Erlend Kydland Faanes

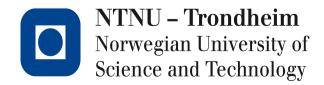
Smart Cities - Smart Homes and Smart Home Technology

Master's thesis in Health Science

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Abstract

This master's thesis consists of two articles where the first article is theoretical and the second is the empirical study.

Article I

The purpose with this paper is to explore and illuminate how smart home and smart home technology can contribute to enhance health and Quality of Life in elderly citizens and allow them to live longer in their home. The paper provides a brief introduction to health promotion and highlights the thesis theoretical framework and foundation of Aaron Antonovsky's theory of Salutogenesis. In light of a growing elderly population worldwide, many nations are eager to search for new ways to meet this challenge. One of several possible solutions to this is smart homes and smart home technology. The papers concluding remarks is that even though there exists little empirical data in relation to achieved health benefits the literature shows that smart homes and smart home technology might contribute to enhance QoL in elderly citizens. Furthermore the paper is providing a proposal to a health promotional (salutogenic) framework and an example on how salutogenesis can be used in a practical and new way of thinking in relation to future development of smart homes and smart home technology.

Article II

The study's primary objective is to examine in which ways smart homes and smart home technology can contribute to enhance health and Quality of Life (QoL) in elderly citizens and allow them to live longer in their homes. In addition to this it aims to explore if such technology increases safety, independence and enhances social activity. Six in-depth interviews with elderly citizens living in a smart home make the basis of the result. The interview protocol included questions regarding QoL, smart homes and smart home technology, safety and security and independence. The interviews were recorded and the recordings were transcribed. To analyze the data material a content analysis and systematical text condensation were used as inspiration. The results showed that there wasn't a single factor that could contribute to an enhancement in QoL, but the totality of several. The study concludes that smart homes and smart home technology can contribute to enhance health and QoL in elderly citizens and master to live longer in their homes, but further investigation is needed in order to draw a final conclusion.

Sammendrag

Denne masteroppgaven er skrevet i artikkelform og består av en teoretisk og en empirisk artikkel.

Artikkel I

Hensikten artikkelen er å utforske og belyse hvordan smarthus og smarthusteknologi kan være med på å forbedre helse og livskvalitet hos eldre mennesker. I tillegg til dette undersøkes det om denne teknologien kan bidra til å øke eldre menneskers muligheter for å bo lengre i sine egne hjem. Artikkelen gir en kort innføring i helsefremming, og belyser masteroppgavens teoretiske rammeverk og fundament i Aaron Antonovsky's teori om Salutogenese. I lyset av en raskt voksende aldrende befolkning verden over, er mange nasjoner ivrige etter å søke nye metoder for å møte denne utfordringen. En av flere mulige løsninger til dette er smarthus og smarthusteknologi. Artikkelens avsluttende bemerkninger er at selv om det finnes lite empirisk data på dette feltet, viser litteraturen at smarthus og smarthusteknologi kan være med å bidra til en økning i livskvalitet hos eldre mennesker, dette gjennom en økt følelse selvstendighet, trygghet, sikkerhet og trivsel. Videre blir det foreslått et mulig helsefremmende salutogent rammeverk, og gitt et eksempel på hvordan salutogenese kan brukes i praksis og som kan være med på å bidra i utviklingen av fremtidige helsefremmende smarthus.

Artikkel II

Studien tar sikte på å undersøke på hvilken måte smarthus og smarthusteknologi bidrar til å forbedre helse og livskvalitet hos eldre mennesker og om denne teknologien bidrar til å øke deres muligheter til å bo lengre i sine hjem. Det undersøkes også om denne teknologien bidrar til økt sikkerhet, uavhengighet og sosial aktivitet blant eldre. Det ble gjennomført seks dybdeintervjuer med eldre beboere i et smarthus som danner det empiriske grunnlaget i studien. Intervjuguiden består av spørsmål som tar for seg livskvalitet (QoL), smarthus og smarthusteknologi, sikkerhet og uavhengighet. For å analysere datamaterialet har en innholdsanalyse og systematisk tekstkondensering vært en inspirasjon. Resultatene viser at det ikke var en enkelt faktor som bidro til å øke deres livskvalitet, men det totale av det Kampen Omsorg+ (KO+) tilbød. Smarthus og smarthusteknologi kan bidra til å øke helse og livskvaliteten og i tillegg bidra til at eldre mennesker kan leve lengre i sine hjem, men det er et behov for videre undersøkelser for å kunne trekke en avsluttende konklusjon.



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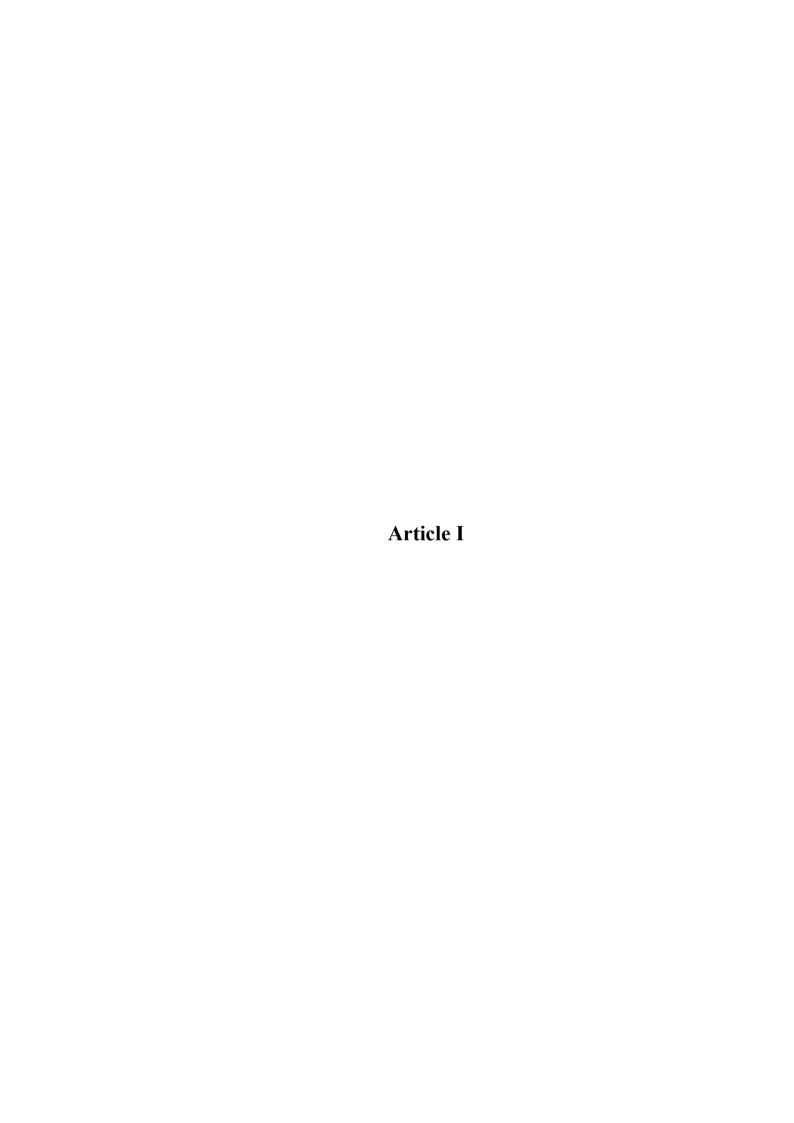
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SMART HOMES AND SMART HOME TECHNOLOGY:

Part I

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Abstract: In light of a growing elderly population, many nations across the planet are eager to seek new ways of facing this challenge. Two out of many possible solutions to this are smart homes and smart home technology. Many communities have already started development and financing of these homes with an overall goal of maintaining or improving the Quality of Life (QoL) for the elderly generations. This process involves many participants and amongst these are the municipality, political entities and technology vendors. This paper is a review with a theoretical perspective in health promotion and a foundation in Aaron Antonovsky's theory about salutogenesis. The papers intention is to reveal whether smart homes and smart home technology contribute to enhance QoL and help elderly citizens to master to live longer in their homes. In addition to this, a proposed health - promotional framework, HP 2.0, and a suggestion on how to use salutogenesis in a practical way of thinking are presented. The framework and the suggestion may be an inspiration on how to implement salutogenesis in a practical and useful way and a manner of thinking that may direct the emergence of salutogenical smart homes. The results show that there exists little research related to health benefits of smart homes and smart home technology, but it appears in the literature that such technology might contribute to an enhancement in QoL, increased independence, safety and security.

Keywords: Quality of Life (QoL), Aging population, Salutogenesis, technology, health - promotion

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Introduction

Like most nations across the planet, the population of Norway is getting older. The UN Department of Economic and Social Affairs claims that the population aged 60+ is the fastest growing population, globally (UN, 2012). In the less developed countries the population is aging at the fastest rate ever. The UN predicts that this growing elderly population is expected to reach a number of 2,5 billion individuals in the world by the year 2100 (Ibid.). The Central Bureau of Statistics in Norway predicts that the number of individuals aged 67 will double by 2050 and the population aged 80+ will rise from 190.000 to 570.000 individuals (Meld. St. 29 (2012-2013).

One out of several reasons for this increasing number of elderly people is that life expectancy is expected to rise both in developed and developing countries. Over the next four decades it is expected that this development will continue at the same rate, and global life expectancy is projected to reach an average of 82 years in 2100. Another reason for this tendency is that there will be a decline in both total fertility and number of children born (UN, 2012). In the future there will be more elderly people in the world than children, particular in western countries, including Europe. As a result of the population aging at a fast phase, we face a possible demographic challenge: the elderly population has an increased need for health and social services and the supply of labor decreases (Teknologirådet, 2009). At the same time we do not have the financial means, if the current situation continues, to cover the future costs of aged care. The municipalities in most western countries are therefore eager to seek out new ways of addressing the diverse needs of this aging population.

Possible solutions to this challenge might be assistive technology in homes, or in better terms: modern housing or smart homes. Many communities have already started to develop and finance these homes with an overall goal of maintaining or improving the health and Quality of Life (QoL) for the elderly generations. This comprehensive process involves many participants including the municipality, political entities and system developers/technology vendors. The last mentioned participant might promote their products to benefit the older generation and claim that they will provide better QoL, and most likely they do, but there is little quantitative and qualitative data and research on health effects or health benefits derived from the use of smart homes and smart home technology (Chan et al., 2009). In particular, there is a lack of research on elderly citizens living in smart homes and possible health

benefits this brings. How should these smart or modern homes be constructed to meet the diverse needs of this aging population? Is it possible to found the construction based on a health-promoting framework like Aaron Antonovsky's theory about salutogenesis? The research question for the paper is: "In which ways can smart homes and smart home technology contribute to enhance health and Quality of Life in elderly citizens and allow them to live longer in their homes?". This paper is a review and the essential aim is to review and discuss the salutogenic theory (health promotion) and the existing empirical research on the field of smart homes and smart home technology.

Method and search strategy

In this paper several literature searches were conducted using the large scientific databases. The searches were conducted in: "Google Scholar", "CINAHL - EBSCO", "Medline", "Pubmed – NCBI", "Oxford Journals", "Proqolid – Quality of Life Instruments database", "Technology and Health Care" and "Journal of Telemedicine and Telecare". The time period of the searches was from September 2013 to February 2014 and several keywords were used. The keywords used included: "smart home technology", "smart home technology AND QoL", "smart homes and QoL", "modern housing and QoL", "smart homes AND health benefits", "domotics", "home automation". These keywords were only some out of many and all were used in different permutations to obtain as much information as possible.

Keyword: "Smart home and smart home technology"

n=2972 potentially relevant papers identified in electronic databases

n=2519 Excluded due lack of health perspective

n=453 potentially relevant papers including health perspective identified

n=6 were identified from reference lists

n=116 rejected on the basis of content: technology focus

n=29 papers were included in the review

Fig. 1: Search Strategy

The inclusion criteria for this paper are:

• Articles published after year 2000

• Language: primarily English/Norwegian literature

• Content: Smart home technology and smart homes

• Perspective: Health and Quality of Life

Target group: Elderly citizens

The majority of the articles included are systematic literature reviews (not primary literature) and in addition to this some quantitative and qualitative studies are included.

Theoretical framework

One of the characteristics of health research in our culture is that it often focuses on the disease and what creates it. Aaron Antonovsky proposed that researchers were asking the wrong questions and constructed his own concept named "Salutogenesis" in the late 1970s. Salutogenesis focuses on what creates good health rather than the pathogenic factors that makes us ill. If architects and technology vendors, in their work, considered this point of view it may have a positive impact on the development of health and QoL. With this in mind it makes this papers theoretical foundation that the built environment, innovation and technology may have a great impact on our health and well-being and might be central for elderly citizens to live longer in their home and have good health and Quality of life. The main aim of this paper is to locate factors, both internal and external, contributing to enhance elderly citizens way towards the health end of the ease/dis-ease continuum. Salutogenesis was choses as the main theory and approach to this paper instead of other health promoting concepts such as like Emmy Werner's (1929-) concept of "Resilience" or Paulo Freire's (1921-97) idea of "Empowerment". The main reason for choosing salutogenesis was that the theory is a broader concept focusing on "...resources, competencies, abilities, assets on different levels, the individual, the group such as families, and also societies" (Lindström & Eriksson, 2010, p.55). Both empowerment and resilience are valid concepts but lack the totality salutogenesis offers, something that was important in the selection of a theoretical framework.

Health Promotion – a short introduction

The history and origin of health promotion is considered a complex process with a lot of sources involved in its development (Von Heimburg, 2010). In time there have been events that are central in relation to the development of health promotion as a term and it was first presented as a concept in 1974 when Lalonde introduced "health promotion" in his report "A new perspective on the health of Canadians" (Lalonde, 1974; Von Heimburg, 2010). As a result of this, WHO initiated initiatives starting with the Alma Ata declaration in 1978. The international conference on primary health care in Alma Ata is seen as one of the great milestones in public health in the 20th century (WHO, 1978). The declaration underlined the importance of primary health care worldwide and committed all member countries to the "Health for all 2000" principle (Ibid.). The conference reaffirmed that health is more than just absence of disease and underlined that health is to be seen as "...a state of complete physical, mental and social wellbeing..." (WHO, 1978, p.2) Eight years later, in 1986, the focus shifted from primary health care over to a more health promotional perspective with the Ottawa – Charter in Canada.

On November 21th 1986, the first international conference on "health promotion" was held in Ottawa. As a consequence of this conference, the Ottawa Charter (OC) emerged. Its purpose was to initiate action towards "Health for All" by the year 2000 and into the future. The establishment of the OC contributed to make "health promotion" internationally known (WHO, 2009). The OC defined health promotion as "...the process of enabling people to increase control over, and to improve their health" (Ottawa-charter, WHO, 2009). This definition is to be been seen as a point of departure and not as a definite definition of what the term health promotion signifies (Lillefjell et al., 2011). According to the OC, health promotion is more than just health care; the concept goes beyond and puts health on the agenda not only in community politics but also in the society as a whole (WHO, 2009). The core of OC is that it primarily focuses on promoting health and does not emphasize pathogenic factors and thereby can be seen as a salutogenic approach to health (Ibid.). In many ways, the OC laid the foundation for a paradigm shift in public health on the basis of its broad social perspective on health as a whole and the distribution of health (Helsedirektoratet, 2010; Espnes et al., 2011).

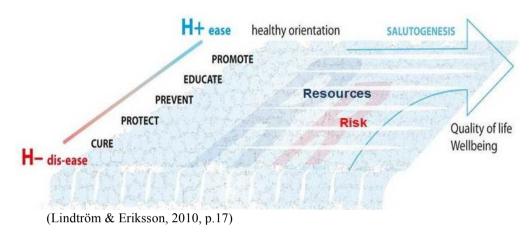
Salutogenesis

The term "Salutogenesis" arrived from the medical sociologist Aaron Antonovsky in the late 1970s (Lindström & Eriksson, 2010). With the salutogenical question: "what is the reason that some of us are staying healthy, and some don't, despite traumatic events in life?" he turned the question that had been traditional within the biomedical model around. The biomedical model was concerned with the pathogenic factor that makes us ill or unhealthy, and by removing these factors would make us healthy. The salutogenical approach focuses on what creates health and by doing this Antonovsky claimed that it is more important to focus one's attention towards people's resources and capacity to create health rather than risk factors, illness and diseases that makes us ill or unhealthy. The core of the salutogenical approach is a life orientation towards problem solving and the capacity to use available resources. Salutogenesis makes it possible to view health and health promotion in a new, more nuanced way. This approach allows us to recognize the *characteristics* of the human beings exposed to difficult episodes and traumatic events and how they are able to live good healthy lives. In addition to this Antonovsky claimed that good health is not just the absence of disease and that poor health should not be solely associated with illness.

Antonovsky claimed that health must be seen as a continuum between health (positive) and disease (negative) and defines salutogenesis as "the process of movement towards the health end of a health ease/dis-ease continuum", and determining the position of individuals on this continuum (Lindström & Eriksson, 2010,p.18). He thereby rejected the dichotomy between health and disease like in the traditional biomedical model of health (Leirset, 2013). When one faces stressors or pathogenic factors two possible outcomes exist: the destructive forces (stressors) makes us sick or ill and pulls us towards the negative side, or salutogenic factors helps us regain our health and moves us towards the positive side of the health continuum. Antonovsky explains this in a very practical and reasonable way by using a river as an example: health in the river of life (Eriksson & Lindström, 2008; Lindström & Eriksson, 2010). The river whose flow represents the direction of life flows upwards along our field of view. Along one whole side of the river there is a waterfall, representing dis-ease, while on the other, there is a bank representing ease. With a river like this there is always a chance of encountering risk factors. When we are born we drop into the river and move with the flow, and over our lifespan we can learn how to swim. Some of us are born in the ease side and some are born in the *dis-ease* side of the river. Children born in the *ease* side meet an easier current where there is time to learn, where the life conditions are good and with many

resources at our disposal. But on the *dis-ease* side it is the opposite: there the conditions are rough and difficult to manage, and the risk of going down the waterfall is bigger. Some, wherever they are, manage to swim against the current and some do not, just like in life itself. The outcome depends on our life orientation and our ability to learn to identify and discover the resources available to us and to use them in order to improve our health.

Fig.2: Health in the river of life:



There are two key concepts in the salutogenical approach: Sense of Coherence (SOC) and Generalized Resistance Resources (GRR).

Sense of Coherence

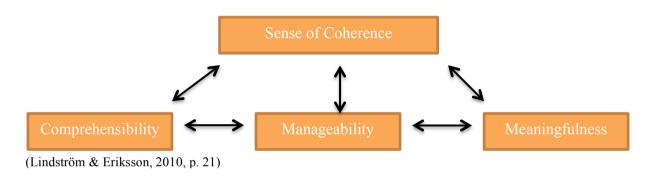
The first key concept of salutogenesis is SOC and Antonovsky defines SOC as:

A global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that (1) the stimuli from one's internal and external environments in the course of living are structured, predictable, and explicable; (2) the resources are available to one to meet the demands posed by these stimuli; and (3) these demands are challenges, worthy of investment and engagement (Lindström & Eriksson, 2010, p.18).

The results Antonovsky have found in his empirical work on the salutogenic theory were that the characteristics of the human being with good health or high QoL are SOC. He describes SOC as a life orientation or a way to relate to the world, and not just a central element in the salutogenic theory. In relation to the health continuum, SOC is seen as the ability to

comprehend the whole situation and one's ability to use the resources available to move towards the health end of the continuum (Leirset, 2013). With an overall high SOC it is possible that you will find yourself at the positive side of the health continuum and also more likely that one will master the challenges encountered during life, something that brings you even closer to the health end compared to someone with a low SOC. SOC consists of three central dimensions: (1) *Comprehensibility*: (2) *Manageability*: and (3) *Meaningfulness*. All three dimensions are understood as closely related and interacting with each other:

Fig. 3: Sense of Coherence:



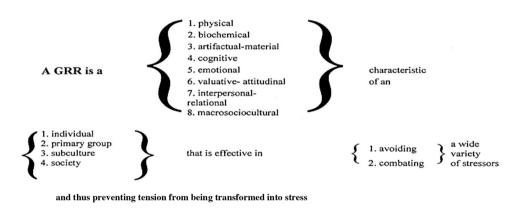
Comprehensibility constitutes the cognitive dimension of the SOC. Persons scoring high on the comprehensibility score expects that stimuli, both from the inside and outside, are predictable. If a stimulus comes as a surprise, or is unexpected, people scoring high in this dimension will be able to put the stimulus in to context and explain it. This attitude towards life makes it possible to human beings to have a strong belief in that life will be good, or as good as it can be. Challenging events in life, such as war, death and failure, are seen as challenges that are possible to face and conquer (Antonovsky, 2012). The second dimension, manageability, is the behavioral or instrumental concept of the SOC, and focuses on the extent to which the person experiences that they have sufficient resources at their disposal to be able to cope with their requirements that they are confronted by and the different kinds of stimuli they are facing (Ibid.). Antonovsky added that this may be a matter of resources controlled by a second – person; someone the person has trust or faith in –like a spouse or a close friend. The third and most important dimension is *meaningfulness*, and is considered to be the affective or the motivational dimension in SOC and the driving force in life. With meaning in life it is possible to create structure and to search for resources to strengthen the other two components in SOC, comprehensibility and manageability. It is not the content of

what gives meaning to life that is essential, but the belief in that life itself has a meaning that matters (Lindström & Eriksson, 2010).

Generalized Resistance Resources

The second key concept are the GRRs. GRRs are the resources that make the movement towards SOC possible. In their research report, "The Hitchhiker's guide to salutogenesis – salutogenic pathways to health promotion", Lindström and Eriksson present a figurative definition of GRR:

Fig. 4: Generalized Resistance Resources:



(Lindström & Eriksson, 2010, p.19)

The GRR's are resources within each individual bound to their identity and capacity, but they are also bound to their current and remote environments as both of material and non – material qualities. These qualities are both from the individual and the society (Lindström & Eriksson, 2010). Antonovsky suggested that factors or challenges that could create disease are also able to create health. Within the biomedical tradition, it is commonly known that stressors are to be seen as risk factors, but Antonovsky asserted that this view is too narrow. He thinks that stressors are equally likely to be salutogenic or health promoting. An existence marked by meaningful activities, existential thoughts, connection with their inner feelings and social relations are according to Antonovsky particularly important for the individual in the context of facing difficult challenges in life, to provide us the strength that we need to be drawn to the positive side of the health continuum and to establish a high SOC. "The key is not only about having the resources at disposal, but the ability to use them in a health promoting way" (Lindström & Eriksson, 2010, p. 20).

Smart Homes and an aging population

In light of the rapidly growing elderly population across the world, the municipalities in Norway and many other Nordic and western countries are eager to seek new ways of addressing their diverse needs of this aging population. This challenge will be especially noticeable in the health sector in Norway, and this is also likely in other countries. As people are getting older, the risk of illness and disease increases, in addition to this the need for health care and support increases. These challenges are standing at our front door and needs to be dealt with in a way that makes the society ready for future elderly generations. Municipalities have started founding programs to face this challenge and possible solutions to this are to develop smart homes, or modern housing installed with smart home technology. Technology can contribute to enhance both security, autonomy and allow the possibility to live longer at home. In addition to this, there is also the possibility fore an enhancement in the quality of living and QoL. The technology in these homes can be pre programmed to contribute towards household tasks, window and lighting controlling, multimedia, advanced sensors both in flooring and infrared sensors in roofing. Not only does the smart home provide support to elderly people still living at home, but also this new model of health service is able to provide better quality of information communicated between the health personnel, services and institutions. The technology installed in can deliver, measure (over time) and provide physical and psychological information collected from the user, and be translated into information that can predict health risks, particularly at early disease stages. This information collected can, combined with different kinds of alarms or triggers pre programmed in the system, notify health personnel and family that action needs to be initiated (Chan et al., 2009). These are a few of the benefits that technology offers. In the future it will be more and more important to implement technologies in the health sector and in care strategies. By doing this elderly have the opportunity to live longer at home, feel safer and has health personnel available at all times. But its important to have in mind that different people have different needs, therefor the smart homes and the smart home technology must be tailored or customized into each individual's demands and needs (Ibid.).

Smart Homes & Smart Home Technology

The term "smart home" was coined in the 1980s by the American Association of House builders, although there were hobbyists that actually constructed the first smart, or wired homes prior to that (Harper, 2003). What is a smart home and what makes a smart home

smart? Those are two crucial questions. While a smart home may have smart construction or the architecture is smart, nor the environmentally friendly elements or the solar panels providing the home with electricity, a smart home is smart because it contains interactive technologies that makes us able to control and manage the home in response to its residents' needs (Ibid.). This development started already in the middle of the 20th century, and by the end of the century smart homes continue to evolve with technology. By the beginning of the 21th century smart homes are developed across the planet, particularly in the western countries with an overall goal of improving health and QoL of vulnerable populations. England, America, Denmark and Scotland are some of the leading countries that have developed and initiated such projects (Teknologirådet, 2009). The technology in these projects is comprehensive and covers a wide range of solutions to different kind of users including elderly, frail elderly and physically disabled people. But as technology always evolves it is difficult to give a full or a precise definition of smart homes. According to Chan et al. (2009) one of the main reasons for this is that it is sometimes difficult to separate smart homes and smart home technology from assistive technology, gerontechnology or other similar systems and it seems that the terms, to a certain point, are being used interchangeably.

By reviewing various articles and studies it emerges that the definition of the term "Smart home" does not differ so much from article to article and consists mostly of the same content. E.g. Demiris and Hensel presented a definition of "smart home" that seems to cover the most important elements: "A "smart home" is a residence wired with technology features that monitor the wellbeing and activities of their residents to improve overall quality of life, increase independence and prevent emergencies" (2008, p. 33). This definition is not a final statement, or a final answer intended to supersede other definitions, but it serves as a relatively good description on what a smart home is understood as in most predications and what it should be able to assist its residents with.

- Lê, Nguyen and Barnett (2012) suggested a conceptual framework based on the different kinds of features and functions that smart homes could have. The framework consisted of five elements:
 - (1) Automation: the ability to accommodate automatic devices or perform automatic functions; (2) Multi functionality: the ability to perform various duties or generate various outcomes; (3) Adaptability: the ability to adjust (or be adjusted) to meet the

needs of users; (4) Interactivity: the ability to interact with or allow for interaction among users; and (5) Efficiency: the ability to perform functions in a timesaving, cost-saving and convenient manner (p. 608).

This framework combined with the definition above, comprise the total framework of smart homes and the technology it consists of in this paper. The essential idea of smart homes is that they offer the inhabitants a better quality of living, by offering autonomy and safety, but a sixth; salutogenic element added to this framework may help promote health more than they currently do.

There is a variety of technological solutions and opportunities that can be installed in homes, and make them "smart". Smart home technology is defined as "the integration of home-based technology and services for a better quality of living" (Van Berlo, 2002, p.77) and may include light control, temperature control, multi – media, window and doorway options and health related solutions. It seems that there is only our imagination that are the limitation for the development of such technology. In their systematic review Demiris and Hensel (2008) propose that the different varieties of health related smart home technology utilize a wide range of technology that are serving different goals and can be defined as six categories:

Table. 1: Categories of health related smart home technology

Physiological monitoring	Measurements of pulse, respiration, blood
E	pressure.
Functional monitoring/Emergency detection and response	Measurement of activities, motion, food intake etc.
Safety monitoring and assistance	Automatic lighting, fall reduction/detection hazard detection.
Security monitoring and assistance	Intruder detection, security breach
Social interaction monitoring and assistance	Phone call assistance, video communication, social connection
Cognitive and sensory assistance	Medication reminders, lost key locator, reminder and management tools

(Demiris & Hensel, 2008, p. 34)

Projects and prior research

As a result of the technological development and its progressively lower cost over time, more and more nations are seeing this as a possibility to initiate smart home projects to face the different challenges with the aging populations, such as economical and societal problems and a lack of health professionals. Since the 90s when sensory, networked appliances, mechanical engineering and computer technologies became rapidly available to all, scientists and other professionals saw this as an opportunity to develop smart homes. In the following sections some of these projects and prior research on this field are highlighted.

Norwegian Smart Home projects

During the last decade there has been a remarkable development in the use of smart homes in aged care in most parts of the world, especially in wealthy western countries. Although smart home technology, assistive technology and information and communication technology (ICT) applications have been available and on the market for two decades, corporations, municipalities and big societies have just recently begun to understand the promising benefits of their use of this related to health, health care and well-being (Coughlin et al., 2007). In Norway, the exploration of smart homes and smart home technology began in the mid 90s with the BESTA project in Tønsberg, Norway (Bjørneby et al., 1992). Even though the BESTA project was lunched and smart homes were built, this development stagnated. Questions were raised about their use, especially in terms of the ethical and legal problems. To this day, Norway has had a limited development in smart homes and smart home technology (Bogen, 2008), but several projects have now been lunched and the development is currently gaining strength. The "InnoBuild" project in Lyngdal municipality (Norway) and Falun municipality (Sweden), are together with NHO/KS (National program for supplier development) and Difi (Agency for Public Management and ICT), developing a smart home project. The project is a three-year plan (2012-2015) with an overall goal of buying and developing smart homes to meet the demographic and environmental challenges in the future (Ellingsen, 2012). Another example is the EU (European Union) project "eSenior" involving Oslo, Fredrikstad, Sarpsborg and Göteborg municipalities. The goal with eSenior is to develop and test new products and services that may be helpful in making the everyday life of an elderly citizen easier and safer in their own home. "Omsorg+" project in Oslo, as a part of eSenior, has a goal of building 1000-1500 smart homes for elderly citizens.

Japan, America and Europe

The Welfare Techno–house project was constructed in Japan in 1995. To meet the societal challenges caused by an increasingly elderly population in Japan, the Agency of Industrial Science and Technology, in collaboration of the Ministry of International Trade and Industry (MITI) and the New Energy and Technology Development Organizations (NEDO) constructed 16 demonstration and research homes (Tamura et al., 2007). The main focus was to implement smart home technology in these residents with an overall goal of promoting independence and quality of life for elderly and disabled citizens. The houses were built on scientific terms, by that they were meant to serve as research homes with the purpose of exposing any problems or technical issues. The homes were therefore used for testing, and if future homes were built, they would be built on the principles of the Welfare techno-house, but with improvements if necessary.

In USA, Helal et al. (2005) presented the Gator Tech Smart House (GTSH). They created the GTSH in collaboration with the University's College of Public Health and Health Professions and got federal founding by the state from the National Institute on Disability and Rehabilitation Research (NIDRR). The GTSH goal was to create an environment: smart homes that could practically sense themselves and their residents. This project is one of the more high-tech projects that has been initiated on a bigger scale and consists of advanced technology within the field of pervasive computing systems. Cook et al. (2003), the University of Texas at Arlington, presented the MavHome (Managing An intelligent Versatile Home). The basic idea of the MavHome was to create a home that was acting as an intelligent agent, where the agent's function was to maximize both comfort and productivity of its inhabitants and at the same time minimize total costs. To achieve this goal the home must operate and be able to predict possible outcomes, react and adapt to its inhabitants. Cook et al. (2003) presented an example on how the MavHome operates: "At 6:45am, MavHome turns up the heat because it has learned that the home needs 15 minutes to warm to optimal waking temperature. The alarm sounds at 7:00, after which the bedroom light and kitchen coffee maker turn on" (p. 1). The Gator Tech Smart house is a very advanced smart home, with impressive artificial intelligence that operates and controls the house.

In Europe, several projects have been lunched. Amongst these are the Smart Homes for All project (Aiello et al., 2011), a European Union project in collaboration with several partners: University of Rome, University of Groningen, technical University of Vienna and University

of Stockholm. The projects were lunched in September 2008 and investigated the innovative middleware platform for the interaction of smart embedded services in immersive environments, through the use of composability and semantic techniques, this in order to guarantee dynamicity, dependability while preserving privacy and security of the inhabitants and the platform (Ibid.). Numerous projects with smart homes and smart home technology have been launched globally. In addition to the aforementioned projects there are also the Assisted Interactive Dwelling House in the UK (1996), Tiger place in the America (2004) and Health integrated Smart Home Information System in France (2002) (Lê et al., 2012).

Prior research

In their study on assistive ICT technology Moe and Molka- Danielsen (2012) conducted several literature searches in different databases (Google Scholar and Science Direct) and found that there is very little prior research on the effects of assistive technology for elderly in the need of care while living at home. Laberg (2005) presented a similar assumption in her work on smart home technology; technology supporting independent living – does it have an impact on health? Laberg (2005) explains, as far as she knows, that there is no systematic research on the use of smart home technology and what impact this technology may or may not have on health. To bring focus on this field she shows us what impact it may have by quoting some of the users' experiences. One of the users, a disabled man who had smart home technology installed, said that the technology made the apartment more modern, that he slept better at night and had less pain in neck and shoulders because of the help he gets from technology retrofitted in his apartment. In addition to this, Laberg also interviewed a staff member of this smart home complex. The biggest benefit from the installation of such technology was that the increased quality of the services provided by the staff to the inhabitants increased. The staff member pointed out that the alarm systems made them more relaxed, made the surroundings of the complex quieter and they did not need to check on to the residents at all times which helped to maintain residents' independence. Another aspect Laberg (2005) pointed out is that it made a big difference for the residents to live "at home" and not in an institution where the chance of being hospitalized or institutionalized are bigger. She concluded that smart home technology benefits elderly and disabled people in many aspects of everyday life, in particular by providing increase independence and safety. By collecting user experiences, useful data regarding the practical use of such technologies was gained that may be useful in future smart home projects.

Torp et al. (2008) conducted a pilot study supported by the Directorate for Health and Social Affairs and the Association of Local and Regional Authorities. The study focused on how ICT technologies may contribute to health promotion among elderly spousal carers. The results presented showed that ICT interventions have potential health promoting effects for frail elderly people since they enable the carers to have more control over their spouse's perceived health due to increased knowledge, social contact and support (Torp et al., 2008). In their systematic literature review, Bernd et al. (2009) searched through models and instruments for selection and the advisory process of assistive technology in the rehabilitation field as it is reported in the scientific literature (p. 146). In a total of 16 relevant papers they found that none of them had an experimental design and that nine of the publications were literature reviews. Overall they found a lack of reliable and valid models and instruments for the selection process of the technology involved.

When it comes to prior research on the field of health benefits very little empirical data exists, especially specifically to smart homes and smart home technology. It seems the terms "smart home", "smart home technology", "ICT" – and "assistive technology" are being used interchangeably and not separately as different terms, as Chan et al. (2009) claimed. The reason why there is little empirical research on this upcoming, very important field is unclear. One possibility may be that there is very little research to rely on and compare to, and it may be difficult to conduct this kind of empirical work on an almost "empty" field. Another possible cause might be that technology vendors, investors and other technical developers are more interested in the technology itself than the people living in the smart home. Even though technology may contribute to health benefits and enhance QoL, there is little prior research on how and why. Despite this, an overall assumption exists that smart homes and smart home technology enhance health and QoL. Another thought is that technology is constantly evolving and that technology never gets old – it only evolves and replaces older equipment and systems. So, what kind of technology may be right under certain conditions and circumstances, to a certain kind of user, and when? This is a difficult question to give an answer to and according Blaschke et al. (2009) there is a lack of knowledge on this field to make a final conclusion.

Challenges

When building or refurbishing a home into a smart home by installing technology it raises a variety of questions related to ethical issues, accessibility and usability concerns. These questions are raised from the government, health personnel and the inhabitants. There is a wide spectrum of possible challenges that may occur, but this paper will only provide a short introduction in the ethical issues, accessibility challenges and usability matters.

Ethical issues

According to the Labor and Social Affairs Department in Norway (2001) ethical issues are always present in the relationships between human beings and technology. The questions are related to how we use technology and not to the technology itself, as the technology is dependent on human control. New technology creates an ethical dilemma that must be resolved before installing or implementing it. Automatic functions, video surveillance, and monitoring and other functions in smart homes are one of several functions that raise ethical concerns. It must be decided who has the legal right to view the content of the surveillance, monitoring or audiotapes and this content must also be secured to keep it from falling into the wrong hands. All things connected through the internet, or a local network, will leave an electronic trace. The inhabitants' privacy must be protected, and by removing the traditional ways of treating health problems such as visiting the doctor, we are removing the barrier between inhabitants' homes and the public (Chan et al., 2008). Protection of the network, telephone line and other communication systems are essential to maintain privacy and ethical concerns. An increase in the use of smart homes and smart home technology will have an impact on privacy and this is most important for recipients of care (Teknologirådet, 2009). But smart home technology provides the inhabitants with greater responsibility over their own health care, something that may adversely affect the psychological wellbeing (Chan et al., 2008). By installing such technologies one must consider the effect it has on personal relationships (e.g. patient – physician relationships), moral and human ethical issues and other factors that may be involved.

Accessibility

Although smart homes and smart home technology are considerably cheaper than they were a decade ago, it is still expensive for some individuals. This may be because of the continuing technological development and that technologies are constantly evolving with new advanced

functions and innovative features. When installing such technologies, it may take an expert to do this; one must consider the type of technology installed. Advanced systems require software programming and future updates which are costly for many people. It is important that the government supports this, not only in large residential buildings in the municipality but also in private homes to those individuals who cannot afford to acquire such technology on their own. In Norway, the Housing Bank has been the Norwegian governments most important tool in the housing policy. Through grants, loans and guidance the Housing Bank has helped with the development and construction of better housing solutions (SINTEF, 2013). The Housing Bank is a good example on how technology and smart homes can be a reality for many people that can not afford it themselves. Smart homes may save money for the government, since it might be cheaper to provide smart home technology that allows elderly to live longer at home rather to put them in hospitals and nursing homes.

Usability

According to Lê et al. (2012) another common concern is the limited familiarity that many elderly has when it comes to advanced technology in smart homes. Unlike the X, Y and Z generations, today's elderly generation did not grow up with technology in their hands, something that may reduce their comfort and familiarity with such technologies. In a Korean quantitative survey conducted on 290 elderly participants, Ryu et al. (2009) searched for the factors affecting elderly people's intention to use technology. The involved technology was video user – created content technology that facilitates social interaction through video connection, like an advanced form of Skype. The study showed that it was central that the technology had value, and was practical and usable. There was a strong connection between the experience of utility, usability and enjoyment and it seemed that subjective assessments of their own physical health and resources had a direct impact on their intention to adopt the technology (Ryu et al., 2009). Demiris et al. (2004) conducted three focus group interviews with 15 elderly citizens in their study about older adults' attitudes towards and perceptions of smart home technology. The participants expressed particular concern about the userfriendliness of the electric devices installed. Another concern was related to the lack of human response inherent in these technologies and the need for a tailored training program for older people.

To test usability and acceptability of the technology in the European Union project Smart Home for All (SM4ALL), Aillo et al. (2011) conducted testing of the system with 31 elderly

participants aged between 47-91. The technology involved was an electrical brain activity (EEG) based brain computer interface unit, or BCI. The EEG-BCI unit measures and analyzes the EEG in response to the participant controlling external devices. The results showed a good response and positive attitudes when it came to usability and acceptability, the elderly users seemed to be willing to give up some of their privacy in order to get better support at home. In addition to this they also expressed that it would be an advantage if the technology was able to help them gaining control over tasks that previously had been difficult or impossible. When considering installing smart home technology, it is most important to consider several aspects. Ethics, accessibility and usability are a few of the aspects that need to be considered It is therefore important to obtain information about the users/inhabitants, purpose and goal with technology and other aspects before installing smart home technology.

Discussion

The results of this review shows that even though several initiatives are commencing, including projects in private and public sector, there are currently relatively few studies that can show evidence health benefits achieved through the use of smart homes and smart home technology. In addition to this, Brandt et al. (2011) concluded that due few studies and a lack of study diversity it is not possible to determine whether smart home technology has positive outcomes for people with impairments, even though technology itself has great potential and will be central in future health care. This is the case for most of the studies included in this review. The majority of the studies mention the great potential these technologies have and that they could contribute to deliver cost savings in the provision of health care and support, provide quick response time in relation to safety breach or people in need for treatment. In addition to this the homes have the ability to improve the life opportunities and independent living (Tang & Venables, 2000). The social aspects and opportunities given by this technology are also a valuable element, like video conversations, social contact through the internet and other social applications like Facebook and Twitter (social internet communities). Beauchamp et al. (2005) evaluated the efficiency of a multimedia support system program delivered through the internet to employed family caregivers of persons with dementia. The findings of this study showed a statistically significant reduction in anxiety and depression to the caregivers with the use of a multimedia support system. A study conducted by Shapira et al. (2007) where the purpose was to test the psychological impact of learning how to use computers and the internet. The result showed that elderly people learning how to use the

internet reported a significant improvement in perceived QoL, and reduction in depression and loneliness. According to their systematic review Devik and Hellzen (2012) the association between technological support and perceived QoL seemed to be overall high in several of the included studies, but without being statistical significant. But the studies in Devik and Hellzen (2012) pointed out the participants' statements suggesting enhanced self-esteem, greater confidence and less isolation. In addition to this, several participants reported other positive effects that were helpful in everyday life. For example, increased knowledge about the situations such as a possible disease and how to deal or cope with this is a benefit to elderly, disabled and carers. Knowledge about the situation might increase self-care and improve readiness for action. As a result of this, the effects may contribute to enhancement in perceived QoL (Devik & Hellzen, 2012).

Health promotion 2.0: Smart Homes and Smart Home Technology

As people are getting older many factors in their life changes. These changes are, like many other things in life, individual, but what is common for most people is that age influences mental and physical health, their social well being as well as their social networks (Nygren et al., 2005). This is something that may have a large effect on the perceived QoL and QoL in general, as much of the QoL depends on a person's ability to maintain his or her autonomy and independence (Ibid.). With this in mind, in which ways may salutogenesis help to direct the development of smart homes in a health promoting direction with the central theme of helping older people to maintain both physical and mental health, social networks, independence and autonomy? The salutogenic approach is seen as a rather positive theory meaning that the focus is drawn away from the pathogenic factors and over to what creates health. According to Lezwijn et al. (2010) applying salutogenesis as a theory to healthy aging is justified on the grounds of the theory's search for the positive health (SOC) determinants which strengthens elderly peoples ability to adapt and compensate the negative determinants that follow with old age. It is difficult to give a proper answer to the question above, but in their article Healthy ageing in a salutogenic way: building the HP 2.0 framework Lezwijn et al. (2010) proposes, as the title says, a framework based on health promotion and salutogenesis. There are three dimensions to the HP 2.0 where: (1) SOC plays a central role, along with what they call; (2) "resources for health" (rather than GRRs) and; (3) "health". The reasons for not including GRRs, is that the "resources for health" includes an additional factor: potential resources in the physical and social environment. A given example of this is in the social and physical environment, like public transport, healthcare system, library and

social activates (Ibid.). The third dimension, health, includes physical, social, mental and spiritual wellbeing and is seen as the result of a series of complex processes. All three dimensions are interrelated.

The HP 2.0 framework is meant to support an intersectoral team to create a base of knowledge that have a functions to support processes and content of developing, implementation and evaluation of healthy aging strategies (Ibid.). Even though HP 2.0 is not designed directly to fit smart homes and smart home technology, it may be a good start in what may be a solution to municipalities across the world searching for answers on how to implement and direct the further development of construction of health promoting and salutogenic smart homes.

In addition to this, it is also possible to implement a salutogenical way of thinking without any special framework to support it. The way municipalities, technology vendors and developers think tends to prioritize the economical benefits and how to prevent illness and disease but should possibly focus instead on how to improve health in a positive way. A way of doing this is to take a closer look on how to use salutogenesis in a practical way. Sense of coherence (SOC) consists of three dimensions; (1) *Comprehensibility*, (2) *manageability and* (3) *meaningfulness*. Is it possible to construct and develop smart homes based on these three elements and could they be central in further smart home development? If we take a closer look, investigating Antonovsky's (2012) concept of the SOC it is possible to notice the transferability of the concept of SOC to almost anything. In this case smart homes and the technology it consists of are under scrutiny. In relation to the smart home elderly people increase their chances for a beneficial interaction if the home is built in a way that makes them believe that (1) they can understand the smart home; (2) that they have the resources at their disposal to handle it; and (3) that they wish to cope with the smart home (Hjelm, 2004).

In her doctoral thesis *Making sense: Design for well-being* Hjelm (2004) gave an example on how SOC may be used if one make a slight change of focus over to artefacts. In this scenario we draw the focus away from the artefacts and over to smart homes with inspiration from her example: When building smart homes, it is important to have in mind that the building itself should be *comprehensible*, both inside and outside. There should be little doubt about where the entrance, garden, hallway, living room and kitchen are or how to use the different functions in each room: turning on/off the lights and how to use the dishwasher or the iPad. It

is important to underline that the homes should appear coherent for the user, as well as structured and logical. In addition to this the different functions of the home should be analogous to their appearance (Ibid.). A smart home that is comprehensible would provide the user of understanding of the home and promote usability: both home and applications (functions) should be easy to use and easy to remember how to use.

Manageability in this example relates to how a person handles the functions of the home: the user should know what to do with the functions of the home to reach his or her goal (Ibid.) If this is not the case, it should not be difficult to find out and learn how to handle them, and this information should be easy to acquire and comprehend. Some users may need customizations of some functions to fit their situation or condition, and this is, according to Hjelm (2004), an important aspect of manageability. Still, what would an elderly person do if the central computer that are controlling the home crashes, or goes in to system failure? Not everything in a smart home is manageable for certain individuals. The elderly generation living today is different from the future elderly generations, maybe not in attitude or human aspects, but in technical experience. This may be confusing and frustrating both for carers and especially for people with dementia or cognitive failure. These challenges may be met by making different training programs for different kind of users. But there are still many unanswered questions that need further investigation before an answer can be given.

The motivational factor in this example is *meaningfulness* and is according to Antonovsky (2012) the most important aspect of SOC. The home is meaningful when it has emotional significance and when the individual want to interact with it (Hjelm, 2004). If something is out of place, or something do not work as it should, the individual that is motivated will search for solutions to the problem, even if it might seem difficult. By investing energy in something, no matter what it is, it may become meaningful. Involvement in the home and with material things, for example by learning to live in and with it, practicing and investing effort in the different functions creates meaning, also for material things (Ibid.).

The HP 2.0 framework by Lezwijn et al. (2010) and the inspirational examples from Hjelm (2004) are not absolute solutions on how to implement salutogenesis and health promotion in development or how salutogenesis can help to direct future development, but the ways of thinking are interesting and could be an inspiration to the future development of health promotional smart homes. There are still a lot of unanswered questions and many hours of

research needed before this may be put into practice, but the salutogenical way of thinking may be the future solution in relation to the building of smart homes that enhances elderly citizens' health and QoL.

Considerations

Many advantages offered by smart homes and smart home technology exists, and may be important in future health care. They may be the solution many communities are searching for in relation to future challenges. But since smart homes still are developing many questions and various aspects needs to be investigated, and amongst these are ethical concerns. Ethical considerations must have a central role in the implementation process of smart homes, and it is most important to consider the variety of ethical dilemmas that may occur with different user groups and individuals. This is something that should be included in the calculation when planning, building or retrofitting a home into a *smart* home. The articles included in this paper by Chan et al. (2008), Demiris et al. (2004), Devik and Hellzen (2012) and the report from Teknologirådet (2009), pointed out the importance of the ethical considerations, and most of the ethical focus was on privacy and autonomy concerns. But assistive technology, smart home and ICT technology raises a variety of morality questions as well related to what is defined as a good life, what is central to us in relation to what kind of society we want to live in and what role we give technology (Devik & Hellzen, 2012). These are some of concerns the critics have emphasized: technology is dominant in today's society and will not be less dominant in the future. No matter where we are or what we do it involves technology. What impact does it have on us and can technology be seen as a replacement for human labor and contact? There exists no clear answer for how this situation will be in the future, but to this date the answer should be no. As the Labor and Social Affairs Department in Norway (2001) highlighted ethical issues are always present in the relationship between humans and technology and that the question rather should be about how we use technology. If technology replaces human interaction, something that would be controversial, the questions would be about if technology contributes to enhancement in welfare, social aspects, hope and meaningfulness (Hofmann, 2010). Technology cannot replace human beings at this point in time, but some will argue that such thing may be a possibility in the future. In their defense, technology, smart homes and other related technology may be one of the future solutions to rely on due lack of labor and a reduced number of professionals in the health sector and a limited source of resources relative to face the growing elderly population. Smart homes and related technologies are being developed to meet these challenges and not to replace human

contact. Loss of human contact was regarded as a great concern in the study to Demiris et al. (2004). In the report from the Knowledge Center for Health Services Norway, Hofmann (2010) concluded that the intensions of implementing technology are good, but ethical awareness should be exercised and estimated for each technology depending on whom it serves and where it is implemented.

Concluding Remarks

In light of the growing elderly population across our planet, nations, countries and communities have initiated actions to face this challenge. One of these actions is the numerous projects involving smart homes and smart home technology launched around the world. Amongst these is the BESTA project in Norway (1992), The Gator Tech smart home in the US (2005), The Welfare Techno House in Japan (1995) and other projects. Although there exists little evidence related to smart homes and smart home technology and the effects it may have on health and QoL, there have been several studies conducted concerning older adults attitudes and perceptions of smart homes and smart home technologies, like Demiris et al. (2004), Morris et al. (2013) and Coughlin et al. (2007). The general findings of these studies are that the majority of the elderly are concerned about the use of technology in relation to surveillance around the clock and how this would affect their privacy and dignity. Other concerns pointed out were use and functionality, reliability and accessibility. However they were also positive that the sensors and the technical equipment may contribute to enhance their lives at home and make them feel safer. In summary the studies show that there is a general acceptance for the use of smart homes and for the installation of smart home technology. It is difficult to draw a definitive conclusion due lack of empirical evidence, but it was revealed through the literature that smart homes and smart home technology might enhance QoL in elderly citizens. In addition to this, a possible framework (HP 2.0) and a way of thinking have been suggested that might be an inspiration on how to implement salutogenesis in a practical and useful way that may encourage the emergence of salutogenical smart homes. However, the technological revolution in smart homes and how this may be conducted may take many years to come to fruition.

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Article II

SMART HOMES AND SMART HOME TECHNOLOGY:

Part II

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Abstract: Primary objective: This study aims to examine in which ways smart homes (SH) and smart home technology (SHT) contribute to enhance health and Quality of life (QoL) in elderly citizens and enable them to live longer in their homes. In addition to this it aims to explore if such technology increases safety, independence and enhances social activity amongst elderly citizens. Study design and methods: Six in-depth interviews with elderly citizens living in a smart home complex named Kampen Omsorg+ (KO+) were conducted and are the basis of the results from this study. The interview protocol included questions about QoL, SH and SHT, safety and independence. The interviews were recorded and the recordings were transcribed. To analyze the data material a content analysis and systematical text condensation were used. Results: The results showed that no single factor alone resulted in an enhancement in QoL, but overall there was an increase in QoL at KO+. KO+ offers the residents with social events, increased security and safety and made the majority feel more independent. Conclusion: SH and SHT could contribute to enhance health and QoL in elderly citizens and enable them to live longer in their homes. In addition to this, the participants noted that KO+ contributed to improved social life, security, independence and safety. However, investigation is needed to draw a final conclusion.

Keywords: Quality of Life, smart homes, salutogenesis, eldercare, health

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Introduction

Within few years society will consist of a far larger proportion of elderly people than today and this development will continue for decades, both in developed and developing countries. The Norwegian Technology Council (2009) reported that from the year 2010 the number of persons over 67 years of age will rise dramatically and by 2035 there will be twice as many people over 80 years as there are today. This development is not just locally, but globally according to The UN Department of Economic and Social Affairs (2012). As a consequence of this we may face a double demographical challenge in the future: the elderly populations increased need for health and social services, and the supply of labor will decrease. In addition to this, the workload of the present services provided will eventually surpass the available work force (Teknologirådet, 2009). This future mismatch between the supply of labor and an increasing proportion of the population in need of care has several reasons. Life expectancy will increase due to changes in lifestyle and in new, improved medical treatments, and in therapies. Another important reason is that the elderly are more prone to chronic diseases than younger generation, resulting in an increased need for public health services. Economically speaking, a growing elderly population will add a progressively greater pressure on public finances. Expenses from retirement, medical and social care will thus occupy and increase share national spending (St.meld.nr.9, 2009). According to Garåsen et al. (2008), costs related to home care and inpatient nursing, for a ten-year time period (1998-2008), increased by 131% and in 2006 the expenses were at a total of 45,3 billion Norwegian Kroner. In the upcoming years there will be an increase in the number of elderly in the society and an increasing part of this population will be healthy when they retire or they will live with chronic diseases they not will die from (Wyckmans et al., 2013). That people should live long and worthy lives has always been a goal but the future aging society may bring challenges or difficulties both to the individual and to the systems and structures people will live in (Ibid.). This combination of large societal cost and lack of resources within the health and social sector demands innovation in order to maintain or increase the current standard and quality of health care services in the future.

To meet these challenges, SH and SHT have been suggested as an important future contributor (Teknologirådet, 2009). SH were first described in the 1980s by the American Association of House Builders, and hobbyists were the first to construct a smart home (Harper, 2003). But what separates a typical home from a "smart home" and what exactly

makes a smart home smart? There is no fixed definition of what a smart home is, but a smart home is smart because contains technology that can control and manage the home in response to its users' needs (Ibid.). According to Demiris and Hensel (2008) "a "smart home" is a residence wired with technology features that monitor the well – being and activities of their residents to improve overall Quality of Life" (p. 33). In addition to this definition Lê, Nguyen and Barnett (2012) proposed a conceptual framework suggesting that SH can be characterized or identified as having five basic elements:

(1) Automation: the ability to accommodate automatic devices or perform automatic functions; (2) Multi-functionality: the ability to perform various duties or generate various outcomes; (3) Adaptability: the ability to adjust or be adjusted to meet the needs of users; (4) Interactivity: the ability to interact with or allow for interaction among users; and (5) Efficiency: the ability to perform functions in a timesaving, cost – saving and convenient manner. (p. 608).

This papers theoretical framework is based on Antonovsky's health promotional theory about salutogenesis that focuses on the question of what creates health (Lindström & Eriksson, 2010). The traditional question within the biomedical model has for a long time been related to what factors that makes us ill or unhealthy and the idea that removing these factors will enable us to have good health. But Antonovsky turns the question around and therefore rejects the traditional biomedical model (Antonovsky, 2012). By focusing on the question on what creates health, we firstly learn more about the characteristics of people who despite stressful events in life manage to live well and healthy and it allow us to view health in a new more nuanced way, where good health does not necessarily mean an absence of all disease and poor health is not always tied to illness (Ibid.). According to Antonovsky, health must be seen as a continuum between health and disease and defines salutogenesis as "the process of movement toward the health end of a health ease/dis-ease continuum" (1993; Lindström & Eriksson, 2010, p.18). The salutogenic method helps to determine where an individual is located on this "continuum". Salutogenesis consists of two central elements or key concepts: Sense of Coherence (SOC) and Generalized Resistance Resources (GRR). The theoretical framework along with the definition above is intended to serve as a basis and a frame for understanding SH and SHT in.

During the last decade there has been a remarkable development in the use of SH in eldercare and health sectors across the planet, particularly in the western countries like England, USA, Australia and Scotland (Teknologirådet, 2009). Welfare technology, such as the SH discussed is in this paper, is often specifically aimed at older people, but may also be aimed at people with chronic diseases or people with different forms and different degrees of disability. In general SH may offer technology preprogrammed to assist contribute inhabitants with household tasks, window and lighting control, multimedia (television, stereo), communication (video calling, iPad), advanced sensors, security and safety alarms and infrared sensors to detect fire. The assumptions regarding SH and SHT are that it may lead to positive aging, an overall enhancement in life, increased safety, security and QoL. In addition to this, there are several other aspects of elderly people's lives that may improve, like their autonomy and their opportunity to live longer at home. Technology may also contribute to household tasks, medication, personal hygiene and reminders such as social or important events. Laberg (2005) asserted that SH have contributed to increased safety and independence amongst elderly citizens. SH and smart home technology have great potential in future aged care. But, even though there have been several studies (Demiris et al., 2004; Chan et al., 2009; Agree & Freedman, 2011) showing to good results in relation to both perceptions of the technology and attitudes towards it, there has been very little research specifically on health benefits and how such technologies may contribute to enhance the QoL to elderly citizens. Moe and Molka- Danielsen (2012) conducted several literature searches in different scientific databases and found that there is little prior research on the effects of assistive technologies for elderly in need for care while living at home. Laberg (2005) also highlighted this and mentioned that "as far as we know, there is no systematic research on the use of smart home technology and the impact on health" (p.3). The reason why such research not yet been conducted may have several reasons. One possibility is that the terms inside this field of interest are being used interchangeably, such as "assistive technology", "ICT – Technology" and "gerontechnology", which could complicate the definition of what SH and SHT are. Another possible complication is there are very few studies that actually investigate the health benefits of SH and SHT, and as a result there is little evidence or research basis to rely on for further comparison between empirical data. Despite this, there is an overall assumption that SH may contribute to enhance health and QoL and allow elderly to live longer in their homes.

Main aims

The present study aims to examine in which ways SH and SHT contributes to enhance health and QoL in elderly citizens and enable them to live longer in their homes. Secondly it aims to explore if such technology increases safety, independence and enhances social activity amongst elderly citizens. Third, this study aims to give an example on how to contextualize the salutogenic theory as a new and more nuanced way of thinking in relation to future research and development related to SH and SHT. The paper is based on following research question; "In which ways can smart homes and smart home technology contribute to enhance health and QoL in elderly citizens and enable them to live longer in their homes?". To accompany the main research questions and to be able to give a fulfilling and adequate response two additional questions have been formulated based on this paper's interview guide: 1) "Do smart homes and smart home technology contribute to increase safety and independence?" 2) "In which ways may such technologies enhance communication and social activities amongst elderly?". This paper has a health promotional approach with a foundation in Aaron Antonovsky's salutogenesis theory and therefore offers a different perspective than other papers, reviews and articles on the field of SH and SHT. Traditional work within this field has focused on reviewing previous work, perceptions and attitudes towards this innovations. Another angle is investigating the functionality of the technology itself and its relation to its users.

Method and Materials

The present study is qualitative in-depth interviews with six elderly participants aged 67-92 and a structured interview guide made the basis of the interviews. The data was collected from a strategic sample at "Kampen Omsorg+" (KO+) in Oslo, Norway and the participants were recruited through the management at this smart home residential complex. The participants were volunteers. According to Malterud (2003) a strategic sample is put together with the aim of collecting data that shed light on the research question or the present problem the researcher is working on the basis of. KO+ is a smart home residential complex run by the Church City Mission and consists of 91 apartments that Oslo municipality rents out to those in need. This provision enables many elderly people to be able to stay at home in their own apartment. The interviews were recorded on tape and then transcribed in order to ensure validity. In addition to this, notes were also written during the interview to get a better total impression of the participants' view. The interview protocol included questions about

participants experience and knowledge about SH and SHT, understanding of what health and QoL are and how such technologies could benefit their QoL. The informant's quotes are translated from Norwegian to English, so they may be a little different from the original quotes. A phenomenological analyzing tool and a content analysis were used to analyze the data. Even though this study is based on a more hermeneutical point of view, the systematical text condensation described by Malterud (2003), inspired by Giorgis phenomenological analysis, is considered to be a relevant tool in relation to analyzing the data systematically and properly. The rationale for this is that in hermeneutics it has been more traditional to interpret texts rather than using a step-by-step method in order to analyze data (Kvale & Brinkmann, 2010). By using systematic text condensation and content analysis it made it possible to systemize, organize and select the most central elements in the interviews in order to get a fulfilling answer on the research questions. Systematical text condensation consisted of four steps. Firstly, it was critical to know the data and get a solid general impression. Secondly, it was important to find the meaningful units in the content of the interviews. The third step was to condensate from code to meaning. The last step in this analysis method was to summarize the findings from condensation and codes into descriptions and conceptions. Systematic review of the material in several stages, along with the theoretical framework and influenced by considerations of relevance, validity and reflexivity was ensured through the analysis procedure (Malterud, 2003).

Ethical considerations

The use of human as subjects in research should be based on free and informed consent (Fossheim, 2009). All participants were given an information sheet about the study's purpose and were informed about their protections as informants. All participants signed a consent form after a conversation with the interviewer in which this information was given. The participants were informed that all information and material from the interviews was to be treated confidentially and that they would be presented anonymously in the final paper. In addition to this they were also informed both orally and in writing about the voluntary nature of their participation and that they could withdraw at any time and revoke the interview. In addition to this, the study was submitted and approved by the Norwegian Social Science Data Services (NSD).

Results

A total of six older adults aged 67-92 participated in the in-depth interviews (m=2, w=4). Each interview lasted approximately half an hour to an hour. Both analyzing tools contributed to a better understanding of each interview contents and revealed the most central elements in the text. In order to shed light over, or to illustrate how SH and SHT can contribute to enhance QoL and increase elderly citizens ability to remain in their homes, it was necessary to get a deeper understanding of what the informants understood as QoL and what QoL meant for them. One informant described QoL as:

"Quality of Life is that I manage to maintain communication with the others who live here and to be able to socialize, that's the most important thing to me".

Another informant emphasized independence as a central element:

"Independence is important to me, and the social aspects. Here I have an apartment and can do whatever I want. In addition to this, I think Quality of life means living a dignified life".

The analysis revealed several factors that were equally emphasized by all informants in relation to the meaning of QoL. These central elements can be summarized into keywords as social aspects, well-being, independence, opportunities and freedom to be able to do the things they want to do. The social aspects and to remain independent for as long as possible was the two highest valued aspects and most central in their understanding of QoL.

To be able to give an good answer on the research questions it was essential to ask questions related to the technology and what the informants understood as SH and SHT. In the second interview an informant said:

"Smart home technology is the technology that enables me and assists me in everyday life".

Another informant described SHT as:

"The technology that reminds me when home care is coming and when something happens socially".

The second informant referred to the tablet PC all residents have. The majority of them understood SHT as technology that could assist them in everyday life and keep them safe and secure. Technology contributing to this was discovered through the analysis and from an information sheet from the management:

- Security alarm and property security
- Temperature control and automatic lighting
- Tablet PC (reminders, social, home care and Internet)
- Phone (video functions)
- Emergency assistance (personal safety alarm internal)
- Oven and Stove safety (timer and infrared sensor)
- Fire safety (fire cell)
- Individual assistance

However, technology and eldercare do not always coexist smoothly, this is also the case at KO+. Some of the informants pointed out that the relationship between new technological innovations and elderly was difficult at times. Several of the informants highlighted that this was mainly because they are old and see technology as difficult to adapt to or learn. One informant said that the ability to learn is always present, but pointed out that some of the other residents are negative to new things and are not willing to learn. However, in relation to usefulness and utility value, all informants were positive and thought SHT was easy and understandable and for the most time had high utility value. When questioned about this it seemed that several of the informants spoke negatively on someone else's behalf and not for them self, and all informants were actually surprisingly positive to the technology at KO+, but pointed out that this is not the case for all. It should be noted that all residents are offered training sessions and easy manuals that are designed specifically for elderly residents. One of the most central concerns was related to the residents' fear of technology taking over for all human interaction in eldercare. Several mentioned the good relationship they have with their

home caring nurse and several of them love this contact role in everyday life. It seemed very important to some of the informants that someone came in to their apartment, not only to do medical caring, but that someone that spoke with and cared them, and just being there meant a lot for some. One informant described:

"On the other hand I see the dangers with all the technology, it can sometimes be a bit too technical and not as much social contact. It's a little scary. I like it when home care is dropping by".

In addition some informants underlined that the use of technology could have been a little more facilitated, but there was a positive attitude towards devices and sensors that are installed, and new possibilities in the future. The primary findings in this study are that all informants are in general positive to the concept of SH and SHT if proper training and information is given. In addition to this the social aspect of aged care is important to maintain this feeling and is central to those interviewed living at KO+. Even though there are challenges related to SH and SHT, there are definitely more positive than negative attitudes regarding KO+ among the informants.

The most central findings in the analysis are that all six informants claimed that KO+ enhances their health and QoL and enable them to live longer at home. Even though KO+ is a SH residence, everyone lived in their own apartment and not in a single room as in nursing homes. One informant explained:

"Yes, I am convinced that the SH enhances my QoL, I cannot live without technology now".

Another informant described:

Certainly, I think SH enhances my QoL, in what way? It depends, this technology is something new and there are so many opportunities here than before, there is so much that enhances my QoL here. Both technology and the people living and working her, it's the total package"

There wasn't a single factor that could contribute to an enhancement in health and QoL, but as the second informant says:

"It's the total package".

The central elements within this statement are that KO+ offers the residents with social events, increased security and safety and makes the majority feel more independent. Together these elements could contribute to enhance health, QoL and enable elderly people to live longer in their homes.

Discussion

The present study used qualitative in-depth interviews with six informants from the smart home resident KO+ and followed a structured interview guide. General findings of the study show that SH and SHT can contribute to enhance elderly citizens' health and QoL and enable them live longer at home. Even though their apartments at KO+ were not their property, the informants expressed that it felt like it because they rented their own self-contained apartments. In addition to this, KO+ contributed to increased safety and security, independence and social activity. All informants were positive towards SH and SHT and were excited at the thought of future development in aged care. In relation to challenges presented by SH and SHT, several of the informants expressed a fear about technology taking over for human interaction and that some things could be too advanced. Another thing they noted was that some aspects of the technology could be a little more facilitated, specifically for people with hearing and visual problems.

In relation to this study's theoretical foundation in Antonovsky's concept of salutogenesis, a strong SOC is associated with good health and is in that manner related to QoL (Lindström & Eriksson, 2010). SOC consists of three central dimensions: (1) comprehensibility: (2) manageability: and (3) meaningfulness. These three dimensions are understood to be closely related and codependent with each other (Ibid.). SOC is, according to Antonovsky (2012), seen as a life orientation or a way to relate to the world. In this way of thinking, SOC may be transferred to almost anything: this is also the case for the results from KO+. By transferring Antonovsky's ideas and applying them to SH and SHT it appear as: elderly citizens could increase their chances for a good interaction with the home and the technology if the home is

built in a way that make them believe that; (1) they can understand both the SH and SHT, and that the home and included technology are structured, predicable and explicable: (2) that they have the resources at their disposal to handle it: and (3) that they wish to cope with SH and SHT, that they are challenges worthy of investment and engagement (Hjelm, 2004). In relation to the interpretation of the results, the informants believed that the building itself is *comprehensible*, and that there was little doubt about where the entrance, garden, living room and hallway is and there was no doubt in how to use the different basic functions in their apartments. As one informant said:

"I almost no longer think on the various technologies that is here, it's almost automatic. Now I know the different functions and understand how they work"

A SH that is comprehensible provides the users with understanding and promotes usability, something that is the case at KO+ according to the informants.

The second dimension of SOC is *manageability* and relates to how a person handles the different functions and technical equipment: the user, in this case the informants, should know the functions of the home to reach his or her goal. If this is not the case, the informant should be able to learn how to, and this information must be easy to acquire and comprehend. This was not always the case at KO+, some of the informants explained that it was difficult for some to acquire this information even though they are offered training and easy manuals. One informant described that:

"We have been offered training and someone comes if a problem occurs. People from the IT department conduct training sessions everyday"

Another informants noted that:

"it can be difficult for many people to familiarize themselves with these new things, and it's not all people wanted to familiarize with it either. This was also true for me in the beginning".

If a tablet PC or any other device fails, how will the informants solve this in order to get reminders, information and communication? Not everything in a SH is manageable for curtain individuals and it is difficult to facilitate for all, especially with 91 residents where they must adapt to the majority. A system failure or an error of some sort may be confusing and frustrating both for carers and especially for the user. How can a SH prevent these challenges, or is it possible to meet them? The solution again lies within the field of training and exercise. Users or future users should get proper trainings programs and each training program should be customized to each individual, that's seems to be the proper solution. However, there are still unanswered questions that needs to be further investigated in order to solve or improve this in future SH development.

The third dimension, and the most important according to Antonovsky (2012), is the motivational factor, or *meaningfulness*. SH and consisting SHT should be meaningful in a way that motivates the residents to interact with it, and the home should have emotional significance to the individual (Hjelm, 2004). Several of the informants said that now they were fond of the place they lived, compared to their previous nursing home. One informant said:

"Being with other people and the overall package here that makes my life meaningful"

Another informant said:

"There are so many opportunities here, technology is one of many important things, but what matters most is the social aspect. This is something that's not found in any nursing home. This I experience in my own home, it's pretty special".

If a problem occurs within the four walls of the apartment, the residents who are motivated would search for solutions to that problem, even if the problem seems difficult to fix or figure out. This informant describes that:

"I am not so clever with this technological stuff, I don't understand everything, but I've heard that I cannot do much wrong by trying, so I try a bit, press here and there and it helped".

By investing time and energy in something, no matter what it is, it can become meaningful to the residents. Involvement, learning and coping creates meaning, and this extends to SH and SHT (Ibid.). This is also something that the informants recognized, by investing both time and energy and by trying to use the different SHT that is within their apartment it proved not too difficult. All informants loved their apartment and common areas attached to KO+. The second key concept of salutogenesis are GRRs. GRRs are resources within each individual bound to their identity and capacity, but also to their environmental as either material or non-material qualities (Lindström & Eriksson, 2010). Antonovsky claimed that factors that may bring disease or illness also have the ability to bring health, but not through reducing risks as in disease prevention. Antonovsky thinks that stressors are equally likely to be salutogenic or health promoting. If the existence at a SH is marked with meaningful activities, existential thoughts, and connection with their inner feelings and social relations, it may help the individual to be able to face difficult challenges, not only at the SH but also in life (Antonovsky, 2012). These resources, if promoted at an SH, may pull the individual towards the positive side of the health continuum and help to establish a high SOC and QoL (Ibid.).

There have been several studies conducted on the field of SH and SHT but under other related terms like assistive technology, ICT technology (Information- and communication technology), gerontechnology and welfare technology. But when it comes to prior research specifically on health benefits very little empirical data exists, especially in relation to SH and SHT. This is also difficult to determine, because it seems like these terms are being used interchangeably as Chan et al. (2009) claims. In 2012 Moe and Molka – Danielsen conducted several literature searches using Google Scholar and Science Direct as their databases. Their results found that "to our knowledge there is very little prior research on effects of assistive technology for elderly in need of care" (Moe & Molka – Danielsen, 2012, p. 268). In her research on SHT, Laberg (2005) explained that as far as she knew, no systematical research on the use of SHT and what impact technology has on health existed. However in conversation with one participant in her study, she showed that SHT might have a positive impact on health. By drawing a line from Laberg's work to this present study it is possible to see similar assumptions about SH and SHT: all informants claims that KO+ has an impact on their health and they say that KO+ contributes to an enhancement in QoL. Another similar finding is related to SH ability to increase both independence and safety in everyday life. In their study about information and communication technology (ICT) Torp et al. (2008) found that ICT might have potential health promoting effects for frail elderly people since it gives the carers more control, increased knowledge and social contact. Another study by Demiris et

al. (2004) focused on older adults' attitudes towards and perceptions of SHT. During three focus group sessions they revealed that concerns about the user – friendliness of the devices and the need for training tailored to older learners. Similar concerns were raised for KO+, especially regarding the need for proper training in order to be able to use all the high tech equipment installed in their apartment. In contrast, the results in this paper differ from Demiris et al. (2004) in relation to utility value and usefulness, since the informants from KO+ felt that the technology had both properties. However, both studies found that all participants had an overall positive attitude towards SHT.

In their Masters' thesis, Muselman and Wodruff (2010) conducted an exploratory analysis on changes in QoL for group home residents of the Bob and Judy Charles Smart Home. The primary objective of their research was to determine if living in a SH with SHT increased QoL for eight adults with developmental disabilities. The results indicated an improvement in QoL of life for all eight adults participating in the study. In addition to this, the results showed that the participants had more relationships and relationships of a higher quality, greater interaction with the environment and increased independence (Muselman & Wodruff, 2010).

It is difficult to disprove the findings from this study, but by the same token it is difficult to compare to the existing literature on the topic, which is currently compromised of a few literature reviews and one quantitative study. Another limitation for comparing results is that all studies have different perspectives and consists of different types of technology. As mentioned earlier, technological terms are used interchangeably making it difficult to define and compare (Chan et al., 2009). One question that remains unanswered is: why hasn't anyone thoroughly conducted research specifically on health benefits related to SH and SHT? The question will remain unanswered, but one way of looking at it is that it might be difficult to do research on a field with almost no empirical data to rely on. A second perspective is that technology vendors and investors are more interested in technology itself and the commercial development of it rather than the people living or future residents at SH. However, even if these studies can neither confirm nor disprove the findings at KO+, some similarities exists and are comparable. All studies found that SH and SHT, or similar technology, could benefit the users in different ways. Demiris et al. (2004) found positive attitudes towards the technology; Laberg (2005) noted that SH and SHT could benefit the users in relation to increased safety and independence; Torp et al. (2008) claims that ICT technology has potential health promotional benefits; and Muselman and Wodruff (2010) found an

improvement in QoL for disabled people living in a SH resident. Compared to the findings at KO+ all these studies, in different ways, confirm that SH and SHT can enhance health and QoL and other important aspects of everyday life if used properly and proper trainings in given to the residents.

Even though the findings of this study not offers definitive solutions to the future challenges in aged care, they might be an inspiration and can show self-reported health benefits. In Article I: "Smart Homes and Smart Home Technology: part I", it was suggested a possible health promoting framework: Health Promotion 2.0 (HP 2.0). The HP 2.0 framework is meant to support an intersectoral team to create a base of knowledge that functions to support processes and content of development, implementation and evaluation of healthy aging strategies (Lezwijn et al., 2010). The proposition is not designed specifically for SH and SHT but might be a good start for something that has the potential to be a solution for municipalities across the planet searching for answers on how to implement and direct further development in health promotional and salutogenic SH. By the use of similar or possibly more developed frameworks and further investigation related to health benefits, health promotional SH could be found in many corners of the world. Salutogenical SH could promote health in a new and more nuanced way and a possibly further enhancement in health and QoL.

Limitations

There were some limitations in this study. First, the data had to be collected on one day at KO+ with six informants. It was intended that eight to ten informants would be interviewed in order to obtain enough data to the analyzing work, but the situation at KO+ that day made it difficult to interview all that many. All six interviews lasted long enough to get the data required for analysis. Even though the data is seen as solid and enough to draw a very careful conclusion, more informants would have strengthened the study. More informants could have given even more information and probably a more nuanced analysis. Another concern was related to the selection of informants. The management pointed out which informants who were willing and able to do the interviews. The management could therefore choose informants that are positive to this technology, and not those who are negative.

Another central element in qualitative research is the validity and reliability. According to Thagaard (2009) validity and reliability in qualitative research relates to the interpretations conducted by the researcher. This study's sample of informants brings different perspectives

to the research questions. Different perspectives can result in fulfilling understandings of the involved phenomena, as well as diversity in the data to illuminate the different aspects and strengthen the validity of the data (Kvale & Brinkmann, 2010). The validity of the research also depends on the study's informants, something that might be a weakness in this study. If the study was conducted in two SH in Norway, with similar facilities and technology, it would be possible to compare results from both places and then relate them to previous research, securing the trustworthiness or reliability of the data collected. Since the data only were collected from one SH it is not possible to relate the results in a bigger scale. It was impossible to find another SH with the same technology and facilities and therefore difficult. Another question related to the validity is: were these the right informants to answer and to illuminate the research question? All six informants had lived at nursery homes before they came to KO+ and would be ideal for this study based on their experience both from nursery homes and now at KO+. The quality of the interviews improved with each subsequent interview, something that might affect the final result. The interview situation and the researcher's ability to ask good questions and his or her ability to invite to good reflection is also something that is important for the researcher to have in mind and that might affect the end result (Kvale & Brinkmann, 2010).

The methods for data collection and analysis have been described, which, strengthens this study's reliability, or trustworthiness. However, some limitations exists that need improvement and that weaken the study's final result. Due to the limited sample of informants and only conducting data collection from one SH it is hard to argue that KO+ informants enhancement I health and QoL mainly comes from SH and SHT, but the results points in that direction.

Conclusion

The main purpose of this paper was to examine whether smart home and smart home technology could contribute to an enhancement in health and QoL for elderly citizens and enable them to live longer in their homes. Six (m=2, w=4) qualitative in-depth interviews following a structured interview guide were conducted to gather the data. Since the hermeneutical approach lacks a step-by-step data analysis method, systematical text condensation and content analysis were used. The results of the study showed that smart homes and smart home technology could enhance health and QoL in different aspects of

everyday life: improved social aspects, increased safety and security, and an enhanced sense of independence. In addition to this, smart home technology contributed to increase their ability to live longer in their own apartment, or in their own homes. In the discussion it emerged that the health promotional theory of salutogenesis could be applied to the results, this clearly shows what great potential this theory has in relation to health promotion. Not only is it possible to transfer its central elements to this present study's results, but also to other things and make them health promotional like Hjelm (2004) showed in her doctoral thesis. The main purpose of having salutogenesis as the health promotional focus in this paper was to provide an example on how the theory can be transferred over to smart homes and smart home technology in order to think in a health promotional context. With its new, more nuanced way of thinking, salutogenesis could contribute to an exciting development related to smart homes and smart home technology and help to direct future development in aged care as a whole.

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APPENDIX A

Analyzing matrices

Informant in numbers 1-6. Numbers in boxes= line in each interview x= number of times central elements in a theme is mentioned

Research questions In mind: THEMES	1	2	3	4	5	6
Security (I)	21: xx 35,39: xx	16: x 97:xx	5: xxx 12:xx 88:xx 135-138:xxxx	9: x 48:xx 57:x	43:xx	88-89: xx 95:x 135:x
Quality of life (II)	2 & 7: xx 31: xx 66-68: xxx 71: xx	12,13,19: xxx 57-61:xxx	25-27:xx 65:x 123-125:xx	42-44:xx 48:xx	5-6:xx 7:x 10:x 13:x 39-41: xxx 66-70: xxxxx	15-16:xx 18-20:x 24:x 28:x 95, 98:xx 177:xx 208:x
Challenges (III)	27: x 58:xx 116: xx	49-52:xxxx 161-163:xx	41-45:xxx 146-148:xx	16:xx 18:xxx 21:xx 24:x 59:xx x 67:xx 76:x		86-88: xx 199-200: XX 203-205:XX
Technology (IV) (understanding of, types, etc.)	12,13: xx 50-53: xxxx 57,58: x 60-61: xx 94: xx	36-39:xx 45-47:xxx 80-89:xxxx 99-100:x 141:x	28-30:x 34-35: x 54:xx 97:xx 102:xx	27:xx 34:xx	29-33: xxx 49-53:xx 55-56: xx 58:xx 61:xxx	68-73:xxxx 80-81:xx 91:x 108:x 146-150:xxx 152:x 154-158:xx 165:xx
nursing home (V)		68-73: xxx	16-18:xx 141:xx	106:xx 181:x	10-11: x	180-183:xxx
Smart homes contribution to QoL (VI)	79: xx 81: xxxx 87: xx 106: xxx 112, 113: xxx	15-21: xxx 67:xx 128: x 132:xxx	38: x 40: xx 120-121:xx	12:x 37:xxx 131:xx 161:xxxxxx 177:xx 179-181: xx	76:x 78-79: xxxx 89-92: x 96-98: xxx	33:x 55,57,63:xxx 119-124:xx 131-133: xxxx 187-193:xxxxx 220-221:xx

APPENDIX B

Introduksjon:

Først vil jeg takke for at du tok deg tid til å stille opp på intervju. Du gjør det mulig for meg å gjennomføre min hovedoppgave ved NTNU. Jeg vil bare minne deg på at du når som helst kan trekke deg fra intervjuet. Du kan også velge å trekke deler eller hele samtalen om du ønsker det.

Gi litt informasjon om masterprosjektet og hvorfor jeg velger de som informanter, gi en god men presis innføring, slik at informantene forstår hva du mener.

- 1) Er det noe du lurer på før vi begynner intervjuet?
- 1.0 Generell info
- 2) Alder
- 3) Kjønn
- 4) Hvor lenge har du vært boende her?

- 2.0 Hoveddel
- 5) Kan du beskrive for meg hvordan det er å være boende her? (Stikkord: Trygt, Fint, komfortabelt, godt miljø)
- 6) Har livet ditt forandret seg etter at du flyttet inn her? (bedre, verre)
- 7) Kan du beskrive for meg hva du forstår som smarthusteknologi/velferdsteknologi?
- 8) Hva tenker du når du hører uttrykket/begrepet/ordet velferdsteknologi/smarthusteknologi/smarthus?
- 9) Kan du beskrive for meg hvilke tekniske hjelpemidler (smarthusteknologi) som er mest sentrale i din hverdag? (Stikkord: fallalarm, innbrudd, sikkerhet, flom og brannalarm, lyskontroller, automatisk kontroll av komfyr og annet brannfarlig utstyr, GPS, video)

- 10) kan denne teknologien bidra til å hjelpe deg i din hverdag? eventuelt hvordan? (Stikkord: assistanse, hjelp, behov)
- 11) Opplever du at slik smarthus teknologi gir deg økt selvstendighet? (independence)
- 12) Føler du deg tryggere når du har slik teknologi tilgjengelig? Eller her på Kampen Omsorg+
- 13) Er teknologien på noen måte involvert i sosial og fysisk aktivitet? (Stikkord: sosiale sammenkomster, Facebook, mobiltelefon, skype, tv, stimuli i form av aktivitet (trening). Har du datamaskin, og har du kontakt med venner og familie gjennom den, nettbrett? Teknologi innenfor dette kan for eksempel være tv spill som stimulerer til trening og aktivitet)
- 14) Har du teknologi som hjelper deg til å bli minnet på ting? (stikkord: avtaler, møter, samlinger, medisiner, hjemmesykepleie)
- 15) Hvilke tanker har du rundt brukervennlighet og nytteverdi av slikt teknisk utstyr? (stikkord ha i tankene, ikke led: Får du til alt, eller trenger du hjelp til noe i forhold til utstyret? Ser du nytten av dette utstyret, ser du behovet. Eller føler du at du befinner deg i en uvant situasjon, hvor du ikke vet hva du skal gjøre)
- 16) Kan du beskrive for meg hva du tenker når du hører ordene helse og Livskvalitet?
- 17) Tror du at smarthus og smarthusteknologi kan bidra til å øke helse og livskvalitet hos eldre mennesker, eller om teknologien har en positiv innvirkning på helse og livskvalitet? Og tror du slik teknologi kan bidra til at flere eldre mennesker kan bo hjemme lengre?
- 18) På hvilken måte tror du denne teknologien kan bidra til å øke livskvaliteten?
- 19) Hvilke tanker kommer i hodet ditt når du hører ordet "helsefremming"?
- 20) Hva er de fremste fordelene, for din egen del, med denne smarthusteknologien?
- 21) Hvordan ser du for deg fremtiden blir i forhold til dette feltet?

22) Er det en type, eller noe teknisk utstyr, du savner? (stikkord: roboter: som vasker, assistanse i dusj, toalett)
23) er det noen utfordringer som du tenker på, eller er det noe som kan være vanskelig? Noe du ikke liker med KO+
24) føler du at det er utfordrende, alt dette høyteknologiske?
25) Er det noe mer du har i tankene i forhold til dette tema, hva tenker du? Noe du har kommet på underveis?
Tusen takk for at du tok deg tid,
Mvh
Erlend Kydland Faanes

NTNU – Trondheim Norwegian University of Science and Technology

APPENDIX C

Erlend Kydland Faanes Master Student i Helsevitenskap Telefon: 92255847

E-mail: Erlendkf@outlook.com

Smart Homes and Smart Home Technology

I løpet av våren 2014 avslutter jeg min mastergrad i Helsevitenskap ved NTNU og skriver hovedoppgave om Smarthus og Smarthus teknologi og hvordan dette kan bidra til å øke livskvaliteten hos eldre mennesker. For å kunne fullføre hovedoppgaven har jeg behov for å gjennomføre intervjuer med mennesker som bor i slike høyteknologiske hjem, eller som har erfaring med slik teknologi. Intervjuformen vil bli ført som en samtale mellom intervjuer og den intervjuede, hvor det blir diskutert og spurt rundt tema. Intervjuet vil ha en ca. varighet på 30 – 60 minutter. Hovedoppgaven veiledes av Professor Geir Arild Espnes ved NTNU.

For å kunne gjengi dine meninger fullt og helt, og så nøyaktig som mulig, vil intervjuet bli tatt opp på båndopptaker og notater vil bli skrevet. Om det skulle oppstå en situasjon, der du som den intervjuede, ikke ønsker at noe av de opplysninger og meninger du oppgir eller om hele intervjuet skal trekkes, vil det selvfølgelig være mulig uten at du begrunner hvorfor. Det er også viktig å påpeke at dette er frivillig, og du kan velge å trekke deg når som helst. Det er kun meg (student) og veileder som har tilgang på de opplysninger som blir gitt, og alt vil bli behandlet konfidensielt. Prosjektet er meldt inn til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste AS. Det vil ikke være mulig å gjenkjenne noen ut i fra de opplysninger som gis under intervjuet i det ferdige resultatet. Prosjektet skal etter planen avsluttes 15.mai og alt av datamateriale vil bli slettet etter bruk.

Under intervjuet settes det stor pris på ærlige svar. Om det skulle være noen spørsmål rettet til oppgaven eller om det ønskes opplysninger rundt dette, er det bare å ta kontakt.

Dato	Sted	Underskrift	Underskrift (Erlend Kydland Faanes)
-	•	on om studien, og er vinig t ogaven (anonymt).	n a detta og tinater herved at mine
leg har mot	tatt informaci	on om studien, og er villig t	il å delta og tillater herved at mine
Erlend Kyd	land Faanes		
Med vennlig	g hilsen,		
Takk for at	du tar deg tid.		
oppgaven ei	ner om det øn	skes opprysninger rundt det	ite, er det bare a ta kontakt.

APPENDIX D

Norsk samfunnsvitenskapelig datatjeneste AS

NORWEGIAN SOCIAL SCIENCE DATA SERVICES

Geir Arild Espnes Institutt for sosialt arbeid og helsevitenskap NTNU

7491 TRONDHEIM

Vår dato: 13.03.2014 Vår ref: 37982 / 3 / LB Deres dato: Deres ref:



Harald Hårfagres gate 29 N-5007 Bergen Norway Tel: +47-55 58 21 17 Fax: +47-55 58 96 50 nsd@nsd.uib.no www.nsd.uib.no Org.nr. 985 321 884

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 05.03.2014. Meldingen gjelder prosjektet:

37982 Smart homes and smart home technology Behandlingsansvarlig NTNU, ved institusjonens øverste leder

Daglig ansvarligGeir Arild EspnesStudentErlend Kydland Faanes

Personvernombudet har vurdert prosjektet, og finner at behandlingen av personopplysninger vil være regulert av § 7-27 i personopplysningsforskriften. Personvernombudet tilrår at prosjektet gjennomføres.

Personvernombudets tilråding forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, ombudets kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/meldeplikt/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://pvo.nsd.no/prosjekt.

Personvernombudet vil ved prosjektets avslutning, 15.05.2014, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Katrine Utaaker Segadal

Lene Christine M. Brandt

Kontaktperson: Lene Christine M. Brandt tlf: 55 58 89 26

Vedlegg: Prosjektvurdering

Kopi: Erlend Kydland Faanes Erlendkf@hotmail.com

Dokumentet er elektronisk produsert og godkjent ved NSDs rutiner for elektronisk godkjenning.

APPENDIX E

Personvernombudet for forskning



Prosjektvurdering - Kommentar

Prosjektnr: 37982

Utvalget informeres skriftlig om prosjektet og samtykker til deltakelse. Informasjonsskrivet er godt utformet, såfremt setningen "Dette infoskrivet fungerer som en kontrakt mellom intervjuer og den intervjuede og skal sikre at du som person holdes anonym i rapporten, men også at de opplysninger og meninger du oppgir kan brukes videre i min oppgave" slettes, jf. telefonsamtale med Erlend Kydland Faanes 12.03.2014. Videre endres dato for prosjektslutt til mai. Det kan også gjerne tilføyes at prosjektet er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste AS.

Data samles inn gjennom personlig intervju og evt. gruppeintervju. Materialet behandles elektronisk. I lys av formålet og intervjuguiden tas det høyde for at det vil kunne bli registrert sensitive opplysninger om helseforhold, jf. personopplysningsloven § 2 nr. 8 c).

Personvernombudet legger til grunn at forsker etterfølger NTNU sine interne rutiner for datasikkerhet. Dersom personopplysninger skal lagres på privat pc og ekstern harddisk, bør opplysningene krypteres tilstrekkelig.

Forventet prosjektslutt er 15.05.2014. Ifølge prosjektmeldingen skal innsamlede opplysninger da anonymiseres. Anonymisering innebærer å bearbeide datamaterialet slik at ingen enkeltpersoner kan gjenkjennes. Det gjøres ved:

- å slette direkte personopplysninger (som navn/koblingsnøkkel)
- -og slette/omskrive indirekte personopplysninger (identifiserende sammenstilling av bakgrunnsopplysninger som f.eks. bosted, alder og kjønn)
- samt slette lydopptak