal is offering universal and targeted preventative support to university students. ROOM is a micro-intervention; it includes short and actionable ER exercises which were shown to successfully regulate users' emotions in real time (Laure et al., 2024), transfer elements (i.e., tools for applying ER techniques in real-life settings), a self-assessment module, a mood tracker, and an intelligent recommendation system linking users to ER exercises based on their needs and preferences. This study's goal was to evaluate the full-scale impact of ROOM intervention on student's distress levels, ER skills, resilience, and its uptake among this population in a naturalistic setting.

**Methods:** A superiority parallel-group RCT involved 208 participants randomized to either the intervention group receiving full access to ROOM (n = 104) or a waitlist control group (n = 104). Primary outcomes included ER skills and stress symptoms. Secondary outcomes included anxiety, depression, resilience, and intervention uptake (likeability and helpfulness of ROOM's features, usage). Assessments occurred at baseline and weeks 3, 8, and 12, with continuous log-data collection for user engagement.

**Findings:** The findings indicated no significant impact on primary or secondary mental health parameters. Exploratory analyses suggested that highly engaged participants experienced reduction in stress, while those moderately engaged experienced improvements in resilience levels but also increases in depressive symptoms. ROOM saw a promising initial engagement; however, usage sharply declined after the first week, stabilizing at a lower level by week 6, with over half of participants still active at day 30. Breathing and relaxation exercises were the most popular and well-rated. Overall, the app features were positively received, however features like transfer-elements and self-assessments module were used less than expected. A bug was found in the recommender system post-study, which impaired its functionality; nonetheless, it received favorable ratings from participants.

**Discussion:** Our research indicates that micro-interventions can provide a short-term relief, however, sustaining its' impact may require features stimulating progress tracking, rehearsal to facilitate internalization and maintenance of desired behaviors beyond the digital interaction. Secondly, user engagement is crucial—however it is not just about time spent, but the quality of the interaction (e.g., including content sequence, frequency of engagement over certain period) which influence outcomes. Thirdly, personalization matters; this population (Gen Z) prefers adaptive systems. Despite technical challenges, ROOM's recommendation feature was well-received, possibly reducing cognitive load and sustaining engagement. Lastly, this target group favored simpler techniques (e.g., breathing exercises) over more cognitive demanding ones. This may limit skill development. Digital platforms should consider guiding users toward diverse content using structured support (e.g., scaffolding).

## Students' needs and requirements for a chatbot supporting student mental well-being: a student counsellors' perspective

**Valentina Bartali, Emmelyn Croes, Renate de Groot, Tibor Bosse & Marjolein Antheunis**

**Background:** Almost half of the student population in higher education in the Netherlands experiences poor mental well-being (StMWB). Students do not always want to seek support because they fear to be judged or because they do not trust professional help. Research showed that chatbots could be a possible technology to support younger generations with their StMWB. This is also because chatbots have a non-judgmental character which might make people feel more comfortable sharing their personal information. However, to develop an effective chatbot for students in an ethically responsible manner, the needs and requirements of this target group ought to be investigated. There are only few studies which focus on the needs of students for chatbots for mental well-being. Additionally, in many of these studies this is not investigated from the perspective of the student counsellors. This perspective is important due to the expert knowledge they can provide on the target group and the symptoms related to StMWB. Furthermore, it is important due to the role this stakeholder plays in facilitating the acceptability, and thus the implementation of the chatbot. Accordingly, in this study, we aimed to investigate the needs and requirements of students for a chatbot to support StMWB from the standpoint of student counsellors.

**Methods:** Semi-structured interviews with 14 student counsellors from different universities (also of applied sciences) in the Netherlands were conducted. The interviews were 60 minutes long and conducted in Dutch or English. After transcribing the interviews, a first coding scheme was created. Its interrater reliability was measured, and it had a score of k = 0.76. Afterwards, themes were formed.

**Findings:** At the time of writing, the analysis of the data is not finished yet, but we have identified a few main themes: "the concept of StMWB", which entails how the student counsellors define poor and good StMWB; "the needs of (this generation of) students", which entails how the student counsellors envision this generation of students and their needs; and "Chatbot features", which entails the features that the chatbot should have, like the look of the avatar. Additionally, the results showed that some student counsellors seem to have a personal interest in the implementation of the chatbots as they would like to use the chatbot to support them in their sessions with the students.

**Discussion:** Based on the results of this study, we will create a list of user requirements according to the student counsellors to develop the chatbot. This list will be unified with another list of user requirements created from previous research we conducted with the students themselves. Each requirement will then be classified according to its relevance and its feasibility and divided into: must-have (requirements which are mandatory), should-have (requirements which are not important for the functioning of the chatbot but add value), and nice-to-have (requirements which are nice to have but they do not add any significant value). Consequently, the first prototype of the chatbot will be developed.

## Supporting the mental health of parents of neurodivergent children through a mobile app: the cocreation of "Adappt"

**Kim Tönis, Stans Drossaert, Peter ten Klooster & Ernst Bohlmeijer**

**Background:** Parents of neurodivergent children, including Autism, ADHD, Learning Disabilities, Intellectual Disabilities, and Motor Disabilities and Tics, experience more stress than parents of typically developing children. Some positive psychology interventions (PPIs) have been developed to support these parents, but these interventions may not be feasible in the daily lives of most parents. Despite the potential effectiveness and suitability of low-threshold self-help PPI applications, no mobile app-based interventions have yet been developed specifically for this target group. This European study aims to describe the development of an app called "Adappt" in cocreation with parents of neurodivergent children and professionals working with these parents and children. Adappt aims to improve the mental well-being and resilience of these parents through PPIs.

**Methods:** The CeHRes Roadmap was used to develop the app starting with an inquiry of the context, followed by a specification of values by key stakeholders, and prototype testing and designing the actual intervention. Firstly, as part of the context inquiry (1) a review of reviews was performed on stressors experienced by parents of children with autism, (2) a systematic review was performed on PPIs developed for parents of neurodivergent children, (3) parents were interviewed on their experiences and needs, and their opinions about a comparable existing generic PPI, and (4) professionals were interviewed about parental experiences. Secondly, based on the input of the first phase, requirements for the content and functionalities of the intervention were described. Thirdly, the requirements of the previous step were used to write a first version of the app-content and a list with requirements for functionalities of the app. The written content was evaluated in iterative cycles in which (1) parents gave written and verbal feedback on the exercises, the instructions and ideas for the design of the intervention, and (2) professionals gave feedback on the content. Then, a high-fidelity prototype was developed by an external organization, and evaluated and improved in iterative rounds by researchers, professionals, and parents.

**Findings:** "Adappt" consists of six themes: points of light, strength-based empowerment, attention to yourself, balanced relationships, accept and let go, and asking for and receiving help. Each theme consists of a video with psychoeducation and five exercises based on positive psychology, mindfulness, or acceptance and commitment therapy. Exercises can be performed within the app (e.g. think about the strengths of your child) or outside the app (e.g. discuss your strengths with someone you trust). Based on parental feedback, the app includes ideas on the inclusion of children in exercises, despite being targeted at the parental mental well-being.

**Discussion:** This study shows the development of an application for parents in cocreation with parents. A variety of parents were included in this process, including mothers and fathers with children of different ages, and neurodivergent parents. One stakeholder is missing in the early stages of development, namely the insurance company. Including this stakeholder would be beneficial for the adoption of the application. Currently, the application is being implemented in an international randomized controlled trial for a summative evaluation.

## Unsupervised Change Point Detection for Early Complication Identification in Post-Surgical Oncology Patients

**Fatime Oumar Djibrillah, Ilse Waanders, Daan Lips, Annemieke Witteveen, Gabriela F. Nane, Maurice van Keulen & Arlene John**

**Background:** Postoperative complications following major abdominal surgeries are associated with high morbidity and prolonged hospital stays. Early detection of physiological deterioration is crucial for timely intervention. Traditional monitoring methods, which rely on periodic vital signs measurements and fixed thresholds, may fail to identify early signs of deterioration or can generate false alarms. Continuous physiological tracking presents a promising solution, especially with increasing trend of remote monitoring. However, it requires advanced analytics to differentiate between clinically relevant changes and normal fluctuations. To address this challenge, we propose an unsupervised deep learning approach using an LSTM autoencoder to analyze continuous home-monitored physiological data and detect potential complications early.

**Methods:** Physiological data were collected from 30 patients who underwent oncological colorectal or pancreatic resections and were monitored with HealthDot, a wearable patch sensor, for 14 days postoperatively at their homes. The sensor recorded various physiological parameters, including heart rate and respiratory rate. A subset of 10 patients (5 with complications, 5 without) was selected for model evaluation. An LSTM autoencoder was trained on continuous heart rate and respiratory rate data to learn physiological patterns and detect change points associated with potential complications. The architecture consisted of two LSTM layers (32 and 16 units) in the encoder, followed by a RepeatVector layer for latent representation, and two LSTM layers (32 and 16 units) in the decoder, with a time-distributed dense output layer reconstructing the original input. A dynamic thresholding method was applied to identify significant deviations in reconstruction errors. The Time-to-Detection (TTD) was calculated as the time difference between the first detected change point and the first clinically documented complication.

**Findings:** The proposed unsupervised deep learning model identified physiological deteriorations up to 50.12 hours and 49.74 hours before the first clinically documented complications in two test patients. These results highlight the potential of combining LSTM-based autoencoder with dynamic thresholding for early detection of postoperative complications, particularly in home-monitored patients using wearable sensors. However, change points were also observed in patients without recorded complications, which indicate the need for further refinement to improve specificity.

**Discussion:** The ability to detect physiological deterioration before clinically documented complications suggests that unsupervised deep learning approaches can enhance postoperative monitoring, even outside the hospital environment. However, the detection of change points in patients without recorded complications indicates that certain physiological variations may not always be sign of adverse events. This emphasizes the need to improve specificity by incorporating additional clinical parameters, fine-tuning the model, and refining the thresholding methods as well as validating the model in a larger patient cohort to minimize false alerts.

## Automated Detection of Cardiac Syncope Causes in 12-lead ECGs Using Residual Neural Networks

**Anouk van Kessel, Margot van Hest, Marjolein van Breugel & Arlene John**

**Background:** Syncope, a transient loss of consciousness due to cerebral hypoperfusion, is a common emergency department (ED) presentation, with incidence increasing with age. Detecting cardiac causes is crucial, as cardiac-related syncope is linked to higher one-year mortality. Traditional telemetry monitoring often generates excessive alarms, leading to alarm fatigue and diagnostic delays. This study explores a two-step deep learning approach using a residual neural network (ResNet) with an Efficient Channel Attention (ECA) module to improve automatic detection of syncope-related arrhythmias in 12-lead electrocardiograms (ECGs).

**Methods:** A cardiologist-guided selection process identified the most clinically relevant arrhythmias associated with syncope. The study utilized the Chapman Ningbo dataset, comprising 45,152 ECG recordings. Although the dataset included 48 distinct diagnoses, not all were relevant to syncope. Consequently, eight diagnoses deemed critical for syncope detection were selected, resulting in a refined subset of 11,432 multi-labeled ECG recordings for model training. A novel two-stage classification framework was developed. The first stage employed a binary classification model to differentiate normal from abnormal ECGs. ECG recordings were classified as normal if they exhibited a sinus rhythm with no additional abnormalities, while all other recordings were labeled as abnormal. The second stage applied a multi-classification model to the subset identified as abnormal, further categorizing ECGs based on the presence of specific cardiac conditions associated with syncope. The model's performance was optimized using Bayesian hyperparameter tuning, class-weighted adjustments to address dataset imbalances, and early stopping techniques to prevent overfitting. Performance evaluation was conducted using recall, precision, F1-score, confusion matrices, and receiver operating characteristic (ROC) curves.

**Findings:** Through expert consultation, the arrhythmias most relevant to syncope were identified as prolonged QT interval, atrial fibrillation, left bundle branch block, second-degree AV block, low QRS voltages, complete heart block, and Wolff-Parkinson-White (WPW) syndrome. The two-stage classification approach demonstrated superior performance in detecting key arrhythmias associated with syncope, outperforming single-stage models from prior research in several critical areas. The binary classification model achieved high sensitivity, with macro-averaged recall, precision, and F1-scores of 0.99 on the test set. The multi-classification model also produced promising results, particularly in identifying second-degree AV block, left bundle branch block, and WPW syndrome, where recall scores showed notable improvements (>0.05) compared to the single-stage classification approach. These findings underscore the potential of this deep learning framework as a valuable clinical tool for detecting high-risk arrhythmias in patients with syncope.

**Discussion:** This study demonstrates that a two-stage deep learning framework improves sensitivity in detecting cardiac syncope, particularly high-risk conditions like left bundle branch block and second-degree AV block, highlighting its potential as a clinical decision-support tool. By reducing alarm fatigue and enhancing arrhythmia detection, this method could aid real-time syncope risk stratification. Challenges remain, such as optimizing sensitivity for sinus rhythm and addressing dataset imbalances, but the model’s performance supports its clinical potential. Future research should focus on expanding datasets, refining training, and exploring real-time telemetry applications. With further development, this approach could improve early syncope detection, enhancing patient safety and clinical efficiency.

## PROMIS-driven convalescence: Clustering patient trajectories of physical functioning following surgery

**Daan Toben, Astrid de Wind, Carlien Straat, Eva van der Meij, Judith Huirne & Han Anema**

**Background:** Knee arthroplasty (KA) is an effective procedure to mitigate the debilitating impact of osteoarthritis (OA) of the knee. By 2050, the global prevalence of knee OA is projected to grow by 74.9%. What’s more, the patient demographic is shifting from those aged 70 and over to working age patients with different expectations, focused in greater part on return to work (RTW) and sports activities. A better understanding of postoperative recovery and its impact on return to work (RTW) for KA is needed. Trajectory analysis can be a valuable tool in this regard, mapping the heterogeneity of recovery trajectories into distinct, clinically meaningful patterns. These patterns can help healthcare providers identify subgroups of poor responders, as well as enhance shared decision. In this study, we therefore aim to investigate the heterogeneity of functional recovery following KA surgery in working age patients, and to link the resulting patterns to RTW.

**Methods:** We used data collected through the ACTIVE trial, a multicenter, single-blind, randomized, placebo-controlled trial. Patient reported outcome measurement information system (PROMIS) physical function (PF) t-scores were used as the measure functional recovery. Latent Class Growth Models (LCGA) and Growth Mixture Models (GMM) were then specified to classify each individual trajectory into longitudinal patterns. We used structured interviews with clinical experts to provide substantive interpretation of the patterns, using an interactive dashboard as a medium for discussion. Regression analyses were used to investigate the association between patterns and RTW, as well as to identify factors associated to pattern membership.

**Findings:** Three distinct patterns - which we labelled Gradual recovery, Fast recovery, and Slow recovery - were found. Linear regression analysis revealed membership of the Fast recovery group was associated with a 60 days faster return to work, and membership of the Slow recovery group with a 60 day slower return to work, compared to the average 150 days estimated for Gradual recovery. Preoperative predictors of Fast recovery were (OR; 95% CI) were male sex (2.25; 1.16 - 4.4), Unicompartmental surgery (3.26; 1.62 – 6.56), and higher perceived health (1.03; 1.01 – 1.05). For Poor recovery, these were higher pain (1.37; 1.02 – 1.86), lower perceived health (0.98; 0.95 – 1.00), low expectations (2.60; 1.05 – 6.21), and not achieving RTW within the study's timeframe (4.22; 1.62 – 11.04). Clinicians were quick to recognize the utility of the model for their practice.

**Discussion:** Recovery from KA is not only heterogenous, distinct recovery patterns are apparent and the patients exhibiting these patterns can be identified by their characteristics prior to surgery. Some of these, like sex, are static and limited to serve as early detectors of suboptimal recovery prior to surgery. In this role, they may nevertheless benefit recovery by enhancing shared decision making if they are used to manage patients' expectations. Others seem actionable and may be leveraged to alter a patient's prognosis from a poor recovery to a gradual, or even fast one. Future research may build on these findings by linking longitudinal recovery to patient satisfaction regarding the outcome of their surgery.

## AI in automatic recognition of palliative care demand

**Richard Maria Hermanus Evering, Evi Swinkels, Betsie van Gaal, Iris Heerlien & Marjolein E.M. den Ouden**

**Background:** In the Netherlands, approximately 600,000 individuals are diagnosed with COPD and 240,000 with heart failure. Recognizing and marking the palliative phase in patients is difficult due to the erratic course of these diseases. During the palliative phase, the focus of care shifts from curative treatments to symptom management and quality of life enhancement. This phase is typically identified when the patient's expected remaining lifespan is approximately twelve months. Hence, difficulty in recognizing the palliative phase, may lead to over- and under-treatment of patients.

Artificial Intelligence (AI) makes it possible to automatically recognize the palliative phase based on data from the electronic health record (EHR). In the Telemap project, an AI model has been developed for application in the EHR of home care for the automatic recognition of palliative care needs. In a feasibility study, research was conducted among home care professionals into initial experiences with its application.

**Methods:** The AI model has been implemented in the EHR of 6 home care teams from 2 different home care organizations. After 2-3 months, experiences were collected from home care professionals through 6 focus groups.

**Findings:** Home care professionals think that the AI model based on data from EHR will improve care, by timely identification of the palliative phase. However, they need insight into the data and arguments why the palliative phase has been identified in order to follow-up the AI-advice. In addition, they state that it could help them in communicating with the general practitioner, and even help them understand which topics they need to report on in more detail in order to generate better data to improve the AI.

The AI tool still has a number of limitations, such as:

- the explanation from the AI tool about why a client has been flagged is insufficient;

- wrongly marking the start of the palliative phase because intensification of care can clearly be explained on the basis of something else;
- It may happen that a client was marked as entering the palliative phase, however later it was not marked as such anymore. According to home care professionals, this makes the AI tool unreliable.

Also, the integration of the AI tool into the EHR is not yet optimal, which means that the user-friendliness can be improved. For example:

- the AI tool does not yet work in every web browser;
- working with the AI model on the iPad was not possible,
- extra steps have to be taken to arrive at relevant clients that have been flagged by the AI tool.

**Discussion:** The research shows the added value of an AI tool to flag the palliative care, however improvements are needed in its operation and user-friendliness. The AI model was not used by a large number of healthcare professionals during the test period, despite the fact that the AI tool was shown and information was given about how it works. This emphasizes the importance of a thorough implementation.

## Co-design of Digital Mental Health Support for LGBTQI+ Youth

Tessa Dekkers & Anne van Dongen

**Background:** Many LGBTQI+ youth experience minority stress due to internal and external stigmatization. This results in disproportionately high rates of depression, anxiety and suicidal ideation. Lack of access to mental healthcare due to long waiting lists further exacerbates these disparities. Digital mental health support could alleviate these mental health concerns, but currently no solutions specifically tailored to LGBTQI+ youth exist in the Netherlands yet. Therefore, this study seeks to understand how LGBTQI+ youth perceive mental health and well-being, as well as their specific preferences for digital mental health interventions.

**Methods:** This qualitative co-design study involved seven young people (19-24 years, mean age 22) who self-identified as queer in two focus groups in April 2023. The first group explored how LGBTQI+ youth define and understand mental health through storytelling. The second focus group concentrated on young gay men who had experienced depressive symptoms. Participants engaged in mind-mapping exercises and a structured think-share activity, in which they brainstormed their ideal digital intervention. Both focus groups were recorded and transcribed and data were analyzed using reflexive thematic analysis to construct key themes related to participants' experiences and eHealth preferences.

**Findings:** Four major themes were constructed. In the first, Depression & Discrimination, all participants reported experiencing depressive symptoms, which they linked to both general life stressors (e.g., relationships) and specific minority-related stressors (e.g., discrimination and hiding their identity). While some participants found strength in their identity, others struggled with distress when navigating unsupportive environments. In the second, Community and Companionship, social connection was identified as a crucial source of support, often valued even more than professional therapy. Participants expressed the need for an eHealth intervention that fosters peer connection, provides emotional support, and offers access to LGBTQI+-affirming spaces and events. In the third, Coping, individual coping strategies were described as a secondary source of mental health support. This included reading, journaling, and sports. However, some participants also resorted to unhealthy coping strategies (e.g., substance use and risky sexual behaviour). In the final theme, eHealth, participants shared that they had limited prior experience with digital mental health tools. They were most drawn to features that fostered a sense of community, such as anonymous peer chat functions, or sharing of LGBTQI+ events. They also wanted tools for self-reflection and practicing gratitude. Finally, safety was discussed, with a strong preference for a queer-friendly or even queer-only platform.

**Discussion:** This study highlights the urgent need for digital mental health interventions that prioritize community and connection for LGBTQI+ youth. Existing solutions often fail to effectively engage this population, making co-design a critical step in ensuring adoption. The findings from this study are considered a first step in the currently on-going development of an eHealth intervention tailored to LGBTQI+ youth. The next phase of this research will extend these insights to transgender and gender-diverse youth.

## Co-Creating ESM Items for Monitoring Triggers and Coping Strategies in Forensic Psychiatry

**Carlijn Serno, Marileen M. T. E. Kouijzer, Martin Izaks, Yvonne H. A. Bouman, Saskia M. Kelders & Hanneke Kip**

**Background:** The Experience Sampling Method (ESM) is emerging as a valuable tool in psychiatry, offering insights into variations in behavioral, psychological, and contextual features in real-world settings. Limited research has demonstrated the potential of ESM in forensic psychiatry, for example, to gain insight into the relationship between mood and stressors and monitor risk factors for offending behavior. ESM could also be useful for identifying and monitoring triggers and coping strategies, to counter issues associated with existing methods, which include conversations and role play. For example, cognitive impairments, such as impaired memory, are common in forensic patients and pose challenges to existing methods, which rely on the patient’s recollection of past events. Moreover, existing methods often fail to capture the variability in triggers and coping strategies throughout the week. Existing ESM research highlights the benefits of co-creating ESM items with the users to tailor them to the context and needs of the target population. Therefore, this study aims to co-create ESM items with stakeholders that help to monitor triggers and coping strategies in forensic psychiatric patients. Additionally, the study will explore the potential added value of ESM and its possible fit within forensic psychiatric treatment. The ESM items will be delivered via a smartphone app.

**Methods:** Using an iterative participatory design approach, we will conduct qualitative interviews and a co-design process to develop ESM items and explore their implementation in community-based forensic psychiatric treatment. The process will include individual interviews with five therapists, seven patients, and five ESM researchers, with continuous refinement of the ESM items based on iterative feedback. This approach ensures that the ESM items and their delivery via the smartphone app are personalized, meeting the needs and context of the forensic psychiatric population while being adaptable for clinical use.

**Findings:** The final product consists of a set of ESM items designed to identify and monitor triggers and coping strategies among forensic psychiatric patients. To guide the development and implementation of the ESM items and app, we will categorize the user input into five requirements: content, usability and user experience, functional and modality, organizational, and service requirements. Preliminary findings indicate that the use of an app for real-time data collection is a feasible delivery method, allowing for sufficient personalization and ease of use for both patients and therapists.

**Discussion:** This study examines the potential of co-design in developing ESM items tailored for forensic psychiatry. By actively involving users of the final product in the design process, this study introduced a new level of personalization, addressing the specific needs and challenges of forensic psychiatric patients, while also being relevant for therapists. Key factors, such as content, usability, and organizational fit, were addressed to enhance integration into existing forensic treatment. A follow-up study will explore the feasibility of integrating these items into clinical practice using a smartphone app.

## Initiating co-creation in COPD Exacerbation Management: Patients' and Providers' perspectives on Remote Patient Monitoring

**Atena Mahboubian, Marise J. Kasteleyn, Enna Basic, Niels H. Chavannes & Jiska J. Aardoom**

**Background:** Chronic Obstructive Pulmonary Disease (COPD) exacerbations worsen lung function and cause psychological distress, affecting overall health and quality of life. Early diagnosis and prevention of exacerbations are crucial for preserving lung function, improving QoL, preventing hospitalizations, and reducing mortality and healthcare costs. While remote patient monitoring (RPM) offers the potential for early exacerbation detection, challenges remain in recognizing symptoms early. A non-invasive breathalyzer by Respiro B.V. is being developed to monitor COPD patients and detect exacerbations before symptoms arise by measuring breath volatile organic compounds. This study encompasses the initial co-creation phase to align the breathalyzer and corresponding care process with current COPD exacerbation management and user needs.

This study aims to understand COPD care processes, exacerbation management, and RPM in the Netherlands, through three objectives: 1) Explore stakeholders involved in COPD exacerbation care, 2) Understand current COPD care, and 3) Assess stakeholder experiences and expectations regarding RPM in COPD care.

**Methods:** Following the CeHRes roadmap, four research activities were conducted between March and September 2024 for the initial co-creation phase: 1) desk research, 2) interviews, 3) project group meeting, and 4) co-analysis focus group. Desk research involved reviewing literature and COPD (exacerbation) care guidelines. Semi-structured interviews (n=34) were conducted with 18 patients, 14 healthcare professionals, one caregiver, and one hospital policy advisor. Topics included COPD diagnosis processes, exacerbation management, stakeholder roles in COPD (exacerbation) care, and RPM experiences or expectations. The project group meeting between interviews and the focus group verified interim findings and guided the focus group content. Six patients participated in a co-analysis focus group to review interview quotes on exacerbations and RPM. The Framework Method was used to analyze the interviews and the focus group through inductive and deductive coding.

**Findings:** Seven key stakeholders in COPD care, patients, pulmonologists, general practitioners, nurse practitioners, nurse specialists, physiotherapists, and informal caregivers. We observed a lack of uniformity in COPD care, exacerbation management, and information provision across providers. Patients reported struggling to recognize exacerbations. Although patients with experience in RPM generally reported positive experiences, they questioned the added value in early detection of exacerbations. Those without RPM experience were receptive to its use for symptom tracking but were concerned about reduced in-person care and overreliance on data. Healthcare providers reported seeing value in RPM for monitoring between visits and efficiently allocating resources but stressed the need for clear guidelines and noted barriers such as language proficiency and usability of technology.

**Discussion:** This study highlights the opportunities to improve COPD care and optimize exacerbation management supported by the usage of RPM. Future research should refine RPM processes, balance objective data with patient-reported symptoms, enhance communication amongst HCPs and between HCPs and patients, provide clear exacerbation management guidelines, and ensure inclusivity.

## Co-designing implementation materials for the compassionate use of smartwatches in mental health care

**Charlotte van Lotringen, Saskia Kelders, Gerben Westerhof & Matthijs Noordzij**

**Background***:* The use of smartwatches is a promising development in mental health care, as they offer the opportunity to monitor and respond to activity and sleep, among other things. However, the integration of smartwatches into daily mental health care practice is lagging behind. Technologies are often seen as impersonal and 'cold'. Furthermore, professionals lack a clear and meaningful substantiation for why and how they can use technology in treatment. Aligning with the values of stakeholders in mental health care can help improve the implementation of technology. An important value in healthcare is compassion; recognizing and wanting to alleviate suffering.

**Methods***:* As part of the 'compassionate technology for mental health care' project, we conducted 5 co-design sessions with in total 9 patients and 13 professionals from a department for acute mental health care. The sessions focused on the treatment journey and experiences of patients and professionals, iterating multiple prototypes, and testing the final prototype in a treatment session.

**Findings***:* Based on the co-design sessions, a card set has been developed that can be used in group sessions to work compassionately with smartwatches. Taking into account the needs expressed by participants, the cards encourage group interactions and assignments, and focus on the personal and qualitative interpretation of smartwatch data.

**Discussion***:* Co-design methodology helped to develop implementation materials based on the needs and preferences of stakeholders in mental health care. Moreover, the focus on compassion during the co-design process and in the final card set could help align the use of technology with values of stakeholders for a more meaningful and successful implementation. We are currently evaluating the effects of the use of the card set on the experiences of using smartwatches by mental health professionals.

## Personalization in eHealth; urgent needed but how to come forward? A Methodological framework based on literature and expert knowledge

**Steven Lankheet, Sandra Strakova, Anouk Middelweerd, Femke Schröder, Monique Tabak & Miriam Vollenbroek-Hutten**

**Background:** The field of eHealth is evolving rapidly and can provide personalized support for people with chronic conditions. Despite these developments, the optimal personalization strategy remains uncertain, raising the question what works best for whom? In addition, the personalization strategy used is often poorly described. To improve the effectiveness of personalization, a method is needed to compare existing personalization strategies. Such a method can consist of a framework that describes and categorizes existing interventions. The categorization, using the framework, can be used to analyze which aspect of personalization is linked to more effective interventions. Furthermore, the overview provided by the framework can help developers choose and describe the personalization strategy consistently.

Existing frameworks that describe the personalization lack the depth needed to thoroughly compare interventions and link the strategy to effectiveness. To address this gap, this research aims to develop a framework to fully analyze and categorize the personalization strategy. This detailed description allows for comparison of different eHealth interventions to bring the field of personalized eHealth forward.

**Methods:** A mixed-methods approach was used to construct the framework, integrating literature review and expert discussions. The development occurred in two phases. In the first phase, an initial framework was iteratively designed through a synthesis of existing frameworks and insights from five eHealth experts. In the second phase, an interactive panel session will be conducted to test and refine the framework. Panelists will be presented with five real-world cases and apply the framework to each eHealth interventions. The resulted descriptions are compared for inconsistencies. Together with feedback gathered during the panel session, the framework is finalized.

**Findings:** The literature review has shown that most papers defining personalization categories had some variation on input, method and output categories. Klooster et. al.'s framework had the most defined subcategories. Only two papers categorized the extent of the personalization. The iterative discussion with the experts in the first phase resulted in the framework with three main categories and 19 subcategories. The first category evaluates the type of input variables (e.g., demographics, behavior, etc.) used for personalization and how it is obtained. The second category examines how this input is processed to generate personalized outputs (e.g., rule base, self-learning, retrospective learning, etc.) The final category assesses the output aspects of an intervention (e.g., content, timing and representation) that are personalized and to what extent. Within this category, the output is further divided and graded across five levels of personalization (e.g., group-based, individual-dynamic-based etc.). The input obtained from the panel session will provide insight into consensus of the developed framework and possible adaptations.

**Discussion:** The developed framework serves as a structured checklist to categorize personalization strategies within eHealth interventions. By applying this framework, researchers and developers can systematically compare different interventions and link personalization approaches to intervention outcomes. Additionally, the framework can guide eHealth developers in selecting an appropriate personalization strategy that aligns with their intervention goals. This framework has the potential to advance the field by facilitating more precise and effective personalization in eHealth interventions.

## Unlocking the potential of Real-World Data for dynamic evaluation in digital health

**Annemiek Kwast, Deirisa Lopes Barreto, Nelly van Uden & Miriam Vollenbroek-Hutten**

**Background:** Healthcare systems worldwide are under growing pressure due to aging populations, the increasing prevalence of chronic diseases, and shortages of healthcare professionals. Hybrid care - blending digital health technology(DHT) and in-person healthcare – is seen as key enabler for more efficient, patient-centered care. However, scaling these innovations requires solid evidence of their value. Traditional evaluation methods, such as randomized controlled trials, are often time-consuming and insufficiently account for the evolving nature of digital care. Hybrid care generates vast amounts of real-world data (RWD). This includes frequent individual measurements and diverse data from daily life, offering opportunities for continuous evaluation and personalized interventions. However, this potential remains largely untapped. Therefore, we explore the added value of dynamic evaluation based on RWD and the challenges involved.

**Methods:** The Zorg bij Jou (ZBJ) initiative, developed within the Santeon hospital network, provides a structured approach to integrating digital tools for patient monitoring and care coordination. The implementation and evaluation of ZBJ is structured likewise the CeHRes roadmap. This study builds on the ZBJ approach while incorporating additional frameworks for assessment. We explore the added value of RWD-driven dynamic evaluation through expert opinions, insights from ZBJ, and literature review. This allows us to identify key opportunities and challenges, leading to the development of a new theoretical framework for continuous evaluation based on RWD. The framework will subsequently be tested in practice using the ZBJ program.

**Results:** Preliminary findings indicate that RWD has strong potential to enhance digital health evaluation, particularly in measuring reach dynamically over time (users and non-users), adherence trends can be tracked to understand how engagement evolves over time and its relationship with clinical outcomes and effectiveness. RWD and continuous evaluation allow for tracking the evolution of personal health goals over time. As patients' conditions improve or fluctuate, their health objectives may shift. Capturing these changes enables a deeper understanding of hybrid care effectiveness on both individual and group levels. It also enables broader system-wide impact assessment, shedding light on how digital tools influence different healthcare settings. Despite these benefits, several challenges must be addressed. Data availability, privacy, and reliability remain critical concerns, requiring robust governance frameworks. Establishing causality with RWD is complex, demanding advanced analytical techniques. Methodological challenges, such as handling missing data and standardizing metrics, must also be overcome. Moreover, there needs to be sufficient trust among stakeholders in RWD-based evidence to support its use in policy and clinical decision-making.

**Discussion:** Determining the value of hybrid care is crucial for their successful scaling and adoption. This study highlights the potential of RWD to better accommodate the dynamic nature of digital care and provide continuous insights into its effectiveness. To validate this approach, we will apply our proposed framework in the ZBJ program, evaluating both its feasibility and stakeholder acceptance. Ultimately, integrating dynamic evaluation with RWD could strengthen the evidence base for DHT's, supporting their long-term sustainability in healthcare and accelerating the scaling of digital care.

## Emerging Technology to Revolutionize Healthcare

**Lisette van Gemert-Pijnen & Thijs Veugen**

**Abstract:** Growing access to vast global datasets, coupled with the emerging power of artificial intelligence, could be transformational. However, unlocking this potential depends on addressing crucial concerns surrounding privacy, security, and data sovereignty. Privacy Enhancing Technologies (PETs) are innovative tools embedded in privacy by design. Their objective is to safeguard privacy and security while enabling large-scale data sharing, processing, and analysis between different parties. By facilitating the utilization of vast datasets across institutions and nations, PETs are set to revolutionize multiple sectors, including healthcare, mobility, and energy. In healthcare, for instance, PETs stand to profoundly impact society by promoting precision medicine and personalized treatments while simultaneously addressing concerns regarding data privacy, security, and trust.

PETs are one of the Top Ten Emerging Technologies of 2024, as announced in the report published by the World Economic Forum in collaboration with Frontiers (World Economic Forum, 2024).

This presentation demonstrates the pros and cons of PETs for innovation of healthcare, like precision medicine and personalized healthcare. We highlight following topics:
- Enabling safe data processing in various medical contexts (multi party computation)
- Synthetic solutions to data scarcity and data privacy (Synthetic Data)
- Data governance to ensure legal and financial application of PETs (legal, ethical aspects)
- Trust and willingness to increase adoption of PETs
- Data wisdom, improving training and education to understand the added values of PETs
- Standardization and harmonization in PET application (Quality of Data)

The aim of this presentation is to create awareness and to share knowledge about smarter data utilization across institutes, nations to promote precision medicine and personalized healthcare.
The presentation is based on my publications in World Economic Forum (2024), The transformation map for Privacy Enhancing Technologies with key issues shown at the centre and related to announced topics around the perimeter (2024). The Research Topic about Pets in Frontiers with several publications (expected March 2024, editors LVG and TV), a Panel with Dutch experts about implementation of PETS in practice which will be presented at the conference ICT& Health, 2025) and a discussion with Aleid Wolfsen, authority Persoonsgegevens.

## A roadmap for certifying software as a medical device under the European Medical Device Regulations (MDR)

**Anouk van der Gracht, Marijn Maas, Willem von Meijenfeldt, Erwin Waas, Govert de Vries & MyBit Group**

**Background:** With over 500,000 health apps available globally, the regulatory landscape for medical software is increasingly critical. The MDR, in effect since May 2021, aims to ensure the safety and effectiveness of medical devices, including software. It qualifies and classifies devices based on their medical purpose and associated risks, placing a significant emphasis on its specific intended use. For instance, an app that monitors asthma symptoms and alerts patients to consult a doctor qualifies as a medical device, while one storing health data without analysis does not.
The certification process is rigorous, requiring organizations to adopt ISO13485-compliant quality procedures, conduct clinical evaluations, and actively monitor the product in the market via post-market surveillance. However, the rewards – such as access to 30 European countries, reimbursement opportunities, and competitive advantages – often outweigh the challenges.

**Methods:** Certifying software as a medical device involves a structured, multi-step approach:
1. Define intended purpose: Determine if the software qualifies as a medical device under MDR based on its purpose and functionality;
2. Develop a regulatory strategy: Decide whether you can self-certify, work with consultants, or outsource technical and regulatory responsibilities;
3. Implement a QMS: Establish and maintain an ISO13485-compliant Quality Management System;
4. Prepare a technical dossier: Compile detailed documentation, including risk analyses, clinical evaluations, and software specifications;
5. Engage a Notified Body: Collaborate for audits and product certification with a Notified Body - a company which is accredited by the government and assesses medical devices documentation for

compliance with EU regulations;
6. Ensure Post-Market Compliance: Set up procedures for complaint handling, software updates, and ongoing surveillance.

Examples of software that have been certified as medical devices are: MASK Air app, which monitors asthma symptoms, MySugr, for diabetes patients, and BMI calculators, illustrating the nuances of classification and certification.

**Findings:** While the certification process is resource-intensive – costs can range from €80,000 to €160,000 for QMS implementation alone – the benefits are substantial. CE certification grants access to the European market, improves product safety and reliability, and fosters trust among healthcare providers and patients. It also reduces business risks by validating quality through independent audits. Organizations can choose between fully managing certification in-house or outsourcing certain tasks, depending on their expertise and resources. Notably, a shortage of Notified Bodies and expert consultants makes early planning crucial.

**Discussion:** Following the medical device certification route for health apps and other software under the MDR is essential for ensuring safety, compliance, and market access. While the process demands significant time and financial investment, the resulting benefits – ranging from regulatory approval, perceived market trust in the product, to competitive positioning – justify the effort. This paper underscores the importance of aligning technical development with regulatory requirements early in the project lifecycle. Future work should focus on streamlining certification processes, particularly for small and medium enterprises, and expanding awareness of the MDR's implications.

## The potential of HoloLens in addressing obstacles experienced by preceptors of nursing students during internships

**Anouk Jansen, Fenne Verhoeven, Julia Heij, Marleen de Vries & Inge Pool**

**Background:** Technology-based simulation learning (TBSL) applications, such as HoloLens, immersive rooms, and Virtual Reality, are becoming increasingly prominent in nursing education. These tools offer promising opportunities to enhance learning and professional development, and provide opportunities in the rising shortages in healthcare, where adequate supervision of nursing students during internships is becoming increasingly difficult. Much research has already been performed on the use of TBSL in the educational (school) setting, but there is still little experience with and research on the use of TBSL in daily clinical practice. For example, in the Isala Hospital in Zwolle in the Netherlands (859 beds, 6,878 employees), mixed-reality technology like HoloLens is used to support clinical reasoning among nursing students during their internships. But whereas initial findings suggest that HoloLens can be valuable for students, it is unclear how this technology can address specific challenges faced by their preceptors. To bridge this gap, this study aimed to identify the barriers preceptors experience while supervising nursing students during their internship and to explore how TBSL, particularly HoloLens, might address these barriers.

**Methods:** Semi-structured interviews (n=29) were conducted between October and November 2024, with internship preceptors (n=18) and educational coordinators (n=11) of twelve different wards of Isala. Four of these wards experimented with HoloLens last year. Questions involved facilitators and barriers perceived while supervising nursing students, and the (potential) use of TBSL in their work and supervision.

Afterwards, a focus group was organized with six TBSL experts (November,2024), to discuss the possible applicability of TBSL regarding the barriers. Verbatim transcribed interview data regarding the HoloLens were coded deductively according to the Npuls-framework for XR implementation. This analysis was supplemented by extracted notes from the focus group.

**Findings:** Ten barriers were found among preceptors towards supervision of nursing students. Three of these barriers have potential to be supported by HoloLens: Change in students' attitudes (less motivated); Students' theoretical knowledge is not up to standard; Uncertainty of students towards physical collaboration with their preceptors.

Interviews showed that HoloLens contains several advantages that can be beneficial for the three barriers mentioned above, such as improvement of clinical reasoning, collaboration (by creating more learning opportunities), communication (students expressing observations and thoughts), growth in self-assurance, and enjoyment of learning.

However, it also became clear that the use of HoloLens brings obstacles in the form of organizational issues, such as staff deployment, technical operation and support, physical availability, logistical challenges, and practical organization.

**Discussion:** The results of this study show that internship supervisors encounter several barriers when supervising nursing students. A number of barriers could (partly) be solved by the usage TBSL, and specifically with HoloLens. Future research should elaborate on this, by studying the impact of using HoloLens on the barriers related to internship supervisors and nursing students. In order to do so, the organizational obstacles in the adoption of HoloLens need to be further explored and addressed. This would give the opportunity to adopt the HoloLens more sustainably and more efficiently throughout the work of internship supervisors and enhance the competences of nursing students.

## Using Technology to Explore the Link Between the Future Self and Goal Achievement

**Tiffany Tettero, Esther C. A. Mertens, Aniek M. Siezenga & Jean-Louis van Gelder**

**Background:** Future self-identification—the extent to which people vividly imagine, feel related to, and experience positive feelings toward their future self—is closely linked to goal achievement. For instance, people with stronger future self-identification tend to achieve higher GPA scores, save more for retirement, and engage in career planning. These findings demonstrate that a strong sense of identification with the future self motivates individuals to engage in behaviors that benefit their future self, which suggests that goals are being pursued. Based on these findings, it seems plausible that future self-identification is related to goal achievement. However, it remains unclear whether future self-identification and goal achievement solely correlate or whether one predicts the other. Therefore, I investigate whether and how future self-identification and goal achievement are related over time.

To draw robust conclusions regarding this relationship, I will analyze these constructs within an intervention context. The behavioral intervention, FutureU, is designed to strengthen future self-identification using unique technologies, including a smartphone application (app) and virtual reality (VR). Within this intervention, people interact with and embody an age-progressed rendered avatar of their future self. By engaging with this personalized future representation of themselves, people are expected to experience a stronger sense of identification with their future self. This experimental manipulation allows us to determine whether changes in future self-identification can account for subsequent changes in goal achievement.

**Methods:** In a three-armed randomized controlled trial, 321 first-year university students were assigned to one of three conditions: (1) an active control, (2) an app intervention, or (3) a VR intervention. All students set goals. In addition, students in the intervention conditions interacted with their future self, either through the app or VR.

Using cross-lagged panel model analyses, I will analyze whether changes in future self-identification at one wave can predict changes in goal achievement at a subsequent wave, and vice versa. Additionally, I will investigate whether an intervention can manipulate this relationship.

**Findings:** Data collection for this study has been completed, and analysis is imminent.

**Discussion:** At the conference, I will present the study's findings on the relationship between future self-identification and goal achievement. In addition, I will discuss the FutureU behavioral intervention, which leverages the app and VR to strengthen future self-identification.

## A first step towards implementing DEEP within (forensic) mental healthcare – a pilot study

**Lisa Klein Haneveld, Hanneke Kip, Yvonne Bouman & Saskia Kelders**

**Background:** Treating forensic psychiatric patients is a complex endeavor, as patients often lack treatment motivation, show complex psychosocial problems, and sometimes have lower cognitive abilities. Consequently, there is an ongoing search for interventions that better align with the interests and abilities of forensic patients. An example of such an intervention is DEEP, which is a VR environment that teaches its user how to reduce stress through diaphragmatic breathing using biofeedback. Earlier evaluation studies of DEEP showed its promise to support patients to reduce tension and stress, and prevent aggressive outbursts. However, as implementation in regular care is often challenging, it is important to gain insight into the benefits and barriers healthcare professionals and patients experience when independently using DEEP, outside of evaluation studies.

**Methods:** An implementation study was conducted, in which DEEP was introduced to patients in two forensic departments during a 3-month pilot. The results from previous studies, as well as the Consolidated Framework of Implementation Research (CFIR), were used to prepare the pilot study and develop the implementation materials. During the pilot, six healthcare professionals were given the freedom to use DEEP with their patients in ways they found most beneficial. They were asked to evaluate every DEEP session using short evaluation- and sign-up forms. Lastly, all six healthcare professionals and 3 patients were interviewed after the pilot study.

**Findings:** Healthcare professionals and patients shared input on how they wished to use DEEP together. This led to using DEEP both ad hoc and structurally integrated within treatment. Moreover, healthcare professionals recognized their own value in being intrinsically motivated to use DEEP as they had a key role in introducing DEEP to their colleagues and patients. Finally, all participants agreed that the use of implementation leaders and ambassadors were crucial to provide structure and vision. However, they acknowledged that management should provide clear eHealth blocks within the workflow to ensure enough time to use DEEP.

**Discussion:** This pilot study showed that DEEP could be used in various ways as long as it meets the patient's needs. There was a recognized necessity for structural support for healthcare professionals if DEEP were to be implemented, fitting other implementation study outcomes. Future research will focus on how DEEP can be implemented in other psychiatric populations, gaining insight into whether the found implementation factors and strategies can be transferred across psychiatric fields.

## cpThrive: Development of an mHealth aide to facilitate evidence-based treatment choices for Cerebral Palsy

**DanaKai Bradford, Michelle Jackman, Alex Griffin, Jessica Marie Bugeja, Remy Blatch-Williams, Maria McNamara, Joel Flude, Catherine Morgan, Jennifer Wilson & Iona Novak**

**Background:** Cerebral palsy (CP) is a lifelong condition with no known cure. While it is the most common physical disability and the fifth most common cause of death in childhood, 55% of patients do not receive effective interventions and 43% receive harmful or ineffective care. Evidence exists demonstrating that treatments targeted to specific symptoms or activities can improve function in CP, but this evidence is not readily available to people with CP and their families. Instead, families must navigate a sea of treatment options, without knowing which criteria best informs decision making. To better match individuals and treatments, we aimed to develop a mobile health (mHealth) aide that streamlines and filters established evidenced-based interventions according to the needs of people living with CP.

**Methods:** Six focus groups were held with research partners (RPs) with lived experience (N=15) over six months to understand required features, functionality, user interface and how the aide could be most responsive to consumer needs. All RPs were invited to all focus groups. Resources from the Cerebral Palsy Alliance were incorporated into the aide, including algorithms developed by clinicians to accommodate age and capability in treatment choice; treatment effectiveness rankings based on published literature and consumer factsheets for each treatment (130+). Media files were included where relevant and available. A design company used fixed architecture and a content management system (CMS) to create a prototype for testing.

**Findings:** RPs provided iterative, in-depth insight into preferred language, layout and logic. The resultant mHealth aide, named cpThrive by RPs, comprises a guide allowing consumers to narrow down treatments based on age and capability for themselves, or for up to five significant persons; and a search function with filters to find treatment options using keywords. Consumers can save, print and/or share treatments of interest. Media files demonstrate activities in some treatments. Information about cerebral palsy, and about Australia's disability funding provider is easily accessed from the landing page. Support resources are provided for using the app, understanding the effectiveness ratings and severity classifications, and for living with CP.

**Discussion:** Our mHealth aide, cpThrive, codesigned and endorsed by RPs, will be available, free of charge, through app stores worldwide following extensive user testing. The app has been made with data sustainability in mind – with the CMS allowing updates as new treatments arise or effectiveness ratings change. For consumers, the aide will empower self-management, promote health literacy, and support personalised decision-making.

## Preliminary results and lessons learned from a stepwise eHealth intervention with the Participatory Approach

**Hanneke Lettinga, Sandra van Oostrom, Karin Proper, Trees Juurlink, Allard de Smalen, Luuk Bouwens, Roosmarijn Schelvis, Eva van Doeveren, Aartjan Beekman & Han Anema**

**Background:** More than a third of absenteeism is caused by work-related stress, and nearly 27% of absenteeism is due to psychological complications. Besides the severe consequences for the individual, absenteeism imposes a considerable economic burden on employers and society. As the probability of eventual return to work (RTW) declines with longer absence, early intervention is necessary with a clear RTW focus. Research showed that an eHealth intervention was effective on first RTW, but not on lasting RTW for employees with distress. Another study on a Participatory Approach (PA; a step-wise process to reach consensus on obstacles and solutions to enable RTW) found that the PA was effective on lasting RTW, but only for employees who indicated they were open to RTW despite symptoms. As the eHealth was effective on first RTW – but not lasting RTW, and the PA was effective only for the subgroup who had a positive cognition towards RTW, these effective elements are combined. The eHealth offers a tailored 'recovery path', built from a set of modules. The content of the modules is based on the principles of psycho-education, cognitive-behavioral therapy (CBT) and problem-solving therapy. The aim of the eHealth is to identify and change negative cognitions regarding intention to RTW with symptoms by CBT, and to provide employees with the basics of the PA.

The PA is a structured procedure that involves the employee, their direct supervisor, and a neutral party to guide the conversation. This collaborative process aims to identify obstacles for RTW, and subsequently develop a consensus-based RTW plan with a strong commitment of both the employee and employer. The effectiveness of the intervention is studied in two different designs; a stepped-care and a tailored-care approach. In the stepped care approach, the intervention starts with eHealth and is followed by PA in case of persistent absenteeism. In addition, in the tailored-care approach the form of the PA is dependent on the perceived relation between complaints and work relatedness. The aim of both studies is to evaluate the effectiveness of the intervention on lasting RTW.

**Methods:** Employees between 2 – 12 weeks of absenteeism with distress (measured with a distress screener) will be randomized to receiving either eHealth or usual care, and randomized to PA or usual care. The PA is only provided in case of persistent absenteeism. Primary outcome is lasting RTW, defined as full RTW in previous or equal work for at least four consecutive weeks. Secondary outcomes are (the severity of) stress-related symptoms, total number of absenteeism days, self-efficacy for RTW and self-reported health.

**Findings:** During the presentation we will present preliminary findings of both RCTs with different designs, started December 2024 and January 2025. In addition, more detailed information about the technical mechanisms of the eHealth and lessons learned will be shared.

**Discussion:** The implications of the preliminary findings will be discussed, in addition to some reflections of lessons learned along the way, such as (dis)advantages of the design of the eHealth and privacy considerations specifically for eHealth interventions and research.

## Advancing eHealth Integration in Mental Health: A Collaborative Approach to Treatment Pathways

Maaike Meurs & Merel van Hoogdalem

**Background:** Mental health services (GGZ) are facing significant challenges, including long waiting times, limited capacity, and high workloads. These challenges create an urgent need for cost-effective solutions, such as the more efficient use of eHealth. However, mental health professionals struggle to effectively integrate eHealth in their treatments. The goal of this research project is to set up a comprehensive framework for the transition of eHealth as an additional tool to a core component of the care pathway. This will be achieved by developing and evaluating a hybrid care pathway, integrating eHealth components into the treatment of mood disorders. This pathway will be developed in collaboration with Therapieland and mental health professionals, with a focus on optimizing the treatment process through the personalized use of eHealth solutions. Ultimately, by enabling more effective use of eHealth, this transition aims to reduce workloads and waiting times while increasing job satisfaction for professionals and promoting greater autonomy for patients in managing their care.

**Methods:** The project follows a four-step process: Initial Planning and Consultation: A series of interviews were conducted with therapists who specialize in mood disorders (N=4) to identify the most relevant methods, themes, phases, and eHealth options to incorporate into the care pathway. Additionally, this phase involved reviewing internal data of online programs that are used for mood disorders and care standards to ensure alignment with existing best practices.

Designing the Care Pathway: The care pathway has been outlined, incorporating treatment phases and thematic areas where eHealth options can be integrated. These were further validated through feedback from therapists (N=3).

Prototype testing: A comprehensive list of treatment elements derived from around 30 online programs related to mood disorders will be grouped into relevant themes and integrated into the care pathway. A prototype of the pathway will be tested, and the effectiveness and feasibility of the hybrid framework will be validated through feedback of therapists (N=10).

Implementation and Evaluation (Future Research): Further research will be conducted to assess the long-term impact of the hybrid care pathway. This includes evaluating its potential to partially replace in-person appointments across a wide range of health care domains, reduce workloads and waiting times, increase job satisfaction for professionals, and promote greater autonomy for patients in managing their care. This step represents a longer-term goal and will not be completed by the date of the conference.

**Findings:** In the period of February to April data collection will take place for “Prototype testing”, described in the method section. Both the content and usability of the prototype, as well as its alignment with care processes, will be evaluated.

**Discussion:** By embedding eHealth as a core element of mental health treatment, this research seeks to improve both the efficiency and accessibility of care. The prototype testing serves as the first step in a broader evaluation and discovery process. Over time, continued research will enable a more comprehensive assessment of the impact of eHealth integration on patient outcomes, therapist workload, and overall care quality.

## Explainable AI (XAI) for Arrhythmia Detection in ECG

**Joschka Beck & Arlene John**

**Background:** Advancements in deep learning have enabled highly accurate arrhythmia detection in electrocardiogram (ECG) signals. However, these models are often considered "black-box" systems, limiting their clinical adoption due to a lack of interpretability. Explainable AI (XAI) techniques aim to bridge this gap by providing insights into model decisions. Despite the progress in XAI, most techniques are designed for image and feature-based models rather than time series data like ECG signals. This study aims to explore explainability of AI models for arrhythmia detection.

**Methods:** A model was developed utilizing the MIT-BIH arrhythmia dataset. The study employs deep learning techniques, specifically Long Short-Term Memory (LSTM) networks. Data preprocessing includes segmentation based on R-peak, detected using Pan-Tompkins algorithm, and handling class imbalance through Synthetic Minority Over-sampling Technique (SMOTE). To assess performance on a large dataset, an additional 12-lead ECG dataset was included. Various eXplainable AI (XAI) techniques were analyzed and tested, leading to the use of SHapley Additive exPlanations (SHAP), a method based on game theory. Four different SHAP-based techniques were implemented, tested, and compared (Permutation importance, KernelSHAP, gradients, and Deep Learning Important FeaTures (DeepLIFT). Additionally, medical professionals were consulted to gather their perspectives on the explainability of these models.

**Findings:** The deep learning model achieved a high validation accuracy of 98.3% on the MIT-BIH dataset. However, performance dropped significantly when trained on the combined dataset, highlighting the importance of consistent measurement environments. Of the four tested methods, permutation importance and KernelSHAP exhibited similar behavior, producing cluttered output. The remaining two methods produced more promising results, showing the points of interests more clearly. These methods provided clear indications of important waveform segments used in classification, aligned with clinical knowledge. However, the patterns they highlighted differed between the two methods and also varied across samples, raising concerns about reliability. Additionally, medical professionals preferred heatmap-style visualizations for interpretability.

**Discussion:** This study highlights the potential of XAI in improving transparency in arrhythmia detection models. While the deep learning model demonstrated strong classification performance, its reliance on single-heartbeat segmentation limited the detection of arrhythmias that require rhythm context. The study underscores the need for domain-specific adaptations in XAI methods for ECG analysis. While the explainable methods sometimes produced incorrect highlight areas, the arrhythmias were still correctly identified. Future work should focus on refining XAI techniques for time-series data and validating their clinical applicability.

## Predicting Psychological States using Machine Learning and Digital Biomarkers from wearable data

**Lingxi Wu, Arlene John & Jorge Piano Simoes**

**Background:** Prior research has shown that digital biomarkers can predict mental states associated with depression and anxiety. However, their ability to detect positive psychological states—such as positive emotions, meaning in life, self-esteem, and accomplishment—remains less explored. This pilot study aims to address this gap by investigating whether smartwatch-derived digital biomarkers can predict daily psychological states aligned with the PERMA framework (Positive Emotion, Engagement, Relationships, Meaning, and Accomplishment), providing a more comprehensive understanding of mental well-being.

**Methods:** Thirty-four healthy volunteers wore research-grade smartwatches for eight consecutive days, enabling the passive collection of physiological signals, including heart rate variability (HRV), electrodermal activity (EDA), and actigraphy. Participants also completed end-of-day ecological momentary assessments measuring 18 PERMA-related psychological states. After data preprocessing, we extracted 177 features from actigraphy, HRV, and EDA. Principal component analysis (PCA) was applied to identify relevant feature subsets. Machine learning models—including Random Forest, Long Short-Term Memory (LSTM) networks, and Convolutional Neural Networks (CNNs)—were employed to predict psychological states from the complete feature set and the reduced subset. Classification performance was evaluated using three metrics: (1) prediction accuracy, (2) threshold accuracy (correct if within ±1 of the true label), and (3) top-3 accuracy (true label among the top three predictions). Additionally, interpretable AI techniques identified the most influential features, while conformal prediction assessed prediction uncertainties.

**Findings:** While overall classification accuracy for PERMA-related psychological states was low across all models, the CNN-based model achieved a threshold accuracy of 62%, indicating that all predictions fell within ±1 of the true label. The LSTM model, when applied to PCA-extracted features, achieved the highest threshold accuracy of 60%. Performance analysis of individual psychological states revealed that self-esteem constructs had the highest prediction accuracy for both positive and negative emotions. Anger-related negative emotions also demonstrated strong accuracy, likely due to well-documented physiological responses associated with anger in prior research. Constructs related to meaning in life and personal relationships exhibited moderate accuracy, reflecting their complex cognitive and emotional components. Our findings demonstrated moderate explainability of daily psychological states, with actigraphy consistently emerging as the strongest predictor across different algorithms. These patterns held true even after accounting for physiological signals from HRV and EDA, highlighting the contribution of movement data. Movement patterns explained substantial variations in participants' positive mental states, emphasizing the role of physical activity.

**Discussion:** These findings suggest that wearable-derived biomarkers can effectively track fluctuations in positive psychological states in real-world settings. By integrating interpretable AI techniques and uncertainty quantification, wearable technology holds promise for personalized mental health monitoring and timely interventions. Future research should refine feature extraction methods and validate these results in larger, more diverse populations to enhance generalizability.

## Opportunities, challenges, and conditions for data-driven working and the use of (generative) AI in insurance medicine

**Dominika Borowiec, Astrid de Wind, Elena Syurina & Johannes R. Anema**

**Background:** The shortage of insurance physicians presents a challenge for providing statutory social-medical services by the Dutch Social Security Institute: the Institute for Employee Benefits Schemes (UWV). Not only does this lead to extended delays for guidance and assessment, as well as extended sick leave, but it also contributes to a reduction in employment opportunities for benefit claimants. In recent years, there has been an increasing interest in data-driven working and the application of innovative technical solutions, such as generative AI. It has commonly been assumed that those newest innovations and advancements in technology have the potential to help address capacity challenges and reducing workload by decreasing administrative burdens. It could be done by summarizing files, answering questions about medical history, and drafting reports. On the other hand, there is some evidence that suggests that time savings after implementing AI were limited. Another aspect of the implementation of data-driven solutions is user acceptance. Previous research has suggested that technological innovation is not automatically embraced by all stakeholders. Facilitating and inhibiting factors within the socio-political context, the organization, the user and the innovation itself can influence the acceleration or delay of technology implementation in social-medical services.

**Methods:** This research follows a qualitative design, utilizing semi-structured interviews and focus groups among employees of the Dutch Social Security Institute, to gain in-depth insights. The interview design was chosen to gather a wide range of perspectives, which are then used to organize focus groups discussing the opportunities, challenges, and conditions for implementing data and AI-driven solutions. The results will be framed and interpret according to the theoretical model: Consolidated Model For Implementation Research (CFIR).

**Discussion:** The research provides an overview of current practices, including potential opportunities, challenges, and conditions for data-driven working and generative AI by the Dutch Social Security Institute: The Institute for Employee Benefits Schemes (UWV). This study aims to identify bottlenecks that can be addressed with data driven working and technological innovation, explore potential and desirable solution strategies, including conditions, challenges, facilitating and inhibiting factors for AI application, and investigate attitudes towards the acceptance of data and AI solutions.

## The Impact of AI Integration on Clinical Decision-Making: A Qualitative Study of Primary Care Physician Workflows in Simple and Complex Scenarios

**Sormeh Mehri, Krizia Mae Francisco & Catherine M. Burns**

**Background:** Primary care physicians are at the forefront of clinical diagnosis, referral, and treatment processes. Over the past decades, electronic medical records (EMRs) have become an integral part of clinical practice, and they are now poised for further evolution through the integration of artificial intelligence (AI) technologies. While AI enhancements promise to augment clinical decision-making capabilities and streamline workflows, there has been limited exploration of how AI integration impacts clinicians' decision-making patterns and practices, particularly across different types of clinical scenarios ranging from routine to complex cases. This study addresses this knowledge gap by comparing traditional and AI-integrated EHR workflows to understand how clinicians' decision-making processes change—or remain unchanged—with the introduction of AI in primary care settings.

**Methods:** In collaboration with TELUS Health, we utilized their EMR platform, the collaborative health record, to conduct a qualitative study. We performed 17 semi-structured interviews with primary care clinicians in the first phase of the study, examining their workflows and cognitive processes across two distinct scenarios: uncomplicated urinary tract infections (UTIs) and mental health visits. The interviews were conducted individually using standardized scenarios while allowing for situational follow-up questions. Data analysis employed decision ladders and contextual analysis to map cognitive workflows and identify decision-making patterns. This study specifically focuses on understanding how clinicians gather information, interpret data, and make clinical decisions in both simple and complex scenarios with AI assistance.

**Findings:** The study revealed that clinicians' reliance on AI varies based on scenario complexity. In straightforward cases like UTIs, clinicians showed greater acceptance of AI suggestions and prescriptions, typically using them after verification and patient consultation. However, in complex scenarios like mental health visits, clinicians demonstrated reduced trust in AI-generated treatment plans due to the contextual and individualized nature of these cases. Concerns about AI-introduced bias were more prominent in complex scenarios compared to straightforward cases. Legal considerations emerged as a significant factor influencing AI adoption, particularly in complicated cases, while being less frequently mentioned in simple scenarios. Additionally, clinicians emphasized the importance of maintaining human connection in patient care, especially in complex cases, expressing reluctance to streamline these interactions through AI automation despite potential gains in efficiency or accuracy.

**Discussion:** The integration of AI into EMR workflows can significantly influence clinicians' decision-making processes, particularly in information gathering and task prioritization. While AI tools effectively streamline certain processes and provide decision support by pre-populating patient histories and suggesting treatment options, they simultaneously introduce new considerations around bias management and professional autonomy. Clinicians demonstrate varying levels of trust in AI capabilities, generally accepting its role in administrative tasks while maintaining cautious oversight of clinical decision-making aspects. These findings emphasize the importance of designing AI tools that complement rather than replace clinician decision-making processes, suggesting near future development is better to focus on supporting existing cognitive workflows while preserving professional autonomy.

## Doing Good Care with Digital Technologies: between Being Spontaneous and Predictable

**Artur Vlas Nikulkin & Catharina Margaretha van Leersum**

**Background:** Digital dossiers, mobile applications, and emergency safety systems aim to enhance the quality of care but come with additional work, complex procedures, and a new set of failures, mistakes, and inconveniences. This is due to the digitalisation of care being a multifaceted process involving multiple actors and practices. The differing care cultures and logics of care managers, technical specialists, and care professionals often contradict each other. Furthermore, new digital technologies introduced from above, with little training, may take care workers, nurses, and their care recipients by surprise, proving more of a challenge than an opportunity.

**Methods:** Using ethnographic social research methodology, we reconstruct the everyday practices and challenges faced by care workers and care recipients during the implementation and use of new digital technologies. We conducted a thematic analysis of 26 semi-structured interviews, further supported by observations made in various care settings within three care organisations based in the Zuid-Limburg region.

**Findings:** We identified numerous everyday practices of tinkering with and adjusting newly adopted digital technologies. We also witnessed informal knowledge sharing between tech-savvy and tech-challenged care workers. Moreover, we identified multiple human-technology interactions that are situational and spontaneous, as established, stable, clear, and formal procedures have yet to emerge for these new technologies. Ultimately, some of these spontaneous relations and entanglements are becoming the new normal—predictable, expected, and supportive of care work. In the paper upon which the presentation is based, we reconstruct the specifics of these spontaneous and stable relations, how they emerge, and how different human and non-human actors are entangled through various care, organisational, communicative, and technical practices.

**Discussion:** The findings of our research contribute to the scholarly debate about the relational nature of human-technology interactions, showing how specific entanglements and arrangements stabilise despite initial uncertainty and confusion. We examine different forms of informal and spontaneous practices, some of which are actively subversive, but most are supportive, despite being outside the intended and proposed scope of procedures. Theoretically, we contribute to understanding how fluid relations become stable and outline the analytical differences between them. Empirically, we provide specific advice for care workers and care managers on adopting digital technology processes, such as focusing on collective decision-making in care, actively involving care workers and care recipients in planning, and paying attention to numerous subjectivities and approximations in what may seem an objective and precise process of using digital technology.

## State of Digital Care in the Netherlands in 2024

**Jelle Keuper, Eva Alblas, Miel Vugts, Lilian van Tuyl, Sarah Vader, Maria Villalobos-Quesada & Karlijn Leenaars**

**Background:** The healthcare sector in the Netherlands is currently facing several major societal challenges, such as an aging population, a high demand for care, staff shortages, increasing costs, and persistent health inequalities. To keep healthcare accessible, affordable and of good quality, it is necessary to do things differently. Digital care is seen as one of the solutions, if applied properly. However, it is not yet clear what the current state of digital care is in the Netherlands, how it is experienced by patients and providers, and what its potential is to address societal challenges. Therefore, Nivel and the Dutch Healthcare Authority (NZa) initiated the annual Digital Care Monitor in 2021. This monitor provides insight into the use and experience of digital care from the perspective of patients, people with chronic diseases and healthcare providers (doctors and nurses).

**Methods:** For the Digital Care Monitor 2024, Nivel conducted a questionnaire study among patients and people with a chronic condition, and the NZa among healthcare providers (doctors and nurses) in different sectors. In the questionnaire, respondents were asked about the use and experience of various forms of digital care, including self-care, communication and data exchange. The questionnaires also included items on perceived benefits and barriers, and the potential of digital care to address societal challenges. Data collection took place between April and July 2024. In total, 7750 respondents participated in the patient survey, 3035 in the survey for people with chronic diseases, and 1360 healthcare providers.

**Findings:** The results show that the use of digital care has increased slightly compared to 2023. Especially the use of digital communication with healthcare providers and the exchange of data increased. Patients and people with a chronic condition are generally positive about digital care, but also see limitations, especially regarding personal contact and trust in digital applications. Healthcare providers are more critical: they often see the added value, but also experience barriers, such as lack of time, knowledge and support. Furthermore, there are differences between sectors: in mental healthcare, digital care is more widely used and more positively evaluated than in, for example, elderly care. The monitor also shows that digital care can contribute to societal challenges, such as reducing workload and improving access to care. However, this requires appropriate preconditions, such as good infrastructure, support and funding.

**Discussion:** The Digital Care Monitor 2024 provides valuable insights into the state of digital care in the Netherlands. The results underline the importance of targeted policies and support to promote the appropriate use of digital care. It is essential to take into account the experiences and needs of both patients and providers, and to invest in training, infrastructure and cooperation. Only then can digital care actually contribute to sustainable and people-centered healthcare.

## Organisational eHealth readiness of top clinical hospitals in the Netherlands: a mixed-methods study

**George Garritsen, M.E.M. den Ouden, T. Bondarouk, N. Beerlage-de Jong & S.M. Kelders**

**Background:** eHealth has the potential to improve the accessibility, quality, and efficiency of healthcare. However, its implementation often requires organizational change, for which organizations need to be prepared. Organizational eHealth Readiness (OeHR) reflects the extent to which an organization is prepared for this change. Although research has been done into OeHR, it remains unclear how OeHR can best be measured in Dutch hospitals and how it can support care transformation. Therefore, this study aimed to test the psychometric properties and usability of the OeHR scale in the Dutch context.

**Methods:** A mixed-methods approach was used. The OeHR scale, originally developed and validated in English, was translated into Dutch and then administered to 22 professionals (e.g., managers, policy officers, healthcare providers, researchers, and IT personnel) in three Dutch top clinical hospitals. Quantitative data was analyzed using descriptive and multiple regression analyses. Additionally, focus groups were conducted to gain insight into the usability and applicability of the scale.

**Findings:** The results showed that the internal consistency of the five subscales (Strategic, Competence, Cultural, Structural, and Technological Readiness) ranged from acceptable to good. Regression analysis revealed that Competence Readiness was a significant positive predictor ($B = 0.606$, $p = .030$) and Cultural Readiness a significant negative predictor ($B = -0.706$, $p = .045$) of self-reported readiness. The overall model explained 50.2% of the variance in self-reported readiness ($R^2 = .502$, $F(5, 16) = 3.23$, $p = .034$). The focus groups showed that the OeHR scale was useful in practice, but that some concepts and formulations were difficult to understand. In addition, the participants indicated that some aspects of readiness were missing, such as personal, operational, and societal readiness.

**Discussion:** The Dutch version of the OeHR scale has sufficient psychometric properties and can be useful for assessing readiness for eHealth implementation in Dutch hospitals. However, adjustments to the scale are necessary to improve its comprehensibility and completeness. This study provides practical and theoretical recommendations for the further development of the OeHR scale and the application of the concept of organizational readiness in healthcare.

## Culture matters: A cross-country comparison of technology acceptance

**E.I. Metting, T.T. Nguyeng, M. Spiller & L. Dassen**

**Background:** Lack of staff, increasing costs and high workload also force healthcare organisations to find more efficient way of providing care. For example by cross-border collaboration in innovation development. Technology acceptance might be related with cultural differences but hardly anything is known about this.

**Methods:** Aim of this study is to explore eHealth acceptance of COPD patients in the Netherlands, Flanders, UK and Germany. A paper and online questionnaire was distributed by patient organisations and professionals. Questions were based on previously held focus groups and the unified theory of technology acceptance.

**Findings:** 412 questionnaires returned (27% on paper, 61% female, mean age 68±8 years, 67% Netherlands, 14% Flanders, 9% Germany, 10% UK). UK patients were least digital experienced (not online in the past week:12% UK, 4% Flanders, 1% Netherlands, 0%, Germany | not in position of smartphone: 30% UK, 20 % Flanders, 14 % Netherlands, 11% Germany | "I expect to be able to use eHealth independently": UK 41%, Flanders 70%, Netherlands 69%, Germany 65%). Poor digital literacy was most common in the UK (33%) and least present in the Netherlands (11%). Motivation to use eHealth is highest in Belgium (72%) and lowest in the UK (42%). Remarkable was the high level of eHealth experience in Flanders (e.g. use of online medical records 86%). Patients from Flanders were less afraid of losing personal contact (28% vs 41% Netherlands, 36% Germany).

**Discussion:** Although most respondents have digital experience there not all willing to use digital technology. Patients from Flanders were most experienced eHealth. Patients from the UK are least experienced and also less positive about digital health innovations. There are clear differences in patient perspective not only reflecting differences in healthcare systems but also cultural differences. This information can be used to improve the uptake of eHealth innovations.

## Identifying Needs, Motivations, and Challenges for a Multidomain Digital Intervention to promote Brain Health among older adults

**Nikita Sharma & Geke Ludden**

**Background**: Cognitive decline is a growing global health concern, currently affecting over 55 million people, with nearly 10 million new cases projected annually due to aging populations and longer life expectancies. It is closely linked to modifiable risk factors such as hypertension, diabetes, obesity, smoking, excessive alcohol consumption, physical inactivity, social isolation, and depression. Addressing these factors can significantly reduce the risk of cognitive impairment. The FINGER-NL trial explored the impact of a 2-year multidomain lifestyle intervention—including cognitive training, diet and nutrition, physical activity, sleep, social engagement, stress management and relaxation—on cognitive functioning in 1,210 older Dutch adults at risk of cognitive decline. Combining face-to-face coaching sessions with online resources, the trial demonstrated the potential of multidomain lifestyle interventions to mitigate risk factors and improve cognitive health. As a step further, the current study seeks to identify the needs, motivations, and challenges of older adults at risk of cognitive decline to guide the development of a self-management digital lifestyle intervention designed to foster engagement and promote behavior change for improved brain health in older adults.

**Methods**: Semi-structured interviews were conducted with fourteen experts - three lifestyle coaches, seven early-stage researchers, and four senior researchers involved in the FINGER-NL trial. Interviews were transcribed verbatim, and a combination of inductive and deductive thematic analyses was used to identify motivations, needs, and challenges that older adults at risk of cognitive decline may face when using such a self-management multidomain digital lifestyle intervention.

**Findings**: The study revealed two primary types of motivations - intrinsic (fear of cognitive decline and a desire to improve overall health) and extrinsic (social and research contribution, particularly for the well-being of future generations) among participants in FINGER-NL trail. While experts acknowledged the positive impact of incorporating multiple lifestyle domains on cognitive health of FINGER-NL participants, they emphasized the importance of thoughtfully designing each domain to identify those requiring targeted monitoring, coaching, and training. They also stressed the necessity of skill development through psychological, micro, and visual educational elements across domains. Personalization was also a key recommendation, with experts suggesting that adaptive goal setting, progress tracking, and feedback could improve user engagement and the overall success of the intervention. Lastly, several key challenges that could impact the implementation of such an intervention were identified, including varying personal choices and circumstances, limited education about brain health and healthy lifestyle practices, and insufficient long-term resources to maintain such an intervention.

**Discussion**: The findings of this study highlight the significance of adopting a multidomain approach when designing digital lifestyle intervention for improving cognitive health in older adults. Insights into user motivations can be leveraged to enhance user engagement. Additionally, skill development and education are pivotal in empowering users to adopt and sustain healthier lifestyles behaviors independently over time. Overcoming challenges such as resource limitations and knowledge gaps could lead to the scalability of such interventions. These findings offer valuable guidance for developing a personalized, user-centered multidomain digital lifestyle intervention aimed at reducing cognitive decline risk while fostering healthier behavior among older adults.

## Acceptability of an m-health application for individualized fall prevention in nursing homes

**Jonathan Diener, Kerem Dogan, Iris ten Klooster, Jelena Krafft, Janina Krell-Roesch, Lisette van Gemert-Pijnen; Alexander Woll & Kathrin Wunsch**

**Background**: Innovative digital technologies for application in care settings have received increasing attention in research as well as in clinical practice, further amplified by the COVID-19 pandemic. Although digital solutions for use in care have been available for a long time, adherence to these technologies is regularly low, and their integration into everyday care is often limited to pilot projects rather than widespread implementation across the healthcare system. To address this gap, it’s important to explore the acceptability, user experience, and reasons for non-adherence. Therefore, the aim of this study was to examine the acceptability of a fall prevention and physical activity promotion mobile application for nursing homes (BeSt Age App) to gain insights into the factors influencing adherence and improve broader implementation of these digital solutions.

**Methods**: A cluster-randomized controlled trial was conducted in nursing homes in Southern Germany. The intervention delivered via the tablet-based BeSt Age app consisted of individualized exercise sessions including strength, balance and coordination exercises. It spanned 12 weeks, with two sessions per week. Nursing home employees operated the tablet and provided the sessions to small groups of residents. Usability was assessed using the System Usability Scale (SUS), and user experience was measured with the AttrakDiff Questionnaire. Employee adherence, defined as the percentage of intended exercise sessions delivered, and resident adherence, defined as the percentage of intended sessions attended and the percentage of delivered sessions attended (adjusted adherence) along with reasons for non-adherence, were documented within the app. Usage data were analyzed based on the FITT-Scheme (frequency, intensity, time, and type of engagement). Qualitative data (e.g., feedback on the BeSt Age intervention) were analyzed using topic modeling. Additionally, the influence of engagement type (use of gamification, tailoring, personalization, and education features) on resident adherence was examined using multilevel modeling.

**Findings**: Eleven nursing homes, including 36 employees and 137 residents, utilized the app. Usability was rated at 87.1 ± 15 out of 100 points, and user experience scored 1.94 ± 1.49 on a scale from -3 to 3. The most common reasons for non-adherence were illness (employees) and physical complaints (residents). 12.1% of non-adherence among residents was due to motivational reasons. The app was used on average 34.7 out of 94 days. Employees delivered 85.6% of the intended sessions. The adjusted adherence rate for residents was 75.1% (unadjusted 64.3%). Topic modeling and multilevel analysis will be completed in the upcoming weeks.

**Discussion**: The findings demonstrate that the BeSt Age App achieved high acceptability and was well implemented in most nursing homes. Nevertheless, some nursing homes faced challenges in consistently offering the exercise sessions. The relatively low proportion of motivational reasons for non-adherence (12.1%) suggests that the exercise program delivered via the app successfully engaged residents, despite physical limitations being the primary barrier to participation. Future research should aim to identify factors that promote sustained engagement and explore the relationship between different engagement patterns and clinical outcomes.

## Designing Technology for Liminality and Autonomy in Dementia Care

Bard Wartena & Job van t' Veer

**Background**: Dementia care unfolds within liminal transitions, where individuals with dementia, informal caregivers, and formal caregivers navigate shifting roles and autonomy. As dementia progresses, people move from early uncertainty to redefined identities and deep dependency (Turner, 1969; Kitwood, 1997). Informal caregivers, note, experience a "fruitful darkness", where caregiving reshapes their identity, while formal caregivers must balance protocol-driven care with person-centered support (Gibbons et al. 2014). At the heart of these tensions are Collopy's (1988) autonomy polarities, particularly the interplay between "freedom to" act and "freedom from" harm. Technology can play a key role in mediating these tensions, adapting to evolving autonomy needs across different liminal stages. This presentation explores how perspective-taking and co-creative solution-making can inform technology-driven interventions, ensuring that support remains adaptive, flexible, and aligned with changing needs in dementia care.

## Implementation of age tech via different Dutch markets: Opportunities and challenges

Christian Wrede, Annemarie Braakman-Jansen & Lisette van Gemert-Pijnen

**Background**: Age tech refers to technologies designed to help older adults live at home for longer and to support (in)formal carers in providing home-based care. However, sustainable implementation is often hindered by a limited understanding of the specific markets where age tech might be introduced. This study aimed to identify entrepreneurial opportunities and challenges of implementing age tech via three Dutch markets: 1) the consumer market (where the technology becomes a consumer product), 2) the healthcare market (where the technology becomes part of professional care delivery), and 3) the social support market (where the technology becomes part of municipal support services).

**Methods**: Semi-structured interviews and focus groups were conducted among three stakeholder groups (n=20): care providers (innovation advisors within aged care institutions; n=8), potential payers (health insurers, long-term care offices, municipalities; n=6), and technology providers (age tech companies; n=6). The sessions focused on the example of remote monitoring technology to support home-based dementia care, and addressed entrepreneurial opportunities and challenges of implementation for each market. All sessions were analyzed thematically.

**Findings**: Several entrepreneurial opportunities and challenges of implementing age tech were identified per market. The consumer market is aligned with the growing shift towards informal care but the target group (older adults and their informal carers) is currently difficult to reach via this market. The healthcare market offers good opportunities for scaling up age tech and the target group (older adults and their formal carers) is relatively easy to reach via care organizations, but this market is also complex in terms of achieving structural reimbursement for age tech. The social support market has similar opportunities as the consumer market, but scaling up age tech is challenging because each municipality organizes care and support in a different way.

**Discussion:** Our findings add to the limited body of research on the entrepreneurial side of implementing age tech. We show that each implementation market brings specific points of attention that need to be considered. These insights can help developers of age tech to refine implementation strategies and to select a high-potential market.

## Mapping Behavior Change Techniques, Health Data Integration, and Delivery Channels in Virtual Agents for Chronic Condition Management: A Systematic Scoping Review

**Martha Kreuzberg, Lean Kramer, Sandra Straková, Saskia Kelders & Monique Tabak**

**Background**: Virtual agents (VAs) – digital entities ranging from rule-based systems to advanced AI-powered tools - can support interventions for chronic conditions by integrating behavior change techniques (BCTs), health data, using diverse delivery channels. The optimal combinations of these elements for effective chronic condition management remain unclear. This systematic scoping review synthesizes findings from 21 studies on how VAs integrate these elements.

**Methods**: A systematic scoping review was performed (Arksey & O'Malley's, 2005). Real-world intervention studies for adults with chronic conditions were searched for in PubMed, Scopus, PsycINFO, Web of Science, and IEEE Xplore. Data extraction focused on study design, population, BCTs, health data, delivery channels and outcomes and analyzed using descriptive and thematic analyses.

**Results**: 21 studies were included. Key findings:

1. Interventions: VAs like chatbots, ECAs, and virtual coaches focused on self-management and behavior change.
2. Target Populations: Mainly diabetes, hypertension, chronic pain, and cancer.
3. BCTs and Health Data:
    - Objective data (e.g., blood pressure, glucose levels) pairs with BCTs like self-monitoring and goal-setting in diabetes and hypertension interventions.

- Subjective data (e.g., symptom severity) combines with BCTs like feedback and emotional support, especially for cancer care.
- Hybrid approaches enhance personalization, but are less common.

4. Delivery Channels:
    - Mobile apps dominate, integrating data tracking and BCTs like feedback.
    - Messaging platforms (e.g., Telegram, SMS) support symptom tracking and adherence in cancer and hypertension care.
5. Rationale for Design Choices: Diabetes interventions integrate objective data for self-care, based on Health Belief Model and Theory of Planned Behavior principles. Cancer interventions focus on subjective data for symptom management, guided by Social Cognitive Theory.

**Discussion**: The diversity in VA design, as well as inconsistent reporting (complicating comparison and scalability), highlights the need for standardized frameworks to define BCTs, health data, and delivery channel integration. Findings suggest integrating real-time personalized feedback and self-monitoring, especially through VAs, enhances engagement and adherence. Standardized terminology and reporting of BCTs in VA interventions will improve replicability. Future interventions could focus on adaptive AI systems that personalize feedback using objective and subjective data across multimodal channels.

## Enhancing Tele-Monitoring with AI-enabled Personalized Coaching and Real-Time Support

**Govert de Vries, Ivo Jansch, Marijn Maas, Willem von Meijenfeld,Teun Klijn & MyBit Group**

**Background**: Integrating artificial intelligence (AI) into tele-monitoring applications offers a promising avenue for enhancing patient engagement and outcomes. This presentation focuses on how we have enriched Atris, our tele-monitoring app for measuring physical activity, by embedding AI-driven personalized coaching tailored to patients' personality traits. Dynamic patient-specific guidance can be enabled in Atris by leveraging innovative Large Language Models, such as ChatGPT. This innovation empowers individuals to make sustainable lifestyle changes. In this presentation, we describe the background, methodology, and insights gained from integrating personality-driven AI coaching into Atris, emphasizing its potential for transforming tele-health.

Atris has proven to be an effective solution for monitoring and enhancing physical activity among patients. Research conducted by UMC Utrecht demonstrates that patients using Atris in hospitals increased their physical activity by an average of 30%. This success highlights Atris' potential not only as a tracking tool but also as a meaningful intervention for improving patient mobility and recovery. The Atris app has successfully monitored physical activity using the Atris PAM movement sensor and integrations with platforms like Google Fit and Apple Health. While these tools provide valuable data, they do not inherently motivate behavioral change or address the need for real-time support. Research underscores the importance of personalized coaching, tailored to an individual’s behavioral tendencies, as a critical factor in fostering engagement and adherence.

To address these challenges, we introduced three key enhancements to Atris:

- AI-Powered personalized coaching: Tailored to the DISC personality model, which categorizes individuals into Dominance (D), Influence (I), Steadiness (S), and Conscientiousness (C).

- AI-Powered chat function: Enabling patients to ask questions about both the functionality of the system and general health coaching topics.
- Daily health reports: Automatically generated summaries that provide an overview of the patient’s activity, progress, and key insights.

Together, these features aim to create a more supportive and engaging tele-monitoring experience.

**Methods**: Personalized coaching using DISC: Patients complete a DISC-based self-assessment during onboarding, which classifies them into one or more dominant personality styles. This data is combined with physical activity insights, enabling AI-driven coaching tailored to each patient’s personality. For example: Dominance (D): Receives assertive, goal-oriented feedback; Influence (I): Encouraged through social and motivational suggestions; Steadiness (S): Provided with empathetic and consistent guidance; Conscientiousness (C): Offers structured, detailed recommendations. AI-Powered chat function: This feature allows patients to interact directly with the system, asking questions about Atris functionalities (e.g., “How do I view my activity history?”) or receiving guidance on health coaching topics (e.g., “What exercises can I do to improve flexibility?”). The chat function leverages LLM technology to deliver accurate, context-sensitive responses. Daily health reports: At the end of each day, Atris generates an automated report summarizing key metrics such as total activity, intensity patterns, and progress toward personalized goals. This report is presented in a clear, user-friendly format, offering patients actionable insights and an overview of their achievements.

**Findings**: Although no formal quantitative studies have been conducted, preliminary feedback highlights the value of these features: i) Patients appreciate the tailored coaching messages, noting that they feel more understood and motivated; ii) The AI-powered chat function has been particularly well-received for its ability to provide instant support and guidance, reducing confusion and enhancing user engagement; iii) Daily health reports have been praised for offering a clear, structured summary of activity, helping patients track their progress in a meaningful way; iv) Clinicians of several hospitals in which Atris is already being used (UMC Utrecht, UMC Amsterdam and Hospital Mij Smelling) have also expressed enthusiasm about these innovations, emphasizing their potential to complement in-person consultations.

**Discussion**: The integration of AI-powered personalized coaching, a real-time chat function, and daily health reports marks a significant step forward for tele-monitoring applications like Atris. These features not only enhance user experience but also create opportunities for sustained behavior change through tailored support and actionable insights. Next steps include formal evaluations to quantify the impact of these enhancements on patient outcomes and engagement. Additionally, we plan to refine the AI’s adaptability to ensure that its recommendations evolve with patients’ changing behaviors and needs.

Furthermore, to comply with the AI Act, we must conduct an assessment to ensure transparency, risk management, and data protection. This includes evaluating the AI's decision-making process, documenting potential risks, and implementing safeguards to meet regulatory requirements. This work demonstrates how AI can transform tele-monitoring systems into dynamic, patient-centric tools, paving the way for more personalized and effective tele-health solutions. We invite discussion on the implications of this approach, particularly in scaling such features across diverse healthcare settings.

## A pilot usability study of Smart Virtual Assistants to monitor medication adherence in chronic patients

**Emanuele Tauro, Martina Vigorè, Grzegorz Bilo, Lucia Zanotti, Alessandra Gorini & Enrico Gianluca Caiani**

**Background***:* The World Health Organization identifies low medication adherence as a significant factor contributing to elevated morbidity and mortality rates among hypertense patients. Smart Virtual Assistants (SVA) devices are becoming more common in households, presenting opportunities to implement voice-activated interventions designed to mitigate behavioral patterns associated with medication non-adherence. Thus, the aim of this study was to develop and evaluate the usability of the most commercially available SVA device, as part of the InTakeCare platform, to monitor medication adherence in chronic patients.

**Methods***:* The InTakeCare platform is a modular and scalable platform composed by a cloud database, an online server and a series of modules for user interaction. A skill was developed for the intended device, along with a connected web dashboard that enabled physicians' access and management of the therapies of their patients. Participants were asked to complete a survey capturing their sociodemographic details and the eHealth Literacy Scale (IT-eHEALS) questionnaire. Subsequently, physicians inserted prescribed medications, dosages, and scheduled intake times into the web dashboard. Information was synchronized with the participants' SVA device, setting reminders at the defined time and 55 minutes later. Patients were required to vocally confirm their medication intake within a 120-minute window around the scheduled time. After seven days, participants underwent a semi-structured interview, including the System Usability Scale (SUS) questionnaire.

**Findings***:* The study included fifteen subjects (11M; 4F), with median (25th; 75th) age 67 (57; 67) years old. IT-eHEALS scores reported a median value of 27 (21; 31.5). Post-experiment SUS questionnaire yielded a median score of 72.5 (55; 85), above the literature threshold of 68. The semi-structured interview reported high interest and perceived innovation, together with lack of trust towards the company producing the SVA device and presence of difficulties in the communication with the devices.

**Discussion***:* Participants were satisfied with the usability of the skill, viewed as engaging and interactive, with strong interest in vocal interaction. However, difficulties were reported in correctly interfacing with the SVA device vocal system, and the skill was not identified as easy to use. Further research is needed to better understand and address these issues, with the goal of enhancing vocal interaction and evaluating its effectiveness in monitoring medication adherence among hypertensive patients.

## Evaluating Perfect Fit: A virtual coach-based mHealth intervention for smoking cessation and physical activity.

**Milon H. M. van Vliet, Anke Versluis, Niels H. Chavannes, Bouke L. Scheltinga, Nele Albers, Kristell M. Penfornis, Walter Baccinelli & Eline Meijer, on behalf of the Perfect Fit consortium**

**Background***:* Mobile health (mHealth) interventions with virtual coaches (i.e. AI conversational agents) offer scalable, cost-effective solutions for promoting health behavior change. However, these interventions often present challenges such as insufficient personalization and lack of evidence-based approaches. Perfect Fit (PF), a personalized mHealth intervention with a text-based virtual coach, supports adults in simultaneously quitting smoking and increasing physical activity. Through innovative techniques (e.g. sensor technology), iterative development involving end-users, and integrating evidence-based techniques, PF aimed to overcome common challenges faced by mHealth interventions with virtual coaches. The study examined the feasibility, acceptability, and preliminary effectiveness of PF.

**Methods**: A single-arm, mixed-method, real-world evaluation study was conducted in the Netherlands with 100 adults who smoke. The intervention duration was personalized, averaging approximately 16 weeks. Data were collected at baseline, post-intervention, and two-month follow-up. Quantitative data included usage data and self-report questionnaires on feasibility, acceptability, preliminary effectiveness, and participant characteristics (e.g. socioeconomic position, eHealth literacy). Qualitative data consisted of post-intervention semi-structured interviews with a subsample. Descriptive analyses, generalized linear mixed models (for the quantitative data), and the Framework Approach (for the qualitative data) were used for data analysis. Quantitative and qualitative data were integrated during interpretation.

**Findings**: Thirty-eight percent of participants had either no or low PF usage, 34% had moderate usage, and 28% had high usage. PF was rated as moderately feasible and acceptable at post-intervention ($n$=77). At the two-month follow-up, 35% ($n$=35) of participants self-reported smoking abstinence. High-usage participants had the highest likelihood of smoking abstinence (61.5%), followed by moderate-usage participants (46.7%), and low-usage participants (22.7%; $p$<.05). Participants also reported a significant increase in physical activity between baseline and two-month follow-up ($p$<.001; *Cohen's d*=.458), with no significant differences between usage groups. Qualitative analysis of the semi-structured interviews ($n$=12) revealed that most participants tailored PF use to their preferences and appreciated the combined focus on smoking cessation and physical activity. The virtual coach offered anonymity, which was positively experienced by some (e.g. non-judgmental) but negatively by others (e.g. reduced accountability). Suggested improvements included a more human-like coach (e.g., less repetitive and more in-depth responses and reflections) and fewer technical issues to enhance usage and effectiveness.

**Discussion**: The findings demonstrate the potential of interventions like PF as strategies for multiple health behavior change, contributing to chronic disease prevention and public health promotion. Identified areas for improvement in PF provide valuable insights for the future development of mHealth interventions.

## Reporting, representation and subgroup analysis in studies assessing consumer wearable validity: a scoping review

**Rebecca Marie Schipper, Fatime Oumar Djibrillah, Meyke Roosink; Laura Winkens; Arlene John; Annemieke Witteveen, Eric Hazebroek & Agnes Berendsen**

**Background***:* Consumer wearables provide promising opportunities for early detection and prevention of disease through continuous remote monitoring of vital signs. In many cases, however, the validity of the measurements from these devices is unknown and thus has to be assessed. User characteristics like sex, age, BMI and skin tone could influence the validity of wearable sensors. Therefore, it is important that studies assessing this validity: 1) report the distribution of these characteristics in their study population; 2) ensure representation of different categories of these characteristics within the study and across studies; 3) perform appropriate subgroup analysis to investigate differences in validity outcomes between categories. It is currently unclear to what extend these user characteristics are reported and represented in consumer wearable validation studies and which analysis methods are used to investigate the influence of these characteristics. This scoping review aims to map the current reporting, representation, subgroup analysis results and subgroup analysis methodology to provide recommendations for future validation studies.

**Methods***:* A literature search was conducted in Scopus, PubMed and IEEE Xplore in June 2024. Publications were eligible if they assessed the validity of consumer wearable vital sign measurements expressed as the agreement with a reference method. After duplicate removal, 551 publications were screened for eligibility of which 164 were included. The percentage of people in specific age categories, BMI categories and Fitzpatrick skin tone scale categories was estimated based on reported means and standard deviations. Additionally, the methods and results from 26 included publications investigating the influence of these user characteristics on validity were compiled.

**Findings***:* Of the 164, only 14% reported skin tone and 50% reported BMI. Almost all studies (95%) reported sex and age. When it comes to representation, the median percentage of older adults [0%], people with a BMI <18.5 kg/m2 [4%] or ≥30 kg/m2 [6%], and people with Fitzpatrick skin tone category 5 [1%] or 6 [0%] in a study was low, compared to the other groups. When it comes to the subgroup analysis, some studies reported a significant effect of sex (2/11), age (2/11), BMI (2/8) or Fitzpatrick scale (2/8) on heart rate measurement validity. However, among these studies contradicting results were found. Variation in sample size, the validity outcome used (e.g., absolute vs relative error) and the physical activity engaged in during the studies likely contributed to the inconsistency in results.

**Discussion***:* The results of this scoping review indicate gaps in the reporting and representation of user characteristics in studies. Additionally there are inconsistencies in the results of studies investigating the influence of these characteristics on validity. To close the current gaps in reporting and representation, reporting of BMI and skin tone and the representations of older adults, people with BMI <18.5 kg/m2 or ≥30 kg/m2 and people with darker skin tones should be increased. To reduce heterogeneity in results when it comes to the influence of user characteristics on validity, future validation studies should include multiple validity outcomes in the subgroup analysis, as well as investigate different physical activity levels separately.

## Exploring Key Values in the Design of Wearable Stress Management Technology: A Multi-Method Approach

**Merel van den Berg, Armağan Karahanoğlu, Els Maeckelberghe & Geke Ludden**

**Background**: The severe negative effects of chronic stress on physical and mental health indicate a need to find ways to regulate and relieve stress. Continuous measurement of physiological stress responses (e.g., heart rate variability) can help to recognize the onset of stress episodes and engage in timely interventions. Advancements in wearable technology, such as the development of smartwatches, can offer innovative approaches to tracking stress responses and provide timely and personalized stress-relieving interventions, such as breathing exercises. Technology is not neutral but has certain values embedded in them. Users may prioritize different values, such as health, privacy, or freedom. Since embedded values can either support or conflict with users' values, some technologies may appeal to certain users while failing to resonate with others. For example, a device prioritizing privacy by collecting minimal health data may appeal to privacy-conscious users, but frustrate users seeking detailed health insights. Understanding the values people consider important is crucial for designing acceptable and effective wearable stress management technology. Therefore, as part of the research consortium Stress in Action, we adopt a value-sensitive approach to guide the selection and design of technology that enables long-term stress assessment while aligning with diverse user values.

**Methods**: To elicit values that are relevant for stress tracking and intervention technology, we used different methods. We started with a narrative literature review, in which we used inductive coding to explore user perspectives on wearable stress management technology. We then identified the values that are currently embedded in commercial stress tracking technology (e.g., Garmin smartwatch). Next, we selected two values that posed a clear and relevant value tension: societal well-being on the one hand and individual responsibility and autonomy over one's health on the other hand. We will explore this tension by creating value-sensitive mock-ups (i.e., prototypes of the technology that put a certain embedded value "to the extreme") in dedicated design workshops.

**Findings**: We have finished the first two steps that were described in the Methods, during which the following values emerged: Health and Well-Being, Privacy, Autonomy, Identity, Accountability, and Health Equity. In current commercial stress tracking technology, we mainly observed Health and Individual Responsibility as embedded values. For our next steps, we will zoom in on the tension between the values Societal Well-Being and Individual Responsibility to investigate how to balance these values in designing future stress management technologies.

**Discussion**: Our work highlights the importance of considering the tension between putting responsibility over one's stress levels with the individual or with society. For instance, a housing crisis may affect one's stress levels but is outside of one's direct control. Our value-sensitive mock-ups can serve as a means to elicit relevant questions and considerations regarding such conflicts to inform responsible future design of stress management technology.

## 'Open doors' policy in nursing homes: using GPS-trackers to monitor residents with psychogeriatric problems

**Chiem Tuil, Job van 't Veer, Hans Drenth & Jirza Zwerver**

**Background**: Nursing homes are struggling with the introduction of open-door policies. This despite the fact that the Care and Coercion Act – as the main reason for implementing these policies - has been in effect since 2020. Family members and healthcare professionals generally take a critical stance, fearing that residents' safety is not sufficiently guaranteed. There are several technologies that nursing homes can implement to monitor residents' whereabouts. While more of these systems hit the market, it is necessary to systematically evaluate how these systems fit the needs of professionals and residents; more specifically, how they can increase quality of care for residents and professionals' work efficiency.

**Methods**: We conducted 4 pilot studies in a large Frisian nursing home (late 2024 until spring 2025), using a GPS-system. In these 4 pilots (approx. 16 weeks runtime each, we conducted semi-structured interviews with professionals (pre-pilot n=44; post-pilot n=tbd) and family-members (pre-test n=55, post-pilot, n=tbd) to evaluate developments in efficiency (number of (un)necessary checks and actions, reduced workload-peaks, workload experiences) and quality of care (overall safety, frequency of residents causing disturbances, residents wandering off the premises, time reserved for patient centered care, shift in responsibilities between professionals and family). Additional quantitative data was provided by the GPS-system (system use, time/frequence of incidents).

**Findings**: In both populations, pre-pilot measurements showed only moderately positive expectations about the efficiency benefits of the system. This is probably due to the fact that only a small population of residents appears to meet the criteria to use the GPS-system. Professionals report that residents' agitated behavior is often linked to restrictions in living space, expecting problematic behavior will decrease with the new policy. This contrasts with expectations of most family-members, who assess that increased freedom will not necessarily lead to less problematic behavior. While most professionals think safety is sufficiently guaranteed, family-members show more critical attitudes. Further, pre-pilot results show that most family-members are reluctant to take on more responsibilities (in case of incidents), while most professionals do expect that they should be able to call upon family-members to help out. Post-pilot results are to be collected in spring 2025.

**Conclusion**: Open-door policies in nursing homes, as a result of the Care and Coercion Act, are still a challenge for many healthcare organizations. Technical solutions, such as GPS-tracking seems to solve only a modest piece of the puzzle, since it is only applicable for a small population. A greater challenge lies in creating general support for open door policies among family-members and professionals, since it implies an important shift in responsibilities between these formal and informal caregivers.

## Exploring what matters to rehabilitation patients for adopting home-based rehabilitation technology: A Q-methodology study

**Karlijn E. te Boekhorst, Sanne J. Kuipers, Gerard M. Ribbers & Jane M. Cramm**

**Background**: Rehabilitation technologies can support recovery and rehabilitation outside clinical settings. However, their adoption remains challenging. Factors such as ease of use, perceived benefits, and social influence play a role, but little is known about how rehabilitation patients perceive their relative importance. This study systematically explored rehabilitation patients' preferences for home-based rehabilitation technology using Q-methodology.

**Methods**: Between May and September 2024, the study examined the viewpoints of rehabilitation patients with acquired brain injury regarding the adoption of home-based rehabilitation technologies. A purposive sample of 21 participants ranked 34 opinion statements based on perceived importance and explained their choices during follow-up interviews. By-person factor analysis identified common patterns in how participants ranked the statements. These patterns, referred to as factors or viewpoints, were further interpreted using qualitative interview data.

**Findings**: Three viewpoints were identified, each highlighting different factors important for adopting home-based rehabilitation technologies: (1) Technology Supporting Rapid Recovery, (2) Technology Supporting Independence and Self-Control, and (3) Technology as a Supporting Partner. Participants consensually emphasised the importance of regaining independence, receiving feedback during exercises, and having simple, easy-to-use designs, while placing less emphasis on media influence, support from friends, and reducing travel to rehabilitation centres.

**Discussion**: The findings suggest that rehabilitation patients with acquired brain injury prioritise different factors when adopting home-based rehabilitation technologies. While some factors are commonly valued, the diversity in patient preferences highlights the need for tailored, user-centred approaches in the design and implementation of such technologies. A one-size-fits-all strategy would be ineffective in meeting the varying needs of rehabilitation patients.

## Applicability of behavioral design methods in the Metahealth project

**Nymphaea Notschaele, Lea Hohendorf, Janine Sikkens & Laurence Alpay**

**Background:** The MetaHealth project—aims "to reduce overweight and dental caries particularly in children growing up in families of a low socioeconomic position (SEP) by understanding health in a microbial, sociocultural and care context in the first 1000 days of life". Since this group is, so far, underrepresented in research—it is needed to gain a clear understanding of this target group. This study aimed to better understand the needs and wishes of this group and identify factors that influence their behaviors. This understanding will help to spread the knowledge gained during the Metahealth project and support designing interventions that promote healthy lifestyle in a way that is suitable and effective.

**Methods:** The CeHRes roadmap was used to guide the research, focusing on the first two phases: (1) contextual inquiry and (2) value specification. To achieve the study objectives, we employed behavioral design methods such as personas, user journey mapping, and the behavioral design canvas, alongside the persuasive systems design (PSD) framework. These methods were chosen for their ability to capture and represent user motivations and behaviors, and to analyze the persuasive design features in existing applications. Data collection included qualitative interviews with parents over a period of several years and an analysis of existing digital applications aimed at promoting healthy lifestyles among children and parents.

**Findings:** Results from the user journey mapping of pre-existing interviews revealed that parents' information needs are closely linked to their child's age. Notably, significant differences emerged between the needs of first-time parents and those with one or more children. The analysis of existing digital applications using the PSD framework and a list of Risk and Protective Factors of Poverty yielded the following insights: Common persuasive features in these apps include tailoring, personalization, self-monitoring, suggestions, trustworthiness, expertise, and surface credibility. Additionally, the analysis identified which risk factors these apps addressed and the protective factors they aimed to strengthen. To reflect the varying needs and behaviors during different stages of the first 1000 days, two personas were developed. Using the Behavioral Design Canvas, the study identified the personas' pains, gains, anxieties, comforts, and primary "jobs-to-be-done." For example, being a good parent emerged as the key "job-to-be-done," while having a child with good oral hygiene provided social validation, particularly among oral health practitioners. Conversely, anxieties included fears of being perceived as a bad parent, potentially leading to severe consequences, such as the involvement of social services.

**Discussion:** These personas and the associated behavioral canvas serve as valuable tools for creating realistic scenarios that inform design decisions in subsequent project phases. Furthermore, the knowledge gained during the contextual inquiry and value specification phases supports other research efforts within the MetaHealth project. For instance, persona characteristics can be used to enhance virtual agents in microbiome simulations and to develop integrated strategies—both digital and non-digital—to disseminate information and promote beneficial behaviors among parents, care professionals, and other stakeholders.

## Results of the Six-Month eHealth Lifestyle Intervention "Diameter" for Type 2 Diabetes in secondary care

**Sacha E.M. Teunissen, Eclaire A.G. Hietbrink, Maartje Kuperus, Chiara I. Lansink, Anouk Middelweerd & Gozewijn D. Laverman**

**Background**: The "Diameter" app is a personalized eHealth intervention developed to support lifestyle modification with individual goal setting in type 2 diabetes (T2D). With the use of the Diameter app, tailored advice based on a flash glucose sensor and ambulatory lifestyle data collection can be provided.

**Methods**: The DIAMETER-1 study was performed in people with T2D treated in the ZGT Hospital or primary care who use the Diameter app for six months. Body weight, waist circumference and medication use were measured at baseline, and after three and six months. TIR was assessed via flash glucose monitoring (FGM). Changes were analyzed using linear mixed models. Currently, the inclusion in secondary care is completed and the last follow-up results are expected in the end of May.

**Findings**: Interim analysis in the first 27 of 80 participants who have completed the DIAMETER-1 study showed significant variation between participants in all outcomes. The results showed a significant decrease in BMI (−0.57 kg/m² [95% CI −1.02; −0.12]; P = 0.015) and waist circumference (−3.00 cm [95% CI −4.64; -1.36]; P <0.001) after six months. While nine participants successfully reduced their blood glucose lowering medication, no significant changes in TIR (−5.15% [95% CI −10.85; 0.56]; P = 0.08) were reported. FGM provided participants useful insights regarding the effect of lifestyle habits on their glucose regulation.

**Discussion**: Whereas the DIAMETER-1 study is designed as feasibility study, the use of the Diameter app shows promising short-term results. The continuous ambulatory data collection paves the way for further development of AI based, "just-in-time" coaching.

## Predictors of engagement and adherence in blended eHealth Cardiac Rehabilitation

**Isra Al-Dhahir, Linda D. Breeman, Iris ten Klooster, Renée IJzerman, Roderik A. Kraaijenhagen, Niels Chavannes, Veronica R. Janssen & Andrea W.M. Evers, on behalf of the BENEFIT consortium.**

**Background:** Blended eHealth lifestyle interventions are increasingly used for secondary prevention in cardiovascular disease (CVD). Although these approaches improve accessibility for individuals with low digital literacy and enhance behavior change support through in-person guidance, their effectiveness remains suboptimal. This is partly due to declining adherence and limited engagement caused by a lack of personalization. Adherence refers to the extent to which individuals follow prescribed interventions, such as attending sessions or completing tasks, while engagement reflects interaction with the intervention, including login frequency, time spent on the platform, and module completion. Therefore, understanding socio-demographic factors, digital skills, and behavioral determinants that predict adherence and engagement can help tailor interventions for diverse populations.

**Methods:** This study involved a secondary analysis of data from the BENEFIT project, a longitudinal, non-randomized, cluster-controlled trial including 658 participants from seven Dutch cardiac rehabilitation (CR) centers. The BENEFIT program is a blended CR intervention combining human-guided and remote-guided components. Human-guided components include face-to-face sessions with physiotherapists (Fitness Training [FIT]) and psychologists (Psycho-Educative Prevention [PEP]) as well as phone-based lifestyle coaching. Remote-guided components, delivered via the Personal Health Application (PHA), offer educational content, progress monitoring, and lifestyle interventions covering e.g., nutrition, physical activity, and stress management. Regression analyses examined relationships between socio-economic position (SEP), age, gender, digital skills, motivation, self-efficacy, social support, and stress, and their impact on adherence to and engagement with these program components.

**Findings:** Motivation and self-efficacy positively predicted adherence in FIT and PEP sessions. Better digital skills predicted higher engagement in remote-guided components. The data showed trends of higher engagement in PEP sessions and remote-guided components of women compared to men. SEP was not a major factor in predicting adherence, but engagement in lifestyle tele-coaching was marginally lower for higher SEP participants. In contrast, lower SEP participants showed strong adherence to group-based sessions, suggesting that face-to-face components may be particularly beneficial for them. Home-related stress reduced adherence and engagement across multiple components.

**Discussion:** This study explored predictors of adherence and engagement in a blended CR program. Motivation and self-efficacy were important predictors for adherence, while digital skills were a significant predictor of both adherence and engagement. However, effects varied among participants. Those with higher self-efficacy were less likely to attend group-based sessions, suggesting they preferred managing their health independently. Participants with higher digital skills engaged more with remote-guided components but attended fewer lifestyle-stress management sessions, indicating a preference for digital tools over structured in-person support. These findings highlight the need to tailor interventions to different needs. The blended model—combining digital tools with human guidance—can improve accessibility but requires adjustments to support individuals with varying digital skills. For those struggling with digital engagement, lifestyle-stress management sessions, which focus on mental and emotional well-being, may be a useful alternative. Additionally, integrating stress management strategies is essential, as home-related stress reduced both adherence and engagement. Future research should explore how blended CR programs can be optimized to improve accessibility and effectiveness, focusing on strategies to support individuals with lower digital skills and ensure equal access.

# Workshops

## Time for a heart-to-heart. Practical ethics and the development of a soft-robotic artificial heart.

**Anne Bonvanie & Wouter Weijermars**

**Background:** In the development of highly innovative and personal medical technologies, many researchers face difficulties in raising ethical issues in the project team. There is a multitude of reasons for this, including urgency issues (we can do this later), issues with relevance (I don't have to say this, it is common sense), hierarchical issues (if my supervisor doesn't say anything, then who am I to raise these issues) and knowledge issues (if you don't know how to signal ethical issues, how can you raise them?). In the Holland Hybrid Heart (HHH) project (www.hollandhybridheart.nl), we are developing a soft-robotic biocompatible artificial heart. To safeguard the responsible innovation of this heart, we use practical tools to initiate, facilitate and stimulate the debate about ethical issues, structured in the 'Ethical Parallel Track' (EPT). The outcomes from this EPT are used to guide design, development, and project choices.

**Goals:** In this workshop, we have 2 goals. Firstly, we want to let researchers who work in medtech experience how different activities can stimulate collective thought about ethical considerations in a research project. Doing so enables researchers to overcome difficulties in their own (future) research projects, improving the research community as a whole. The second goal of this workshop is to diverge the range of topics to discuss in the HHH. We aim to get a view of potential ethical issues identified by the broad community of medtech researchers, who know enough about innovation in medtech to be critical, but who are not personally invested in our project. This enables us to address the most important ethical issues in HHH, and to overcome a potential bias from only talking to people who are personally invested in the HHH project.

**Content and (interactive) activities:** We will give very short overview of which tools are part of an EPT and how and in which phase of an innovation project they can be applied. These tools include the Ethical Readiness Check, the Product Impact Tool, Peer to Peer sessions, Stakeholder Dialogues, et cetera. After that, we will do 2 of these activities ourselves. We ask a researcher in the HHH project to give a 1-minute pitch about their work, and then we apply one of the practical tools that is used in the HHH to the pitched work. All participants in the workshop will have to actively participate, and we will send them home with (a) practical experience with easy and accessible discussion of ethics in a research project and (b) information on how to organize this yourself including digital and physical materials to do so.

**Expertise of workshop leader(s):** Workshop leader is Anne Bonvanie, associate lector Ethics & Technology at Saxion UAS. She has over 10 years of experience with executing and supervising projects in which ethical issues were made practical. In their research group, Anne and her colleagues work on development of tools for critical reflection in innovation projects and implement these tools in various projects in health, public administration, and industry.

## Understanding Biases in Healthcare Technologies and Envision Alternative Futures.

**Roberta Antognini, Francesca Toso, Cristina Zaga & Mascha Van der Voort**

**Background:** Each day, as designers and researchers, we embed biases in our research and technological outcomes that support health. Biases are characterized by Sasha Costanza-Chock (Design Justice, 2020) and Caroline Criado Perez (Invisible Women, 2019) as systemic and frequently unconscious preferences that mirror societal power dynamics, influencing design and data in ways that marginalize underrepresented groups. Dana Abdulla elaborates in Eye on Design Magazine, stating that "With every design decision we make carries the potential to not only exclude but also oppress." The development of digital technologies can reinforce biases and perpetuate ableism in digital frameworks (Foley & Ferri, 2012). Recognizing the biases designers and researchers may unconsciously impose on their study subjects is crucial, urging them to acknowledge the misrepresentation of certain social groups. This awareness is particularly vital in healthcare, as overlooking these issues can leave some groups vulnerable, affecting their physical health and participating in their disempowerment. Therefore, it is critical to understand how biases from designers and researchers impact technology development.

**Goals:** Through Responsible Futuring (Zaga et al., 2023), this workshop invites participants to examine industry biases, as well as their own, and how they manifest in the technologies they design, highlighting the impact on the quality of life for study subjects. The objective is to deepen understanding of researchers' perspectives on the current status quo and to explore alternative futures. From this workshop, participants will gain more awareness and develop scenarios that will guide their future work, transforming their approach to practicing technological development.

**Content and (interactive) activities:** Lasting approximately 1 hour, the workshop uses activities from the Responsible Futuring Toolbox (e.g., understanding values and perspectives or alternative futures from non-repeating history) and will be enhanced by a visual taxonomy of biases identified in the healthcare industry based on literature. Engaging between 5 to 20 people, the goal is to firstly foster awareness and perspective-taking among participants and, secondly, envision alternative futures together.

**Expertise of workshop leader(s):** Roberta Antognini is a PhD Candidate within the Human-Centered Design (HCD) group at the University of Twente. Her research focuses on supporting the quality of life for patients with chronic illnesses through design methodologies.

Dr. Francesca Toso, PhD: Assistant Professor in Stakeholders Engagement and Co-Design at the University of Twente (NL). She is interested in participatory design methods involving people living with chronic illnesses for designing technologies that can support a better quality of life.

Dr. Ir. Cristina Zaga: Assistant professor at the Human-Centred Design group at the University of Twente. Her research focuses on transdisciplinary and relational design methods for just futures of work and care with AI technology.

Prof. Dr. Ir. Mascha van der Voort is a full professor of Human-Centred Design, Vice-Dean of the Faculty of Engineering Technology and Scientific co-director of the DesignLab at the University of Twente. She is founder of the Transdisciplinary Master-insert programme 'Shaping Responsible Futures'.

## Unifying the status-quo: A Comprehensive Framework of tailoring strategies for eHealth interventions

**Sandra Straková, Steven Lankheet, Anouk Middelweerd, Iris ten Klooster & Monique Tabak**

**Background:** In eHealth, a tailored intervention has the potential to significantly increase the users' adherence and engagement, enhancing its effectiveness and impact. While various existing frameworks have attempted to unify the concepts of tailoring and the various tailoring strategies, these frameworks often diverge in their approaches and definitions. Furthermore, they do not sufficiently address recent advancements in technology that could make new tailoring strategies possible. In literature, eHealth interventions mainly use similar tailoring strategies, (e.g. personalized feedback, or using one's name in an otherwise generic message). Also, development is often approached from a specific domain, like behavioral change or Artificial Intelligence algorithms. Further developments could benefit from a framework that provides a multi-domain overview of tailoring strategies and that takes the dynamic nature of the field into account. Therefore, our work aims to create a unified framework on tailoring strategies within eHealth interventions from this multidisciplinary perspective. The resulting framework can help researchers and developers gain greater insight into the possibilities, considerations, and applications of tailoring eHealth interventions.

**Goals:** The goal of this workshop is first to inform participants about the current state of the art in tailoring eHealth interventions and share the concept tailoring framework, which resulted from integrating existing literature with the authors' experiences of project-based applications of tailoring. With this background knowledge, the second goal is to interactively gather expert opinions to identify missing or abundant strategies, and to evaluate the participants' understanding of the framework's concepts and components, taking into account the different domains of expertise. To do so, we will use a Delphi method to incorporate views from a multidisciplinary setting and improve the developed framework accordingly.

**Content and (interactive) activities:** We will provide iterative and interactive case-based mini-lectures on the implementation of tailoring within eHealth interventions. We will showcase tailoring processes in interventions from the fields of diabetes, COPD, metabolic syndrome, and across different target groups, such as people with lower health literacy where we will highlight important considerations for tailoring and the application of our tailoring framework. The participants will be encouraged to participate in interactive discussions, exchange and provide feedback on the proposed framework, as well as share their own experiences with intervention development and/or tailoring.

**Expertise of workshop leader(s):** The workshop leaders are members of the Biomedical Signals and Systems and the Management and Social Sciences research groups, drawing upon the extensive knowledge of and experience in the development and tailoring of eHealth interventions applied in many large-scale research projects (e.g. RE-SAMPLE (H2020), LoAD (NWA-ORC), Healthbox (NWO-KIC)) as well as part of daily care (e.g. Diameter). The work is performed across various healthcare fields and with different target groups in an iterative and multidisciplinary manner where stakeholders are part of the development process.

## Supporting Health by Design Rationale; Navigating and articulating design decisions in technology for health.

**Bard Wartena & Joanneke Weerdmeester**

**Background** Design in healthcare requires navigating complex constraints, diverse stakeholder perspectives, and rapidly evolving technological landscapes. However, articulating the design rationale—the reasoning behind design choices and their justification—is often overlooked, making collaboration and iteration challenging (Moran & Carroll, 2020). This workshop introduces a structured approach to navigating the Playground of Design, where designers move through Problem, Design, Change, and Solution spaces, integrating fragmented insights from different healthcare stakeholders to make informed decisions. To do so, designers rely on perspectives—viewpoints that provide pieces of information essential for shaping design choices. These perspectives help designers maneuver between roles, facilitating cocreation and structured decision-making. Designers must balance rigor, ensuring methodologically sound and well-structured choices; relevance, aligning decisions with real-world needs to ensure practicality and impact; resonance, fostering meaningful engagement with stakeholders to establish emotional and social connection; and rapidness, maintaining agility in the design process to allow for continuous iteration and adaptation. Schön (1983) describes design as “a reflective conversation with the situation”, emphasizing the need for continuous evaluation and justification of choices. By engaging with multiple perspectives in design for health, participants will learn how to maneuver between constraints, perspectives, and stakeholder needs, ensuring that design choices in healthcare solutions can be articulated.

**Goals**: 1. Show how stakeholder perspectives shape design rationale and inform decision-making.
2. Provide strategies for maneuvering through the Playground of Design spaces with structured reflection.
3. Equip participants with tools to balance rigor, relevance, resonance, and rapidness in collaborative design processes.

**Content and (interactive) activities:** 1. Introduction: Stakeholder Perspectives & Design Rationale
a. Overview of how fragmented insights inform decision-making across the Playground of Design spaces (Canvas). b. The role of shifting perspectives in structuring design rationale.
2. Case Study: E-Health Junior. a. A real-world example where stakeholder perspectives influenced design decisions. b. Group discussion on trade-offs between rigor, relevance, resonance, and rapidness.
3. Interactive Exercise: Structuring a Collaborative Design Rationale. a. Teams receive stakeholder input fragments/pieces and synthesize a coherent design decision. b. Mapping justifications to the Playground of Design and discussing trade-offs.
4. Reflection and Takeaways. a. Strategies for actively seeking and integrating stakeholder perspectives. b. A checklist for structuring and articulating design rationales.

**Expertise of workshop leader(s)** The workshop leaders are members of the Biomedical Signals and Bard Wartena is a Senior Researcher and Lecturer at NHL Stenden University of Applied Sciences,
affiliated with the Research Group and Master Program in Health Innovation. With a background in codesign, design research, health innovation, autonomy, and applied game design. His work focuses on developing and evaluating interactive and user-centered solutions for healthcare and well-being.
Joanneke Weerdmeester is a Postdoctoral Researcher and Lecturer at HKU University of the Arts Utrecht, and an Associated Researcher at Monobanda. With a background in experimental psychology and design research, she specializes in human-centered design, behavior change, and serious games.
Her research focuses on the design and evaluation of digital interventions for mental and physical

health, integrating principles from game design and behavioral science to create engaging and evidencebased solutions.

## Nothing Gets LEFT Behind: Navigating Legal, Ethical, Financial & Technological eHealth Implementation Challenges Through Gaming

**Britt Bente, Meyke Roosink, Nienke Beerlage-de Jong & Lisette van Gemert-Pijnen**

**Background:** Implementing eHealth technologies is a complex process, among others influenced by Legal, Ethical, Financial, and Technological (LEFT) aspects. These factors are often overlooked or insufficiently addressed, leading to fragmented decision-making and implementation failures. While frameworks and guidelines exist, they frequently fail to bridge the gap between theory and practice for key stakeholders such as eHealth developers, researchers, policymakers, legal experts, and business leaders. Challenges like legal compliance with regulations such as GDPR or MDR, ethical concerns about patient consent and autonomy, financial sustainability issues including reimbursement models, and technological barriers such as interoperability remain prevalent. These challenges often result in delays or failure to scale up innovations. To tackle this issue, we are developing a gamified intervention that guides stakeholders through LEFT challenges, supporting informed decision-making, agenda setting, and strategic planning in eHealth implementation. The game offers a dynamic, scenario-based tool that helps stakeholders navigate LEFT considerations in eHealth implementation. By guiding them through key LEFT aspects, it supports informed decision-making and contributes to making the eHealth technology viable and sustainable.

**Goals:** The goal of this workshop is to engage participants in testing one of the first (lo-fi) prototypes of our LEFT implementation game. Through this interactive experience, we aim to gather valuable feedback on how participants' perceive the game's ability to raise awareness and provide guidance on the various LEFT aspects. We will explore participants' needs for such support, determining whether they require a greater emphasis on awareness, guidance, or both to effectively navigate the LEFT challenges presented by eHealth implementation. Participants will also have the opportunity to co-develop the next iteration of the game, contributing their insights and ideas through structured discussion to refine and enhance the game's design.

**Content and (interactive) activities:** The workshop will be divided in two parts. In the first segment, participants will play the initial version of the LEFT game, navigating legal, ethical, financial, and technological challenges involved in eHealth implementation. Following this gameplay session, we will move into the second part – a structured interactive brainstorming discussion. During this phase, we will assess the game's usability, user engagement, and overall learning experiences, as well as explore whether the game should focus more on raising awareness or also provide practical guidance. We will also discuss the level of decision support the game should offer – whether it should primarily inform, provide expert referrals, or decision-making support. Additionally, we will discuss potential game formats (e.g. individual versus team-based, online versus physical setups) and target audiences, and which key stakeholders should be involved in its development. This co-creation session will shape the next iteration of the game, helping to refine and enhance its ability to support stakeholders in navigating LEFT challenges in eHealth implementation.

**Expertise of workshop leader(s):** Our research team has extensive experience in eHealth implementation, stakeholder engagement, and serious game development. We have previously conducted a scoping review and grey literature study to identify LEFT barriers and enablers. These insights formed the foundation of the game’s first prototype. By actively involving stakeholders in its development, we ensure that the game addresses real-world challenges and meets the needs of its users.

## The Digital Data Divide: a festival experience to discuss the increasing impact of personal data

**Sjors Groeneveld, Harmieke van Os-Medendorp, Lisette van Gemert-Pijnen, Ruud Verdaasdonk & Marjolein den Ouden**

**Background:** In today's interconnected world, the generation and collection of personal data are exponentially increasing. Not only is there more data being produced than ever before, but it is also being combined from various sources to create detailed and holistic personalized profiles, especially in healthcare. Technologies like Artificial Intelligence illustrate this trend by using personal data, including vital functions, environmental, and lifestyle information. This increasing reliance on data presents significant opportunities and challenges.

While this increasing use of personal data offers opportunities for more personalized care, it also raises questions about privacy, reliability, data ownership, and whether it is even desirable to collect such personal data in the first place. To encourage a dialogue about this topic with a wide audience in an engaging and accessible way, the festival experience The Digital Data Divide (www.thedigitaldatadivide.nl) was developed. This conversation tool premiered at the Zwarte Cross Festival and has since been featured at various festivals, events, congresses, as well as in educational and healthcare settings and is currently being used in a scientific study.

The design of The Digital Data Divide is based on narrative learning, which uses stories and dialogue to help people make sense of their surroundings. Narrative learning, particularly in the form of speculative fiction, is also well-suited for discussions about possible future scenarios. By presenting a future scenario within a story, it challenges individuals to critically reflect on their current perspectives.

In The Digital Data Divide, this concept is implemented through two short films depicting different (utopian/dystopian) future scenarios (trailer: https://youtu.be/SAZAgA2zeRM). Participants choose between a red or blue pill to decide which scenario to watch. Afterward, they are paired with others who viewed the opposite film and engage in a guided discussion using dialogue cards. In this way speculative fiction serves as a tool to spark conversations about the pros and cons of potential future scenarios involving the impact of personal data.

**Goals:** - Experience The Digital Data Divide festival experience and start a discussion with other workshop attendees on the increasing impact of personal data.

-Discuss the concept and development of speculative fiction as a tool in research, healthcare and education.

**Content and (interactive) activities:** During this workshop, attendees will experience The Digital Data Divide. After a brief plenary introduction, everyone will choose either a red or blue pill (M&M) and, based on their choice, watch a short (English subtitled) movie. Following the movies, attendees will engage in a conversation with others to share their thoughts and ideas on the topic. The workshop will conclude with a plenary discussion about the potential use cases of speculative fiction tools within research, healthcare, and education.

**Expertise of workshop leader(s):** Sjors Groeneveld is a principal lecturer at Saxion University of Applied Sciences and PhD candidate AI in long term care at the University of Twente. In his research, Sjors focuses on the collaboration between healthcare professionals and AI-driven innovations, as well as the broader relationship between humans and technology in society. In several projects he collaborates with artists to design artistic experiences aiming to create impact.

# Symposia

## Empowering Health by Technology: Tailored Solutions for Diverse Populations

**Janine Sikkens, Joan M. Dallinga, Hanneke E.M. Braakhuis, Diana G.M. Eijgermans & Sanne I. de Vries**

**Background:** Technological innovations in healthcare and education hold significant promise to empower diverse populations and promote behavior change. However, successful implementation of technological innovations requires user-centered, tailored approaches to address unique challenges in varying contexts. This symposium, organized by the SIA SPRONG-program Vitale Delta, highlights three projects that exemplify the integration of health technology into practice.

**Content:** The first project investigates how healthcare professionals can be supported in using wearable sensors to stimulate physical activity in patients with chronic conditions. Findings underline the need for flexible methodologies to address organizational differences and varying technological competencies among healthcare professionals. (Hanneke Braakhuis)

The second project, the Influencergame, is a serious game for prevocational students designed to enhance media and health literacy. By imitating real-life social media content, the game helps students to learn how to debunk misinformation and make informed lifestyle choices. (Diana Eijgermans)

The third study explores applicability of The Box, a home monitoring concept, for Systemic Sclerosis patients. It highlights potential of personalized self-management while addressing challenges related to emotional and disease complexity. (Janine Sikkens)

**Symposium objectives:**

- Highlight the value of co-design and iterative development with the target group and intermediate group in creating user-centered technological solutions.
- Discuss the unique challenges and opportunities of implementing health technologies in diverse settings, including primary care, secondary education, and specialized healthcare.
- Share lessons learned on the interplay between technological, organizational, and individual factors influencing adoption and impact.

**Discussion**: Together, these projects demonstrate potential of tailored health technologies to improve health-related outcomes in diverse populations. By integrating user-centered design and stakeholder collaboration, they highlight pathways for bridging research and practice, inspiring innovation in health technology development and implementation. After each presentation questions can be asked. After all presentations, we will facilitate a discussion on lessons learned regarding implementation of health technology in practice.

### Presentation 1: Moving with Technology: From Awareness to Action

**Hanneke E.M. Braakhuis, Jeroen H. Davids, Lieke D. Hollander, Lianne E.A. de Vries, Jorit Meesters & Monique A.M. Berger**

**Background**: Sufficient physical behavior is essential for everyone, but particularly for patients with chronic conditions. Wearable sensors have great potential to effectively encourage physical activity in these patients within primary care and rehabilitation centers. Healthcare professionals recognize the benefits of these sensors, especially for raising awareness about physical activity and providing targeted feedback. However, they face challenges in using these sensors, such as difficulties with setup, data interpretation, and lack of skills and knowledge for effective use. Despite their potential, wearable sensors are underutilized because healthcare professionals lack the necessary tools, training, and guidelines to apply them purposefully. There is currently no structured support system for integrating these devices into daily care practices. This design-oriented research project aims to develop an Evidence-Based Practice methodology to support healthcare professionals in incorporating wearable sensors into their daily routines. The first phase of the project, which is the focus of this presentation, explores the challenges faced by healthcare professionals and identifies the organizational and individual factors influencing the adoption of wearable sensors in clinical settings. These insights will inform the development of a structured methodology that aligns with professional needs and organizational requirements.

**Methods**: Following the Double Diamond model, this first phase focuses on problem exploration. Data was collected through stakeholder analysis, stakeholder mapping, four best-practice interviews, three focus groups, and process analysis.

**Findings**: Preliminary findings reveal significant variability in how organizations integrate wearable motion sensors. Even within similar institutions, implementation strategies differ considerably, underscoring the need for a flexible methodology adaptable to diverse organizational structures. Additionally, technological competence among healthcare professionals varies widely, affecting the effective use of these devices. This highlights the necessity of a tailored approach that accommodates different levels of technological proficiency.

**Discussion**: The findings emphasize the need for a methodology that is both structured and adaptable to varying organizational contexts and health care professional competencies. A one-size-fits-all approach is unlikely to be effective; instead, a customizable framework will enhance adoption and integration. By addressing these challenges, this research aims to optimize the use of wearable sensors in clinical practice, ultimately supporting improved physical activity and health outcomes for patients with chronic conditions.

### Presentation 2: The Influencergame: A Serious Game for Prevocational Students to improve Media and Health Literacy

**Diana G.M. Eijgermans, Astrid S. Doorduijn, Joan M. Dallinga, Wendy Scholtes-Bos & Sanne I. de Vries**

**Background**: A healthy lifestyle is important for everyone's wellbeing, but many students, particularly those in prevocational education (VMBO), do not meet the national nutritional and physical activity recommendations. Previous studies have shown that these students often consume insufficient fruits and vegetables, and their other lifestyle behaviors frequently deviate from those promoting health. In the Food Boost Challenge, a community-up approach to stimulate healthy food choices among students, it was highlighted that these students prefer learning in a playful, competitive, and interactive manner. Building on these insights, we developed the Influencergame, a serious game aimed at improving the media and health literacy of students at prevocational secondary schools.

**Methods**: The Influencergame leverages findings from the Food Boost Challenge and was inspired by the projects of 62 students across four different bachelor programs at The Hague University of Applied Sciences. While focusing on creating a healthy lifestyle related game for students, we discovered the profound influence of social media on students' behaviors. Many students struggle to differentiate between the truth and misinformation, particularly regarding health-related claims. To address this, the Influencergame integrates a social media component in which players encounter posts and videos mimicking real-life content. The core mechanic of the Influencergame empowers players to act as influencers, earning likes and growing their popularity by debunking misinformation with the help of reliable sources. This reward system mirrors real-world social media dynamics, making the experience engaging and relevant. By focusing on developing practical health skills, such as reading nutrition labels, rather than merely providing knowledge, the game addresses the fact that knowledge alone does not always directly lead to behavior change, particularly among adolescents.

**Findings**: The Influencergame is the result of a co-creation and iterative design process with (prevocational) students. The prototype of the game includes modules on sustainable food behavior and physical activity. Currently, a third module on fact checking is being developed. And later, we will add modules on additional lifestyle topics. Initial testing of the first two modules in schools in The Hague has been promising, with students and educators praising its interactivity and relevance while providing constructive feedback for improvement. Our presentation will include a demo of the Influencergame and a discussion of lessons learned during its development. We will highlight successes, such as its alignment with student preferences, and setbacks, such as challenges in usability.

**Discussion**: The Influencergame underlines the potential of technology to drive meaningful change by empowering students to critically navigate through digital content and make informed, health-conscious decisions in an increasingly complex digital landscape.

### Presentation 3: Exploring the Applicability of The Box Concept for Home Monitoring in Systemic Sclerosis Patients

**Janine Sikkens, Laurence Alpay, Nymphaea Notschaele, Katie van der Wouden & Jeska de Vries-Bouwstra**

**Background**: Patients with connective tissue diseases (CTDs), such as systemic sclerosis (SSc), require frequent hospital visits for the monitoring of their disease. SSc is a rare rheumatic disease characterized by autoimmunity, microvascular damage, and fibrosis affecting the skin and major organs. To date, there is limited access to remote monitoring technologies that allow self-assessment of disease-related parameters for SSc patients. Recent advancements in eHealth however, have led to the development of home monitoring solutions, such as The Box, introduced at a Dutch University Medical Center. This exploratory study aims to evaluate the applicability of The Box for home monitoring in SSc patients.

**Methods**: The CeHRes roadmap was utilised to conduct a contextual inquiry into the current care delivery setting, define value specifications for the target groups, and develop an initial design for home monitoring tailored to SSc patients. Within the contextual inquiry phase, an assessment of selected existing applications of The Box was performed. Additionally, qualitative interviews were conducted with both healthcare professionals and patients to identify needs, expectations and potential barriers. The value specification and design phases incorporated user experience (UX) design methods, including the development of personas and scenarios. Furthermore, the Persuasive Systems Design (PSD) framework was applied to identify design elements that could enhance patient engagement with home monitoring tools.

**Findings**: Patients generally expressed a positive attitude toward home monitoring, recognizing its potential benefits. Beyond the convenience of measuring vital parameters at home, patients emphasized the added value of being able to record and communicate additional health-related information, such as disease symptoms and complaints. In contrast, some healthcare professionals, particularly nurses, perceived limited advantages in implementing home monitoring for SSc patients. However, both patients and healthcare providers acknowledged that home monitoring could contribute to reducing hospital visits and facilitating more personalized care. Due to the complexity and heterogeneity of symptoms in SSc, multiple domains were identified in which The Box could be applied. These included skin and wound care, mucus and respiratory health, vital sign monitoring, physical activity, nutrition and weight management, fatigue assessment, and activities of daily living (ADL). Many of these aspects are directly linked to self-management strategies in chronic disease care. Drawing from the development of four persona's and three scenarios, a set of user and functional requirements were formulated. These mostly relate to supporting self-management activities and focus on primary tasks (through personalization & self-monitoring) of the PSD framework. Results indicate that The Box may mostly contribute to medical management and role management but very little to emotional management.

**Discussion**: This exploratory study provides insights into the applicability of implementing The Box for home monitoring in SSc patients. While the potential benefits of remote monitoring are evident, further research is needed to refine the components and requirements of The Box for this specific patient population. A follow-up study will develop a Proof of Concept focussing on the design and operationalization phases of the CeHRes framework.

## Advancing mobile mental health interventions for anxiety and depression.

**Felix Fiß, Jannis Kraiss, Chani Nuij & Alyssa Jongeneel**

The rising demand for accessible and scalable mental health care has prompted innovation in mobile mental health interventions such as ecological momentary interventions (EMIs) and just-in-time adaptive interventions (JITAIs) that aim to deliver personalized support in daily life. This symposium presents research focused on developing and examining JITAIs for anxiety and depression.

The first presentation introduces a novel transdiagnostic process-based framework for JITAIs, co-developed with mental health professionals. Through mixed-methods research, it identifies key therapeutic targets (e.g., cognitive defusion), new targets (e.g. lifestyle) and maps them to intervention elements.

The second presentation evaluates the efficacy of ecological momentary interventions (EMIs) using a novel approach: a micro-randomized trial. Findings show the short-term (proximal) benefits of savoring, gratitude, and acceptance exercises on affect and emotion regulation, and informing future studies with JITAIs regarding the moderating effect of baseline distress.

The final two presentations focus on the JADE project, a mixed-methods study aimed to design and evaluate JITAIs for behavioral activation in depression. The third presentation outlines a co-creation process involving patients and therapists, developing JITAIs for behavioral activation for depression. The fourth presentation details a protocol for feasibility and preliminary effectiveness, combining a non-randomized quasi-experimental trial with a micro-randomized trial to assess both proximal and distal outcomes.

### Presentation 1: Towards a transdiagnostic process-based framework of just-in-time adaptive interventions for anxiety and depression

**Felix Fiß, Nienke Beerlage-de Jong, Julian Rubel, Peter ten Klooster, Ernst Bohlmeijer & Jannis Kraiss**

**Background**: As the demand for mental health care rises, resources to provide therapy to all people in need are insufficient. Mobile mental health interventions offer a scalable and accessible treatment, yet their personalization is limited. Recently, researchers have started adopting an advanced type of mobile intervention, the just-in-time adaptive intervention (JITAI), which aims to provide clients with individually tailored interventions. Preliminary evidence suggests that JITAIs can improve mental health, but little is known about which transdiagnostic processes they should target, and which intervention elements can target these transdiagnostic processes. To fill this gap, this study aims to identify key transdiagnostic processes in depression and anxiety, two common mental disorders, and maps them to specific intervention elements for JITAIs. The first objective is to collect mental health care psychologists' perspectives on which transdiagnostic processes are relevant in depression and anxiety and which elements can effectively target these processes in JITAIs (Phase I). The second objective is to externally validate the framework through a survey study (Phase II).

**Methods**: We first created a theory-driven framework comprising 11 transdiagnostic processes and 18 intervention elements derived from various psychological intervention protocols. Phase I: Ten mental health care psychologists from the Netherlands and Germany with experience in treating depression or anxiety participated in semi-structured interviews. They assessed the completeness of the transdiagnostic processes and intervention elements. They also completed a card sorting task to match transdiagnostic processes with suitable intervention elements. Phase II: A survey study will be conducted with 100 mental healthcare psychologists, who will rate each intervention element based on its expected effectiveness in targeting each of the transdiagnostic processes .

**Findings**: Phase 1: Mental health care psychologists were overall in agreement with our initial framework. However, several transdiagnostic processes and intervention elements have been added, such as lifestyle as a new transdiagnostic factor, and cognitive defusion and relaxation as intervention elements. The card sorting task demonstrated that psychologists found new, additional matches between intervention elements and transdiagnostic processes. Further, psychologists stressed the importance of assessing whether interventions can be performed without therapeutic guidance and outlined the need to individualize exercises based on personal variables, such as emotional intelligence. Phase II: Findings on the validation survey are expected to be presented during the conference.

### Presentation 2: Addressing mental health with daily-life ecological momentary interventions: a micro-randomized trial

**Jannis Kraiss, Felix Fiß, Serafima Anickova, Lukas Berndt & Thomas Vaessen**

**Background**: Mental disorders are widespread, imposing a significant burden on both individuals and society. Despite the high prevalence, many individuals seeking help do not receive care, mainly due to limited resources and availability of mental health services. Ecological Momentary Interventions (EMIs), facilitated through mobile devices, offer a promising avenue to bridge this gap by providing timely and accessible support in daily life, especially during critical moments of need. The micro-randomized trial is an innovative experimental design that can be used to examine the effects of EMIs on proximal outcomes and understand under which circumstances they are most effective. The aim of the ALERT micro-randomized trial was to examine the effects of EMIs on different transdiagnostic processes, including positive and negative affect and the emotion regulation strategies rumination, acceptance, savoring, and experiential avoidance.

**Method**: Seventy-two individuals with elevated distress levels participated in the study (mean age = 22.9, 64% female). Over 16 days, at four decision points per day, participants were randomized to receive either one of four different EMIs (savoring, gratitude, acceptance, or cognitive restructuring exercises) or no intervention. Proximal outcomes were assessed before and 30 minutes after each randomization using ecological momentary assessment.

**Findings**: Significant improvements in negative and positive affect were found shortly after completing the savoring, gratitude, and acceptance exercises, while no significant effect was observed for the cognitive restructuring exercise. However, cognitive restructuring was found to improve the emotion regulation strategy cognitive reappraisal, and the acceptance exercise improved experiential avoidance. Additionally, the distress level at the moment of receiving an EMI significantly moderated the effects, with higher distress levels enhancing EMI effectiveness.

**Discussion**: As one of the first studies worldwide, these findings suggest that EMIs are effective in improving a wide range of transdiagnostic proximal mental health outcomes, including affect and emotion regulation strategies. This study informs the evidence-based construction of EMIs and more advanced ways of providing timely support in daily life, including just-in-time adaptive interventions.

### Presentation 3: JITAIs for Behavioral Activation in Patients with Depression (JADE) phase I – Participatory design

**Farid Chakhssi, Alyssa Jongeneel, Nadine Köhle, Eva Goedendorp, Jorge Piano Simoes, Fennie Wiepkema, Gerben Westerhof & Jannis Kraiss**

**Background**: Depression is a major public health issue, with increasing prevalence and adverse effects. Although treatments like behavioral activation (BA) are effective, only about half of the patients experience significant benefits. BA encourages patients with depression to seek activities that are expected to result in a sense of pleasure, mastery, or accomplishment. Adherence to performing activities may increase its effect but remains a significant challenge in therapy. Just-in-time adaptive interventions (JITAIs) could be promising by providing context-specific support to improve adherence in patients' daily lives. However, perspectives of clinicians and patients on JITAIs for BA remain insufficiently understood. The JADE study aims to develop JITAIs for BA and examine their feasibility, acceptance, and preliminary effectiveness. The first phase of this study is the design phase, which aims to develop JITAIs for BA in close collaboration with patients with depression and clinicians, through focus groups.

**Method**: Participants were 10 patients with depression, 5 of whom self-identified as low digital literate, and 5 clinicians. Each participant participated in two focus groups of one hour. In the first focus group, the content and design of the JITAIs were discussed, and in the second focus group, the timing and context. The focus groups transcripts were analyzed using a thematic analysis.

**Findings**: Participants indicated the JITAIs should be highly personalized for each individual user. They suggested that the content should promote activation without being obligatory, and include acknowledgment for the patient's situation. Recommended activities ranged from physical exercises to household tasks and social interactions. JITAIs should be brief, ideally with visual support, and include reminders, as timing of the JITAI may the activity might not always be convenient. Most participants indicated that the timing of the JITAIs, tailored in advance to the patient's needs, would be helpful. Few saw any issue with receiving a JITAI, as they could also be ignored if necessary. Almost all participants agreed that JITAIs should be integrated into the patients' psychological treatment.

**Discussion**: The findings from the design phase of the JADE study highlight the need for personalized JITAIs integrated into psychological treatment to potentially improve adherence and outcomes. A prototype is currently being developed based on the findings. In the next phase (phase II), we will evaluate the feasibility and acceptability of integrating JITAIs for behavioral activation for depression into patients' psychological treatments.

### Presentation 4: JITAIs for Behavioral Activation in Patients with Depression (JADE) phase II – Evaluation Study Protocol

**Farid Chakhssi, Chani Nuij, Nadine Köhle, Eva Goedendorp, Jorge Piano Simoes, Fennie Wiepkema, Gerben Westerhof & Jannis Kraiss**

**Background**: Depression is a significant public health challenge, with increasing prevalence and negative impacts on quality of life, morbidity, and mortality. While treatments like behavioral activation (BA) are effective, only about half of patients experience meaningful benefits. Adherence to prescribed activities between therapy sessions is linked to better BA outcomes, yet remains suboptimal. Just-in-time adaptive interventions (JITAIs) may enhance adherence and improve BA outcomes for depression, but have yet not been studied to date. The JADE study aims to develop JITAIs for BA and examine their feasibility, acceptance, and preliminary effectiveness. The second phase of the JADE study is the evaluation phase, which aims to examine the feasibility and preliminary effectiveness of JITAIs for BA for patients with depression.

**Methods**: A mixed methods design will be used to study the feasibility and preliminary effectiveness. Feasibility and distal effects of JITAIs will be studied by a nonrandomized quasi-experimental design, while proximal effects of JITAIs will be evaluated by a micro-randomized trial. Eighty participants diagnosed with a depression will be recruited from a mental health institution: 40 receiving TAU plus JITAIs and 40 receiving TAU only. The primary outcome is feasibility, defined as a dose-received adherence rate exceeding 60%. Secondary outcomes include acceptance, assessed via the System Usability Scale, Client Satisfaction Questionnaire, and the Twente Engagement with E-health Technologies Scale. Proximal outcomes (momentary depression and well-being) will be measured via ecological momentary assessments, while distal outcomes (e.g., depressive symptoms, recovery, and quality of life) will be assessed using the Patient Health Questionnaire-9, Mental Health Continuum–Short Form, Questionnaire about the Process of Recovery, and EuroQol-5 Dimension at the end of treatment.

**Discussion**: This study aims to evaluate feasibility and preliminary effectiveness of JITAIs to support behavioral activation in the treatment of depression. If feasible, JITAIs have the potential to be further examined in randomized controlled trials and benefit people with depression by providing a scalable approach to improve adherence and outcomes in behavioral activation.

## Advancing Equity in Digital Mental Health: Current Research Insights from the field of youth and women's mental health and Future Research Priorities

**Caroline Figueroa, Ruixuan Zhang, Nic Orchard, Kathleen W. Guan**

Digital mental health technologies, such as apps and AI, have the potential to bridge the treatment gap by providing easy access to personalized support on people's personal devices. Digital mental health holds great potential to improve population health through scalable, timely and accessible health promotion. Digital mental health might be particularly helpful for the mental health of young people, who are digital natives, and women, who face more barriers to accessing care related to costs, time, and childcare, and higher mental health symptoms. However, a major challenge is the lack of diversity, equity, and inclusion (DEI), which can help to drive ultimate democratized healthcare access with justice.

This symposium organized by RISE (Research On Inclusion Social Justice and Equity) Digital Health will present our research on the current state of research and practice regarding equity in digital mental health while proposing new methodologies for inclusive design, testing, development, and dissemination. Through systematic reviews and empirical work, we explain the challenges of bias in digital mental health applications, the systemic barriers to equitable adoption, and emerging design methods to ensure that digital mental health tools benefit all populations equitably.

Focusing on young people and women, we show how digital mental health interventions that align with the needs of minoritized populations, e.g., those with lower socioeconomic status and ethnic/racial minorities, are lacking. DEI considerations, such as language, culturally tailored content, and diverse representation, are often ignored in their design. We also discuss how this problem will worsen with many new tools using

AI. Our goal is to drive research and innovation that lead to better mental health outcomes for historically underserved populations, reduce health inequities, and pave the way for “digital health justice”: the equitable opportunity for everyone to access, use, and benefit from digital health, to achieve their greatest health.

### Presentation 1: Advancing Adolescent Well-being Through Citizen Science in Digital Health: Data-Driven and Participatory Approaches to Investigating Just-in-Time Adaptive Interventions

**Kathleen W. Guan, Mohammed Amara, Viviana Cortiana, Imran Khan, Rayyan Ali, Sıla Gürbüz, Carmine Iorio, Christopher Adlung, Crystal R. Smit, Annabel Vreeker, Eva Thalassinou, Eeske van Roekel, Loes Keijsers, Mark de Reuver, Caroline A. Figueroa**

**Background:** Adolescence is a formative developmental period for cultivating positive health behaviors, with significant implications for preventative well-being across the lifespan. Early intervention is essential to mitigate long-term health risks, yet many existing approaches lack adequate personalization. Further, while adolescents are avid adopters of technology, effectively engaging and addressing their needs through digital health interventions remains challenging. Recent advancements in mobile technology, such as just-in-time adaptive interventions (JITAIs), offer promise for enhanced personalization, engagement, and efficacy of adolescent behavioural interventions. JITAIs leverage mobile sensing technology to dynamically monitor individual-level contexts in real-time, enabling precise and personalised delivery of behaviour support upon heightened health risk detection. However, a comprehensive understanding of JITAIs for adolescents is lacking, and participatory approaches are needed to evaluate and harness their full potential with adolescents.

**Methods:** To assess evidence of effectiveness and guide future design and implementation, we conducted the first systematic review of JITAIs for adolescents following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines and Joanna Briggs Institute (JBI) frameworks for critical appraisal. 75 studies were identified and analyzed based on intervention mechanisms, targeted health behaviors, theoretical frameworks, and ethical considerations. The review also incorporated patient and public involvement through collaboration with adolescents around the world, including members of WHO Europe’s Youth4Health network, integrating their perspectives as co-researchers in study selection and interpretation.

**Findings:** Among the studies we identified, the majority of JITAIs for adolescents focus on substance use reduction, with significant heterogeneity in intervention design across all health outcomes. JITAI components such as tailoring variables, decision rules, decision points, and intervention options are inconsistently reported, which limits comparability and replication of studies. Further, while many studies demonstrate positive or mixed effects, high risks of bias in study design—particularly pertaining to reporting of randomization, blinding, and statistical procedures—introduces uncertainty in interpreting their findings. Additionally, few studies explicitly account for the needs of diverse adolescent populations in JITAI personalization mechanisms. Evaluation of ethical considerations such as privacy and accessibility was also limited in our study sample.

**Discussion:** The findings highlight the need for innovative approaches to designing and evaluating JITAIs for adolescents to fully realize their potential in early intervention and personalization of health behavior support. Insights from adolescent co-researchers of the review highlighted how such an effort requires a multi-level citizen science approach whereby adolescents are not only end-users but also active contributors in the design of JITAIs for ongoing personalization. To address these gaps, we are developing key recommendations for JITAI researchers with members of WHO Europe's Youth4Health network and conducting participatory research with adolescents to inform design of JITAI-based large language models for mental health. Additionally, we plan to organize a Delphi expert panel, involving young medical students and patients, will facilitate and examine the inclusion of adolescents in identifying JITAI tailoring variables, decision rules, decision points, and intervention options, particularly for cancer prevention.

## Presentation 2: Redesigning co-creation of AI for mental health with young people: a qualitative analysis of challenges and opportunities faced by researchers

**Nic Orchard, Ruixuan Zhang, Kathleen W. Guan, Mark de Reuver, Caroline Figueroa**

**Background**: Globally, one in five young people (12-25) experience mental health problems, such as anxiety and depression, but less than 50% receive treatment. Digital Mental Health—including apps, websites, and virtual care–is key to tackling the treatment gap. A rising trend is integrating artificial intelligence (AI), such as large language models (LLMs). Involving young people in the research and development of digital mental health interventions, such as apps, websites, or chatbots, can increase the effectiveness and uptake of these emerging tools. However, this practice is not widespread. While there is increasing recognition for the need of co-creation, tools and guidelines for meaningful youth participation in the context of digital health are missing. The aim of this paper is to identify process requirements to inform the development of a practical guide for researchers and developers.

**Methods**: Over the course of 1,5 years, we conducted a co-creation study with 70 young people receiving preventive youth care to develop a digital health assistant based on a Large Language Model. In this study, we thematically analyze meeting notes, team members reflections, documents on relationship building and the decision-making journey. Our analysis extends on previous research that assesses individual and organizational challenges identified by researchers. We identity key themes which are discussed with the researchers during multiple focus groups.

**Results**: Our results include a number of challenges and facilitators encountered throughout the co-creation process. The include organisation challenges (time and finding), relationship building and design activities, and team composition (team member experiences and identities).

**Discussion**: Working effectively with youth requires careful planning, investing in relationship building and understanding how to deal with behaviour of young people in group settings. We provide recommendations for academic institutions, on how to invest more in their community engagement infrastructure to better support their researchers engaging in meaningful collaborations with communities.

## Presentation 3: Designing for All: A Critical Inspection on the Design Process of Digital Mental Health Interventions for Women

**Ruixuan Zhang, Mark de Reuver, Angela D. R. Smith, Nic Orchard, Caroline Figueroa**

**Background**: Women represent a demographic group with unique needs and challenges in the context of mental well-being, necessitating tailored interventions that fulfill their needs and experiences. Research has shown a lack of digital interventions designed to address the mental wellbeing needs of women, especially women from marginalized backgrounds, such as minority racial/ethnic backgrounds or with low socioeconomic status, which potentially exacerbating the existing health disparity and leading to a digital divide. Despite the existence of numerous digital mental well-being solutions developed for women, how women are involved in the design and development, and how considerations of diversity, inclusion and intersectionality of involved women (such of addressing intersecting identities) are integrated in the development of DMHIs is under-researched.

**Objective**: This study aimed to examine the design and development processes, methods and frameworks used in DMHI research for women and examine whether and how studies include women from diverse backgrounds, and tailor to their diverse cultural needs in the design and development process.

**Method**: We conducted a scoping review following the PRISMA guidelines. The databases included are Scopus, PubMed and IEEE Xplore, and the databases are searched from the inception until the 31st of December 2024. We included 52 articles that described the design process of digital mental health solutions for women.

**Results**: A total of 52 studies meet the eligibility criteria, among which the indication of design methods and user involvement among is limited. Most studies only involve end-users in the assessment stage, after a minimum viable product is developed. Overall, considerations of diversity, inclusion and intersectionality among these studies are under-reported.

**Conclusions**: Our findings reveal a persistent gap in the design and development of digital mental health interventions for women, marked by limited user involvement and an underrepresentation of cultural diversity and inclusion. Future research should emphasize robust user-centered and participatory approaches that actively involve end-users from the earliest design phases and consist throughout whole process. We provide recommendations to improve the design process of digital mental health for women, to maximize the impact of digital mental health for women, especially those from marginalized groups.

### Presentation 4: Skepticism and Excitement when Co-designing Just-In-Time Mental Health Apps with Minoritized Youth

**Caroline A. Figueroa, Kathleen W. Guan, Dimpy Gupta, Neslihan Can, Kayla Green, Jiwon Jung, Eva Thalassinou, Gerben Kuiper, Niko Vegt**

**Introduction**: Mental health issues among young people have surged post-COVID-19. Mental health apps can offer accessible preventive support on a large scale, yet the perspective of minoritized youth–such as those from low socioeconomic and ethnic/racial backgrounds–are underexplored. This risks low uptake and effectiveness and exacerbating health inequities. We aimed to understand the needs and concerns of minoritized youth in the Netherlands using a participatory approach.

**Methods**: We conducted 3 co-creation sessions with 17 adolescents (16 females, majority Dutch Moroccan background) aged 11-22 years, recruited through community centers in lower-income neighborhoods in The Netherlands and organized a discussion session with 26 preventive youth workers. A subset of youth (n=10) analyzed the data in 2 co-thematic analysis workshops. We compared youth and researcher themes.

**Results & Conclusion:** Youth saw data-driven mental health apps as useful for short-term stress relief through motivational quotes, social activity suggestions, and homework support, but unable to solve severe issues. In the co-analysis, youth analyzed based on emotion and functions, whereas researchers employed a technical lens. Key themes included identity-based (such as religion, gender, and age) and contextual tailoring (to school/home schedules), compassionate as opposed to fake support (robots), safety, and social media. App design for young people should prioritize authentic, compassionate communication, safety–including transparency about data–tailoring to identify aspects, timely notifications, and integrating social media. Participatory approaches are promising to better understand the needs of youth from minoritized backgrounds for digital mental health technologies, with the aim of equitable digital solutions.

## Educating future-proof professionals: best practices and research in vocational education.

**Lieke Brons, Diane Beerlage, Alfons Brink, Jolanda van Til, Wouter Keuning, Miranda van der Velde, Marike Hettinga, Marjolein den Ouden, Anne-Ruth Oosterbroek, Ingrid ten Haken, Femke Veld, Theo Olthuis, Marloes Postel, Rudie van den Heuvel & Jeltje Kok**

Educational programs, healthcare, and social work services must continually innovate to address the evolving demographics and aging population worldwide. The rise in chronic diseases and co-morbidities, coupled with increasing disparities and the digitization of society, significantly impacts healthcare and social work services. Organizations in these fields strive to balance high standards of care with economic efficiency, especially in the face of staff shortages. Emerging technologies offer potential solutions to these challenges by bridging the gap between the growing demand for care and the limited availability of staff. To fully comprehend this potential, it is crucial to incorporate the application and use of such technologies into educational programs. This approach will help future-proof healthcare and social work professionals (hereafter: healthcare professionals) and equip them to effectively incorporate technologies into their practice.

In vocational education (mbo) research is grounded in “practoraten” (i.e. research group). The aim of practoraten is to initiate demand-led and practice-based research that leads to innovation in vocational programmes and/or the quality of teaching and learning environments. In this symposium four practoraten share their research with regard to:

- The role of Design Thinking in fostering a research-oriented mindset among students;
- Digital skills of healthcare students (mbo) as a precondition for successful implementation of technology (Practoraat Gezondheid & Technologie, Deltion College);
- Technology competencies of teachers and students and innovative strategies to innovate vocational education;
- Adoption of technologies in health care and collaboration in innovation labs.

By integrating Design Thinking and practice-based research, students not only develop digital and technological competencies but also strengthen their ability to critically assess and implement innovations in healthcare settings. This symposium highlights best practices and research findings that contribute to the future-proofing of vocational education in healthcare.

### Presentation 1

**Lieke Brons, Diane Beerlage & Alfons Brink**

**Background:** Technological and social innovation in healthcare requires a multidisciplinary and practice-driven approach. Vocational education (MBO) plays a crucial role in bridging the gap between theory and real-world implementation. By integrating Design Thinking and applied research within fieldlabs (research workplaces), students, teachers, and healthcare professionals collaborate to develop, test, and refine innovations. This research explores how MBO students contribute to the adoption of new technologies and process improvements in healthcare through structured, inquiry-based learning.

**Methods**: This study is based on action research conducted within MBO research workplaces, where students (MBO and HBO), teachers, and professionals co-develop solutions to healthcare challenges. We focus on 1) The implementation of Design Thinking as a structured research methodology; 2) The effectiveness of learning communities (Communities of Learners, COLs) in driving interdisciplinary collaboration; 3) The impact of student-driven research projects on technology adoption and practical implementation in healthcare settings. Data were collected through observations, semi-structured interviews with students and professionals, and analysis of project outcomes within fieldlabs.

**Findings**: Design Thinking supports the development of a research-oriented mindset, enabling students to critically analyze problems rather than jump to quick solutions. In addition, MBO students bring a fresh perspective to healthcare innovation, which is recognized by professionals as valuable in critically evaluating existing practices. Collaborative fieldlabs facilitate dialogue about technology adoption in healthcare. While the long-term impact is still being explored, early experiences suggest that student involvement encourages open discussions about new technologies on the work floor. Finally, students' structured testing and prototyping processes help generate insights that professionals may not have considered, though further research is needed to assess the extent of their influence on actual implementation.

**Discussion**: The findings highlight the potential of MBO education in bridging the gap between innovation and implementation. By embedding research methodologies such as Design Thinking in vocational education, students not only gain essential professional skills but also actively contribute to innovation in healthcare practice. However, successful implementation requires a structured approach, strong partnerships with healthcare providers, and continuous feedback loops between education and practice. This presentation will explore best practices and strategies to strengthen the role of vocational education in healthcare innovation through research workplaces and living labs.

### Presentation 2: Digital skills of healthcare students (mbo) as a precondition for successful implementation of technology

**Jolanda van Til, Wouter Keuning, Miranda van der Velde & Marike Hettinga**

**Background**: Research showed that healthcare professionals need sufficient digital skills to work well with digital care technology, particularly within nursing and care homes, home care and disability care. People involved in digital skills in healthcare organizations, indicated that students were less digitally proficient and that this hindered adequate professional practice. Internship supervisors spend a lot of time teaching basic skills. In addition to this signal, research on a broader scale showed that the digital skills of secondary vocational education (mbo) students were insufficient. Within the care and welfare sector, it was urgent to address this problem in order to contribute to the successful implementation of technology. The goal of this study was to retrieve the most necessary digital skills for vocational education. For these skills, a toolkit and a roadmap were developed to provide concrete tools to get started with this theme in care and welfare education. The research was commissioned by the Ministry of Health, Welfare and Sport. The research took place between July 2024 and March 2025.

**Methods**: We used a variety of ways to collect data, i.e. questionnaire to score the digital skills of mbo-students (N=27); interviews with stakeholders from care organizations N=6); interviews with teachers from mbo-schools (N=10); interviews with experts on digital skills in National programmes (N=3); desk research (110 documents were included). We used thematic analysis to analyze the data.

**Findings**: In the study were 46 digital skills included. The results of all the data revealed a list of 17 improvable digital skills in four categories: file management, (online) security, privacy and working with software programs (care specific and generic like Microsoft Office). For these 17 skills, existing materials were searched for teaching. In addition, suggestions were given for how and by whom this can be taken up within the education team. In this way, the opportunities to work concretely with digital skills in education were provided in manageable parts. Furthermore, policy recommendations were provided to give direction on what stakeholders (e.g., education teams, policymakers) can do to address the urgency of this theme.

**Discussion**: The response from the field to participate in the study was lower than expected. In order to realize a concrete list of digital skills, we included knowledge from other studies about the digital skills of mbo-students in general. Results may therefore be less specific to the healthcare sector than expected. Digital skills among mbo-students in general and among healthcare students in particular, are a hot topic. On a national level and within the mbo-schools, thought is being given to how this theme can be given a place in the curricula and to make it as specific as possible. With this research, we hope to show that if you are concrete in what you expect from the student, you can develop educational materials that can be used properly, and education can actually get to work on improving digital skills. Further research is needed to see if this works in practice.

### Presentation 3: Technology competenties of students, teachers and professionals: how to take the next step?!

**Marjolein den Ouden, Anne-Ruth Oosterbroek, Ingrid ten Haken, Femke Veld, Theo Olthuis & Marloes Postel**

**Background**: It is nearly impossible to imagine health care and social work without the use of technology. Examples include interactive care robots, smart apps and digital platforms to decrease workload and improve the quality of care. Hence, future-proof professionals are expected to have a positive critical attitude towards technology and technology competencies to skillfully use technology. In addition to professionals in health care and social work, the same holds for teachers. Technology is no longer a choice, but should be an integral part of education. The aim of this study was to: 1) investigate the technology competenties of students and teachers 2) explore what they need to embed technology in their (teaching) practice.

**Methods**: We developed a competency scan (n=26 items) to measure the technology competenties of students, teachers and professionals. The competency scan “Technologiecompetentie Wijzer” is based on existing theoretical frameworks such as UTAUT and TAM. Students and teachers of ROC van Twente were invited to participate in the study. The participants were affiliated with the following study programs: nursing, social care, assistents in health care (general practitioners, farmacy and dentist). Data were analysed using SPPS and open answers were explored using Atlas.ti.

**Findings**: In total 135 teachers and 369 students filled out the competency scan. The majority of teachers (60%) and students (51%) had a positive attitude toward technology. In addition, both teachers and students were enthusiastic about working with technology (both had a mean score of 79, scale 1-100) and open to learn more about technology (mean scores of 87 and 85, scale 1-100). However, they rated their own competencies to work with technology lower. The mean score of teachers was 65 (sd 18) and of students 64 (sd 17) respectively. Among them, 1 in 5 feel insufficiently competent to work with technology.

**Discussion**: Most teachers and students are (reasonably) positive about the use of (new) technology, enthusiastic and willing to learn about it. Although their self-reported technology competenties are sufficient, they do not feel competent. In addition, there is also a group of respondents that lag behind and they need additional support to integrate technology in their practice. ROC van Twente currently trains teachers and professionals as “TechAmbassadors” (i.e. frontrunners) that can help others to increase their technology competencies and integrate technology into the curriculum.

### Presentation 4: Adopting technology together

Rudie van den Heuvel & Jeltje Kok

**Background**: The research group Tech@adoptie is a public private collaboration (PPS) between ROC Rijn IJssel, ROC Nijmegen and 34 partners from Health Care, Social Care and education.

**Methods**: Participation from the PPS-partners work together in working groups regarding the following topics: 1) research and position of research group and PPS; 2) product line with a focus on learning arrangements; 3) innovation labs

**Findings**: The participants of the working groups identified relevant themes for joint collaboration and (applied) research topics. For example with regard to the Inventory of Innovation Scan, technology competenties and adoption models. Finally, different types of knowledge (e.g. research, practice, experiences) are connected through innovation centers in the region.

**Discussion**: Our key focus is to strengthen “onderzoekend vermogen” of all partcipants, i.e. curiosity/open attitude, knowing how to apply research from others to one's own professional practice and being able to conduct research that supports innovation of professional practice.

## Developing an immersive learning tool to support Change Agents in sustainable health technology implementation

**Miriam van Ittersum, Erik Soepenberg, Marianne van Dommelen, Gijs Terlouw, Lise Beumeler, Annemarie van der Wees & Kirsten Poelma-Tap**

"Are you also finding that implementation protocols or formats aren't effective in your organization or (research) setting? That you're struggling to achieve sustainable adoption of health technologies or other innovations, and that change tends to halt once the pilot phase is over?"

In a project called Train the Change Agent, we are working on a tool that supports professionals who are responsible for adoption of technological or social innovations in their organization. During this symposium we'll inform you about our assumptions, experiences and findings from the project in which we develop an immersive digital learning tool that supports continuous applied learning about implementation processes.

In the first part of the symposium, we will showcase how we identified the key challenges and tasks that change agents must navigate, which form the foundation for the content of our tool.

The second part focuses on the technical aspects and the development of the simulation tool and scenario templates. We will present lessons learned and showcase our prototypes.

The third part delves into the importance of a learning community and how it can support the work throughout this process. We will also provide insights on how to effectively organize learning communities in health and care settings.

In the fourth and final session, participants will be challenged to actively engage with the template for the simulation tool. This will allow them to explore, test, and discuss the tool's learning potential.

We look forward to sharing experiences and insights to collectively identify best practices.

### Presentation 1: Exploring Implementation: What Change Agents Face in Digital Innovation

**Erik Soepenberg & Marianne van Dommelen**

**Background:** The implementation of digital innovations in residential care and nursing homes often faces significant challenges. Change agents, responsible for guiding these innovations, struggle with many barriers. To address these challenges, the *Train the Change Agent* project is developing an immersive learning tool that supports professionals in sustainable implementation. As a first step, we identified the key challenges and tasks that change agents must navigate, forming the foundation for the tool's content. This presentation focuses on this crucial first step.

**Methods:** Through semi-structured qualitative interviews with change agents from seven organizations and a broader quantitative questionnaire, we gathered insights into the challenges they face during different phases of implementing digital innovations. The questionnaire was based on three complementary frameworks—CFIR (Implementation Science), NASS (Complexity Science), and NOMAD (Social Science)—each offering a different theoretical perspective. This combination provided a comprehensive and multidimensional view of implementation challenges, ensuring that insights were drawn from multiple disciplines. The qualitative study was conducted across seven organizations in the northern Netherlands, while the quantitative survey reached a wider audience, allowing for a broader exploration of regional implementation dynamics.

**Findings:** Our study revealed critical challenges that change agents face when implementing digital innovations in healthcare. To structure these challenges, we mapped them across different phases of the implementation process, identifying key obstacles that hinder successful adoption and long term integration.

**Discussion:** While organizations often struggle to achieve sustainable implementation regarding technology, our research provides insights into what change agents must address. By structuring these challenges in a phase-based approach, we highlight what is required to be tackled to move from initial implementation to long-term integration and scaling.

While addressing these identified challenges is essential, they may not cover everything needed for a successful implementation. During this session, we invite participants to reflect on these insights, share their experiences, and explore whether additional elements should be considered to strengthen the implementation process further.

### Presentation 2: Development of a Simulation Tool to Train Implementation Competencies for Change Agents: Iterative Design Approach

**Gijs Terlouw, Jan-Wessel Hovingh, Eelco Braad & Steven de Rooij**

**Background***:* Change agents require substantial conceptual knowledge and skills to guide innovation processes effectively. They must be able to navigate ambiguous frameworks, uncertain outcomes, and unpredictable stakeholder responses—factors that are inherently present in real-world change processes. To better prepare change agents for these challenges, the *Train the Change Agent* project is developing a simulation tool that allows them to practice within a context where these complexities are at play. This design study aims to develop a simulation-based learning environment that accurately reflects the complexity of implementing digital technology in work processes within elderly care. This environment aims to facilitate deep learning through *reflection-on-action* and *reflection-in-action*, enabling change agents to critically engage with and adapt to dynamic implementation challenges.

**Methods***:* This study is structured around the Design Research Framework to develop a simulation tool through an iterative-incremental process. Five prototypes were conducted in co-creation with healthcare professionals, healthcare students, and professionals and students in the creative sector. During the design research process, we examined in small steps whether the developed prototypes are feasible and whether they have the potential to achieve the formulated goals.

**Findings**: Several insights were found and used to improve the design by testing various prototypes. Insights were gained in composing authentic and life-like scenarios, the amount of physical, functional, and psychological fidelity, and the content and themes of the simulation tools. Through testing, targeted feedback was obtained on how and with what approach the substantive objectives of the simulation tool can be effectively achieved in practice.

**Discussion***:* The iterative design process has been beneficial for finding a constructive structure for the simulation tool to address the formulated goals, and it contributed to the design of a simulation tool and scenario template to capture the authentic needs, objectives, and stories of different stakeholders. We present five lessons learned from the design process and will show the (paper-)prototypes during the session.

### Presentation 3: Workshop: how to organize learning communities to facilitate technology implementation in healthcare

Margot van Rees, Kirsten Poelma-Tap, Niek Zuidhof & Annemarie van der Wees

**Background***:* Simulation technology implementation and incorporation in health and care is challenging due to its dynamic and complex nature. Organizations often struggle to incorporate new technologies into daily practices. Informal learning through learning communities (LC) offers a promising approach to support this process from a bottom-up perspective on an operational level. This interactive workshop aims to: 1) present current research on learning communities with change agents, 2) showcase best practices from other sectors, and 3) engage participants in considering the most appropriate approaches within elderly care.

**Methods***:* To establish and maintain an effective learning community that supports the development and sustainable use of simulation for implementing digital technology in healthcare organizations, we investigate the creation of a sustainable interprofessional learning network around innovations in elderly care. This will be achieved by establishing learning communities alongside desk research, analyzing activities, utilizing contribution mapping, and applying the most significant change method.

**Findings***:* Currently, the findings from our desk research show that a learning community seems a suitable concept for adopting and incorporating technology in employees' daily working practice. However, there are some crucial factors within the learning community before technology incorporation can be achieved. First, it seems that *experimentation* is crucial for technology incorporation, but also discussing and evaluating the outcomes in LC-meetings appears necessary. Experimenting enables employees to observe and understand the possibilities and limitations of the technology and experiment simultaneously. Through discussing and evaluating these experimentations, the technology and the process will be properly evaluated. Secondly, the *organization* plays a crucial role in supporting employees and making sure they receive room to experiment. Moreover, technology should already be present and functional within the organization and available to employees before starting with the LC. Lastly, in a learning community, a *facilitator* seems needed to encourage experimentation, provide ideas and manage the process. For *sustainable implementation* in the organization after the learning community, participants can develop a new challenge around the technology for a new learning community or serve as representatives of what they have learned, bringing their insights back into the organization.

**Discussion***:* This ongoing research builds upon previous studies to identify the necessary conditions for promoting learning, working, and innovation. By fostering community formation and experimenting with the incorporation of technology into daily work practices we will gather new knowledge and best practices to inform other health and care practices. Subsequent studies will focus on lessons learned and developing context-specific guidelines for healthcare organizations, culminating in an actionable plan. The workshop session at the Health by Tech conference offers invaluable insights for professionals, change agents, researchers, and policymakers to effectively organize learning communities in health and care settings.

## Presentation 4: Workshop: Training Conceptual and Metacognitive Skills through Capturing Experiences with a Simulation template

Gijs Terlouw & Lise Beumeler

**Background***:* The potential for learning through digital tools, such as virtual reality simulations and serious games, is widely recognized and well-documented in scientific literature. However, creating and organizing the content for these tools is a learning process in itself. It demands a certain level of scenario or script-based thinking to conceptualize a scenario and anticipate all possible choices available to a participant or player. Each choice should have consequences, and an effective tool also provides feedback, allowing participants to adjust their future decisions. By using templates, participants receive structured guidance that helps them engage in scenario-based thinking. This process deepens their understanding of their own experiences and requires them to utilize conceptual and metacognitive skills to develop a well-structured and meaningful scenario for a serious game or simulation.

**Goals***:* The aim of this workshop is to explore, test, and discuss the learning potential of a template for a simulation tool designed to support the implementation of digital healthcare technology.

**Content and (interactive) activities***:* In this workshop, a template is presented to capture best practices and barriers in the implementation processes of digital technology in healthcare. During the session, the template will be introduced, and participants will be challenged to actively engage with it in group discussions.

# Posters

## Does Engagement Behavior Predict Mental Health Outcomes in Digital Mental Health Interventions? An Individual-Level Approach

**Jonathan M. Faria da Silva Dias, Iris ten Klooster, Sofia Bastoni & Saskia Kelders**

**Background**: Digital Mental Health Interventions (DMHIs) have demonstrated effectiveness in reducing psychological distress and offer scalable, stigma-free access to mental health care. However, most research continues to focus on group-level outcomes, with limited understanding of how individuals engage and respond to different intervention types. As a result, DMHIs are often designed and evaluated in a "one-size-fits-all" approach.

Objective: This study aims at mapping (individual) differences in engagement and effectiveness (i.e., changes in depression, anxiety, and well-being) across different intervention types. Additionally, it explores whether specific patterns of engagement over time can predict post-intervention outcomes.

**Methods**: University students were randomized into one of 27 variations of a two-week mobile well-being intervention, based on a 3x3x3 structure (Content, Design, Feedback). Participants completed baseline and post-intervention measures for depression, anxiety, and well-being. Engagement was measured at three time points (Day 1, Day 3, Day 7). A series of one-way ANCOVAs were conducted to examine the effects of intervention type (Content, Design, Feedback) on post-outcomes, while controlling for baseline scores and initial engagement. Linear regression and trajectory modelling were then used to evaluate how engagement levels and change patterns over time predicted intervention effectiveness.

**Results**: One-way ANCOVAs revealed no significant differences in effectiveness between intervention types (Content, Design, Feedback) for depression, anxiety, or well-being outcomes post-intervention. In contrast, regression analyses showed that engagement at different time points, particularly late-stage engagement on Day 7, was a consistent predictor of post-intervention outcomes. Trajectory modelling further indicated that participants showed stable or increasing engagement patterns experienced greater improvements in mental health, while early disengagement or fluctuating engagement was associated with poorer outcomes. Visualizations and variability also revealed significant within-group differences, highlighting the importance of individual engagement behavior over intervention type.

## Unfolding the Processes between User Needs and Health Technology in the socio-technical Transition of Healthcare Services

**Vaitiare Mulderij-Jansen, Niki Frantzeskaki, S. Labib & Ajay Bailey**

**Background:** The global demographic landscape is undergoing rapid transformation, marked by an ageing population and widening disparities in healthcare access. This trend is mirrored in the Netherlands, where the number of older individuals is increasing while the younger population declines. Simultaneously, health inequalities are expanding across various age groups and socioeconomic strata in Dutch society. In addition, healthcare needs are becoming more complex, with many older adults managing multiple chronic conditions and facing a rise in non-communicable diseases. To address these challenges, healthcare systems must evolve, and health technology presents a promising solution. Its success, however, depends on user preference and acceptance, a robust infrastructure, effective integration with existing systems, and addressing issues of technological literacy and accessibility. A comprehensive strategy involving all stakeholders is essential for successfully implementing health technology, ensuring that health systems can effectively serve the diverse groups mentioned. We aim to investigate socio-technical transition pathways in healthcare settings in Utrecht. This study will document the implementation and usage of health technologies, identifying key facilitators and barriers to enhancing their utility in improving healthcare services for elderly people.

**Methods:** The study will adopt a qualitative approach, exploring transition pathways from the perspectives of diverse stakeholders within the health technology ecosystem in Utrecht. This comprehensive analysis will offer a deeper understanding of the interplay between technology, its users, and the healthcare system. This study is grounded in the Multi-Level Perspective (MLP) framework and involves focus group discussions and in-depth interviews. We will select two healthcare facilities in the Utrecht region that utilise health technologies. We will recruit these facilities along with their health professionals and users through our networks, including the Community Engaged Learning Network. We also aim to recruit entrepreneurs/health technology service providers, health insurance providers and policymakers based in Utrecht. A snowball sampling approach will be employed to recruit participants, connecting them based on their engagement with the same technologies to facilitate the development of detailed case studies. The qualitative study explores how diverse health technology users engage with and utilise various health technologies within Utrecht's social and institutional frameworks. It identifies and examines the barriers and facilitators that influence their adoption and use. In addition, we will assess how technological devices and applications have been implemented to better understand technological transition pathways for healthcare. All participants will be informed about the study aims, methodology, and data management plan. Participation will require oral informed consent, and participants can choose their preferred mode of participation (e.g., in person or online) to minimise the study's burden. The total number of study participants will be determined by data saturation, but we aim to recruit at least 25 participants. The interviews/group discussions will be recorded, transcribed, translated into English, and analysed using inductive and deductive coding. The data will be managed and analysed using NVivo software.

### Do attitudes towards technology mediate engagement with digital mental health interventions?

**Valentina Fietta, Merylin Monaro, Nicolò Navarin, Saskia Kelders & Silvia Gabrielli**

**Background:** Digital Mental Health Interventions (DMHIs), including mHealth apps and serious games, promise to improve mental health outcomes, particularly among vulnerable populations, who have logistic, time and economic difficulties to reach health services or hospitals. However, high dropout rates remain a critical barrier to DMHIs' success. Previous scientific studies suggest that users' characteristics and predispositions significantly impact their engagement with DMHIs. Investigating implicit and explicit attitudes towards these technologies could reveal crucial insights into factors influencing user retention and motivation, opening the way for more effective and sustainable mental health solutions.

**Methods:** The present research will focus on mediators of engagement with DMHIs. This work adopts a novel approach, comparing users' explicit and implicit attitudes towards mental health interventions before and after their use. Implicit attitudes, measured through techniques such as Implicit Association Tests (IAT), will be correlated with explicit self-reports (e.g. the TWente Engagement with eHealth Technologies Scale, TWEETS) and objective engagement data collected pre-, during and post-intervention usage. Objective metrics, including app usage frequency and task completion rates, will be paired with subjective feedback to understand user engagement and attitude towards technological tools for mental health comprehensively.

**Future Findings:** The study will identify key motivational and attitudinal factors influencing engagement with DMHIs. Preliminary analyses of the literature suggest that implicit attitudes could serve as significant predictors of user retention, critically complementing explicit measures of motivation and satisfaction with DMHIs for mental health. These findings will offer valuable insights into tailoring DMHIs to better align with users' needs and expectations, ultimately reducing dropout rates and enhancing the effectiveness of digital mental health technologies.

**Discussion:** Understanding the mediators of engagement with DMHIs is crucial for their successful implementation. This study aims to test these assumptions, thereby aiding future research in addressing outcomes for populations with unique vulnerabilities and stressors. This research aims to address the current knowledge gap surrounding implicit attitudes' role in predicting user engagement with DMHIs. By examining how biases and preconceptions affect interaction, this approach may reveal how initial attitudes influence long-term commitment to these tools. The outcomes are expected to advance the field of digital mental health by providing actionable insights into improving user retention and optimizing interventions design for general and specific vulnerable populations, they will also underscore the importance of integrating psychological principles Caregivers' willingness to pay for digital support services: comparative survey into the development of health technologies, contributing to their broader adoption and impact.

## A Design Framework for Developing AI-powered and Engaging Digital Interventions for Disease Prevention and Management

**Marco Pozza, Munesu Maminimini, Marco Bolpagni, Valentina Fietta & Silvia Gabrielli.**

**Background:** Digital interventions such as Digital Therapeutics (DTx) are transforming the landscape of chronic disease and mental health management by leveraging technology for personalized care. A persistent challenge in their design is achieving optimal user engagement, a critical factor for ensuring adherence and effectiveness of treatment. Our research and development framework is focused on experimenting AI-powered solutions integrating Digital Twins with Digital Therapeutics to address engagement challenges, specifically in the prevention and treatment of Chronic Obstructive Pulmonary Disease (COPD) and stress. Our aim is to advance state-of-the-art research in this application field by combining predictive analytics with real-time personalization for more effective, personalized, adaptive, scalable, cost-effective and engaging interventions.

**Methods:** Our design framework encompasses several components. Digital Twins are deployed to simulate personalized patient health profiles using multimodal data, including physiological markers (e.g., heart rate variability, oxygen saturation), behavioral patterns, and self-reported metrics (e.g., stress levels, COPD symptoms). Advanced AI models process this data to provide tailored interventions and predictive insights. Large Language Models analyze unstructured self-reports, such as stress diaries and COPD symptom logs, to identify disease-related conditions and psychological states. To enhance engagement of users with our DTx, our design is informed by sound methodological approaches such as the Transtheoretical Model of Change (TTMC) to understand users' readiness to change, and Self-Determination Theory to foster motivation to change. Ecological Momentary Assessment method is also deployed to collect user self-reported data supporting a more effective delivery of just-in-time adaptive interventions.

**Findings:** We expect to showcase our design framework by means of 2 proof of concept implementations supporting its future validation in both simulated and real-world settings. For COPD management, predictive models and DTx are expected to support prevention of symptom exacerbation. In the area of stress prevention AI-powered DTx will enable just-in-time cognitive-behavioral intervention deployment to reduce stress and strengthen the user's coping skills.

**Discussion:** By leveraging on AI-powered DTx our research framework contributes to support a paradigm shift in the management of chronic diseases and mental health. This approach is meant to enable early detection of exacerbation risk and timely interventions to reduce symptoms, improve quality of life, and lower treatment costs.

AI related challenges such as data standardization, global representation, and biases in AI models will be also addressed in our future design and validation efforts. Moreover, we will focus on expanding predictors to include genetic and environmental factors, enhancing cultural adaptability of our solutions, ensuring equitable access to these technologies.

By adopting a user-centric perspective in the development of our framework, these research efforts promise to redefine how chronic diseases and mental health conditions are managed, bridging critical gaps in engagement, personalization, and therapeutic outcomes of digital interventions

## Assisting caregivers in enhancing self-reliance in clients with autism: the impact of social robot “Maatje”

Bas Kamer & Ellen Janssen

**Background:** The Dutch Integral Care Agreement emphasizes that healthcare institutions need to apply and scale hybrid (a combination of personal and digital) forms of care, in order to reduce pressure on the healthcare system. This agreement led to an increase in the implementation of new technologies, e.g. social robots, in Dutch healthcare settings. The regional Autism Center (RAC) in Helmond started using social robot “Maatje” in 2022, to help their long-term clients improve their self-reliance, i.e.: achieving an acceptable level of functioning in the important domains of daily life. This three-year longitudinal qualitative study has examined how the use of “Maatje” enhances clients' self-reliance and the changes in workload for caregivers. RQ1: What is the effect of social robot “Maatje” on the self-reliance in clients with autism? RQ2: How does the use of social robot "Maatje" affect the content and scope of care provision of RAC caregivers?

**Methods:** Twenty-five semi-structured interviews were conducted with RAC caregivers who used robot “Maatje” with one or more of their clients. After 4 to 6 months, caregivers were contacted again to determine whether the clients were still using the robot and whether and how their care provision had changed.

**Results:** The results show that a majority of the clients who worked with robot “Maatje” during the first measurement point are still using the robot after 4 to 6 months. The most common goals for which the robot is used are: daily structure (waking up and going to sleep on time, preventing hyperfocus), reminders for household tasks and self-care (reminding clients to eat/drink, take medication, shower, brush teeth, and use the toilet).

The caregivers report that the majority of clients experience a better quality of life. A smaller portion of clients has become somewhat more self-reliant. In some cases, the clients feel robot “Maatje” is their friend and therefore, clients feel less lonely. The content and scope of the provided care hardly changed, according to the caregivers. In some cases, using robot “Maatje” led to modest time savings because clients feel mentally or physically better, for example, by not forgetting to drink or by signaling earlier when they are at risk of becoming mentally overwhelmed.

**Discussion:** There is a great deal of interest from healthcare providers in using social robots with clients. However, the implementation of robots within (autism) care is complicated. Self-reliance is a broad and complicated concept, especially for long-term care clients. Robot “Maatje” can help improve the self-reliance of these clients to some extent. However, more research is needed to determine which types of psychosocial issues and specific care needs are best addressed by social robots. Additionally, the conditions for implementing robots need to be further investigated. The robot's lifespan must also be considered; after three years, more technical issues were reported, such as the robot understanding the client less clearly. Future research should also involve clients and their informal networks, in order to gain a better understanding of the use and effects of social robots in various care settings.

## Optimizing COPD Care: Evaluating the Virtual Companion Program (VCP) for Patients and Healthcare Professionals

**Damion Lourensz, Giulio Pagliari, Rain Jõgi, Dumiana Chamaon, Stephanie Jansen-Kosterink & Monique Tabak**

**Background:** Chronic Obstructive Pulmonary Disease (COPD), a lung disease that affects a person’s breathing often leads to more complications like exacerbations, respiratory infections, and heart problems. If these conditions are not managed well, the patients’ conditions often worsen. Therefore, the project RE-SAMPLE developed and implemented a virtual companion program (VCP). The VCP aims for patients with COPD to take control of their chronic condition while also helping them improve their way of living. The VCP also allows healthcare professionals (HCP) tailor their treatment based on the patient’s condition while gaining continuous visibility on their health. Even so, the effectiveness of the VCP must be studied. Therefore, this study aims to identify the obstacles and facilitators experienced by patients with COPD and HCPs involved in the VCP.

**Methods:** For this research we follow a qualitative approach. First an interview guide is developed based on literature and expert opinions. Semi-structured interviews are then conducted with 10 patients and 5 HCPs who participated for at least 8 weeks in the cohort study. This interview is meant to gather information on preferences, needs, satisfaction, and facilitators for the virtual companionship tool. Interviews are conducted at 3 different hospital sites with participants from three different European countries (the Netherlands, Italy, and Estonia).

**Results:** Although the interviews have yet to be conducted, preliminary findings are expected to provide insights into user satisfaction, perceived utility of the VCP in supporting patient care, and areas for improvement in its implementation. The results should highlight the needs of both the patients and HCPs, with HCPs focusing on the Team, Tool, Routine framework.

**Discussion:** This study aims to explore critical factors influencing the effectiveness of the VCP for COPD care. By identifying the strengths and weaknesses of the VCP, future iterations of the program can enhance the technical, organizational, and usability aspects, as well as the integration of the program within a clinical setting. Potential implications can be the improvement of patient engagement and scalability of the VCP within other clinical settings. Furthermore, this study may be able to provide recommendations for the care of patients with COPD and the ways in which eHealth technology can be more beneficial

## Self-Management in Reintegration: Development of www.mijn-reintegratie.nl

**S. ten Hoeve, T. Juurlink & H. Anema**

**Background:** Evidence suggests that the involvement of sick employees in decision-making during the early stages of the reintegration process enhances their likelihood of returning to work. Despite these findings, practical implementation remains challenging. This project aims to empower sick-listed employees to take control of their reintegration by providing accessible resources through the website “www.mijn-reintegratie.nl." The platform offers clear, evidence-based information, tools, and modules designed to promote self-management and self-efficacy, while fostering improved collaboration among all stakeholders involved in the reintegration process.

**Methods:** For the development of mijn-reintegratie.nl, data were gathered through interviews with 14 sick employees and focus groups with 13 professionals, including occupational health professionals and HR managers. These insights were used to identify the key information and (existing) tools to according to the stakeholders to support employees in managing their own reintegration and translate these into an accessible and user-friendly website. Currently, in an observational study, the use of the website and return to work is followed among sick-listed employees using the website over a period of 6 months through questionnaires and interviews.

**Findings:** The website was developed with input from several stakeholders and includes: a) comprehensive information on the return-to-work process and evidence-based interventions, b) tools designed to enhance self-efficacy (e.g., strategies for preparing for meetings with occupational health professionals and supervisors), and c) resources that facilitate shared decision-making between employees and employers.

**Discussion:** The development of the website was a collaborative process involving sick-listed employees and occupational health professionals involved and experienced in the reintegration process. Currently, data of the observational study is being collected. With this data we are studying the use of the website, self-management skills, knowledge and time to return to work. With this we aim to investigate which modules and tools of the website are used the most and to what extent using the website contributes to an increase in self-confidence and self-efficacy regarding the reintegration process, and ultimately return to work among sick-listed employees.

## Designing and disseminating digital lifestyle interventions for vulnerable young families: an interview study

**Ashley J.P. Smit, Nicolien D.M. Dinklo, Linda D. Breeman, Lieke Schiphof-Godart, Andrea W.M. Evers & Koen Joosten**

**Background:** The young family phase, from preconception to early childhood, is a critical period in which lifestyle behaviours significantly influence children's health later in life. As such, this phase is a window of opportunity for promoting health through lifestyle changes. eHealth lifestyle interventions are a promising solution to support young families in improving their lifestyle. However, challenges such as financial hardship and limited health literacy can hinder the usage and adherence to eHealth lifestyle interventions. The study aims to understand the facilitators and barriers to eHealth use in vulnerable young families, to design tailored interventions that better align with their skills, preferences and needs.

**Methods:** We conducted interviews with members of young families living in a socioeconomically disadvantaged neighbourhood in Rotterdam, the Netherlands. Before the interview, participants were asked to rate the importance of 23 eHealth functionalities (e.g. goal setting, chatbots and social functions) through a questionnaire. The semi-structured interviews included questions on current eHealth use, functionalities for an eHealth lifestyle intervention (based on the results of the questionnaire) and dissemination of an eHealth lifestyle intervention. Interviews were thematically analysed, and themes were categorised as facilitators or barriers.

**Results:** We interviewed 12 women with an average age of 32, of which 6 (50%) were pregnant, 5 (42%) had a child aged four or younger, one (8%) had an active child wish and 6 (50%) had children older than four. In addition, we interviewed 2 men with an average age of 32, both of whom had a pregnant partner.

We found various vulnerabilities among the participants, including difficulty with the Dutch language (n=9, 64%), not living together with their partner (n= 5, 36%), having a lower level of education (n=2, 14%), and receiving organised support (e.g. psychiatrist and the municipality, n=6, 46%). In addition, participants experienced loneliness (n=5, 38%), (some) financial stress (n=6, 46%) and stress from their living situation or neighbourhood (n=4, 33%). Furthermore, 6 participants (46%) were not completely satisfied with their lifestyle. Among the participants, we identified current eHealth users and non-users. Our preliminary analysis suggests that the needs of this population are diverse and indicate that functionalities such as goal setting, personalized lifestyle advice and information on family activities in the neighbourhood may be particularly appealing. Responses on functionalities such as chatbots, peer chatrooms, and feedback on weight status were mixed. Participants suggested that social media could be an effective platform for disseminating eHealth interventions, as well as recommendations by a healthcare provider or a trusted individual within their social network.

**Discussion:** Valuable insights for developers of eHealth lifestyle interventions targeting young families with varying vulnerabilities were found. Future eHealth lifestyle interventions should offer more than solely providing lifestyle information to remain relevant. The use of social media and the involvement of healthcare providers can enhance the dissemination of these digital interventions. The skills, preferences and needs of young vulnerable families indicate an opportunity to increase usage and adherence to eHealth lifestyle interventions, ultimately improving their lifestyle.

## Happy again! Social support app

**Sanne Schoenmakers, Mieke Ronckers, Manic Djelantik, Paul Boelen, Matthias Brinkhuis, Wijnand IJsselsteijn, Will Hurst & Ebo Kwabena Bennin**

**Background**: Many people struggle with recovering from grief, and professional help is often unavailable due to the high demand on the mental health sector. We are developing an app people can use at home to work through their grief with the help of their social environment.

**Methods:** We researched why existing grief apps are insufficient and what features should be in a grief application in order to support people at home. We started our work by interviewing grief therapists and grief counselors. Based on these findings we performed a qualitative search on existing grief apps, and researched the literature on the hypothesis that social support lowers depression and anxiety. Through co-evolutionary design with the various stakeholders we are now developing the various modules for the app.

**Findings:** We found a need for psychoeducation, a personalized approach, tracking progress, a need for empathic responses, and a low expected risk of working with an app at home. Moreover, we investigated existing technology and existing apps. Existing apps offer information, mindfulness exercises or chats and forums. In rare cases we found apps with cognitive behavioural exercises, however often they have not been thoroughly tested. Moreover current apps don't offer the variety in requested features. Furthermore, our main finding was that especially social support was an important factor for a speedy and pleasant recovery, yet no apps exist that help people with establishing a better social environment. Research into good social support shows that it often correlates strongly with a lower chance of depression and anxiety. Therefore, we expect that a good social support structure may be an important factor for preventive health. Furthermore we found that measuring depression, stress and anxiety could be helpful to give a personalized intervention. For high levels of depression and stress we see that people are taking on difficult tasks while they may not be mentally fit for it. Yet for high scores on anxiety we saw that people avoid difficult tasks, which could prohibit their recovery.

**Discussion:** We aim at creating a social support app for grief in young adults, but we expect this app to be translatable to other groups of people (adults, students, children) and other types of mental health support (e.g. depression, anxiety, autism, ADHD, Parkinson, Alzheimer's etc.) Moreover, we intend to develop a novel therapeutic approach to help people enhance their social support network with professional help to deal with more complex mental health problems.

## From relapse to resilience: the development of a technology-assisted self-management platform for people with severe mental illness.

**Joyce Bierbooms, Emiel Krahmer & Inge Bongers**

**Background**: Mental health care is under pressure, with long waiting lists and suboptimal use of care. This especially applies to people with severe mental illness (SMI) who often relapse and, thus, intermittently utilize the limited available care. Technology-assisted relapse prevention could alleviate this pressure by empowering people with SMI to engage in technology-assisted self-management.

In this symposium we will discuss the co-creation of a digital self-management platform for people with SMI, that aims to prevent relapse. To develop a sustainable solution, we take a holistic approach, meaning we address different stages of the development process in the workpackages and fuel the productive interactions between these workpackages by involving all stakeholders right from the beginning. In our first presentation, we discuss the identified transdiagnostic symptoms that predict relapses and how these are translated into personalized early warning signs, which form the foundation of the platform. Subsequently, in our second presentation, we will elaborate on the iterative technical development of such a digital self-management platform with the use of an experience sampling methodology (ESM). In the third presentation, we discuss the intrinsic evaluation of the platform, adopting a human-centered design (HCD), through which we gain a better understanding of what is needed for the platform to fit in the daily lives of people with SMI as well as the platform's compatibility with current mental healthcare practice. In our fourth presentation, we will reflect on how to ensure a sustainable transdisciplinary collaboration in the development of a digital self-management platform, through the development of a multi-stakeholder learning community.

Our shot to the moon revolves around the empowerment and sustainable recovery of people with SMI, lowering the individual and societal costs accordingly, and diminishing inequalities in mental health, as a contribution to more accessible, affordable, and high-quality specialized mental health care.

## Expanding Horizons: brainstorming requirements for international deployment and additional health conditions for mHealth aides

**DanaKai Bradford, Jennifer Wilson & Iona Novak**

**Background**: Mobile apps that tailor information to the individual improve consumer knowledge, self-management and time management, promoting informed decision making and reducing conflict of choice. Depending on the app, mHealth can also provide increased patient-provider communication, accessibility, cost-effectiveness and scalability, all of which have the potential to improve outcomes and reduce economic burden for families and the healthcare system.

Usually when we develop an mHealth app, we do so within specific confines such as our own country – using our native language, national resources and familiar icons; or a diagnosed condition, such as cerebral palsy (CP), focusing on individual priorities and resources to assist families. What then happens if we decide to make the app available more widely – deploying it worldwide, or adding a range of conditions in modular format? How do we ensure the app has the same value in other countries or for consumers with different needs? We would like to take the opportunity to harness the knowledge of an international group of health tech researchers to brainstorm primarily the gap between domestic and international scalability of mHealth; and secondarily to work with experts focused on developing tech for other health conditions, particularly neurological disorders, to look for commonalities in supporting improved decision making for health management.

## The data infrastructure of Rehablines databank: from data sources to data release.

**Bregje L. Seves, K. van Kammen, S. Jacobs, L.A. Krops, J.H.B. Geertzen & R. Dekker**

**Background:** Rehablines is a unique databank that purely focuses on the re-use of clinical data for research, optimization of health care and health care policy, with patient consent, being the first in its kind on rehabilitation in The Netherlands. The databank was successfully implemented at UMCG-Center for Rehabilitation for all adult patients in 2024. Currently, Rehablines faces challenges related to data quality and availability. Despite the clear benefits of routinely collected data, this type of data may suffer from incompleteness and measurement errors. To efficiently generate research datasets, there is an urgent need for data harmonization and optimization of data extraction processes. The aim is to describe the current data infrastructure of Rehablines and strategies to address the challenges.

**Methods:** Rehablines is a further-use databank, for which patients give their written informed consent. Data collected during routine clinical care will be re-used without additional measurements. Available data sources are medical history and treatment information (patient record; Epic), questionnaires (e.g., RoQua), gait analyses from the MotionLab, cardiopulmonary exercise tests (SentrySuite), and exercise training information from training equipment LODE and HUR. Data extraction will be performed to generate pseudonymized datasets per scientific study.

**Findings:** Two pilot data releases are currently being conducted, which are being evaluated for the usability and quality of the routine clinical data, as well as the extent to which the data is directly usable for end users. It will also give an overview of the process from data collection from distinct data sources to data release for end users (e.g., researchers, clinicians). Key challenges within this process from data sources to data release will be addressed and presented during the Health by Technology symposium.

**Discussion:** Through integrating data from different sources that are used during routine clinical care, the Rehablines further-use databank provides valuable data for the development of personalized treatment strategies, ultimately improving patients' health. By addressing the key challenges in the process from data collection to data release, we are able to improve the Rehablines data infrastructure, facilitating scientific research and ultimately improving patients' outcome.

## Requirements for a personalized eHealth coaching tool for people with knee osteoarthritis

**Elke Warmerdam, Steven Lankheet, Anouk Middelweerd & Monique Tabak**

**Background:** Knee osteoarthritis (OA) is a progressively disabling and painful disease of the knee joint. It starts with minor effects like pain while walking longer distances but can lead to significant issues such as loss of productivity, social isolation, and inability to live independently. There is no cure or disease-modifying treatment. Patients are advised to stay physically active, although both too much and too little activity can worsen the condition. Personalized coaching via an eHealth tool could support patients in adjusting their lifestyle and gaining insights into activities that trigger or reduce their symptoms. This study aims to identify the requirements for a personalized coaching tool to aid in the development of the eHealth tool.

**Methods:** A pragmatic literature search was performed on existing eHealth tools for knee OA, focusing on functionalities, patient engagement strategies, and facilitators of use. The findings were used to identify known aspects and which aspects needed further exploration with potential future users. Focus groups with knee OA patients were conducted to discuss their issues, needs, and desires for managing their condition. Interviews with healthcare professionals (HCPs), including general practitioners, physiotherapists, sports physicians, and orthopedic surgeons, were held to discuss the difficulties regarding treating people with knee OA and their wishes to improve the treatment. The transcripts were analyzed and combined with the literature search results and translated into requirements for the eHealth tool. Prioritization of the requirements was done according to the MoSCoW method based on how often the aspects were mentioned by patients, HCPs and literature.

**Findings:** Five people with knee OA participated in the focus group, and seven HCPs were interviewed. More sessions are planned to reach data saturation. The focus groups highlighted the need for personalized information and exercises. HCPs emphasized that tailored information is crucial for better preparation for clinical appointments and self-management of the patients. An important addition from the literature was that the patients should work towards a specific goal.

The requirements that were extracted from the focus groups, interviews and literature are: The eHealth tool must provide information about the emergence and progression of knee OA, different treatment options and self-management strategies. It must provide exercises that patients can perform, help patients reach their goal, monitor symptoms, physical activity and knee loading, and provide coaching and feedback based on the monitored aspects. The ‘should have’ requirements for the eHealth tool are the possibility to share reports with HCPs and to add red flags to report the occurrence of a specific symptom. The ‘could have’ requirements for the eHealth tool are an activity planner, monitoring intake of pain medication, message function to contact physiotherapists and a chat function with peers.

**Discussion:** The goal of the eHealth tool is to help knee OA patients understand how their actions affect their condition, as well as support them to improve their symptoms via personalized coaching. The key requirements of the eHealth tool include information provision, monitoring, and personalized feedback and coaching. These requirements will aid in the development of the eHealth tool.

## Bridging Research and Practice: Identifying Barriers to Social Robotics in ASD Home Therapy

**Catherine Burns & Sabrina Saiko**

**Background:** Social robots have emerged as a promising intervention for supporting children with underdeveloped social skills, particularly those with Autism Spectrum Disorders (ASD). Extensive research, including studies by Dautenhahn, Abbasi, Dickstein-Fisher, and the AskNAO initiative, has demonstrated the potential of these robots in therapeutic sessions and home-based interventions for social skill development. Investigations of both short-term and limited long-term outcomes by Amirova et al., Jain et al., and Javed and Park, have shown measurable improvements in key social interactions, including eye contact, verbal communication, physical interaction, and joint attention.

Despite the documented therapeutic benefits and commercial availability of social robots, such as QTRobot, Nao, Milo, etc., their adoption remains limited in both clinical and domestic settings (Salimi et al.). While existing research has predominantly concentrated on demonstrating therapeutic efficacy for children, this narrow focus overlooks the critical perspectives of key decision-makers: parents and clinicians. Beyond positive child outcomes, factors like cost-effectiveness, usability, and practical implementation significantly influence technology adoption by caregivers and healthcare providers.

**Methods:** A systematic search was conducted using PubMed, IEEE Xplore, and Google Scholar. We found studies published between January 2014 and December 2024 which are peer-reviewed papers examining the design and use of social robots for ASD intervention in home or clinical environments, with an emphasis on robot-child interactions and their therapeutic applications. The research is ongoing, and findings will be refined as analysis progresses.

**Preliminary Findings:** 25 studies have been reviewed, so far, covering seven different social robots designed for ASD care. However, only two of these robots were originally developed specifically for ASD interventions. All studies reported positive impacts on children’s social skills, but none of the robots have been systematically integrated into regular therapy sessions. Further analysis is being conducted to explore the underlying factors limiting real-world adoption.

**Discussion (Ongoing Analysis):** Initial findings suggest that some of the barriers for adoption of Social Robots into therapeutic care are inconsistent robot design (e.g., varying personalities and appearances), lack of evidence to create a clear guideline, and limited user-friendly interfaces for caregivers and therapists. As the study progresses, we aim to identify key areas where standardizations such as defining core therapeutic activities, ensuring adaptable robot design, setting cost-effectiveness benchmarks, and prioritizing ASD-specific robots—could enhance research quality and support medical adoption of these technologies. The final findings will provide a more comprehensive understanding of the barriers to social robot integration in ASD care.

## From Crisis to Continuity: Longitudinal developments and Socio-Economic Influences on Digital Health Adoption in Friesland

**Inge Tuitert & Job T.B. van ‘t Veer**

**Background:** Over the past decades, digital technologies have become increasingly important in the healthcare sector. The COVID-19 pandemic has accelerated the shift from traditional to digital healthcare, but this rapid transition risks widening the "digital divide," leaving older adults, economically disadvantaged groups, and those with lower educational levels at a greater disadvantage. There have also been reports suggesting that the COVID-19 pandemic may have contributed to minor reductions in the “digital divide.” The main question is whether the increased use of digital health applications driven by the COVID-19 pandemic will persist and how this trend is influenced by socio-economic factors. This study examines the longitudinal changes in the adoption of digital health applications and investigates the role of socio-economic factors in shaping these changes.

**Methods:** A panel study on digital health was conducted in the Frisian population in the Netherlands in 2019, 2020, and 2024. A representative sample of approximately 7,000 residents from Friesland, a province in the northern Netherlands, is regularly invited to complete surveys on various regional public concerns. The current survey took a broad approach of 13 digital health technologies, extending beyond the healthcare context to include preventative, health-promoting solutions available on the consumer market, such as wearables and lifestyle apps. First, to analyze whether the use of separate digital health applications increased across time, we conducted Cochran’s Q tests on the separate types. Second, to examine the longitudinal changes and the influence of socio-economics factors on the use of digital health applications, a sum score of all separate items, a generalized linear mixed model was fitted with the use of digital health applications as the dependent variable, time as within-subject variable, and socioeconomic factors as between-subject factors.

**Findings:** The percentage of people who reported using digital health technology rose from 69.9% (965/1380) to 82.8% (1143/1380) to 93% (1283/1380). This increase was significant for most separate types of digital health technology, such as health information on the internet, patient portal use, and wearables (all P<.001). In addition, for use of digital health applications we identified interaction effects for time with age and educational attainment, revealing that the initially lower overall usage among older individuals and those with lower educational attainment decreased over time.

**Discussion:** These findings on the longitudinal changes in the adoption of digital health applications, and the investigation of the role of socio-economic factors, suggest that the use of most types of digital health applications has increased over time, where older individuals and those with lower levels of education seem to catch up on use. Furthermore, although this study demonstrates a continued increase in the adoption of digital health applications, future efforts should still focus on vulnerable populations. It is essential to ensure that these groups receive the necessary attention to guarantee their access to healthcare, preventive health-promoting solutions, and social services.

## Mapping Biases and Misrepresentation of Marginalized Groups in Healthcare Technologies

**Roberta Antognini, Francesca Toso, Cristina Zaga & Mascha Van der Voort**

**Background**: Historically, the healthcare industry has centered the white, cisgender male as the "ideal" subject, marginalizing groups that deviate from this standard and, therefore, influencing how today's digital technology supports health. Because of researchers' biases, women have systematically been excluded from clinical trials due to their fluctuating hormones, which the medical industry often regards as an "uncontrollable variable" that complicates results (Place, 2023). Misrepresentation of marginalized groups is also evident in thyroid disorders, which have been recognized since the early 1900s and predominantly affect women at a rate of 9:1 compared to men. Nonetheless, there is a lack of comparative studies due to the non-specific nature of their symptoms (Bianco, 2022). Dana Abdulla elaborates in Eye on Design Magazine, stating that "With every design decision we make carries the potential to not only exclude but also oppress." Currently, the same biases and misrepresentations continue to influence technological development aimed at improving the quality of life for these marginalized groups, leaving them vulnerable. Consequently, it is crucial to assess how biases and misrepresentations influence technological development to design more inclusivity technologies.

**Methods**: Through a critical review of literature, we evaluate cases of misrepresentation of marginalized groups in the healthcare sector, as well as the biases of physicians and researchers that are reinforced by technology. The findings will be organized into themes and visualized through a taxonomy. Therebywe offer a deeper insight by highlighting essential relationships between themes and topics as shown in projects like the Anatomy of an AI system (Crawford & Joler, 2018) facilitates understanding the life cycle of an Amazon Echo unit. Data visualization of the findings boosts audience engagement and comprehension, (see similar works as presented by Milan & Treré

**Expected Findings**: The findings provide insights about how misrepresentation and biases embedded in healthcare technology impact the quality of life for patients suffering from chronic hormone-related illnesses, specifically patients with thyroid issues (e.g., work-life balance (Leso et al., 2020), the definition of identity (Place, 2023), symptoms gaslighting (Bianco, 2022)). Findings take stock on methodologies addressing biases and misrepresentation in technology design and deployment, thereby providing reflections on how patients utilize digital technology to enhance their health and current limitations. All in all, the review offers a collection of best practices, methodological challenges and opportunities for future technological development.

**Discussion**: Healthcare technology design has a direct impact on the quality of life of patients. Thus, it is more important than ever to consider the biases designers and researchers project on participants and address the misrepresentation matters. In healthcare, neglecting to address bias and misrepresentation issues would leave certain groups vulnerable, impacting their physical health and disempowering them. The literature review and the visual taxonomy of findings stimulate reflection among researchers on their own biases, helping them recognize their impact of their studies and laying the groundwork for more inclusive technology.

## Personalizing eHealth for Metabolic Syndrome: Identifying Key Determinants for user-profiles

Hakan Kuru, Jasper Faber & Jos Kraal

**Background:** Metabolic syndrome (MetS) is a significant public health concern, with increasing prevalence and serious long-term health consequences. While eHealth interventions have shown promise in supporting lifestyle changes, many are designed as one-size-fits-all solutions. These often fail to address the unique needs of populations who would benefit the most, particularly those with a low socioeconomic position (SEP). To enhance the effectiveness and inclusivity of eHealth interventions, it is essential to identify specific end-user profiles that can guide personalized approaches. Therefore, this study aims to: (1) identify key determinants for system engagement and lifestyle change in patients with MetS, and (2) develop end-user profiles that reflect the diversity in psychological, behavioral, social and environmental factors determining the variance in individuals with MetS, including those with a low SEP, ensuring that eHealth solutions are better aligned with their needs.

**Methods:** We conducted 90-minute semi-structured interviews with 9 patients diagnosed with MetS to explore the personal, social, environmental, psychological, and behavioral factors influencing eHealth engagement and lifestyle change. Participants were recruited through various channels, including GP practices, neighborhood centers, newspaper advertisements, and snowball sampling, to ensure a diverse sample. Our research materials—such as flyers, consent forms, and the interview guide—were developed in accordance with inclusive research guidelines to ensure accessibility for all participants. The interviews were transcribed and thematically analyzed, resulting in a list of key determinants. Based on these findings, we developed a digital questionnaire, which is currently being distributed through the previously mentioned recruitment channels across three regions: Leiden, Utrecht, and Twente. We will perform a cluster analysis on the collected data to develop detailed end-user profiles that reflect the needs and preferences of individuals with MetS.

**Results:** The results of the interview study highlight key determinants that influence user variation among patients with MetS, which are critical for designing interventions aimed at facilitating system engagement and promoting lifestyle change. These determinants include: (1) personal characteristics, such as age, income, health literacy, and digital literacy; (2) health status, encompassing risk factors like weight, cholesterol levels, blood glucose, blood pressure, and the duration of these conditions; (3) behavioral, social and psychological factors, including beliefs about disease risk, emotional responses, motivation, and the capability and opportunity for change; (4) intention and readiness to address physical activity, diet, and stress; and (5) user needs related to the eHealth system, such as preferred coaching style, intervention intensity, monitoring functions, modes of interaction, and types of messaging. The questionnaire phase of this study is currently underway, and preliminary results will be presented during the conference.

**Discussion:** This study highlights key insights regarding personalizing eHealth interventions for patients with MetS by considering differences in personal characteristics, health status, behavioral factors and eHealth preferences. Developing end-user profiles based on these determinants will help create more effective and inclusive interventions. As the questionnaire phase continues, concrete end-user profiles will further guide the design of personalized eHealth to improve adherence and lifestyle.

## A Multi-Method Approach to Developing Personalized Text-Messages for Improving Diet, Physical Activity and Stress: A Within-Subject Repeated Randomization Study

**Iris ten Klooster, Kerem Doğan, Jasper Faber, Bert-Jan van Beijnum, Saskia Kelders & Monique Tabak**

**Background:** In the Netherlands, an estimated 24% to 34% of adults aged 30 to 70 years have metabolic syndrome (MetS). People with low socioeconomic positions (SEP) are at higher risk of developing MetS and its complications, including type 2 diabetes (DM2) and cardiovascular disease (CVD). Lifestyle modifications, such as increasing physical activity, improving stress management and adopting a healthy diet, can reduce the prevalence of MetS and its associated complications. These lifestyle modifications can be supported through digital text messages, which are commonly used in eHealth interventions to provide ongoing educational and motivational support in daily life. However, the effectiveness of eHealth interventions is often limited by declining adherence and a lack of engagement on one or more levels—affective, behavioral, or cognitive. One possible explanation is that the one-size-fits-all approach often used in these interventions does not properly address individual differences such as motivation, self-efficacy, and personal needs. Therefore, this study aims to explore how individual differences can be addressed by personalizing health text messages focused on increasing physical activity, improving stress levels and adopting a healthier diet. Specifically, we examine (1) which individual characteristics and preferences predict the perceived relevance of the health messages, (2) engagement with these health messages over time, (3) how experts evaluate the health messages, and (4) how individuals with various socioeconomic positions evaluate the health messages, exploring potential differences in their evaluations.

**Methods:** Participants will be students recruited during the exam period, with inclusion criteria being a need for change in one or more lifestyle areas (stress, diet, or physical activity). They will receive daily health messages via the TIIM platform (University of Twente, Enschede, NL) targeting stress, diet, and physical activity. A within-subjects design will be used, with messages randomly selected from a database and sent to participants each day. At enrollment, participants will complete baseline questionnaires assessing demographic characteristics (e.g., age, income, education, health and digital literacy, stage of change (transtheoretical model), motivation, capability, and opportunity (COM-B model), and message preferences (e.g., coaching style, interaction level, message type). After receiving each message, participants will be asked to rate the perceived relevance of the health message. Furthermore, weekly Ecological Momentary Assessment (EMA) questions will assess their cognitive, behavioral and affective engagement with the health messages over time. To gain deeper insights, semi-structured interviews will be conducted with individuals with different socioeconomic positions to explore their perspectives on the perceived relevance, motivation, clarity, and their preferences for certain message characteristics (e.g., coaching style, interaction level, message type) In addition, individuals with experience in the development of eHealth interventions will evaluate the messages based on dimensions such as coaching style, interaction level, and message type to validate that the messages reflect these characteristics.

**Results:** The development of the health messages is currently ongoing and recruitment for the study will begin soon. During the conference, preliminary results will be presented, including insights into the health message development process and participant recruitment.

**Discussion:** This multi-method approach will provide insights into how individual characteristics and message features influence the perceived relevance and engagement with daily health messages. These findings can inform the development of more inclusive, personalized digital health interventions.

# Demos

## A simulation-based training tool for child helpline counsellors

**Mohammed Al Owayyed, Myrthe Tielman & Willem-Paul Brinkman**

**Background:** Child helplines provide a safe and confidential platform for children to reach out and receive support from trained counsellors. Helplines typically operate through two channels: voice calls or online text chats. New counsellors are usually trained through role-playing, where a counsellor takes on the role of the child in the interaction. However, this approach is resource-intensive and time-consuming. To address these challenges, we developed a simulation-based tool designed to train counsellors in a controlled, interactive environment. The tool focuses on teaching the application of the five-phase model, a communication protocol that guides counsellors in keeping conversations child-centered. The phases include: building rapport, clarifying the child's story, setting the session's goal, working towards the goal, and rounding off the conversation.

**Demo:** The main component of the tool is a chatbot-based training system that mimics a child contacting a helpline through a chat interface, which we call Lilobot. Lilobot integrates the Belief-Desire-Intention (BDI) model to enable realistic interactions with children facing challenges. The premise of the BDI model is that the simulated child has sets of beliefs (e.g., "The helpline can solve my issue"), which change based on the counsellor's responses. These beliefs, in turn, influence the child's desires (i.e., goals), which guide Lilobot in selecting an intention (an action). We developed 12 scenarios, all centered around bullying, with variations in two aspects: the setting (e.g., being bullied at football practice or during a piano class) and a misconception about the goal (e.g., asking the helpline to contact the school or seeking revenge).

In this demo, the counsellor's task is to counsel Lilobot by applying the five-phase model with the interactive scenario. If they deviate too much, it likely that Lilobot gets frustrated and ends the conversation. The demo also includes guided tutoring elements since simulation alone is insufficient for fully understanding the consequences. This tutoring is achieved through feedback elements during and after interactions, enabling counsellors to construct knowledge while reinforcing understanding of the five-phase model. Feedback during interactions is provided at two levels: a lower level (e.g., guidance on what the counsellor should say next or how the child is currently feeling) and a higher level (e.g., the counsellor's progress in the current phase or the child's overall goal). Feedback after interactions explains why the child left the conversation and offers suggestions for improvement.

**Activity:** Conference participants can role-play as counsellors-in-training by interacting with Lilobot and receiving tutoring feedback. The demo will run on a laptop, requiring participants to engage in text-based conversations and apply the five-phase model.

## Unlocking Research Anytime: A Demonstration of The Twente Intervention and Interaction Machine and its Latest Developments

**Iris ten Klooster, Elvis Vrolijk, Teodora Spirova & Jan-Willem van ’t Klooster**

**Background:** Traditional research methods such as self-report questionnaires are often limited by recall bias, limited ecological validity, and difficulty in capturing dynamic changes over time, making them insufficient for capturing the complexity of human behavior and health-related outcomes in real time. Therefore, new approaches such as Ecological Momentary Assessment (EMA), experience sampling and wearable tracking have been introduced. However, effectively measuring and engaging test subjects at a distance using multiple modalities remains a significant challenge. Therefore, the need for scalable solutions that support interventions, longitudinal studies, EMA studies and mobile questionnaire has grown. The Twente Intervention and Interaction Machine (TIIM) facilitates these needs by enabling researchers, teachers, and students to design and deploy online interventions and collect data in real time.

**Demo:** TIIM is a no-code research platform designed to facilitate the collection of questionnaire, intervention, and physiological data across various use cases, including experience sampling, mobile questionnaires, and interventions. It features standardized wearable integrations and built-in analytical scripts for common analyses, making it particularly valuable for research in psychophysiology, health psychology, and eHealth.

**Activity:** This demo showcases TIIM through a recent use case focused on developing an algorithm for message personalization to enhance stress management, dietary habits, and physical activity. Participants received personalized daily messages via TIIM, while various questionnaires were used to gather data on their characteristics and preferences. These insights were then leveraged to inform a personalization strategy for message delivery. Additionally, the demo will demonstrate the capabilities of the new TIIM dashboard, which was utilized for data cleaning, transformation, and visualization. The dashboard provides a user-friendly interface with standardized tools to support the analysis of data collected through TIIM. Finally, we will introduce the TIIM Participant Pool, known as the Twente Panel, which simplifies the often challenging process of participant recruitment by offering a dedicated pool of individuals eager to contribute to research studies.