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Critical Factors for Human Computer Interaction of eHealth for Older Adults

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ABSTRACT

The percentage of older adults increases globally with an increased need for medical care. To support the idea of successful active aging, e-health seems to be an interesting concept. This study was conducted as a systematic literature study, with the aim to identify and discuss determinant factors in the Human computer interaction of eHealth for older adults. The important main research question to answer was: *What are the critical challenges to address for an improved human computer interaction in technology enhanced health care systems for older adults?* Findings show that there are several critical factors to consider, with trust, personal integrity, technological acceptance, e-health literacy and accessibility of ICT as the most determinant. If the found challenges are addressed, it might be possible to achieve the identified aim of independent living. The recommendation is a human computer interaction that is elderly centred, and involves the elderly users in the design process. However, no ICT enhanced system will be user-friendly enough to take away the need for social and technological support.

Author Keywords
E-health, E-services, Human Computer Interaction, HCI, Older adults

CCS CONCEPTS
• Human-centered computing → Human computer interaction (HCI) → HCI design and evaluation methods → User studies

INTRODUCTION

In the general population, the percentage of older adults is increasing globally, with the fastest growth in low- and middle-income countries (Tonelli & Riella, 2014). Today there are 5-600 million people that are over 65 years old worldwide, but with an estimated increase to nearly 1.5 billion by 2050 (Kline & Bowdish, 2016). The older people get, the more they tend to be depending on medical and social care, with many older adults living alone and without any family members to look after them (Stroetmann et al., 2002).

There exists a wide variety of terms for the idea of older people's right to remain healthy and 'aging well', some of them are successful aging, active aging, healthy aging, positive aging, productive aging, and competent aging. These concepts have sometimes been combined with the ambition of older adults' independent living and to reduce the costs of health care (Foster & Walker, 2014).

The fast technological expansion during the last decades has opened up new possibilities for telecare and home care, but new technology also creates new critical factors for user satisfaction (Botella et al., 2009). With an improved human computer interaction, eHealth would be a promising alternative to traditional health care when the percentage of older adults increases. This study had a focus on recent research studies on eHealth and their reports on critical factors for older adults.

The aim of the study was to identify and discuss determinant factors in human computer interaction (HCI) of eHealth for older adults. Main research question to answer was: *What are the critical challenges to address for an improved human computer interaction in technology enhanced health care systems for older adults?*

METHOD

This study has a design inspired by the six-step method for literature reviews described by Machi and McEvoy (Machi & McEvoy, 2016). The six steps are: 1. Selecting a topic, 2. Develop the tools of argumentation, 3. Search the literature, 4. Survey the literature, 5. Critique of the literature, and finally 6. Writing the review. The first step was carried out in the intermissions of an inspiration seminar on eHealth, and the second step had the form of a brainstorm session. Step 3 to 6 were conducted iteratively including backward searches on relevant references. Vom Brocke et al. [7] defined a backward search as "reviewing older literature cited in the articles yielded from the keyword search" (Vom Brocke et al., 2009).

To explore the state of the art of HCI and Interaction design for older adults in eHealth contexts, Boolean searches were conducted with various combinations of the keywords that are specified before the introduction. Main databases have been Scopus and Google scholar with a primary focus on articles published between 2010 and 2018. However, older articles were selected when they have had findings that relevant for answering the research question.

Firstly, 456 articles were selected that matched with combinations of the keywords. Then a screening was done by reading all the article's abstracts where 225 articles were excluded because they were not directly related to the research topic. Secondly, the remaining 231 articles were further examined to see if they were more specifically related to the research question and 211 articles were excluded in this step. The remaining 19 articles were further categorised into primarily articles and secondary articles. Primarily articles are addressing all important keywords however secondary articles don't contains all the keywords but they has very specific and detailed information

Finally, results have been analysed and grouped thematically with the aim to find interesting themes for future research. The thematic analysis was carried out as described by Braun and Clarke (Braun & Clarke, 2012).

SELECTED PUBLICATIONS

Table 1 below contains a listing of the selected publications, in chronological order with author(s), location of the study, and the most important column to answer the research question: findings and critical factors. The aim has been to provide an updated state-of-the-art analysis of HCI and Interaction design for older adults in eHealth, but interesting and relevant older articles were found both in the direct searches as well as in backward searches.

Authors	Year	Location	Findings/factors
Henkemans et al.	2007	Netherlands United States	Visual sensing devices, video monitoring, Ethical considerations, Privacy, Sense of false confidence
Jung & Loria	2010	Sweden	Compatibility with citizen needs, User's trust in service provider
Rogers & Fisk	2010	United States	Understanding older adultism's needs, preferences, and desires for technology in their lives
Stojmenova et al.	2012	Slovenia	Technological experience, Education level, Lifestyle characteristics, Cognitive changes, Sensory processes
Lee & Coughlin	2014	Global-Literature review	Confidence, Emotion, Technical and social support, Affordability, Usability, Usefulness
Fischer et al.	2014	Global-Literature review	Privacy vs. Utility, Trust, Internet access, Assistive Technology, Gerotechnology
Vines et al.	2015	United Kingdom	Embracing alternative measures of success. A HCI research agenda shaped by older people
de Veer et al.	2015	Netherlands	Awareness, Internet skills, The role of social influence, Ease of use
Peek et al.	2016	Netherlands	Independent living, behavioural options, personal thoughts on technology use, influence of the social network, influence of organizations and the role of the physical environment
Axelsson & Wikman	2016	Sweden	Independence was critical among older adults in the sense of control and choice, when older persons use e-health services.

Table 1. Primarily articles in the literature review

The articles in Table 1 have all a direct relation to the aim and the research question, and their classification are as 'primarily'. Many articles that were found irrelevant was excluded, but articles with interesting details or with an indirect relation have been part of the analysis to get a more detailed and nuanced discussion. These 'secondary articles' are listed below in Table 2.

Authors	Year	Location	Findings/factors
Rudd et al.	2007	United States	Patient Prospective, Cognitive changes affect the ability to use technology
Courtney et al.	2008	United States	Self-perception of health, physical condition, mental and emotional condition, anticipatory living, environmental influences, the perceived redundancy of the technology
Charness & Boot	2009	United States	Attitudinal barriers, Cognitive barriers, Privacy concerns, Age-related changes affecting technology use
Wagner et al.	2010	Canada	The impact of Person on Environment and the impact of Environment on Person.
Heart et al.	2011	Israel	Perceived usefulness, perceived impact, Perceived ease of use, Technological issues , Personal traits, Social issues, Facilitating issues
Xie et al.	2012	United States	e-health literacy and participatory design
Young et al.	2013	United States	Technological discomfort, Home-based health information technology ,
			electronic health records, data security and confidentiality,
Latulipe et al.	2015	Korea	Behavioural intention, Data security and accuracy, Socio-Technological environment
Latulipe et al.	2015	Korea	
Christophorou et al.	2016	Cyprus	Usefulness, satisfaction and motivation

Table 2. Secondary articles in the literature review

FINDINGS AND DISCUSSIONS

This study aimed to explore critical factors for HCI of eHealth for older adults.

Our analysis identified independent living as an important overall aim for e-health design for older adults and several studies have highlighted the importance of older adults's independence (Henkemans et al., 2007; Bowes & McColgan, 2013; Axelsson & Wikman, 2016; Wiklund & Melander, 2016; Peek et al., 2016). Independent living is the overall umbrella concept that is related to the identified factors. To achieve this independence older persons have a need to be in control while using e-health services (Melander-Wikman et al., 2007). Furthermore, elderly users of e-health have expressed that activities such as hobbies, voluntary work are important parts of independent living (Peek et al., 2016).

Important identified factors to support the concept of independent living are e-health services that facilitates socialization, communication and improvement of user's safety (Christophorou et al., 2016). As recommended by Axelsson and Wikman e-health services should be implemented to strengthen the older adult's mobility and self-management (Axelsson & Wikman, 2016). Our analysis identified independent living as an important overall aim for e-health design for older adults, but for a successful implementation, all the critical factors listed below have to be considered.

Trust
Findings show that various form of trust is a crucial factor for HCI of eHealth for older adults. One reported aspect is the user's trust in service providers. E-health has its problems such as misunderstanding of information, technical problems, and security and privacy issues. User's trust in the service provider can overcome these problems (Jung & Loria, 2010). Older adults' confidence and trust in

interacting with high-tech devices seem to be generally lower than that of younger people. There are for several reasons a need for both technical as well as social support (Lee & Coughlin, 2015). Trust was also found to be a crucial issue in a study on e-health in rural Bangladesh (Hossain, Md Nazmul, et al., 2017).

Personal integrity
As highlighted by Henkemans et al. users perceived benefits have to be weighed against perceived privacy issues (Henkemans et al., 2007). A recommendation from the study is to avoid more detailed monitoring technologies than the monitoring needs. As an example, a point light camera can transmit images where older adults's activities can be distinguished without revealing their identity, which can be compared to the more detailed images from a video camera (Henkemans et al., 2007). When a monitoring system is relatively non-intruding, users are more willing to find it useful (Melander-Wikman et al., 2007).

On the other hand, when the perceived usefulness is strong, users seem willing to trade personal preferences for privacy. Healthcare providers have to handle the balance between supporting older adults' autonomy and promoting monitoring systems (Courtney et al., 2008).

Technology acceptance
Older adult's intention to use e-health is depending on the services' usefulness, ease of use and their general attitude towards using e-health (Jung & Loria, 2010). This not a surprising finding since this is suggested by the technology acceptance model (TAM). What the study found that the TAM model do not predict were the dependency on internet connection and adequate information. As concluded from two studies conducted by Henkemans et al. (Henkemans et al., 2007) older adults can perceive the benefits of technology enhancement in their homes, but that there are integrity issues considering monitoring technologies.

The earlier viewpoint that older adults´ adoption of technology is a matter of performance and costs has been revised, and as highlighted by Lee & Coughlin (Lee & Coughlin, 2015), this is today seen as a complex issue affected by multiple factors. Except for usefulness and usability, most important factors were affordability, accessibility, support, emotion, independence, experience and confidence (Lee & Coughlin, 2015). For more general e-health a hypothesis has been that the willingness to use services is increasing for users with high ICT skills, but the study by Bhatnagar et al. (Bhatnagar et al., 2017) found that the more of ICT experience, the less intention to use the e-health services. The explanation might be that experienced ICT users have a better insight in the actual risks.

E-health literacy
It is important to understand the deficits that come with age to be able to design interfaces, systems, and services that are inclusive and easy for older people to learn and use

(Vine et al., 2015). However, even with an elderly centred design, e-health systems will never be self-explanatory and e-health literacy is depending on proper training. The study by Charness and Boot (Charness, & Boot, 2009) recommended that also the training programs for aging adults should consider elderly people's age-related changes in ability.

According to many researches, improving e-health education and proper training is also considered as a main factor in elderly papulation.

Rudd (Rudd et al., 2009) noted in his research that the education and training needed to use e-health services is not enough even for the adults who are graduated from high school. He also suggested that modern interactive techniques like touch screens and voice activation can be used to help elderly persons to use e-health services (Rudd et al., 2009; Atlanta: U.S. Department of Health and Human Services, 2009).

Wolf observed in his research that aging is directly related to the ability of understanding the information. Older people have the reduced ability to understand the e-health literacy. He proposed that it should be considered to redesign the e-health systems and e-health literacy issue should be addressed (Atlanta: U.S. Department of Health and Human Services, 2009; Wolf et al., 2005).

It is expected that giving proper training and education about e-health applications will improve older adults' intention to use them. It is also predicted that in the future there will be more and older persons who have grown up with internet. Therefore, if they start using e-health services in earlier life, chances are very high that they will continue using them when they get older (de Veer et al., 2015)

Accessibility of ICT
As pointed out by Jung and Loria (Jung & Loria, 2010) internet access is a crucial factor and there might be large variations between the ICT infrastructures in different countries. Access to technology has sometimes been neglected in e-health for elderly (Lee & Coughlin, 2015), and the infrastructure that is taken for granted is some countries can be a barrier in other parts of the world. Regions with low-income populations might have a digital divide that requires a special design to overcome technological barriers (Latulipe et al., 2015). Finally, as recommended by Heart and Kalderon (Heart & Kalderon, 2013), the e-health ICT systems for the elderly should have a simple technical design and have an emphasis on demonstrating the valuable benefits.

CONCLUSION

Findings indicate that independent living and well-being must be the overall objective of future e-health, which also was a recommendation in the study by Vassli and

Farshchian (Vassli & Farshchian, 2018). To achieve this the recommendation is, as suggested by Stojmenova et al.(Stojmenova et al., 2012) and Vines et al. (Vines et al., 2015), an elderly centred e-health, where older adults also should be active participants in the interaction design process. However, no technological systems will be self-explanatory and without proper training, context adaptation and support, there will be technological discomfort and low technological adoption.

FUTURE WORK

The study identified a set of crucial factors for human computer interaction in e-health for older adults. An interesting next step would be categorise in which areas the elderly have the biggest need for e-health and tele-care. Would the found factors be general for all diseases, or how might they be depending on different categories of diseases?

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