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Scanning horizons and future opportunities for service design and
innovation**

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Proactive health and welfare technology for service users and societies: Scanning horizons and future opportunities for service design and innovation

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Abstract

Health and welfare technology (HWT) covers a wide sphere of different appliances and solutions, affecting diverse users' lives, healthcare and care, and societies. This future-oriented study examines challenges and opportunities of HWT use and related service design and innovation in advancing health and well-being of citizens and professional caregivers. With a multi-stakeholder perspective, we scan the horizons regarding HWT support for diverse users, and societies, in healthcare and care. The study is based on a series of creative horizon scanning workshops that involved nearly 200 researchers and stakeholders based in Nordic countries and synthesized knowledge of HWT at three levels: older age clients/patients and people with disabilities and their informal caregivers (micro level); professional caregivers and organizations (meso level); and the societal (macro) level. We collected prior knowledge on HWT use at the three levels and produced an understanding of its future implications by identifying the main challenges and knowledge needs and preparing practical recommendations. An understanding of the three levels and their dynamics is essential to improve service design, policy interventions and innovations to enhance proactive HWT use and the quality of life and work of citizens and caregivers. The identified key messages focus on embracing a collaborative approach, providing orientative activities, acknowledging the diversity of users, and seeking consensus around HWT-related concepts. This study provides building blocks for future studies, services, and policies to deepen the transformation process towards meaningful HWT use at Nordic, European and international levels.

1. Introduction

Healthcare and care are facing a shift in which digitalization, such as health and welfare technology (HWT) use will play an increasingly important role in specific healthcare and care solutions but also in obtaining more effective patient- or client-focused services and processes and facilitating independent life. Despite great interest and increased attention in the political and media agenda, and many pilot projects with promising results, fewer HWT solutions than expected have been implemented (Dugstad et al., 2015; Nilsen et al., 2016). Greenhalgh et al. (2018) listed five persistent problems related to digital technologies: they are either (1) not adopted or soon (2) abandoned by professionals and/or their patients and clients, or the technology-supported service succeeds as a

small-scale demonstration project but fails to (3) scale up locally, (4) spread to other comparable settings, or be (5) sustained over time. Implementation of HWT should be understood as a socio-technical intervention (Moser, 2019) that is skillfully integrated into related healthcare and care services, but there is still a lot to do in advancing such broad understanding. Moreover, successful service design can contribute to the evolution of healthcare and care service systems, enabling a move towards increasingly people-centered, integrated and technology-enabled care (Patrício et al., 2020; Pfannstiel & Rasche, 2019).

The Nordic countries, like many others, are undergoing demographic changes with an increasing older population and, at the same time, care staff shortage. Decision-makers expect HWT to solve the equation where fewer employees should provide more healthcare and care services. However, a profound technological transformation has not yet taken place in the Nordic healthcare and care. It has been suggested that the possibilities, capabilities, and 'hype' surrounding digital technologies have in fact increased the uncertainty regarding how healthcare and care providers ought to operate (Nilsen et al., 2016).

Digital transformation through successful implementation of HWT in healthcare and care is a complex, resource intensive, and time-consuming process, and more so when it represents radical innovation with respect to service design, technology novelty, disruption of care relationships and workflows, moral values, and the need for competences (Dugstad et al., 2019; Fitzgerald et al., 2014; Kane et al., 2015; Pekkarinen & Melkas, 2019; Zander et al., 2023). Even though HWT is promoted to enable seamless, efficient, safe, and patient-centred healthcare and care, it needs to fit the organizational culture, infrastructure, work practices, competences, and management practices to avoid more fragmented, time-consuming, technology-centred, and risky practices (Frennert & Östlund, 2018). A practical aspect is the difficulties in healthcare and care organizations to predict the future needs of the HWT users. The over 1 200 Nordic municipalities, for example, have faced challenges in transforming interest and projects into implemented solutions and innovative new everyday lives for staff and citizens (Søndergaard, 2017).

This future-oriented study examines challenges and opportunities of HWT use when aiming to advance health and well-being of citizens and professional caregivers, scanning the horizons and future opportunities for service design and innovation in the field, with a multi-stakeholder perspective. The data were collected in a collaborative horizon scanning process in the form of workshops conducted in parallel in the Nordic countries that focused on three systems theory levels: (1) older age clients/patients and people with disabilities and their informal caregivers (micro level); (2) professional caregivers and organizations (meso level); and (3) the societal (macro level). The study contributes with identifying the main challenges and knowledge needs at each level and producing practical recommendations (see also Melkas et al., 2023) for decision-makers. This study provides building blocks for future studies, service design and policies to deepen the transformation process towards meaningful HWT use at Nordic, European and international levels. It is particularly focused on the Nordic countries, but the topic is relevant to other countries and regions, as the health and well-being of citizens and professional caregivers are important for all countries.

2. Background

This section provides a brief background by discussing the broad concept of HWT and its diverse users. It also characterizes the role that HWT can play in future-oriented service design and innovation in healthcare and care.

2.1 The Broad Concept of HWT and Its Diverse Users

The concept of HWT covers a wide sphere of diverse appliances and solutions. Health technology and welfare technology are sometimes seen as separate, sometimes used side by side. Various definitions broadly emphasize technology, which in one way or another improves the lives of those who need it (Nordic Welfare Centre, 2023, on welfare technology), or the application of organised knowledge and skills in the forms of devices, medicines, vaccines, procedures and systems developed to solve a health problem and improve quality of life (WHO, 2023, on health technology). Andersson et al. (2021, p. 1) provided a combined definition of HWT with an emphasis on diverse users;

“a technology-based intervention that aims at maintaining or promoting health, wellbeing, quality of life and/or increasing efficiency in the service delivery system of welfare, social and health care services, while improving working conditions of the staff”.

Traditionally, the emphasis in definitions has been more on the patients or clients, such as older people or people with disabilities, whose security, activity, participation or independence is maintained or increased with the help of HWT. There are major differences between the HWT technologies and between different ways to use them. A few examples of HWT are safety alarm systems, remote care applications and care robotics.

The HWT concept is newer than the phenomenon of technology use in healthcare and care (e.g., Bouma, 1998), and there are overlapping concepts that are also used differently even within the Nordic region. The concepts of assistive technology, assistive devices and gerontechnology, inter alia, were used earlier (e.g., Melkas, 2004). Other neighbouring concepts include eHealth, telehealth, telemedicine and distance-spanning solutions. eHealth, for example, is a wide-ranging term and relies on the use of modern information and communication technologies in healthcare, to meet the needs of citizens, patients, policymakers, healthcare professionals and clinics (Black et al., 2011). HWT is used in this chapter as an overarching concept including elements of the other above-mentioned concepts.

In addition to the diversity of HWT, its current and potential users, such as clients and patients of different types of healthcare and care services, are different; they represent different age groups, health conditions, needs and preferences (Banna, Hasan & Dawson, 2016; Cook et al., 2016). Non-clients, people who are not service clients yet but might benefit from proactive HWT use to avoid or postpone health issues or care needs, should not be forgotten (e.g., Fothergill et al., 2023). An increasingly nuanced approach to users should be adopted. Users' technology needs – especially those of end-users (notably older age clients/patients and people with disabilities, in this chapter) – are typically perceived in a narrow way, while knowledge of practical daily needs may be lacking. The manufacturers have their ideas of how the technology should be used by a supposed user; however, the real user may use the technology differently, even changing its purpose (Dekker, 2015). The role of older people may be simply to legitimise digitalization development for fictive users rather than real ones (Östlund et al., 2015). Ideologies maintaining age-based or other assumptions behind technology design and implementation are also resistant to change (Ginn & Arber, 1995; Neven, 2010). User diversity is not considered if designers and technology developers rely on stereotypical views of users' characteristics such as gender and age (Oudshoorn et al., 2016). Old age is typically seen as a homogeneous stage in life, yet it covers tens of years and includes several phases from active retirement to very old age (Hartung, Nemitz & Hülür, 2022).

Disabilities are also seen in a narrow sense, although they exist in many forms. Researchers have mainly investigated older users' experiences of HWT, such as care robots, but the needs and views of people with disabilities have gained little attention, although they face many barriers in activities of daily living and participation in society (Doody, 2015; Gallup & Serianni, 2017; Robins & Dautenhahn, 2018; Ramsten et al., 2018; Sørensen et al., forthcoming). Informal caregivers' role in obtaining HWT, guiding its use, using it and reminding clients and patients about its use may be central, making them another significant user group (Johansson-Pajala et al., 2020; Melkas et al., 2024). There is a need for a paradigm shift and proactive HWT that better meets the needs and demands of today's different types of users, but also future users.

User diversity also applies to professional caregivers and care organizations. There are different age groups and different types of education, professions and work environments within healthcare and care. Proactive HWT use may be of help for professional caregivers, both directly and indirectly. It can support their own work (e.g., exoskeletons for heavy lifting tasks) or maintain wellbeing or assist in rehabilitation of their clients/ patients, thus preventing more serious health problems from arising (Saurio et al., 2023). Moreover, societal actors and stakeholders related to HWT use are diverse (Greenhalgh et al., 2018; Pekkarinen et al., 2020).

2.2 HWT and Future-Oriented Service Design and Innovation

It is easy to slip to an overly technology-centred discussion that overlooks the diversity of (potential or actual) users. The use of HWT is playing an increasingly important role in the digital transformation of healthcare and care services – in users' lives, in healthcare and care work and its processes, and in the society as a whole. HWT use can emerge from a broad range of needs and cause a broad range of experiences, interacting at the individual, organizational, societal and technical levels (Pekkarinen et al., 2020). From the perspective of sustainability, the use of HWT can have social, economic, environmental and cultural impacts. Social impacts, for example, may be related to positive, negative or neutral impacts on clients or patients (e.g., on their health, independence, autonomy or loneliness) or on professional caregivers (e.g., on their coping at work, time use, competence needs or health) (Melkas et al., 2020). The topic is thus in many ways intertwined – and provides space for – future-oriented service design and innovation.

Digital transformation is defined as the use of digital technologies for the transformation of businesses and services (Regulation (EU) 2021/694 of the European Parliament and of the Council of 29 April 2021, establishing the Digital Europe Program and repealing Decision (EU) 2015/2240). HWT can play a role in service design and innovation in healthcare and care, as it – as new digital tools in general – has the potential to facilitate enhanced patient experience, improved health outcomes, and control or reduction of costs (Shaw et al., 2018). Many benefits have been found in recent research, for example, the increase in employee productivity, the improvement of the efficiency and effectiveness of the operation of the health units, and the reduction of their operating costs (Gjellebæk et al., 2020). Numerous side effects and vulnerabilities have also been found, however (Stoumpos et al., 2023). Previous research on digitalization in healthcare and care has typically focused on a particular part of a nursing institution or a disease rather than the management strategy perspective, according to Stoumpos et al. (2023), who call for more profound analyses and debates on obstacles and problems that often face in practice during technology integration.

Shaw et al. (2018) emphasize the intimate connection between new digital tools (such as HWT) and the changes they necessitate to the actual service delivery. They note that sufficient acknowledgement of the interrelation between product innovation and service innovation for digital health has been lacking, which has contributed to the ongoing challenges of technology adoption in

health service delivery settings. They call for an approach informed by service design to promote more successful and sustainable deployment of technology in healthcare and care. Service design is not about the technology per se, but about reinventing the service process to achieve greater positive impacts and effectiveness (Shaw et al., 2018), while also understanding that technologies are revised and refined, not something fixed (Nambisan, 2013).

This chapter approaches the topic of HWT along the lines of future-oriented service design and innovation, utilizing creative participatory methods. Like service design processes, we focus particularly on end-users, but also on service delivery in a broad sense – and thus consider the experiences and needs of managers, organizational leaders, healthcare and care system funders, and other policy-level stakeholders, too (Shaw et al., 2018; Zomerdijk & Voss, 2010), with our three-level systems approach. In line with service design principles (Saco & Goncalves, 2008), our collaborative horizon scanning process set out to contribute to creating services that are useful, useable, desirable, efficient, and effective; and maintaining a human-centred and holistic approach in an iterative process utilizing team-based interdisciplinary approaches and methods.

3. Methods

The data were collected in a multilevel collaborative horizon scanning process in the form of Nordic workshops. Three levels were addressed: (1) older age clients/patients and people with disabilities and their informal caregivers (micro level); (2) professional caregivers and organizations (meso level); and (3) the societal (macro level) (macro, meso and micro levels have also been utilized in a multilevel technology study by Greenhalgh et al., 2018). The workshops involved a representative selection of researchers and stakeholders based in the Nordic countries. Nearly 200 workshop participants contributed to the participatory workshops in 2021–2022. We (i) collected and summarized prior knowledge on HWT use at the micro, meso and macro levels, and (ii) interpreted this knowledge to produce an understanding of its future implications by identifying the main challenges and knowledge needs at each level and producing practical recommendations (see also Melkas et al., 2023) for decision-makers.

Horizon scanning is viewed as a search for “signals”, often related to new science and technology. It has an important role in forward-looking, prospective, or anticipatory activities, serving to explore futures, “emerging issues,” and signals of all kinds, and to evaluate their importance (Cuhls, 2020; Flick et al., 2020; Kjelsnes & Feiring, 2022). Characteristics of foresight were also present in our participatory process, as the workshops strongly focused on dialogue and discussion formats and general outlooks as applied for generating visions, strategies, and policy- or decision-making (Cuhls, 2020), but a comprehensive foresight process was not implemented in this study. Certain weak signals in the sense of Ansoff (1980) were also found. Information was provided especially concerning desirable/ preferable futures. In futures research, possible, probable and preferable futures are often differentiated, and Voros (2003) even adds potential and plausible futures.

Horizon scanning can be undertaken by, for example, small groups of experts who are at the forefront of the area of concern, sharing their perspectives and knowledge with each other so as to “scan” how new phenomena might influence the future (Cuhls, 2020). In this study, the participants represented expertise from both micro, meso and macro levels, importantly, but also research and practical expertise of different kinds. The need to understand the topic of digitalization and HWT use from multidisciplinary viewpoints has been called for (e.g., Pekkarinen et al., 2019), but truly multidisciplinary initiatives are still not mainstream. Transdisciplinarity again focuses on enabling

inputs from both scientific and non-scientific stakeholder communities from outside academia. Both approaches were utilized in this study.

Horizon scanning activities are rarely performed based on only one method. A number of steps using different methods and techniques are usually performed in parallel (more details in European Commission, 2015). In this study, the participatory workshops included various creative dialogue-enhancing methods, such as the use of discussion cards and live visualization of the discussions (please see Table 1 and Figures 1, 2 and 3). As to the analysis, our study was informed by the principles of action research (Waterman et al., 2001). The workshop process was a mutual learning process where the participants – both researchers and stakeholders – worked together to discover what the issues are, why they exist, and how they might be addressed (Bate, 2000). Written notes and memos, visualizations and recordings were used to collect the data. The data and findings (supported also by a reflexive thematic analysis informed by Braun and Clarke, 2022) were fed back (between the workshops and within them, across sessions and countries) to inform subsequent discussions. We also fed back emerging findings to national-level and Nordic decision-makers and other stakeholders. The workshops consisted of keynote speeches, national discussion sessions and international reflexive sessions as well as early-career researchers' presentations on emerging research topics and related discussions.

Tab. 1 Workshop topics and methods. Source: Authors' own Table (2024).

Workshop	No. of participants	Topic	Creative participatory methods
I	71	Proactive health and welfare technology use in care solutions and processes: What technology for end-users and their informal caregivers and why? <ul style="list-style-type: none"> Challenges, trends, and present and future knowledge needs at the micro level 	National discussions and international joint discussions based on national summaries with the help of brainstorming, dot voting and consensus categorisation, discussion cards, and live visualization
II	59	Implementation of proactive health and welfare technology: perspectives of professional caregivers <ul style="list-style-type: none"> Challenges, trends, and present and future knowledge needs at the meso level 	National discussions and international joint discussions based on national prioritizing lists with the help of brainstorming, dot voting and consensus categorisation, discussion cards, and live visualization
III	64	Proactive health and welfare technology use for an increasingly resilient and sustainable society – decision-making perspectives <ul style="list-style-type: none"> Challenges, trends, and present and future knowledge needs at the macro level 	National discussions and international joint discussions based on synthesized national decision-makers' experiences and needs with the help of brainstorming, dot voting and consensus categorisation, discussion cards, and live visualization

In our multilateral Nordic approach, horizon scanning was thus a longer-term process to detect developments and emerging trends that can vary in time horizon, and current and potential challenges that may significantly affect healthcare and care, requiring new knowledge-building. Horizon scanning is considered particularly valuable in sectors where rapid change is common, such as technology, healthcare, finance, and environmental sustainability – informing resilient policy-making, business opportunities and societal preparedness (Cuhls, 2020). Based on an analysis of various cases, Cuhls (2020) concluded that horizon scanning is useful when there is a specific need for it, such as addressing a gap in planning processes, or for the mobilization of external information for decision-making. Our study focused more on the latter, as specific planning processes are more strongly characterized by national, regional and local needs and prerequisites and therefore anchored to the country level (Ibid.). After concluding the study, efforts have, however, been made to disseminate the results as actionable knowledge that can be exploited in a useful way at the country level and to gain the attention of important stakeholders as well as to consult different stakeholders for their sense-making and assessment – activities called for as essential (Ibid.).

The Nordic countries of Denmark, Finland, Norway and Sweden share many characteristics and thus starting points for HWT use in light of the similar social structures, institutions and institutional culture, and shared cultural heritage. However, at the municipal and regional level of service provision, there are differences between the countries in the way HWT implementation is provided, structured and organised. As such, the exchange of experiences among the countries could give valuable insights and understanding of the complexity in the implementation of HWT.

We took several measures to ensure the trustworthiness of our results. The workshops were designed in multidisciplinary collaboration across countries. We listened carefully to the participants to observe how they discussed and summarized the discussions. The professional live visualization and the other creative methods supported engaging people and capturing the essentials. The data collected and findings were fed back both between the workshops and within them, and to decision-makers and other stakeholders. In accommodating for the COVID-19 pandemic, the international workshops were arranged in a hybrid form – face-to-face in the national teams of the participating countries (as far as possible depending on the pandemic situation) and online between the countries. It was possible to engage a large number of stakeholders and researchers in this way. Due to the hybrid model, special attention was paid to the creative participatory methods. Live visualization, for instance, produces immediate and direct information on the participants' activities and knowledge.

The participants were invited based on previous contacts and strong expertise in their areas. Reaching almost 200 participants during the workshop process increases the trustworthiness of our results. Contributions from the workshops were built in collaboration between researchers from many different disciplines (such as caring sciences, physiotherapy, home care nursing, intellectual disability practice and technology; innovation research, organizational change, and technology foresight; eHealth, social sciences, and business and technology; and dementia research and neuropsychology) and a diverse array of stakeholders, such as national, regional and local decision-makers and representatives of user organizations, care organizations and labour market organizations.

4. Findings

This section presents the main challenges and knowledge needs at each level – micro, meso and macro. Whereas one easily thinks about an individual HWT user, HWT use affects (and is affected in numerous ways by) the three – micro, meso and macro – levels and their dynamics.

4.1 End-Users and Their Informal Caregivers – Micro Level

To successfully support the use of HWT, it is necessary to first understand the challenges it faces and the opportunities it provides at the micro level. Knowledge is needed for such understanding to emerge. The participants emphasized that a starting point is to acknowledge diversity and people's individual circumstances. One size does not fit all; in principle, anyone can be a HWT user. At the same time, users can have professional roles, varying needs, and may lack awareness of, access to, or the ability to use technology or make sense of information related to HWT.

The main Nordic challenges, and thus knowledge needs, at the micro level (end-users and informal caregivers) were identified as follows (Table 2, see also Figure 1).

Tab. 2 Main micro-level challenges and knowledge needs. Source: Adapted from Melkas et al. (2023).

Main micro-level challenges and knowledge needs	Examples of essential elements to consider
Digital exclusion	<ul style="list-style-type: none"> - Sufficient support for HWT use - Ways to motivate non-users
User involvement	<ul style="list-style-type: none"> - New methods to involve users
Implementation of HWT	<ul style="list-style-type: none"> - Management practices - Training of professional caregivers (digital skills) - Developing and advancing a shared language
Safety, security and ethical issues	<ul style="list-style-type: none"> - Deep understanding of everyday life - Prerequisites for meaningful HWT use
Research methods	<ul style="list-style-type: none"> - Multiple research methods - Validated instruments and large studies - Multi-disciplinarity

Digital exclusion can be a problem for older people, people with disabilities as well as many other citizens. Awareness of this problem and its risks is key, and a lot of support is needed to overcome digital exclusion. The participants brought up essential questions to be pondered, which are, for example, what kind of active support and how much support is needed, and what is sufficient to decrease and hinder digital exclusion? Active work with digital inclusion is a way to move forward, while the process of digital transformation inevitably continues in healthcare and care services.

It was discussed that many people who could benefit from the use of HWT are not yet its users. It is essential to consider how to motivate such non-users. Involvement of current users during the planning, introduction, use and assessment of HWT brings important benefits in making its use smoother and more effective. It is not necessarily obvious what kinds of methods should be chosen to involve users of different types. The development and refinement of new methods to involve users should be focused on. Overall, building knowledge about the micro level would benefit from the development of research methods and especially collaboration among different scientific disciplines.

In general, it was emphasized that the implementation of technology is challenging and does not occur automatically or 'in a vacuum'. Major efforts are required for truly successful implementation, such as those to develop management practices, train professional caregivers and find a 'shared language' amongst all those concerned (i.e., different professional groups, managers, clients/patients and their informal caregivers, and other stakeholders).

The participants pointed out that an integral part of HWT use is to thoroughly assess needs concerning safety, security and ethical issues. To deal with these issues, there should be a deep understanding of the everyday lives of HWT users, and the prerequisites for meaningful technology use should be carefully considered.

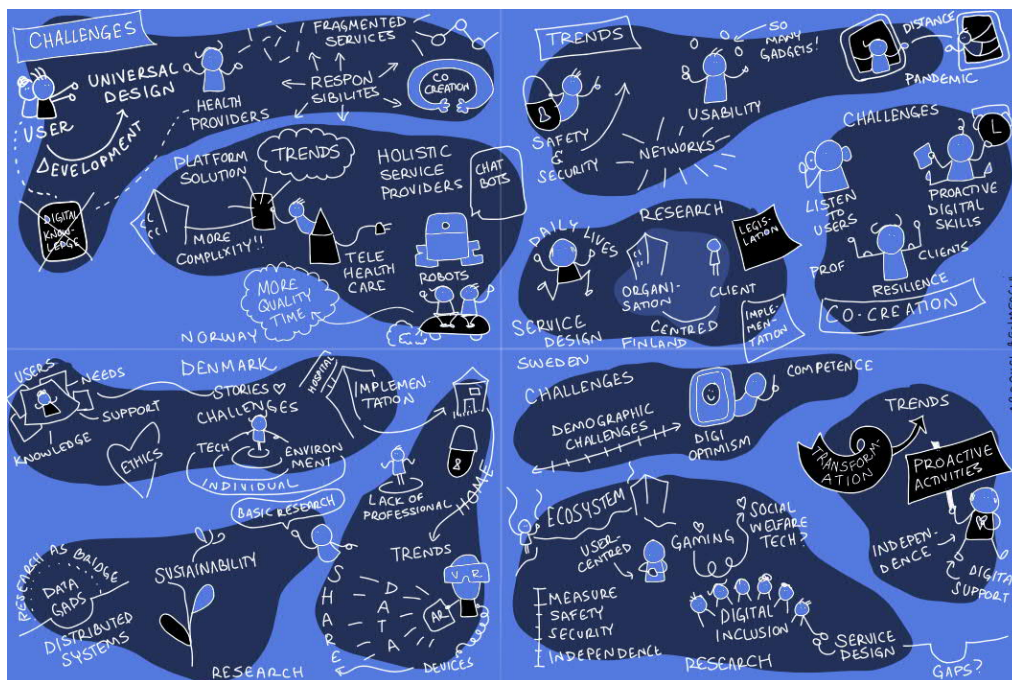


Fig. 1 Live visualization of the first workshop's discussions (visualization: Raquel Benmergui; reproduced with permission).

4.2 Implementation Level (Professional Caregivers and Organizations) – Meso Level

Challenges and opportunities at the meso level depend on local characteristics, needs and prerequisites of the organization, community, municipality or alike. The participants stated that one size does not necessarily fit all at the meso level, either. Each care organization and its personnel, clients or patients differ; thus, their knowledge levels, implementation challenges and opportunities and needs for change management also vary.

The main Nordic challenges and thus knowledge needs at the meso level (implementation level: professional caregivers and organizations) were identified as follows (Table 3, see also Figure 2).

Tab. 3 Main meso-level challenges and knowledge needs. Source: Adapted from Melkas et al. (2023).

Main meso-level challenges and knowledge needs	Examples of essential elements to consider
Change management	<ul style="list-style-type: none"> - Changed ways of giving care - Piloting and testing (environments, practices)

	<ul style="list-style-type: none"> - Work process - Intervention and impact studies
Implementation of HWT	<ul style="list-style-type: none"> - Practical anchoring of implementation - Prerequisites of the implementation process (time, money, knowledge and infrastructure)
Meaningfulness	<ul style="list-style-type: none"> - Increased understanding of why HWT is/ could be/ should be used - Contextual understanding
Education, competence and appropriateness	<ul style="list-style-type: none"> - Provision of insights, education, training and competence - Availability, appropriateness and usefulness for diverse users
Impacts, costs and cost-effectiveness	<ul style="list-style-type: none"> - Relevant methods for studying impacts and effectiveness of products and services

Similarities with micro-level knowledge needs became visible in the discussions: meso-level results also concern management, implementation and meaningfulness. Healthcare and care services, processes and care itself change along with the introduction and use of HWT. Piloting and intervention studies can show appropriate paths forward and build knowledge of short-term impacts. Change management is needed at all levels and stages. As for implementation, anchoring of the implementation of HWT is key at the meso level. Prerequisites in the implementation process need to be known – in the organization and service in question – and this concerns issues such as time, money, existing knowledge and infrastructure.

Along with the micro level, care personnel's and employers' contextual and systemic understanding of meaningful technology use needs to be increased. Central questions were raised as examples: Why would technology be used? What aims are there? From whose point of view? Can they be achieved with the planned technology? Such questions are closely related to knowledge needs more generally. What technology should be used and how? What is available, essential and useful, and for whom? What kind of education, training or other competence-building are needed? For such types of knowledge to accumulate, multimethod research on impacts and effectiveness was brought up by the participants as vital.

Additional challenges and knowledge needs were identified at the meso level as follows. Decision-making processes and leadership were emphasized, along with participation, co-creation, collaboration and assessment of needs. Simplicity is also essential to keep in mind. There may be "low-hanging fruit" and win-win situations and opportunities for the simplification of service processes. Related to decision-making, procurement and system administration require careful attention. Professional caregivers' user needs must be known, and the current gap between users' needs and procurement must be solved. Professional caregivers' working environment changes along with the introduction of HWT, which requires planning, development and assessment. Moreover, the education of professional caregivers should be developed so that expertise in HWT use forms an integral part of future studies in educational institutions.

The interoperability of digital products may be a challenge that requires understanding the broader infrastructure and its readiness to integrate new solutions. Responsibility for the functioning of technologies may remain unclear unless responsible persons are named. Proper familiarisation with

Systematic reviews of what we know	<ul style="list-style-type: none"> - A clear categorisation of solutions - Enabling systematic monitoring of for whom solutions are appropriate and how they affect people - Identification of knowledge gaps
Proactiveness	<ul style="list-style-type: none"> - Preventive care versus HWT - Clients/patients' own experiences (whatever the solution)

The macro-level results further confirm the importance of building knowledge on the diverse impacts of HWT use. To find out about those – including economic perspectives such as costs – appropriate methods need to be considered carefully. It is often beneficial to combine, for example, quantitative and qualitative research when examining impacts so that impacts on people’s well-being and possible digital exclusion can also be made visible.

Broad effectiveness should be aimed at; adopting and examining just one solution is not enough. For decision-makers, systematic reviews of what is already known are essential. This means, for example, the need for a clear categorisation of solutions that would enable systematic monitoring of the appropriateness of solutions for different types of users and of their impacts. It would also ease the identification of various knowledge gaps.



Fig. 3 Live visualization of the third workshop’s discussions (visualization: Raquel Benmergui; reproduced with permission).

Additional knowledge needs were recognised at the macro level as follows. Various macro-level stakeholders should have the opportunity to participate in identifying research gaps concerning HWT and its use. Such identification requires understanding and focusing on the micro, meso and macro levels, and decision-makers have an important role to play in the identification. Decision-makers’ role in supporting the implementation of change management is crucial. The participants emphasized that decision-makers are the ones needed for national-level leadership in the HWT-related transition. Enabling proper change management at the organizational level should be part of this. The implementation of technology as part of health and care processes requires new

knowledge and competences at the meso level, and the macro level plays a role in providing opportunities for obtaining those.

It was brought up that scenario building and horizon scanning on healthcare and care also in the future can assist decision-makers in their tasks, and such foresight activities may also be of help at the organizational level. Overall, there should be large projects covering the entire national ecosystems, including (also environmental) sustainability aspects. The needs for foresight activities and considerations of environmental sustainability could be characterized as weak signals (Ansoff, 1980) of the results, as they are not yet mainstream in healthcare and care services. Moreover, comparative studies were brought up as valuable – studies focusing on, for example, municipalities’/regions’ diversity and comparisons between countries.

The big picture of the economy of well-being was emphasized. How do well-being and health advance the economic situation? Considerations related to HWT should take this into account. The central themes are digital exclusion, or inclusion, and digital literacy. HWT use may prevent or mitigate digital exclusion, but the participants reminded that this is not automatic. Digital inclusion is important to keep in mind – how can it be ensured so that the good potential of HWT use is reached in practice? Digital literacy must not be taken for granted in any context but created, improved and maintained continuously.

4.4 Cross-Level Similarities

While there were many similarities in the workshop discussions at the different levels, which is quite natural, there were also many level-specific emphases, which is also natural. For example, digital exclusion tends to become more visible at the micro level, in individuals’ lives, whereas it may remain more hidden at the macro level and even at the meso level. This also concerns user involvement. On the other hand, change management is a typical meso-level issue that may concern individual workplaces and services and is easily seen as less relevant for the micro and macro levels. On the macro level, again, review knowledge of the ‘big picture’ and proactiveness were highlighted. Proactiveness of HWT use, for example, has the potential to contribute to lower health and care costs, when implemented skillfully.

There were two main cross-level similarities. The topic of implementation was among the main challenges and knowledge needs at both the micro and meso levels (Table 5). The topic of impacts and costs was among the main challenges and knowledge needs at both the meso and macro levels.

Tab. 5 The main challenges and knowledge needs at the different levels, and cross-level similarities. Source: Authors’ own Table (2024).

Micro level	Meso level	Macro level
Digital exclusion	Change management	Impacts, costs and cost-effectiveness
User involvement	Implementation of HWT	Systematic reviews of what we know
Implementation of HWT	Meaningfulness	Proactiveness
Safety, security and ethical issues	Education, competence and appropriateness	
Research methods	Impacts, costs and cost-effectiveness	

The level-specific workshops were experienced as useful because they enabled concentrating on one level while also understanding that each of them represented (only) one part, and it is the whole that counts. This is in line with the broad understanding of service design and the need to understand interrelations of product innovations and service innovations (e.g., Shaw et al., 2018). The workshop series provided many types of information concerning desirable/ preferable futures by showing what should be focused on in improvement efforts.

5. Discussion

Across the different levels, a key question was how HWT use can support users towards increased and prolonged independence, health, social participation, security and safety (at home or at work), and quality of life. Throughout the workshops, the discussions as well as the participants themselves confirmed that an understanding of micro-, meso- and macro-level perspectives on HWT use is essential. Significant information and details are hidden if these three levels remain – or are kept – too separate. Improving service design, policy interventions and innovations to enhance proactive HWT use, and the quality of life and work of Nordic (and other) citizens and caregivers requires both an understanding of each level and of the dynamics between the levels. Such a systemic understanding can be built through broad stakeholder collaboration and supported by research-based knowledge. Creative participatory methods help in engaging people in the discussions.

From a systemic perspective, collaboration partners when implementing HWT encompass a range of important stakeholders. Each of these stakeholders brings unique perspectives, resources and needs to the table, and effective collaboration requires close coordination and communication among all parties. The goal should be to create a cohesive and integrated system that leverages the strengths of each partner to achieve the best possible outcomes for clients/patients, their informal caregivers, professional caregivers and healthcare and care organizations.

In addition to these stakeholders – the ultimate users and beneficiaries of HWT – central stakeholders are industry partners (technology companies, software developers and other businesses that provide the tools and resources necessary for the implementation), researchers (scientists who study and evaluate HWT and its impacts and effectiveness) and decision-makers (e.g., government agencies, regional and local decision-makers and regulators and funders who help to set standards, provide funding and ensure the implementation of HWT).

While there were many similarities in the workshop discussions at the different levels, there were also many level-specific emphases. The topic of implementation was among the main challenges and knowledge needs at both the micro and meso levels, and the topic of impacts and costs was among the main challenges and knowledge needs at both the meso and macro levels. This finding emphasizes the need for more attention to the administration of HWT implementation and to the organizational readiness for change. Cross-level similarities reveal challenges that need to be solved at all levels and thus increase understanding of the complexity of HWT implementation and use.

5.1 Practical Recommendations

Practical recommendations were formulated based on our findings (see also Melkas et al., 2023). While addressing the challenges and knowledge needs identified in this study, some key principles of action for decision-makers (in particular) were summarized as follows:

- Embracing a collaborative approach: It is often misunderstood that HWT use is exclusive to individuals, notably clients or patients, and their homes or care environments. It should be a question of an all-encompassing transdisciplinary partnership, which may involve a broad range

of people and communities, many types of organizations (care organizations, companies) and society (public, private and non-governmental sectors). Likewise, it should be a widely multidisciplinary undertaking, requiring diverse knowledge to develop an understanding of how to build favourable processes and conditions for meaningful HWT use. Participatory processes should be cherished. It is unlikely that top-down policies driven by technological evidence and markets alone will instigate collective (system-level or organizational) and individual-level action. Novel transition policies should have a bottom-up nature and be designed based on participatory processes within communities and organizations.

- Providing orientative activities related to HWT and its use: The focus should be expanded from mere training—relatively narrow, often one-way, provision of information—to a more comprehensive understanding of processes and actions towards interactive knowledge building in this area as a prerequisite for reaping the benefits of HWT use. Such orientative activities are a key issue in societies, workplaces and homes. In addition to an introduction to HWT use and its familiarisation, a continuous co-creative process is needed, including learning multifaceted knowledge and skills for the effective use of HWT. This social action should not be a one-time activity (when a device or solution is brought to use), and as a process, it should also be able to absorb critical views and questioning attitudes (see also Tuisku et al., 2023).
- Acknowledging the diversity of users and their different needs, motivations and preferences: Not all users are the same, nor do they react the same way in response to similar stimuli. There are distinctive user groups with particular needs; one size does not fit all. Technology studies have traditionally been assumption-based and have explicitly omitted this important notion, which should be urgently formalised as a means to prevent digital exclusion and other negative phenomena.
- Seeking consensus around HWT-related concepts: The very nature and features of HWT and its use may be disputed and/or misunderstood and have not yet been fully clarified. In times of urgent action, this hampers the build-up of collective approaches. Decision-makers could have an important role in establishing sufficient and multifaceted consensus within the relevant stakeholders to clarify, even formalise, definitions and approaches that could serve the socio-technical transition (Pekkarinen et al., 2019) related to HWT use.

5.2 Key Messages

A number of key messages were further crystallised (Figure 4) particularly for decision-makers.

Collaboration	Orientative activities	Diversity	Consensus
<ul style="list-style-type: none"> • Involve a diverse range of individuals and collectives in the user, organizational and societal spheres • Take into account the multidisciplinary nature of HWT in collaborative knowledge-building • Promote bottom-up, participatory and action-based policies in needs identification, implementation, assessment of impacts and effectiveness, and knowledge-building 	<ul style="list-style-type: none"> • Provide more than training for HWT use – expand the focus to a more comprehensive and continuous co-creation process • In addition to introduction to HWT use and its familiarisation, take into account learning of multi-faceted knowledge and skills for the effective use of HWT • Ensure that this social action is not a one-time activity and that it also absorbs critical views and questioning attitudes 	<ul style="list-style-type: none"> • Acknowledge different user needs and user responses to technology and market-based (or other types of) stimuli • Develop targeted and differentiated policies at the micro and meso levels • Work actively towards digital inclusion while the process of digital transformation continues 	<ul style="list-style-type: none"> • Embrace joint learning while creating new awareness regarding HWT use • Contribute to clarify HWT concepts and features • Design policy conventions in collaboration with key stakeholders

Fig. 4 Key messages especially for decision-makers.

Source: Adapted from Melkas et al. (2023).

Broad socio-technically oriented service design and combinations of product and service innovation are needed, and creative methods should be utilized to advance those – e.g., to engage a broad array of stakeholders and scan future horizons.

5.3 Limitations and Future Research

The main measures to ensure the trustworthiness of our results were presented in Section 3. The international workshops that were conducted with the help of creative methods and included also national sessions in local languages provided comfortable permissive environments for the participants to share their perceptions. The researchers strived to make a safe environment and the participants were talkative and respectful of each other.

Arranging the workshops in a hybrid form due to the COVID-19 pandemic naturally affected the dynamics in the international group. On the other hand, this arrangement worked well in practice and did not limit our research. Comprehensive results were obtained, and we were able to engage a larger number of diverse participants. Critical mass and expertise were thus also built up at the Nordic level. The hybrid workshops also contributed to more efficient networking. The special attention given to the creative participatory methods, such as live visualization, due to the hybrid model was also seen as useful. However, the participation from patient organizations was lower than the participation from health and care personnel and decision-makers. Because of this, the views of the end-users were, with a few exceptions, provided by the health and care professionals and not by the clients/patients themselves. This limitation could be addressed in future studies.

Many areas for further research were identified, as advancing knowledge regarding future research needs was at the core of study. An example is HWT-related scenario building and horizon scanning on health and welfare in the future, which can assist decision-makers in their tasks. Overall, there should be large projects covering the entire national ecosystem, including sustainability – also environmental – aspects. The big picture of the economy of well-being was also emphasized. Considerations related to HWT should take this into account.

6. Conclusion

Our results showed the challenges and knowledge needs at three levels of HWT use: micro (end-users and informal caregivers), meso (professional caregivers and organizations), and societal macro (decision-making) levels. At the micro level, recognizing individual diversity, addressing digital exclusion and safety, security and ethical issues, and involving users are critical. At the meso level, understanding contextual variations, change management and collaboration, and education and training are key considerations. At the macro level, decision-makers play a crucial role in policy development and in supporting implementation and change management. They need to focus on economic aspects of HWT use and its proactiveness, which are related also to digital inclusion and digital literacy. Despite level-specific emphases, there are common themes such as implementation challenges and the importance of focusing on impacts and costs across different levels.

The workshops provided valuable insights for improving HWT use and understanding the holistic nature of service design in this context. Our practical recommendations emphasized that an understanding of micro-, meso- and macro-level perspectives on proactive HWT use and the dynamics between the levels is essential. To successfully support the use of HWT, it is necessary to understand the challenges it faces and the opportunities it provides at each level, and knowledge is needed for such understanding to emerge. The levels are in numerous ways intertwined, and 'one size does not fit all'. A starting point is to acknowledge diversity and people's individual circumstances. Challenges and opportunities at the meso level depend on local characteristics, needs and prerequisites. Each care organization and its personnel, clients or patients differ; thus, their knowledge levels, implementation challenges and opportunities and needs for change management also vary. Decision-makers again play an important systemic role in societal strategies and planning related to HWT use. They need sufficient knowledge and a systemic understanding of the broadness of the topic and its links to the entire service system. While HWT use has increased across the Nordic countries, there is work to do in encouraging, promoting and even formalizing the use via policies.

Sharing research-based knowledge about similarities and differences in proactive HWT services, implementation, service design and innovation, and policies – including challenges in proceeding from piloting to implementation – across the Nordic societies in the workshops – also with the help of various creative participatory methods – enabled reaching a better overall understanding of the experiences and expectations of diverse users in individual countries and the region. Such understanding will help also in the future to improve policy interventions, service design and innovations to enhance proactive HWT use and the quality of life and work of citizens and caregivers.

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