

Challenges for Making Use of Welfare Technology Generated Data from a System Innovation Perspective

Ella Kolkowska

*Department of Informatics, Örebro University
Örebro, Sweden*

ella.kolkowska@oru.se

Jenny Lagsten

*Department of Informatics, Örebro University
Örebro, Sweden*

jenny.lagsten@oru.se

Shang Gao

*Department of Informatics, Örebro University
Örebro, Sweden*

shang.gao@oru.se

Annika Andersson

*Department of Informatics, Örebro University
Örebro, Sweden*

annika.andersson@oru.se

Abstract

European governments have pushed digitalization of elderly care to meet the challenges with an increasing ageing population. As a result, welfare technologies (WT), as digital safety alarms, are now implemented, generating huge amounts of data which could be used to improve the quality of care. The aim in this explorative study is to analyze and describe the challenges for making use of WT-data in Swedish elderly care. Our qualitative study revealed that making use of WT-data is not a technical issue and suggests that framing the utilization of WT-data from a system innovation perspective is a promising initial move to synergize efforts and lay the groundwork for the more efficient, high-quality data-driven elderly care.

Keywords: Elderly care, Welfare technology, System innovation, Data-analysis.

1. Introduction

This study takes its departure in the urgent need for transformation of the elderly care sector that needs to meet challenges related to an ageing population and reduced available recourses. The use of digital technologies and transformation from a traditional to a digitalized model of care services are often viewed as possible solutions to challenges related to the ageing population and increasing care expenses [10], [28].

For that reason, governments in many countries have pushed digitalization of the care sector [8, 9], [16] and as a result, different kinds of digital technologies such as digital safety alarms, monitoring devices, sensors, movement detectors, assistive robots, and positioning systems are now implemented and in use [13], [43]. The digital technologies, used in elderly care, are often referred as welfare technologies (WT) [7], [11]. Despite the invested efforts and resources, the potential of WT is not fully utilized and the expected higher goals such as improved well-being, increased safety and efficiency of care are not yet achieved [27]. Making better use of the WT-generated data can be understood as the next phase in the development and seen as a means for achieving the desired improvement of care, which is encouraged in strategic documents [8].

Making use of data has a long tradition in the private sector and is in the literature

referred to as ‘business intelligence’ (BI) or ‘data-analytics’ (DA). BI and DA include the collection, integration, analysis, and visualization of organizational data to support and improve the decision-making process [41]. The main benefits of BI and DA include cost and time savings, better decision-making, and improved business performance [41]. BI and DA have been used in several contexts (e.g., insurance industry [1], logistics [44], healthcare [15]). In healthcare, DA is recognized for having an immense potential to improve the quality of care, reduce waste and errors, and reduce the cost of care [18]. Likewise, analysis of WT-generated data could improve decision-making and practice in elderly care organizations leading to increased quality, safety, and efficiency of care. Yet, the application of DA with WT-generated data in elderly care is quite limited. Therefore, the aim of this study is to analyze and describe the challenges for making use of WT-data in Swedish elderly care. The study seeks to answer the following research question: What are the challenges for making use of WT-generated data in Swedish elderly care?

2. Background

2.1. Research Context

This study was conducted in one of the Swedish municipalities. The Swedish government has been proactively pushing the digitalization of the care sector, aiming to make Sweden the most digitalized nation by 2030 [30]. This effort has resulted in a high level of digital transformation, as measured by the Digital Economy and Society Index (DESI), with Sweden scoring above EU average (EU, Digital Economy and Society Index 2022). In Sweden, national electronic health records have been the norm since their introduction in 2009, and since the end of 2016 the use of digital care contacts via video conferencing and text messages, - particularly in primary care, - has grown rapidly [25]. WT have gained widespread adoption in Swedish elderly care [38]. Swedish government strongly believes that WT will help achieve core care values and address the current challenges in elderly care and for this reason significant efforts and resources are invested into the digitalization of elderly care [30]. The adoption of WT is anticipated to enhance the quality of care, allowing older adults to feel safer and live more independent lives [43]. WT are also expected to improve the work environment, optimize staff competence, and increase cost efficiency (e.g., [38]).

The Swedish care model is built on a state responsibility model, where all Swedish residents are covered for health and care as a part of public services. The national government is responsible for regulation and supervision, and the 21 regions have responsibility for financing, purchasing and providing healthcare services. The regions oversee primary, specialist and psychiatric healthcare, while the 290 municipalities are responsible for care for people with disabilities, rehabilitation services, home care, elderly care and schools [26].

2.2. Related Research

Predominant research on WT considers the individual level, examining technological aspects and individual safety [3], [12]. Many studies delve into technological issues, such as monitoring systems [42] and wearable devices [17]. Various studies highlight barriers to WT implementation and adoption, encompassing challenges such as a lack of stakeholder engagement, an understanding of strategic goals or perceived value of WT [5], [13] as well as ethical concerns around privacy and autonomy [37]. Factors influencing WT implementation on an individual level, ranging from attitudes and values to health expectations, are also frequently researched [4], [43]. Other factors that facilitate WT implementation, highlighted in the literature are stakeholder participation [43] and usability [23]. Recent studies [24], [32] underline the challenges of evidence-based evaluation of WT implementations on a broader scale, beyond just a single nursing home.

Baudin et al. [3] examined managers' experiences and decision-making in WT procurement in Swedish regions, highlighting their struggle with uncertainty and reliance on ad hoc decisions. The authors suggest that an evidence-based, person-centered

approach, facilitated by better access to qualitative data, is crucial for informed decision-making. However, there remains a significant gap in understanding how WT-generated data can enhance organizational decision-making and add value to achieve goals like improved efficiency and safety in care.

DA has been applied in healthcare [15]. Various studies [6], [33] have investigated how data processing aids can support decision-making by summarizing and visualizing patient information including charts tracking the progression of a disease and the medication process. Analytics typically shows graphs and summary overviews that display patient adherence and progress reports [15]. Previous studies highlight some challenges for DA in this context, including fragmentation of healthcare services and poor coordination among various care providers and other stakeholders [15], and underdeveloped legal regulations [20].

To summarize, while there are studies on utilizing DA in healthcare, research on using WT-generated data in elderly care is scarce. Previous research highlights that addressing inefficiencies in care coordination and quality requires a comprehensive approach that includes both social and technical aspects [29], as well as improved integration and exchange of data across multiple stakeholders. Despite this, practical examples of DA in elderly care are few, leading us to view the implementation of DA in this context as a transformative innovation. This innovation has the potential to significantly shift care delivery towards a more data-driven, efficient, and responsive model.

3. Making use of WT- generated data from a system innovation perspective

Given that elderly care has not traditionally been digitalized, utilizing WT data requires a transformation from a conventional care delivery model to a more efficient and responsive data-driven care delivery model, effectively changing the entire system. Therefore, we found the system innovation model (referred in this paper as SIM) suggested by The Swedish Innovation Agency, Vinnova [39] suitable for our analysis. The SIM is grounded in the literature on mission-oriented innovation [14] and emphasizes the importance of the whole system change to achieve higher (societal) goals, which address our need. SIM identifies 5 dimensions of change (i.e., Culture and Values; Regulatory framework; Infrastructure and production systems; Business models; Technologies, products and processes) to be coordinated holistically towards sustainable and transformational system change. This is in line with the challenges and complexities of making use of WT-data in elderly care. The five dimensions of the SIM specified by [14, 39], slightly adapted to the context of data analytics in elderly care, are briefly explained below.

- **Culture and values.** To succeed with transformational change, knowledge is needed about behaviour patterns, culture, and values. For example, it includes the view on technology and new ways of working, new roles, application of regulations, and different actors' roles in a future solution. To achieve change at a larger scale, the single individual, the profession, the practice/organisation, the politics, and the public at large may all need to change their understanding and behaviour.
- **Regulatory framework.** This dimension is about adaption to, and development of, existing rules and regulations and legal interoperability between actors. It could be a question of understanding policies and regulations as well as seizing opportunities.
- **Infrastructure and production systems.** This dimension is about the development or use of digital infrastructures that creates prerequisites for data collection, data analysis, and making data available in a secure and efficient way.
- **Business models.** To succeed with system change, it is important to understand how investments, business models and procurement processes contribute to sustainable solutions.
- **Technologies, products and processes.** This dimension is about functionality, applications, and technical solutions to generate, process, analyse, make available, and present data. It is also about technical and semantical interoperability and the use of standards in these areas.

4. Method

To identify the challenges for making use of WT-data in Swedish elderly care, we have conducted a case study at one Swedish municipality [21]. The case study focused (mainly) on digital alarms (i.e., an example of the most frequently used WT in nursing houses). Our primary method for data collection was through in-depth qualitative studies, including interviews and focus group sessions with key stakeholders in municipal elderly care [40]. We also reviewed documents such as system descriptions, decision-making records, and organizational charts. Participants were selected using the snowball sampling method [2], which means that we identified additional stakeholders during our interviews. Interviewees could recommend other key individuals who could provide further insights into the conditions necessary for leveraging WT-generated data. It was important to include a diverse range of roles, from high municipality-level decision makers to nursing home staff who use WT-solutions daily in elderly care.

In total, we conducted interviews with eleven stakeholders including managers of nursing homes, occupational therapists, WT providers, quality coordinators for elderly care at the municipality level, digitalization manager at the municipality level, and IT department staff. Additionally, we facilitated two focus group interviews [36] with 15 representatives for assistive nurses at one of the nursing homes that employed a new WT-solution (i.e., a new sensor-based digital emergency alarm system).

Each interview lasted approximately one hour and was recorded. Two researchers attended every interview: one to oversee adherence to the interview protocol and the other to pose follow-up questions. We conducted semi-structured interviews and focus groups interviews covering four key areas: 1) The welfare technologies (WT) and information infrastructures implemented in elderly care, 2) The nature of data generated and available from WT, 3) The primary needs of stakeholders concerning WT-generated data, and 4) The principal challenges associated with using WT-generated data. The questions within each area were tailored to the respondent's role and competencies but were similar for all respondents and focus groups. For instance, we could ask in relation to area 1: What WT-systems and information infrastructures are implemented in the municipality? At your care institutions? What data is available in these systems? In relation to area 2 we asked for instance: How is the data from WT used today and by whom? Is there anything that you experience as problematic? Why is it a problem? Example questions in area 3 are: Who are the primary stakeholders of the implemented WT, and what are their information needs on base of available data? What is missing today? In relation to area 4, we asked for instance: What are the main challenges related to the use of data generated from the implemented WT (e.g., participation, privacy, exclusion, routines and way of working, data protection, data governance, regulation and legislation)?

The data collected was analyzed using the 5 dimensions of the SIM through deductive content analysis [22]. Initially, we read through the transcribed interviews line by line to identify challenges for utilizing WT-generated data. Subsequently, these identified challenges were sorted according to the corresponding dimensions of the SIM and summarized.

5. Challenges for making use of WT-data in Swedish elderly care

Results from our preliminary analysis are summarized in Table 1. We have identified many challenges for making use of WT-data in Swedish elderly care according to the five dimensions of the SIM. The page restriction does not allow us to give detailed description of all challenges identified but we provide some illustrative examples from our analysis.

Table 1. Summary of the identified challenges

SIM - dimensions	Key challenges	Quotes
Culture and values	<ul style="list-style-type: none"> Cultural resistance to adopting WT data (on several level in the municipality) 	“One problem is that the new digital alarms are used and thought of in the same way as the old analogue ones – the possibilities are

	<ul style="list-style-type: none"> • Misunderstandings about DA use and potential • Fear among decision makers of potential legal consequences due to unclear interpretations of law (privacy) • Lack of knowledge and experience in managing WT-data on municipality level 	<p>not taken advantage of.” [Landlord]</p> <p>“The nurses have logged out of the system, since they’re not interested in using the system, I don’t think it’s their area - <i>I don’t handle alarms</i>” [Occupational therapist]</p>
Regulatory framework	<ul style="list-style-type: none"> • Law and regulations not adjusted in the new context, especially regarding security and privacy • Lack of guidelines for interpretation of existing laws • Healthcare and social care are governed by different laws – hinder data exchange • Lack of legal interoperability 	<p>“We are too late on the ball with night surveillance through cameras. Lawyers put a stop to it, lawyers don’t know elderly care and get scared.” [Quality assurance officer]</p> <p>“One concern is that there are too many requirements for consent – it becomes unequal. People miss out on aids because they cannot give their consent.” [Quality assurance officer]</p>
Infrastructure and production systems	<ul style="list-style-type: none"> • Complex and outdated infrastructure • Absence of a municipal strategy digital transition • Lack of support from the IT-department in the municipality • Lack of unified platform for data sharing • Various, not collaborating providers • Lack of integration between various systems • Distributed and unclear responsibilities • WT systems are often viewed as outlying to the core municipal IT-infrastructure 	<p>The municipality’s IT department asks - What do you want from us - Wifi and internet access - then they are ready. There is no system administrator. It works on the old analog ones, but the new systems are purely IT systems.” [Landlord]</p> <p>“There is a lack of a collaboration model partly between suppliers but also between the provider, the nursing home, and IT-department at the municipality” [Landlord]</p>
Business models	<ul style="list-style-type: none"> • Lack of strategic guidance for investment, sustainable business models, and effective procurement processes regarding WT generally • Lack of clarity for WT within the municipal governance model • Lack of centralized procurement strategy was stressed, leading to fragmented maintenance and governance of WT 	<p>“There is a lack of a strategy for WT. We’re just talking about how we want it. Who should own WT? The landlords or the nursing home or us? Here it is a lot about who writes the contract with the supplier” [IT-department]</p> <p>“I want the municipality to take ownership of all the technology that is purchased” [Digitalisation officer]</p>
Technologies, products and processes	<ul style="list-style-type: none"> • Lack of standardization and clarity in data handling • Semantic disconnection • Lack of clarity about what data is necessary to collect and how it should be used • Unclear requirements for data visualization • Lack of routines to maintain WT-components (devices) • Inconsistent access to, and quality of, data visualization from different WT providers • Poor usability and clarity in data-visualization 	<p>“Difficult for the staff to know who or where to turn to when something doesn’t work - it could be an update that hasn’t been done, a fault with the equipment, a fault with the connection in the house, technical fault in an app, technical fault in a server application.” [Occupational therapist]</p> <p>“When it comes to welfare technology there are more gadgets, lots of gadgets, sensors, data in the cloud, it is more difficult to draw a line for who is responsible for what.” [IT-department]</p> <p>“The difficult thing is to use the data. It is a gold mine” [Digitalisation officer]</p>

6. Discussion and conclusion

The aim of this study was to identify, analyze and describe the challenges for making use of WT-generated data in Swedish elderly care. We found that elderly care is in a transition from traditional care to digitalized care where advanced digital tools become an integrated part of the elderly care practice and give new possibilities to improve the quality and

efficiency of care. Unfortunately, the wider sociotechnical system (values and attitudes, regulatory framework, infrastructure, business models and technology itself) is not ready to support this transition.

Considering the identified challenges, designing a municipality-wide system supporting analysis and visualization of WT-generated data is a complex task. Just adding an additional technical component, to the already diversified and complex landscape of applications and responsibilities, would only add further complexity and would not lead to expected benefits. Therefore, making better use of WT-generated data, on the municipality level, requires identification and analysis of the whole WT-data ecosystem, where different social and technical components need to be better aligned to achieve the high-level benefits from the already implemented WT.

While many challenges for DA implementations highlighted in previous literature are related to technical issues [19], such as the lack of data management processes [35], difficulties to capture, store, transform and analyze data in traditional database management systems [34], and issues with poor data quality [31], our study shows that in the case of elderly care the problem is the wider surrounding ecosystem that is not prepared to support the transition of elderly care practices. Therefore, to grasp the complexity of the problem area and to develop the ecosystem where the WT is deployed with effective utilization of WT-generated data, we need to consider the design of an ecosystem.

The challenges in utilizing WT-generated data identified in our study to some extent align with those highlighted in the literature concerning DA in healthcare [15]. Consistent with previous findings, we identified fragmentation of care services, poor coordination among various stakeholders, and unclear legal regulations as significant obstacles. Moreover, we encountered challenges related to the unclear management and funding of extensive cross-institutional integrations, essential for the effective use of data generated by various WT solutions within an existing common infrastructure. Echoing Mugurusi et al., [20] we also found that integrating WT into care models requires significant changes of existing care processes, responsibility structures, and business models.

However, our study adds a more nuanced and detailed perspective on the challenges across all five dimensions necessary for successful mission-oriented (responsible) system innovation, which in our case is the transition from traditional care to data-driven care. Besides the challenges already noted in previous literature, our study identified various challenges related to Infrastructure and Production Systems, Technologies, Products and Processes, as well as five dimensions in the SIM. Unlike previous research, which identified technological advancements and the feasibility of adopting open API models and standards as enablers for successful DA in healthcare, our study suggests that the technical challenges are considerable in elderly care context. We believe that the challenges exist due to the traditionally low level of digitalization in the elderly care sector, resulting in inadequate technical infrastructure, underdeveloped business models, and insufficient competencies.

Drawing from our findings and the identified challenges, practitioners can enhance their planning of the digital transformation of elderly care and further develop strategies that more effectively utilize WT-generated data. For instance, adopting a system innovation perspective would enable practitioners to develop comprehensive plans to address broader elderly care ecosystem challenges, rather than focusing solely on technical solutions. This approach considers issues such as changes to processes in the digital transformation of elderly care, the restructuring of responsibility among stakeholders, and adapting business models to enhance the utilization of both WT and WT-generated data in elderly care.

In this paper we have framed the problem of the underutilisation of WT in elderly care as an ecosystem problem and approached it from a system innovation perspective. We have used the SIM to identify challenges experienced by key stakeholders at the ecosystem level and have organized them according to the five dimensions of the SIM. Addressing each dimension independently may appear feasible using traditional problem-solving methods, but considering challenges across all dimensions reveals a more complex and interconnected scenario. Today there is no organizational entity that has the jurisdictional

legitimacy, resources and mandate to approach problem solving and development on the ecosystem level. Nevertheless, our conclusion highlights that depicting the underutilization from the ecosystem perspective is a crucial first step to create the leverage to join forces and pave the way for effective use of data analytics in elderly care. Otherwise, the large investments made in WT implementation may be at risk of being wasted.

We are also aware of some limitations of this study. Firstly, we primarily explored the challenges of utilizing WT-generated data on digital alarms and did not examine challenges related to other types of WT. Secondly, this study was conducted within a Swedish context, so the findings may not be applicable to other countries. Thirdly, the respondents in this study were key stakeholders in municipal elderly care, which means the findings may not reflect the views of all stakeholders in this sector.

There are also opportunities for future research. Firstly, future studies can investigate the challenges of utilizing WT-generated data from additional types of WT. Secondly, further research can complement this study by conducting similar investigations in other countries.

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