Informing an assistive living technology intervention to prevent hospitalisations for home-dwelling older persons

by

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Thesis submitted in fulfilment of
the requirements for the degree of
PHILOSOPHIAE DOCTOR
(PhD)

University
of Stavanger

Faculty of Health Sciences

2019

Acknowledgements

I am grateful to the persons who have made this work possible to carry out. First, I would like to thank all informants for participating in the project. I am gratefully humble for the interest, willingness, time, and for sharing their thoughts and clinical insights which made this study possible. I would also like to say thank you to the administrative personnel in the municipality who facilitated the study. Thank you for your willingness to prioritize this in a busy work schedule.

Second, my main supervisor at Centre for Age-related Medicine (SESAM), Stavanger University Hospital, Ingelin Testad deserves a big thanks! The possibilities you provide as director at SESAM, the accessibility you provide as a supervisor, as well as guiding and motivating in all stages of the PhD work are simply invaluable. I am sincerely grateful for being part of the Athena research group at SESAM.

My co-supervisors, Professor Siri Wiig at the University of Stavanger and professor Kolbjørn Brønnick at Stavanger University Hospital and University of Stavanger have both made invaluable contributions to the thesis, as well as the publications encompassing it. Thank you both for taking time to share your comprehensive scientific knowledge throughout the PhD study.

This PhD study has been part of a bigger project, which has provided many experiences in terms of collaboration and partnership. Brita Gjerstad at NORCE (previous IRIS) was project manager in the "Development and Implementation of ALTs" –project, and provided guidance and support for a novel researcher, such as myself. Thank you, Brita! The commencement of the study was due to funding from several partners: one municipality received funding from the Regional Research Fund for Western Norway and together with funding from SESAM, the main funding was provided. The University of Stavanger has also been involved, in terms of both funding and providing an academic

Abbreviations

ALT:	ALT
ALTs:	ALTs
CI:	Confidence Interval
COPD:	Chronic Obstructive Pulmonary Disorder
CRP:	C-reactive Protein test
DoH:	Directorate of Health
GP:	General practitioners
ICD-10:	International Classification of Diseases version 10
ICN:	International Council of Nurses
IQR:	Inter-Quartile Range
LOS:	Length of Stay
MRC:	Medical Research Council
MUSIQ:	Model for Understanding Success in Quality
NSF:	Norsk Sykepleierforbund
PARIHS:	Promoting Action on Research Implementation in Health Services
QI:	Quality Improvement
REC:	Regional Ethical Committee for Medical and Health Research Ethics
REP:	Replicating Effective Programs

RHA: Regional Health care Authority

STC: Systematic Text Condensation

UNFPA: United Nations Population Fund

UTI: Urinary Tract Infection

WHO: World Health Organisation

WMA: World Medical Association

WP: Work Package

List of papers

This thesis is based on the following papers, which will be referred to in the text by their Roman numerals:[1]

Paper I

Gjestsen, MT, Brønnick, K., Testad, I. (2018).Characteristics and predictors for hospitalizations of home-dwelling older persons receiving community care: a cohort study from Norway. *BMC Geriatrics BMC Geriatrics.* doi: 10.1186/s12877-018-0887-z

Paper II

Gjestsen, MT, Wiig, S., Testad, I. (2017). What are the key contextual factors when preparing for successful implementation of ALT in primary elderly care? A case study from Norway. *BMJ Open.* doi: 10.1136/bmjopen-2016-015455

Paper III

Gjestsen, MT, Wiig, S., Testad, I. (Manuscript). Health care personnel's perspective on potential eHealth interventions to prevent hospitalizations for older persons receiving community care. A case study. JMIR Preprints. 12/11/2018:12797 DOI: 10.2196/preprints.12797
Submitted (November 2018) *to Journal of Medical Internet Research*

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[1] Papers I and II are published as "Open Access" articles. Consequently, reprint does not warrant permission, but proper affiliations must be provided.

Summary

This thesis describes the process of planning an assistive living technology intervention for home-dwelling older persons receiving community care. The use of such technologies in the community care setting is heralded as one answer to address the challenges facing the health care system, as well as a mean for the health and care services to improve, simplify and enhance the efficiency of their activities.

Although the implementation of assistive living technologies is complex, the implementation is informed basically in two ways—directly, based on empirical reports, or indirectly, through systematic or meta-analytic reviews. The main objective of this thesis is to provide a theory and evidence-based rationale for applying an assistive living technology intervention in community care to prevent hospitalisations for older persons.

By using hospital admissions which may be prevented as a case, exploring health care personnel's and managers' perspectives, and furthermore using existing theories and research concerning implementation, we have applied both an empirical and theoretical approach to inform a future assistive living technology intervention in the defined context.

A socio-technical perspective has been applied; the different stakeholders involved on different organisational levels and the framework conditions constitute the socio technical system in the study, implying that a multi-level approach is appropriate to help identify potential barriers and incentives for the implementation of assistive living technologies in community care. Furthermore, has the Model for Understanding Success in Quality (MUSIQ) provided guidance to identify contextual factors likely to influence a future implementation process.

The PhD study has had two phases:

Phase 1 aimed to identify the target group for an assistive living technology intervention. In this phase, we applied a quantitative and a qualitative approach, and two publications stems from this work. Phase 2 comprised the identification of key contextual factors through interviews with leaders and health care personnel. One publication represents the work in this phase of the study.

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PART 1

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1 Introduction

This thesis describes the process of identifying and planning a future technology intervention for home-dwelling older persons receiving community care.

As the rest of the world, the Norwegian health care system is currently preparing for the challenge of a population with an increasing share of elderly together with a relative decrease in health care professionals (Rechel, Doyle, Grundy & McKee, 2009; Rechel et al., 2013). Globally, the number of older persons is growing faster than the numbers of people in any other age group. In 2017, there were 962 million people aged 60 or over in the world, comprising 13 percent of the global population. Between 2015 and 2030, the number of people in the world aged 60 years or over is projected to grow by 56 percent, from 901 million to 1.4 billion, and by 2050 the global population of older persons is projected to more than double its size in 2015, reaching nearly 2.1 billion (United Nations, 2015). Today, 11 percent of the Norwegian population is 70 years and above, a proportion which will almost double by the year 2060 (Syse, 2016), and a shortage of 40 000 health care workers is expected towards 2030 (Texmon, 2009).

This global shift in demographics imposes strains on the healthcare system, as older persons are substantial consumers of both primary and specialized health care services (Clegg, Young, Iliffe, Rikkert & Rockwood, 2013; Huseby, 2014; Huseby, 2015). The shift moreover means an epidemiological transition from a predominance of infectious diseases to non-communicable diseases (ischemic heart disease, diabetes, stroke and chronic lung disease) (UNFPA, 2012).

In this context, the use of assistive living technologies (ALTs) is heralded as a mean to address the challenges facing the health care system (Koch & Hagglund, 2009; Milligan, Roberts & Mort, 2011), as they can help monitor and treat these types of conditions using sensors, alarms and

reminders (Greenhalgh et al., 2018; Lewin, Adshead & Glennon, 2010; May et al., 2011). Furthermore, concomitantly facilitate patient empowerment, enhanced quality of life and quality of care (Lewin et al., 2010; McLean, Protti & Sheikh, 2011), as well as enable people to live as long as possible in their own home (Bowes & McColgan, 2013). However, to this date, interventions within the field of assistive living technology (ALT) have been characterised by limited uptake (i.e., not embedded into routine health and social care services), high rate of abandonment by individuals and challenges related to economic, organisational, technical, ethical and clinical aspects (Greenhalgh et al., 2016; Khosravi & Ghapanchi, 2015; McLean et al., 2013; Wootton, 2012). The success rate for implementing assistive technologies in the context of older adults receiving community care has thus been low (Lluch, 2011; Van Dyk, 2014; Yackel & Embi, 2010), with an inconsistency regarding solid comparable evidence on costs and benefits related to the use of ALTs (Greenhalgh, Procter, Wherton, Sugarhood & Shaw, 2012; Hofmann, 2012).

In order to optimize the chance for successful implementation of ALT interventions in community care, it is therefore crucial to have a rationale for choosing appropriate technological applications, to understand how different contextual factors on macro, meso and micro level, i.e., the external environment, organisational issues, technological infrastructure, and human actions interact with each other in adopting ALTs in community care (Dixon-Woods, Bosk, Aveling, Goeschel & Pronovost, 2011; Kaplan et al., 2010; Øvretveit, 2011). Despite of this inherent complexity, most intervention studies do not address this. Instead they are informed either directly, i.e., based on empirical reports, or indirectly, through systematic or meta-analytic reviews (Bartholomew, 2011; Davies, 2015). It is essential that research apply a systematic approach by using theoretical frameworks or models to provide a basis for hypothesised relationships (Khosravi & Ghapanchi, 2015; March & Smith, 1995). It is equally important to provide information about the

intervention delivered and its context of use, as research into one technology-based intervention in one context will not predict the effectiveness or acceptability of another technology in a different context (Greenhalgh et al., 2016; Hoffmann et al., 2014). There is thus an urgent need to improve the design of future intervention programs in the field of ALTs, and this thesis can make a valuable contribution to the increasing body of research.

1.1 Aim, objectives and research questions

This thesis will describe a rationale for how an ALT intervention in community care can be developed in order to prevent hospitalisations for home-dwelling older persons. The overall aim of the thesis is to inform a future ALT intervention, by applying theory and empirical data. More specifically, the objectives are to explore:

1. Characteristics and predictors for hospitalisations of home-dwelling older adults receiving community care (paper I);
2. Reasons for hospitalisations, for the defined population (paper I);
3. Contextual factors at macro-, meso-, and micro levels to guide the implementation of an ALT intervention in community care (paper II);
4. Potential ALT interventions and patient groups who might benefit from such an intervention, described from health care professionals' perspective (paper III).

Research questions:

a) Who is at risk for hospitalisations? (paper I)
b) What is the prevalence of- and correlates associated with hospitalisations for the defined population? (paper I)
c) What are the key contextual factors in relation to the implementation of an ALT intervention in community care? (paper II)

d) Which ALT intervention do health care professionals view as appropriate to prevent hospitalisations for home-dwelling older persons? (paper III)

e) For which patient groups do health care professionals view hospitalisations to be potentially preventable? (paper III)

1.2 Central concepts

1.2.1 Assistive Living Technologies

The rapid development of technology is such that at present there is no standardized definition for technology defined as assistive living technology (ALT). In this thesis, ALTs are defined as "the use of information, communication, and monitoring technologies which allow healthcare providers to remotely evaluate health status, give educational intervention, or deliver health and social care to patients in their homes" (Solli, Bjørk, Hvalvik & Hellesø, 2012). This include telehealth solutions (remote monitoring for clinical biomarkers) and telecare solutions (for example, alarms, sensors, reminders), and they are designed to deliver personalised healthcare over a distance to the patients' home. (Lewin et al., 2010; McLean et al., 2011). Several terms are applied in practice and literature. Telehealth is related to, but distinct from telemedicine, where technology is used to share information over a distance between healthcare providers. Other common terms are telecare, telehealth, e-health, m-health, and the Scandinavian countries often use welfare technology. However, the various technological applications often have the same sort of components.

According to McLean et al. (2011), the following components are essential to ALTs:

1. The patient provides data such as a voice streaming, video, electrocardiography, or oxygen saturation that gives information about the illness.
2. Information is transferred electronically to a healthcare professional at a second location.
3. The healthcare professional uses clinical skills and judgment to provide personalised feedback tailored to the individual.

ALTs can be delivered by both synchronous and asynchronous (such as store and forward) technologies (figure 1). For example, telephone and video conferencing enable consultations in real time (Guise & Wiig, 2017). An example of asynchronous communication would be storing two weeks of spirometry results in a batch and forwarding these on to a healthcare provider, who responds by email or telephone.
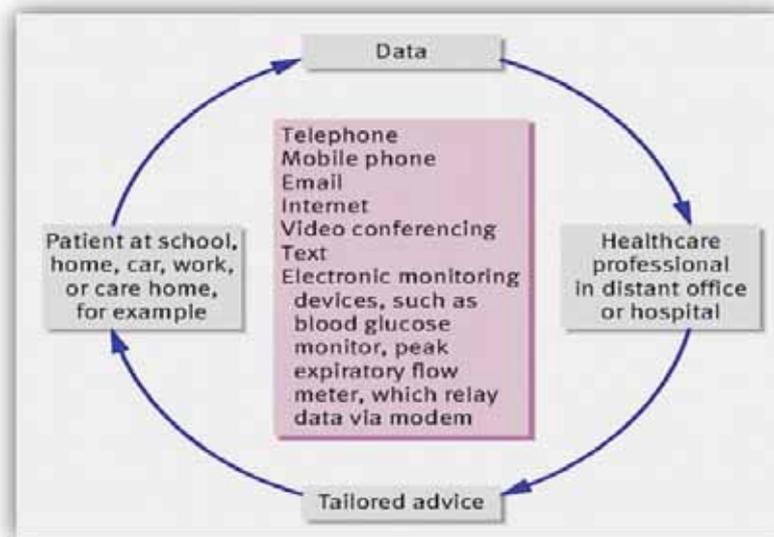
Figure 1 – Key elements of assistive living technologies (McLean et al., 2011, Reuse license number: 4326470085541)

The use of ALTs s are regarded as a mean for the health and care services to improve, simplify and enhance the efficiency of their activities (Greenhalgh et al., 2015; Koch & Hagglund, 2009; *Official Norwegian Reports 2011:11,* 2011). In Norway, the government has issued that ALTs shall be integrated in community care by 2020 (Report to parliament no. 29 (2012-2013)).

The policies on how to use technology to meet the opportunities and challenges related to an ageing population was initiated by the Norwegian Board of Technology (2009). This report was followed by an Official Norwegian report in 2011: Innovation in care (*Official Norwegian Reports NOU 2011:11,* 2011), and a White paper in 2013: Future care (Report to parliament no. 29 (2012-2013)). This White paper was operationalised via a national programme for development and implementation of ALTs in the care services. The latter was introduced by the Directorate of Health (DoH) in 2013, and entails incentives for 1) development and testing of various ALTs in the municipalities; 2) knowledge production and dissemination of ALTs; 3) promoting development of good models for the implementation and use of the piloted ALTs; 4) competence-building; 5) developing legal framework, and 6) introduction of open standards for ALTs. More than 200 municipalities are now involved in projects employing ALT through the programme, and the gained experiences will give input to how ALTs should be implemented and scaled nationwide towards 2020 (Lovett & Barland, 2014).

The underlying assumption is that the use of ALTs potentially can redesign care pathways in a way that will improve monitoring and treatment of degenerative and chronic diseases encourage better self-management of health problems, and alert professional support if devices signal a problem (European Commission, 2014; Hanlon et al., 2017; Kang et al., 2010; D. Lewin et al., 2010; May et al., 2011; Steventon et al., 2012).

However, to date, the use of ALTs has not developed at the pace and scale anticipated (Taylor et al., 2015). Thus, there is a need for increased knowledge concerning the implementation and use of ALT applications in community care. This PhD study has applied existing theories and research concerning implementation to help identify factors vital for the implementation of an ALT intervention in community care for older persons. Furthermore, the study has focused on hospitalisations, which potentially could be prevented for a defined patient group, and on which ALT applications that are viewed as appropriate for this use by managers and health care personnel in community care.

Stakeholders involved in the use of ALTs

Users of an ALT intervention may directly or indirectly be interested in the data the technological solution collects or produces regarding a person's health or wellbeing; it may be the patient, an informal carer, health care personnel or the municipality as a care organization. In addition, vendors and technology companies are involved in this eco-system concerning ALTs, and all these groups are stakeholders (Julia & Marilyn, 2011; Stroetmann, 2015). A prerequisite for meeting the full spectrum of care needs of older persons is high-quality collaboration and frequent communication among this multitude of stakeholders in the context of applying ALTs in community care (Greenhalgh et al., 2012). In order to optimize the uptake and use of ALTs in community care, we need to consider the wide variety of people that might be the actual users of the technology in this context, their incentives, and to understand the underlying socio-technical issues, e.g., how stakeholders organized on various levels (macro-meso-micro) in the health care system interact. In short, it is a necessity to accommodate the competing views and interests presented by the various stakeholders.

This thesis represents mainly the care provider perspective, as previous research has underlined the importance of identifying issues and needs in practice (i.e., community care) (Brewster, Mountain, Wessels, Kelly & Hawley, 2014; Catwell & Sheikh, 2009; Hendy et al., 2012; Joseph,

West, Shickle, Keen & Clamp, 2011). The key is to develop and introduce interventions that are considered useful and fit for a given purpose by the actual users, otherwise there will be user reluctance regarding adoption of technologies in health care (Catwell & Sheikh, 2009; Gjestsen, Wiig & Testad, 2014). In the context of this thesis, identifying patients who might benefit from an ALT intervention, and defining a clear role of the technological application (whether it is a new application, a new clinical tool or a new system for delivering care remotely), are aspects considered paramount for acceptance and adoption of a future intervention (Broderick & Lindeman, 2013; Taylor et al., 2015).

1.2.2 Hospitalisations for home-dwelling older persons receiving community care

Since the 1980s, the population of Norway has increased (Statistics Norway), and as in the rest of Europe, there has been an increasing proportion of persons above the age of 67 years, much due to a decrease in mortality rates. The life expectancy in Norway is now 81.53 years, which is above the EU average of 80.14 (Ringard, Sagan, Saunes & Lindahl, 2013).

Towards year 2060 the number of individuals above 67 years of age is estimated to increase from 0.79 million (2017) to 1.5 million. This means that in 2060, older persons may constitute 22 percent of the Norwegian population (Andreassen, 2010). A parallel development is a dwindling potential support ratio (persons in working age (20-66 years) per person $\geq$ 67 years). While today's support ratio is 4.24, it is projected that the potential support ratio will be between 1.5 and 3.3 in 2050 (https://www.fhi.no/nettpub/hin/befolkning/befolkningen/#andelen-eldre-oeker). Although the increased longevity represent a great achievement (people live longer because of improved nutrition, sanitation, medical advances, health care, education and economic well-being), the shift in demographics may potentially threaten the

sustainability of the health care system (Bloom et al., 2015; Rechel et al., 2013).

In all European countries, there is a peak in hospitalisation rates for both men and women in the age group 80 and over (Rechel et al., 2013). In a Norwegian context, the proportion of older persons (>67 years old) being admitted to hospital constitutes one third of all over-night stays in hospitals and the proportion of over-night stays for this age-group increased from 17.8 percent in 2003, to 19.6 percent in 2013 (Huseby, 2014). Furthermore, in 2013, 68 percent of the Norwegian population above the age of 80 who was admitted to hospital also received community care services (Huseby, 2015). The increasing proportion of older persons is thus associated with an increasing demand for specialized health care (Roland & Abel, 2012), and it is an ongoing discussion whether a proportion of the hospital admissions among older persons could have been prevented through high quality primary treatment and care (Purdy & Huntley, 2013). For example, previous research find that older persons are hospitalised due to lack of an appropriate alternative in primary care (Lillebo, Dyrstad & Grimsmo, 2012; Mytton et al., 2012; Strømgaard, Rasmussen & Schmidt, 2014), whereas a Norwegian study found no association between the volume of general practitioners provided (in a universally accessible healthcare system) and unplanned hospitalisations of the entire elderly population (aged ≥65 years) (Deraas, Berntsen, Jones, Forde & Sund, 2014).

There are no absolute categories of avoidable admissions to hospital (Purdy & Huntley, 2013), but a study from 2012 (Mytton et al., 2012) identified that hospitalisations due to poor mobility/falls or confusion are more likely to be 'avoidable'. Other studies have identified a number of risk factors associated with hospitalisations, but there is a discrepancy in the findings. Increasing age seems to be agreed upon as a risk factor, but heterogeneity in terms of health status and age-related conditions, as well as numerous contextual factors related to the health care system, represent a challenge for isolating factors concerning prevention of

hospitalisations within this age group (Crane et al., 2010; Gamper, Wiedermann, Barisonzo, Stockner & Wiedermann, 2011; Francesco Landi et al., 2004; Lyon, Lancaster, Taylor, Dowrick & Chellaswamy, 2007; Soria-Aledo et al., 2009).

Older persons have in principle the same access to specialised health care as the rest of the population. However, preventing hospitalisations if possible is essential, as previous research have revealed that issues following overnight stays, such as confinement, immobility, diagnostic testing, treatments and complications (e.g., infections and falls) contribute to a decline in activities in daily living, and furthermore increased morbidity and mortality (Ellis, Whitehead, Robinson, O'Neill & Langhorne, 2011; Klausen et al., 2017).

As the rising demand for acute hospital beds imposes strains on an already stretched health care system, there is a strong policy interest in identifying interventions which are effective in identifying and reducing avoidable hospital admissions (Department of Health, 2005; Hippisley-Cox & Coupland, 2013; Sinclair & Furey, 2016; Soria-Aledo et al., 2009). Part of the policy efforts is a transition in responsibility for providing health care services from hospitals to community care (Report to parliament no. 47 (2008-2009)). In this context, the preventative perspective in health care is given great focus, where the use of ALTs is suggested to help monitor and treat degenerative and chronic diseases through the use of sensors, alarms and reminders (Lewin et al., 2010; May et al., 2011). Although previous research underline that more studies are needed to assess outcome and effectiveness related to the use of ALTs in the context of preventing hospitalisations for older persons, there is a potential to provide early warnings of exacerbation events or deterioration, which is a significant issue for the individual patient, and for the society at large (Khosravi & Ghapanchi, 2015; May et al., 2011; Wootton, 2012).

1.2.3 The Norwegian health care system

The national health care system provides more than 95 percent of all health care in Norway, and is built on the principles of universal coverage and equal access for all, regardless of socioeconomic status, ethnicity, and area of residence. The system is managed and financed nationally, and can be characterised as semi-decentralized with the Ministry of Health playing an indirect role towards the 422 municipalities, mainly through legislation and funding mechanisms. In specialist care, however, the ministry plays a direct role through its ownership of hospitals and provision of directives to the boards of regional health care authorities (RHAs), as well as through legislation and funding (Mossialos, Wenzl, Osborn & Sarnak, 2016).

The Norwegian Government introduced the Coordination reform in 2012, to ensure «sustainable, integrated and coordinated health and care services that are of high quality and tailored to the individual user» (Report to parliament no. 47 (2008-2009)). The reform forms the basis for a shift in the content and organisation of community care. The aim is decentralised care, closer to home. Innovation is a key concept in the reform, as part of the effort to address the demographic, social and health-related challenges facing the health care system. Thus, the Coordination reform also comprises a municipal reform, where a main action point is to enable the municipalities to be capable of achieving objectives related to prevention and early interventions to halt the development of disease.

The municipalities cover and are responsible for providing primary health and social care, including home care, and they receive substantial government funding (i.e., through a fixed framework for transfers from the state to the municipalities and partly through regulating the municipalities' opportunities to acquire revenues) in order to do so. Although the funding generally is not specifically allocated, budgets are set locally; the provision of long-term care (both home care and

institutional care) services is statutory. There are few formal requirements in order to receive community care; the municipality determines the levels of care to people in their home. Community care providers are responsible for ensuring the quality of their services, there is no requirement for accreditation or re-accreditation (Ringard et al., 2013).

Also after-hours emergency community care services are the responsibility of the municipalities, whose contracts with general practitioners (GPs) include after-hours emergency services on rotation. There is variation as to whether information from emergency visits is shared with patients' regular GPs. There is an emergency phone number patients can call for urgent ambulance services, but no national medical advice line.

The regional health care authorities are responsible for acute-care hospital services, there is no private alternative. Patients must be referred to hospital by a community care physician or may in particular cases (accidents, suspected heart attack, stroke, etc.), have access directly via ambulance.
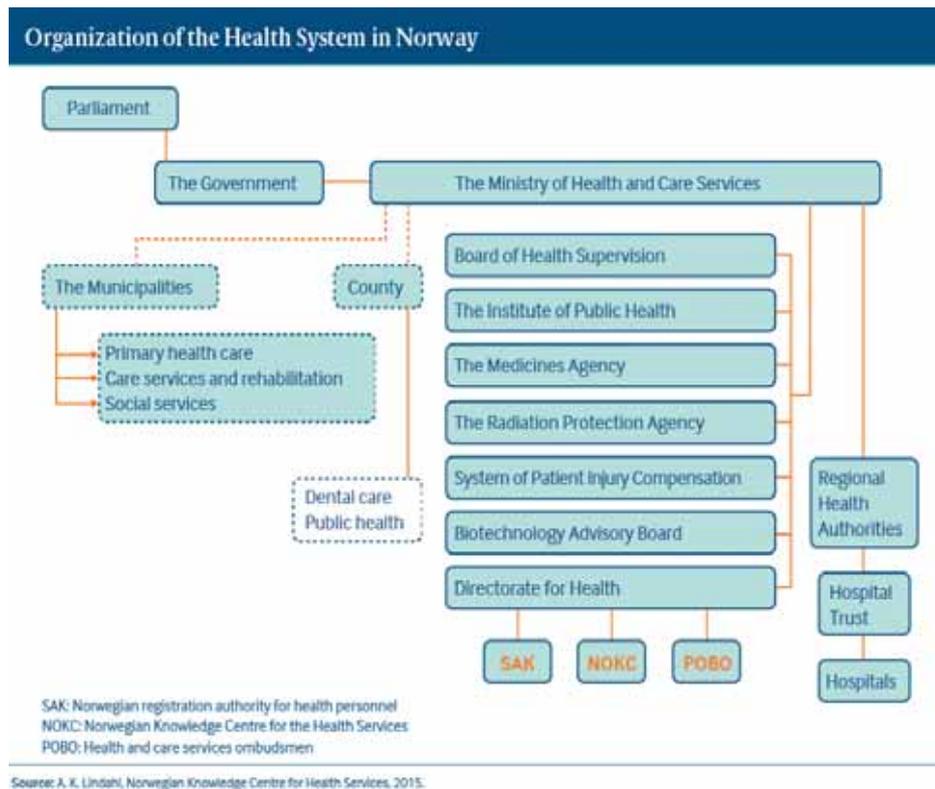
Figure 2 Organization of the Norwegian health care system (Lindahl, 2015). [2]

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[2] From first of January 2016, the Norwegian Knowledge Centre for Health Services (NOKC) was incorporated into the Norwegian Institute of Public Health, and the Norwegian registration authority for health personnel (SAK) was incorporated into the Norwegian Directorate of Health.

1.2.4 Home-dwelling older persons receiving community care

In this thesis, persons aged 67 years or more are characterised as "older persons" or "older adults". Sixty-seven years of age is commonly applied as a marker of older age in Norway, as most residents receive full state retirement pension at this age (Arbeids- og velferdsetaten).

In 2016, 6.7 percent of the Norwegian population received community care services. Community care represents the lowest level of care services provided by the municipality and there are few formal demands required in order to receive community care in Norway. The proper instance in the health- and social district one geographically belongs to, defines the need for assistance and/or care, together with the person seeking help. The number of older persons receiving community care has increased the last decade, and the proportion now constitutes 22 percent of all individuals aged 67 years or more. For the age group 67-79 years, the proportion was 12.6 percent, while it was more than 50 percent for the age group 80-89 and finally more than 90 percent for those more than 90 years of age. The number of recipients and the proportion of the population receiving services thus increase with age. Women have the highest proportion, compared to men in all three age groups, but the proportion of men who receive services is increasing, mostly due to increasing male life expectancy (Statistics Norway, 2017).

More than 50 percent of the recipients of community care aged 67 years and more had less than two hours of care per week. 21-27 percent received between 2 and 5 hours of care per week, while 12-18 percent was assigned 5-10 hours of care per week.

1.3 Study context

This study was conducted in a region where there is great potential for exploring the potential for applying ALTs in community care. Due to the

previously described demographic shift, both the primary and secondary care sectors and technology vendors are actively searching for solutions which can meet the challenges ahead. Consequently, this PhD study was undertaken between 2013 – 2017, as a work package (WP) in a larger project; "Development and Implementation of ALTs in Municipalities" (DIALT), initiated and funded by one municipality in western Norway (funding from the Regional Research Fund for Western Norway, grant agreement no. 725 2316), Centre for Age-Related Medicine (SESAM), University of Stavanger (UiS) and the International Research Institute of Stavanger (IRIS, now NORCE). The overall aim of the DIALT project was to explore and identify barriers, possibilities and solutions related to implementation of ALTs in municipalities in western Norway. In the overall project, a reference group provided valuable input to the thesis. The group comprised researchers in the four work packages, quality audit personnel and representatives from the local elderly council and a user organisation. There was also a working group comprising administrative personnel and researchers from the project partners, who had regular meetings throughout the project period, and contributed to recruit informants, facilitated interviews and provided relevant background information.

The context of the thesis is community care in an urban municipality located in western Norway. Community care in this municipality is organised into four geographically based units, and comprised 1600 older persons when the study commenced. The PhD study commenced in 2013, involved two of these units, with approximately 800 older persons receiving community care. The municipality was in the process of integrating ALTs in community care during the next few years. The research environment for this thesis was provided mainly by SESAM, which has approximately 25 affiliated researchers stemming from a variety of fields (nursing, medicine, pharmacy, psychology) involved in projects concerning issues such as diagnosis, treatment, quality of life and health care services within the field of old age health and medicine.

1.4 Thesis structure

This thesis comprises two parts, where part I covers six chapters. The introductory chapter provides a background for why this thesis is highly relevant in this day and age. It further describes key concepts and the context for using ALTs to prevent hospitalisations for home-dwelling older persons in community care, followed by a presentation of the thesis' aim, objectives and research questions and the study context. Chapter 2 introduces the reader to the theoretical backdrop in which this PhD is grounded. It begins with an introduction of how ALTs are used in a care perspective, as part of the nursing process, and is followed by a presentation and description of the chosen socio-technical systems theory and the MUSIQ implementation framework. Chapter 3 comprises a detailed description of the methodological approach; including philosophical considerations, research design and thesis stages. This chapter further entails a description of the methodological framework as described by the UK Medical Research Council, and a subsequently description of the applied quantitative and qualitative approaches, including data collection and data analysis respectively. Research quality, methodological reflections and ethical considerations are also included. The study's results are presented in chapter 4; first a summary of the three papers respectively, before offering a synthesis of the thesis' findings, which forms the basis for the discussion presented in chapter 5. The findings are discussed in view of previous research and the theoretical perspectives and framework presented in chapter 2. Ultimately in this chapter, some methodological considerations are presented, before chapter 6 finally provides the thesis' conclusion and states implications the findings may have for future intervention planning and further research. Part II comprises the three papers upon which the thesis is built.

2 Theory

This chapter presents theories relevant to the uptake and implementation of ALT interventions in community care. It starts with a description of the use of ALTs in a care perspective through the nursing process (Wilkinson, 2008) and a conceptual model as described by Nagel & Penner (2016). These perspectives are pivotal in understanding how ALTs in community care can be adopted and embedded in nursing practice and processes of patient care (Coiera, 2004; Courtney, Demiris & Alexander, 2005; Pols, 2010). Conversely, lacking understanding of these elements is detrimental to the actual use of ALTs in community care (Finch, Mair, O'Donnell, Murray & May, 2012; Salisbury et al., 2015).

The chapter continues with a description of the socio-technical systems perspective, which forms a basis for understanding for the subsequent chosen implementation framework (MUSIQ), which is presented ultimately in the chapter. As implementation and adaption of ALTs in community care involve processes of change for professionals and patients, as well as for health-care organizations themselves (Mair et al., 2012), the socio-technical systems theory can provide explanations of the processes that shape outcomes (Grol, Bosch, Hulscher, Eccles & Wensing, 2007; May et al., 2011). In this thesis, the use of theoretical frameworks provide an opportunity of making transparent assumptions and premises that underpin the thesis' research questions, methodology, and explanations (May et al., 2011).

2.1 Use of assistive living technologies in a care perspective

Providers of care often have different ways of seeing and treating patients, as differences in profession, specialty, experience, or background lead them to pay attention to particular signals or cues and influence how they approach problems. For instance, one person might assess a patient through a clinical lens, focussing on whether the patient meets clinical criteria for discharge, while another might see the patient through a personal or social lens, considering the patient's broader support system at home. Traditionally, nurses provide holistic care for their patients operationalized through the nursing process, which is a systematic problem-solving process that guides all nursing actions (Wilkinson, 2007). The process encompasses five phases: 1) Assessment; 2) Diagnosis; 3) Planning; 4) Implementation; 5) Evaluation.
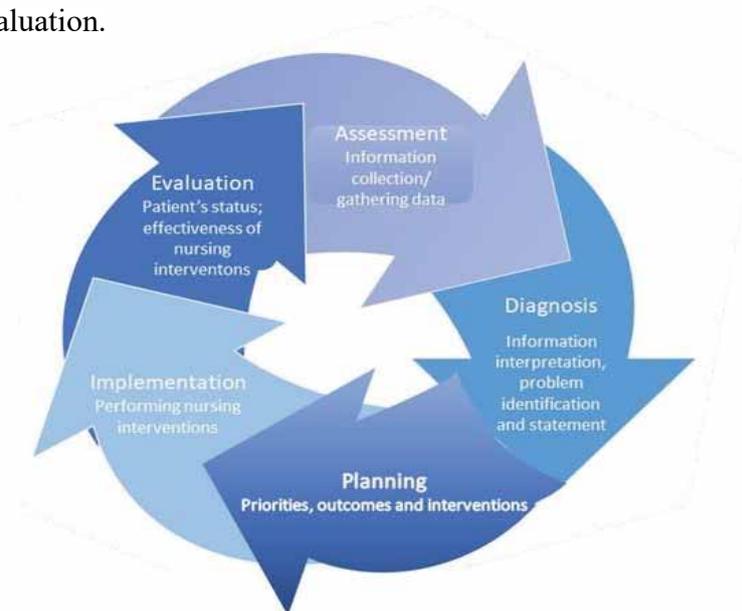
Figure 3   Illustration of the nursing process (author's own).

The nursing process is not linear, but cyclical, implying that it constantly requires clinical decisions and actions, as illustrated in figure 3.

For decades, nurses have worked toward the ideal of providing the best practice to individual patients using the nursing process as a scientific process. Phase 1 in the traditional nursing process is *Assessment*. Assessment involves physical assessment, collection of vital signs data and assessing a patient's knowledge base in a systematic and comprehensive manner (Greenberg, 2009; Wilkinson, 2007). ALTs are used quite commonly for the purpose of assessment, for example to follow up on a patient with Chronic Obstructive Pulmonary Disease (COPD).

Diagnosis is the second phase of the nursing process, which usually entails making a statement of a health problem as perceived by the nurse (Wilkinson, 2007). Based on information gathered in the previous phase, nurses use a diagnostic reasoning process to draw conclusions about the patient's health status and decide whether nursing intervention is needed. This process provides the basis for giving individual care.

The subsequent and third phase in the nursing process is *Planning*. In this phase, the nurse takes professional responsibility to work with the patient, significant others or use other credible sources to develop individualised plans to prevent, eliminate or reduce the health problems through goals and nursing orders (Wilkinson, 2007). Effective planning, like all other phases of the nursing process, depends on the accuracy of other previous steps and the ability to make interdisciplinary connections (Pols, 2010). It is to be noted that planning of interventions should be mutual, research-based, realistic, simple and attainable, and must have measurable expected outcomes and time frames open to modifications based on new evidence.

Implementation is the fourth phase of the nursing process in which the nurse applies the plan, by carrying out a specific, individualised plan, encompassing specific nursing interventions which address the nursing

specified diagnosis (Wilkinson, 2007). The feasibility of implementing the intervention must be considered, as must the acceptability of the intervention to the patient and the capability of the nurse to execute the intervention. Throughout the implementation phase, the nurse must evaluate the effectiveness of the method chosen to implement the plan, and if the nurse anticipates that expertise in specialised areas would help the patient, referrals to other professionals should be made.

The fifth phase of *Evaluation* is a planned, ongoing, deliberate activity in which the patient's progress toward goal achievement and the effectiveness of the nursing care plan are determined (Wilkinson, 2007). Evaluation is a process, which goes on throughout the various phases of the nursing process. In the assessment phase, the nurse evaluates whether sufficient data have been obtained to allow a nursing diagnosis to be made. The diagnosis is in turn evaluated for accuracy and appropriateness to the patient's health problem. Further on, the nurse evaluates whether the expected outcome and interventions are realistic and achievable, and one must consider whether the plan should be maintained, modified or totally revised in the light of the patient's health status. The effectiveness of each intervention and its contribution to progress towards the goal are also evaluated continuously.

A common notion is that applying technology in care potentially can create a sense of distance, objectify and depersonalise the patient receiving care (Locsin, 2016), as the uniqueness of a patients' individual needs and aspirations, and the awkwardness of applying standardised solutions into care; the potentially negative impacts (e.g., social isolation) of ALTs are contraire to the values underpinning the nursing process (Nagel & Penner, 2016). Still, due to requirements for efficient care delivery, health care reforms, shortages of skilled health care professionals, expectations from informed patients, and economic factors have led to increased adoption of technology in health care in recent years. Nurses are also stakeholders in this work, and are actively engaged in the use of ALTs in the provision of care (M. E. Greenberg,

2009; Larson-Dahn, 2000). On a global level, the importance of technological competencies for nurses is emphasized by The International Council of Nurses (ICN) (Bartz & Kouri, 2013) and in the World Health Organization's (WHO) nursing standards (World Health Organization, 2009). Also in a Norwegian context, the Norwegian Nurses Organisation (NSF) has defined the use of ALTs as a focus area; more specifically, in their political platform and action plan, they state that nurses shall be actively involved in the development and implementation of ALTs in nursing practice (Norwegian Nurses Organisation, 2013).

Nurses can use assistive living technologies in the care of home-dwelling persons receiving community care to have a teleconsultation with a patient, for example to provide wound assessment at a distance or to follow up on a patient with Chronic Obstructive Pulmonary Disease (COPD). Technological applications can also be used to a) replace face-to-face visits with virtual visits via the use of videoconferencing; b) monitor vital signs via devices, such as blood pressure, blood glucose levels or heart rate; c) monitor movements in- and around the home via activity sensors; or d) respond to safety alarms by patients (Pols, 2010; van Houwelingen, Moerman, Ettema, Kort & ten Cate, 2016). Nagel & Penner (2016) claim however that the rapid development and evolution of various technological applications in health care has left a "virtual gap" in terms of harmonizing the use of such applications and the provision of care, due to a lack of a conceptual models, frameworks and theories. They therefore conducted a review of existing conceptual and theoretical frameworks to develop a conceptual model for the purpose of harnessing the complexity and challenges following the aim of providing holistic care through the use of technological applications.

The conceptual model illustrates key dimensions and related concepts inherent to the nursing process. At the core of the model is *Holistic Person-centered Care*, with the concepts of *Communication, Assessment* and *Relational Practice* as immediate aspects of the core. These aspects

are specific *Requisite Competencies* within the dimension of *Nursing Competencies*. The dimensions *Knowing the person*; *Building a Picture*; *Clinical Decision-making* and *Nursing Competencies* are complex and interrelated entities. The model is depicted in figure 4.
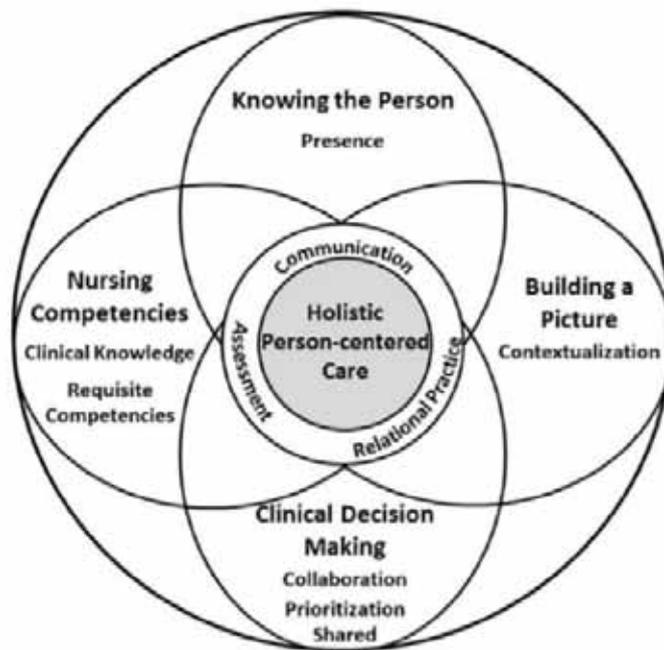
Figure 4 Conceptual Model of Telehealth Nursing (Nagel & Penner, 2016) (permission to reuse).

The first phase (assessment) of the nursing process can be characterised as a General Skill, or Clinical Knowledge, pertaining to the dimension *Nursing Competencies* in the model, while the second phase of the nursing process (diagnosis) is best placed in the *Clinical Decision-*making process, where nursing diagnoses are placed in a prioritised order. For example, if a patient has trouble breathing, and the monitoring device confirms a low oxygen saturation, this problem should be prioritised before for example a wound that needs changing. This phase also pertain to the dimension *Picture Building* in the model, as

determination of urgency of the problem, and the advice to be provided to the individual is described as a process undertaken by the nurse to inform the final triage decision. These are elements in building a picture using a holistic assessment approach in conjunction with strong nursing skills, particularly interpersonal communication and previous clinical knowledge (Nagel & Penner, 2016). It is reasonable to draw parallels between the third phase in the nursing process (planning) and the dimension *Knowing the Person* in the model; constructing an image of a person and context which represents what we know of that person, and use this information to plan appropriate interventions (Pols, 2010). The fifth phase (evaluation) of the nursing process pertains to all of the dimensions of the conceptual model described by Nagel & Penner (2016), as nurses constantly must evaluate the holistic assessments, clinical decision-making and contextualization.

Potter & Frisch (2007) claim that for a nurse to build a picture, and to contextualize a person in relation to health, aiming for a holistic care and presence using ALTs in the day-to-day practice, he or she must be knowledgeable in nursing practice, and possess a theoretical basis, intuition, expertise, and creativity. Consequently, nurses who deliver care using ALTs must be well grounded in general nursing knowledge, theory, and practice competencies, have clinical experience, expertise using technology and a capacity to possess attributes of intuition and creativity to enhance provision of holistic care (Nagel & Penner, 2016).

This conceptual model is still novel, and needs to be explicated and perhaps refined through use in future scientific enquires. In this thesis, in serves the purpose as a theoretical bridge between the traditional nursing process and the use of ALTs in the provision of care.

2.2 Socio-technical systems theory

The most important premise in the socio-technical systems theory (e.g., (Leveson, 2004; Rasmussen, 1997), is to view the system as more than the sum of its elements; it is viewed as hierarchical structures, where each level in the hierarchy (macro-meso-micro) impose constraints on the activity on the level beneath. A key issue is to analyse the system holistically by evaluating the organizational interfaces among the system components and determine the impact of component interactions (Wiig, 2008). Socio-technical approaches increase our understanding of how ALT applications are developed, introduced and become a part of social practices, while Human Centered Design (HCD) advocates the need for an understanding of the intertwinement between technology, the users of it, and the social context of use (Berg, Aarts & van der Lei, 2003). The socio-technical perspective and HCD recognize that people, technologies, organisations and process of care interact in complex ways (Aarts & Gorman, 2007; Coiera, 2004; Li, 2010).

The socio-technical systems theory have several starting points: 1) health care work is viewed as a social, 'real life' phenomenon, which is guided by a practical rationality, 2) technological innovation is a social process, in which organizations are deeply affected, 3) through in-depth, formative evaluation, this theoretical perspective can help improve system design and implementation (Berg et al., 2003). Adopting and implementing ALT interventions in complex health care systems can be challenging, as elements are interdependent and mutually reinforcing; they interact with other systems in unexpected ways, as they comprise technologies, humans and its social environment which can simultaneously be members of several interrelated systems (Cohn, Clinch, Bunn & Stronge, 2013).

Previous research concerning the implementation process related to ALTs in community care has primarily focused on organizational issues, neglecting the wider social framework that must be considered when introducing new technologies in a complex health care system (Mair et

al., 2012). This will consequently lead to a poor understanding of how other contextual factors beyond the intrinsic capacities of a technological system in an organization– i.e., the human use of the technology are critical to its success or limitation, as these types of applications require interaction with people and thereby inevitably affects them. This perspective includes the consideration that implementing such applications induces an important change in the way health care services are delivered. It is crucial that professionals and organisations are ready to adopt the change that consequently follows the introduction of ALTs in community care (Browning et al., 2009; Greenalgh et al., 2004).

2.3 Implementation framework

In the last decades, implementation science and knowledge translation have developed across multiple disciplines with the common aim of bringing innovations to practice (Moullin, Sabater-Hernández, Fernandez-Llimos & Benrimoj, 2015). The Fogarty International Center define implementation science as *"the study of methods that promote the integration of research findings and evidence into healthcare policy and practice. It seeks to understand the behaviour of healthcare professionals and other stakeholders as key variables in the sustainable uptake, adoption, and implementation of evidence-based interventions."* (http://www.fic.nih.gov/researchtopics/pages/implementationscience.aspx). This field of research incorporates a broader scope than traditional clinical research, focussing not only at the patient level but also at the provider, organization, and policy levels of healthcare (Bauer, Damschroder, Hagedorn, Smith & Kilbourne, 2015).

In 2004, Greenhalgh and colleagues' published a review (Greenhalgh, Robert, Macfarlane, Bate & Kyriakidou, 2004) which provided evidence of implementation research, in addition to collating findings that sought to create a conceptual framework for implementation. One key finding is that system readiness for an innovative intervention is highly relevant to the early stages of implementation, and moreover that innovation is

more likely to happen if an organization is mature. Since this landmark review, the field has expanded considerably, and further taxonomies, checklists, conceptual frameworks, theories, and models of implementation have been developed (Flottorp et al., 2013; Mendel, Meredith, Schoenbaum, Sherbourne & Wells, 2008), for example Promoting Action on Research Implementation in Health Services (PARIHS) (Damschroder et al., 2009), and the Replicating Effective Programs (REP) (Kilbourne, Neumann, Pincus, Bauer & Stall, 2007).

One strand of research in this field is pertaining to readiness for change. The term change readiness has its roots in Lewin's model of change (1951), where a key issue for successful change management is to «unfreeze» the current state, based on organisational members' attitudes, beliefs, and intentions about the change, the degree to which changes are needed and the organisations' ability to implement those changes successfully (Drzensky, Egold & van Dick, 2012). Readiness for change at an organisational level refers to organisational members' change commitment and self-efficacy to implement organisational change (Rafferty, Jimmieson & Armenakis, 2013). Change readiness is the most prevalent positive attitude toward change that has been studied in the organisational change literature. Interest in this topic continues to grow as organisations struggle to cope with technological advances, and it has become increasingly clear that various contextual factors on different levels in an organisation are critical to successful implementation (Aarons, Fettes, Sommerfeld & Palinkas, 2012; Rafferty et al., 2013).

Although readiness for change has proved to be of vital importance in relation to implementation of technology in health care (Jennett, Gagnon & Brandstadt, 2005), we have chosen a theoretical framework which builds on existing implementation frameworks. The Model for Understanding Success in Quality (MUSIQ) (Kaplan, Provost, Froehle & Margolis, 2012) is in the forefront of incorporating contextual factors in quality improvement processes. It takes into account *context* as an

explanation for the considerable variability in impact across settings when ALTs are introduced in provision of care, and as an explanation for the inability to replicate previous successes when applied in new arenas (Mair, et al 2012; Greenhalgh, et al., 2015; Dixon-Woods). Context is typically recognised as everything that surrounds an intervention. Kaplan and colleagues (2012) have developed a conceptual model which is based on a systematic review (Kaplan et al., 2010) and expert consensus (Kaplan, Froehle, Cassedy, Provost & Margolis, 2013; Kaplan et al., 2012), (Kaplan et al., 2012). MUSIQ identifies 25 contextual factors pertaining to different levels of the health care system, and characterises context not as a static background factor, but as a complex system that is changing dynamically over time and is influenced by individuals, team, organisation, and system characteristics. Furthermore is the relationships between the various factors tightly linked in a non-linear way and governed by feedback loops (Reed et al., 2018). In this thesis, the MUSIQ framework is employed to better understand key relationships and interactions among factors across multiple nested levels of the healthcare system, which are expected to have an impact on the implementation of a future ALT intervention in community care.

These theoretical perspectives are integrated in in the thesis, and directly linked to research question 3) What are the key contextual factors in relation to the implementation of an ALT intervention in community care? The aim is to increase the understanding of which contextual factors are vital for optimizing the implementation of an ALT application in community care.

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3 Methodology

This chapter presents the underlying methodology for conducting the PhD study. The chapter starts with the underlying philosophical considerations which has guided the choice of methods in the thesis. Thereafter follows a presentation of research design and the methods framework. Subsequently, the data collection and data analysis for the quantitative and the qualitative approach is presented respectively, before reflecting upon issues of the thesis' research quality. The chapter is finalised with ethical considerations relevant for this thesis.

3.1 Philosophical considerations

Methodology is a focal point when presenting scientifically based knowledge. The empirical work needs both an epistemological and ontological basis, as well as theoretical foundation (Mayan, 2009).

History tells us that the methods and purposes of scientific inquiry have been moulded by generations of researchers whose belief were uniform in how to conduct research, where post-positivist assumptions have represented the traditional form of research, sometimes they are even called the scientific method, or doing science research (Creswell, 2009; Young, 2001). Although scientific paradigms evolve, differ by discipline fields, and often are contested, the classical distinction is between two paradigms: the quantitative and the qualitative. John Creswell (1994) pointed out how scientific paradigms in the human and social sciences help us understand phenomena: They advance assumptions about the world, how science should be conducted, and what constitutes legitimate problems, solutions, and criteria of "proof". As such, paradigms encompass both theories and methods. Furthermore, based on the differences in characteristics, one can say that each of the two perspectives has profound implications for the way in which research is conducted. However, qualitative and quantitative approaches should not

be viewed as polar opposites; instead, they represent different ends on a continuum (Newman & Benz, 1998). A qualitative approach uses words and quantitative approach uses numbers. Another way to frame the two approaches is to employ closed-ended questions (quantitative hypotheses) rather than open-ended questions (qualitative interview questions) (Creswell, 2009).

In the last decades, a more pragmatic approach to research has gained terrain. An important premise is that the researcher should choose a method which is appropriate for answering the question or solving the problem in focus, rather focusing on methods and antecedent conditions (as in post-positivism) (Rossman & Wilson, 1985). In this paradigm, researchers emphasize the research problem and use all approaches available to understand the problem. This opens up for the use of multiple methods to inform the study's problem and therefore can be described as being pluralistic an orientated toward "what works" and practice (Creswell & Plano Clark, 2011). It entails appropriate but flexible approaches to outcomes measurement, representation of multiple perspectives and collaborative nature of work and approaches that can be flexibly tailored to particular contexts of study (Finch et al., 2012). This philosophical background has guided the ontological and epistemological considerations underlying the research undertaken in this thesis. Ontology concerns the philosophy of what exists in the world, and the nature of reality. The ontological assumptions guide a researcher's epistemological view of what is valid knowledge (Lincoln & Guba, 1985; Polit & Beck, 2004). This permeates the entire process with designing the study, data collection and – analysis. I have employed both a quantitative and a qualitative approach because they provide the best understanding of the research problem.

3.2 Research design

Aligned with the overall aim of the thesis, an explorative study design has been adopted (Creswell, 2009). More specifically, we employed a multi-method research design (Jick, 1979), comprising a descriptive cohort study with a quantitative approach, and a case study with a qualitative approach. The two approaches were used separately in different sub-studies and articulated in different papers, and are presented accordingly in the results section. In the discussion section, however, results from both approaches are combined in this thesis.

The study used data from several sources: existing registries (i.e., patients records in the municipality and hospital) was collected electronically, documents (i.e., white papers) were downloaded from the Internet, and individual and focus group interviews were conducted in person. In accordance with the thesis' research questions, various approaches were applied to the two samples of which this thesis is comprised. This multi-method design was employed, as it was likely to yield a much richer data material aiming to inform an ALT intervention in community care (Hesse-Biber, Johnson, Hunter & Brewer; Polit & Beck, 2004).

3.3 Building a rationale for applying an assistive living technology intervention in community care

Modelling complex interventions

ALT interventions are defined as complex interventions (Salisbury et al., 2015), involving a number of components, such as the type of technology, the infrastructure, the human support available and the capabilities of the patient in relation to the technology (Greenhalgh et al., 2016). All of these components are interacting, thus presenting practical

and methodological difficulties which must be addressed in order to optimize the implementation of an intervention (Craig et al., 2008).

There are several dimensions to complexity. Very often, an ALT intervention comprises a number of elements in the intervention package itself, but an important premise is that health care services are produced through the interaction of the people, technologies and processes of care. Changes in one of these elements produce further changes in the other elements or in their interactions (Mair et al., 2012). As described in the theory chapter, the health care system is thus a complex system, which further contribute to the practical and methodological challenges that any researcher or evaluator must overcome in order to optimize the adoption of the intervention, and moreover to disseminate study results in a stringent manner.

A review by Joseph and colleagues (2011) identified two challenges related to development and implementation of telehealth projects: Identifying issues and needs in practice. This can be translated into the importance of identifying patients who might benefit from an intervention, and a clear defined role of an technological application (whether it is a new application, a new clinical tool or a new system for delivering care remotely), are factors paramount for acceptance and adoption of an intervention (Broderick & Lindeman, 2013; Taylor et al., 2015). At the same time, it is of vital importance that the involved stakeholders (e.g., researchers, policy makers, health care personnel, patients, carers) are able to judge the value of an assistive living technology intervention in its own right (Greenhalgh et al., 2012; Richards, 2015). If we develop interventions which are not considered to be useful and fit for purpose by the actual users, there will be reluctance regarding user adoption of technologies in health care (Catwell & Sheikh, 2009; Gjestsen et al., 2014).

To overcome some of these challenges, the UK Medical Research Council (MRC) published a framework in 2000 (Campbell et al., 2000),

to help researchers to recognise and adopt appropriate methods when working with complex interventions. The framework has undergone several modifications, based on the experiences that has accumulated since 2000. Publication of the latest update is expected in 2019. In this thesis, the 2008 version of the MRC framework (Craig et al., 2008) has guided the building of a rationale for adopting ALTs in community care, aiming to prevent hospitalisations.

Although the framework is described in terms of phases, in practice these may not follow a linear or even a cyclical sequence, as depicted in figure 5. The first step in the MRC framework is Development, which encompasses identifying a relevant, existing evidence base, ideally by carrying out a systematic review. However, according to Walter Sermeus (Richards, 2015), components of an intervention can also be identified through focus group interviews with patients or health care personnel. The rationale for a complex intervention, the changes that are expected, and how change is to be achieved may not be clear at the outset. Thus, developing a theoretical understanding of the likely process of change by drawing on existing evidence and theory should be done whether the researcher is developing the intervention or evaluating one that has already been developed (Craig et al., 2008). The work undertaken in this thesis pertains to the Development phase, where identifying evidence base and developing theory are components included. The next step would be to model process and outcomes, based on the findings in the previous steps, before moving on to feasibility and piloting.
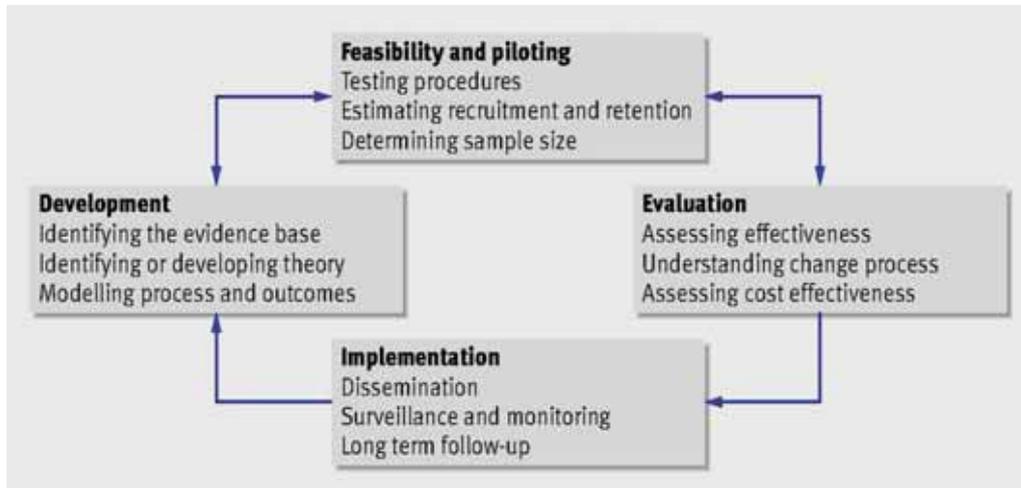
Fig 5: Key elements of the development and evaluation process (Peter Craig et al., 2008) (Reuse licence number: 4438360079263)

3.4 Thesis stages

This was a multi-method study and the research activities were undertaken in two, partly concurrent phases, as illustrated in figure 6. Phase 1 aimed to identify the target group for an assistive living technology intervention. In this phase, we applied a quantitative and a qualitative approach, and two publications stems from this work (paper I and III). Phase 2 comprised the identification of key contextual factors through interviews with leaders and health care personnel. One publication represents the work in this phase of the study (paper II).
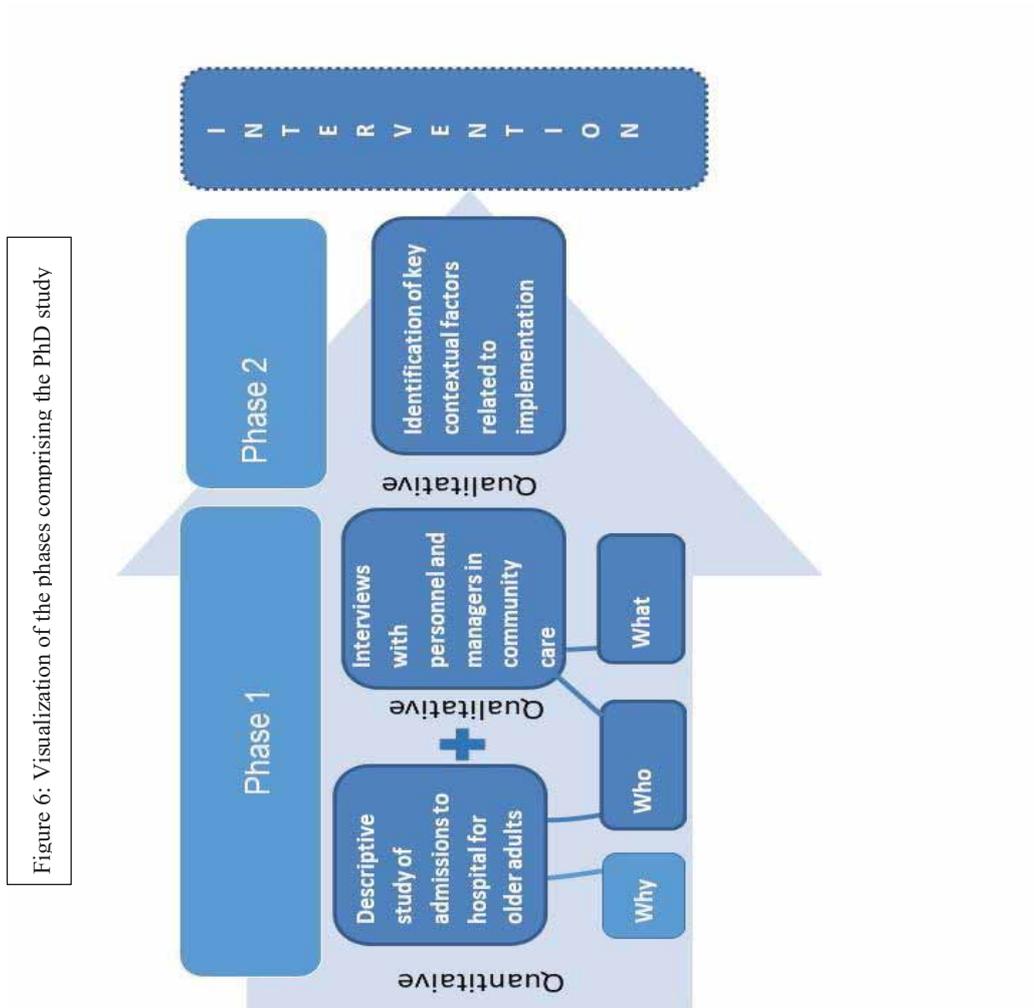
Figure 6: Visualization of the phases comprising the PhD study

Table 1: Overview of studies, data collection, data material and analytical approach

Paper	Study	Design	Data collection	Data material	Data analysis
I	«Characteristics and predictors for hospitalizations of home-dwelling older persons receiving community care.»	Descriptive, cohort study	Quantitative;; retrospectively scrutinized admissions to hospital for a 1-year period, for the study cohort	Study cohort: 1531 Hospitalizations:1457 individuals, electronic records from existing registries	Multinominal logistic regression analysis Z-tests for testing differences of proportions
II	«Identification of key contextual factors when preparing for successful implementation of assistive living technologies»	Single embedded case study	Qualitative; based on a triangulation of methods involving Document analysis Semi-structured individual interviews (N=5) 2 focus group interviews (N=12)	Documents : 6 (national policy documents) 70 transcribed pages* 45 transcribed pages*	Template organizing style; text is organized according to preexisting theoretical categories (MUISQ framework)
III	«Health care personnel's perspective on potential eHealth interventions to prevent hospitalizations for older persons receiving community care. A case study.»	Single embedded case study	Qualitative: Semi-structured individual interviews (N=5) 2 focus group interviews (N=12)	70 transcribed pages* 45 transcribed pages*	Systematic Text Condensation

* Study II and study III have employed the same data material

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3.5 Quantitative approach

Through this sub-study, we identified patient groups for which an intervention could be appropriate. The study cohort comprised 1531 home-dwelling persons aged $\geq$ 67 years, receiving primary home-based care in a Norwegian municipality. The study was carried out in a municipality where 10.4% of the population was $\geq$ 67 years of age (Statistics Norway, 2015), closely mirroring the Norwegian demographics, where 11% of the total population was above 67 years old in 2012 (Huseby, 2014).

The mean age of the study cohort was about 84 years, with a vast majority of women (almost 70 percent). We also stratified the study cohort into three different age groups, as stratification of the cohort into both age groups and gender is in itself interesting, as well as when investigating potential demographic characteristics associated with reasons for referral to hospital. In the study cohort, the majority of individuals was in the middle age group (80-89 years / 43.3 percent). However, the proportion of men was greater in the youngest age group (67-79 years / 40.7 percent).

Based on the data material, we reported the following:

i.   Frequency related to reasons for referral, and characteristics of hospital admissions of home-dwelling older persons receiving community care.
ii. Associations between demographic characteristics and admission to hospital.

Referrals to hospital are made either from patients' general practitioner, or from an out-of-hours primary home-based emergency department. The persons included in our study received services from the municipality, including medical care provided by nurses (medication, wound/ulcer dressing, personal hygiene) and practical home care

provided by formal carers (not necessarily nurses). The studied hospitalisations stems from a hospital located in an urban area; it is the only hospital within an 80 km radius and serves approximately 365 000 persons.

3.5.1 Data collection

We retrospectively scrutinised admissions to hospital for the study cohort between April 1st 2012 and March 31st 2013. Data were collected electronically from existing registries in the municipality (community care records) and the hospital (patients' records).

Based on previous research, the data collection aimed to harness variables relevant to clinical practice. More specifically studies concerning hospitalisations of older persons have identified gender, age and reason for referral to be essential in this matter (Chandra et al., 2015; Hippisley-Cox & Coupland, 2013; Regitz-Zagrosek, 2012). The primary reason for referral to hospital was retrieved through hospital-based patient records, based on the International Classification of Diseases version 10 (ICD-10) main chapters. We deliberately identified reason for referral, as opposed to identifying the main diagnosis reported in the patients' record. This because the main diagnosis serves as a response to the symptoms the patient presented when the doctor made a decision to refer the patient to the hospital, and does not sufficiently mirror the complex situation where an older person presents with general and diffuse symptoms. In order to prevent hospitalisations using ALTs, it is paramount to personalise the intervention according to the situation, and not limit an intervention to specific illnesses.

When reason for referral to hospital was inexplicit (i.e., to clarify whether the patient was referred either for COPD exacerbation or pneumonia), the first author checked the patient's hospital record to identify the most accurate reason for referral. A second rater evaluated the reasons for referral to hospital for 141 randomly selected cases, and

then we performed an agreement-testing, using Cohen's Kappa (κ) to test interrater reliability (McHugh, 2012). The coefficient was 0.7, which supports the reliability and validity of the rating procedure.

3.5.2 Statistical data analysis

In paper I we included descriptive statistics of the characteristics of the hospitalisations including the distribution of reasons for referral among three age groups, and associations between demographic characteristics and admission to hospital. Confidence intervals were based on a Poisson distribution of the frequency of hospitalisations, as event-count data are usually Poisson distributed. Continuous variables are described as means and standard deviations, while categorical variables are reported as frequencies.

The hospital admission incidence rate was calculated by dividing the number of admissions during the study period by the number of individuals included in the study cohort, stratified by age and gender.

Length of stay (LoS) was calculated using inter-quartile range (IQR) and median from admission to discharge date and is presented in days; for persons who had less than six hours at the hospital, LoS is calculated to be 0 days IQR was used to account for the extremes in the material.

We evaluated frequency of admissions separately for each reason for referral for the age groups 67-79 years, 80-89 years and ≥90 year using Z-tests for testing differences of admission proportions in each age group for each reason for referral to hospital. The test was made to compare the proportion of a specific reason for referral (categorical data) for the age groups included in this sub-study, and was performed on an online calculator (http://www.socscistatistics.com/tests/ztest/Default2.aspx). The underlying assumption is that the proportions are equal.

A multinomial logistic regression analysis was then performed in order to investigate the partial, independent effects of age and gender on the

most common reasons for referral to hospital (fall, infections or general decline). The dependent variable was categorical, i.e., fall, infections or general decline using no hospitalisations as a reference group. Age and gender were entered as predictor variables. Alpha level was set at $p<.05$.

All statistical analyses in paper I were conducted using SPSS Release 23.0.0.0 (IBM, Inc., Chicago, IL, USA).

3.6 Qualitative approach

Paper II and III partly utilises identical data material; data collection for these two papers is therefore accounted for in one chapter. The data analysis however, is not identical, thus are the two analysis presented separately.

3.6.1 Study design

The sub-study was carried out in an urban municipality in Western Norway. Paper II and III employed a single embedded case study (Yin, 2014) design, where data were analysed according to

A case study approach is particularly useful to employ when there is a need to obtain an in-depth appreciation of how ALTs could be used in community care in order to prevent hospitalisations for home-dwelling older persons, in its natural real-life context (Crowe et al., 2011; Yin, 2014). The case was defined as the municipality. The embedded design included macro, (policy), meso, (organisation) and micro (clinical team in homecare) levels in the data collection and analysis. In paper II the focus was on key contextual factors from the municipality's perspective, thus getting a better understanding of which factors could be targeted when planning an ALT intervention in community care.

3.6.2 Data collection

Data collection for paper II and III was carried out between March 2014 and July 2015. All interviews were audiotaped and transcribed verbatim, and took place in the informants' work place.

The data collection in paper II and paper III was based on a triangulation of methods involving document analysis, semi-structured individual interviews, and focus group interviews (Crabtree & Miller, 1999). Data were collected on three levels of the healthcare system; 1) national policy documents and regulations (macro) 2) individual interviews with senior managers and municipal strategy documents (meso) and 3) focus group interviews with nurses and nurse managers in direct patient care (micro).

Table 2: Overview of data in the thesis:

System level	Data
Macro level	6 National policy documents), in total 590 pages.
Meso level	5 individual interviews, 70 transcribed pages
	2 local government documents, in total 112 pages.
Micro level	2 (*n=12*) Focus group interviews, 34 transcribed pages

3.6.1.1   Acquisition of documents

For paper II, we collected data at the macro level, involving acquisition of relevant national policy documents (e.g., national care plan and whitepapers) developed by the Ministry of Health and Care Services. All documents are publicly available on the Internet and downloaded from: https://www.regjeringen.no/en/finddocument/id2000006/?ownerid=421 These documents were included in paper II because they provide information about macro level entities' vision and ideas concerning the use of ALTs in health care. With reference to paper II, are macro level data referred to as "external environment" in the MUSIQ framework.

We also included meso level documents; the municipality's strategic plan for implementing assistive living technologies (kommune, 2014), and a report on the use of resources in municipal health and care services (PwC, 2015) were included to provide additional perspectives about key issues (e.g., organisational issues and leadership), and to serve as a supplementary source for understanding discrepancies among informants.

3.6.1.2   Individual interviews

Five individual semi-structured interviews were conducted with senior managers in community care. We used a purposeful sampling method, to include of managers who all had a key strategic position within the municipality with important oversight of the decision-making processes related to ALTs. Recruitment was initiated through the study's working group members, by asking them for a recommendation as to who could best explicate the aspects of interest. All of the informants asked to participate accepted.

To answer research questions pertaining to paper II, individual interviews were employed to ensure a more in-depth understanding of the managers' roles in the implementation of ALTs in elderly community care.

Paper III focussed on a more practical use of ALTs in community care. This is in accordance with the initial phase of modelling a complex intervention, as described in the MRC framework (Craig, 2008). In this context, the managers contributed with a comprehensive insight concerning the municipality's interests in the matter of prevention of hospitalisations for home-dwelling older persons.

A semi - structured interview guide (see the appendix 4) was developed, and included dimensions pertaining to the MUSIQ framework, as well as concrete questions related to preventing hospitalisations for home-dwelling older persons receiving community care. For paper II, the focus was on organisational structures and processes for managing quality, and the leader's role in quality improvement work, while for paper III, the focus was on which technological applications were considered to be useful for the purpose of preventing hospitalisations.

3.6.1.3 Focus group interviews

Two focus group interviews were conducted (n=12) in 2014. Both interviews lasted approximately 90 minutes. According to Wilkinson (2009, p.177), it is "a way of collecting qualitative data, which—essentially—involves engaging a small number of people in an informal group discussion (or discussions), 'focused' around a particular topic or set of issues". The research question and research design guide how the focus group is constructed. Well-designed focus groups usually last between 1 and 2 hours (Morgan, 1997; Vaughn et al., 1996) and consist of between 6 and 12 participants.

Maximum variation sampling was employed to identify a sample of health care professionals who represented different lines of work in community care. Administrative personnel in the municipality, who otherwise were not involved in this study recruited informants; 12 health care professionals who worked either in direct patient care or administered community care services for older persons were invited to

participate in the interviews, all agreed. Eleven women and one man in the age between 30-55 years, who had worked in community care for more than five years, participated. None of the informants was directly engaged in the work with ALTs.

For these interviews, we applied a thematic interview guide (See appendix 5) which was developed for the purpose of 1) exploring aspects related to implementation of ALTs (paper II); 2) potential ALTs which were considered to be appropriate for preventing hospital admissions (paper III); and 3) for whom (patients) hospitalisations potentially can be prevented (paper III).

Focus group interviews were employed so that participants could discuss perceptions, opinions and thoughts related to the abovementioned topics. A thematic interview guide is more suitable for this kind of interview, as contraire to the semi-structured interview. This because it opens up for the informants to share and compare experiences, and discussing the extent to which they agree or disagree with each other. At the same time, it was important to have data related to the thesis' research questions (Breen, 2006).

3.6.3 Data analysis

In this section, a thorough description of the data analysis undertaken in paper II (template organising style) and paper III (systematic text condensation) will be provided respectively.

3.6.3.1   Qualitative data analysis in paper II

The aim of paper II was to identify contextual factors at the macro, meso, and micro levels in order to guide the future implementation of an ALT intervention in community care.

The MUSIQ framework was used as a guide in the data analysis, by providing a priori themes in advance of the analysis process (see example

in appendix 6). Crabtree & Miller (1999) describe this as a template organising style. With the template (theory-based) analysis style, the text is organised according to pre-existing theoretical or logical categories, to provide new descriptions of previously known phenomena. Template Analysis is a form of thematic analysis where a key feature is the use of hierarchical organisation of codes, with groups of similar codes clustered together to produce more general higher-order codes but with the flexibility to adapt it to the needs of a particular study (Brooks, McCluskey, Turley & King, 2015). In the thesis, 25 contextual factors included in the MUSIQ framework provided pre-existing codes to the data analysis.

Three data sources were analysed; at the macro level, national policy documents underwent analysis to map the stated governmental expectations related to implementation of ALTs in Norwegian municipalities. The role of the macro-level data is to link the governmental expectations concerning the use of ALTs in community elderly care, and how these were addressed by the municipality at meso and micro level. At the meso level, key documents from the municipality underwent analysis, along with transcripts from individual interviews; and at the micro level, the units of analysis were transcripts from focus group interviews. The research group (comprising the PhD student and two supervisors) read the meso– and micro-level transcripts repeatedly to gain familiarity, and then discussed the emerging findings as a team. Data material was analysed iteratively until no new codes emerged, related to the pre-defined codes defined in the MUSIQ framework.

3.6.1.4   Qualitative analysis in paper III

Qualitative data in paper III were analysed by way of Systematic Text Condensation (STC), as described by Malterud (2012), as it is well suited to analyse the multifaceted phenomena of ALTs.

This approach involves the following steps in the analysis process: (1) establishing an overall impression of the data material and identifying preliminary themes; (2) identifying and sorting units of meaning into code groups; (3) condensing the contents of each of the coded groups into subgroups; and (4) summarising and re-contextualising the contents of each code group to generalise descriptions and concepts, in this case related to the uptake and use of ALTs in community care. This represents a pragmatic approach, with a descriptive and explorative method for thematic analysis of the data material by organising the text in categories which highlights the text's true meaning (Malterud, 2012).

Hence, the STC was evaluated to be appropriate for analysing transcripts from the individual interviews and focus group interviews. The first step of the analysis requires the researcher to read with an open mind from a bird's-eye perspective all pages with transcripts, and then ask which preliminary themes (usually four to eight themes) can be identified in the material. In the data material included in this thesis, four themes were identified, namely aspects of implementation, ethics, training and potential use. To accommodate the thesis' objective concerning exploration of health care professionals' perspective on potential ALT interventions and patient groups who might benefit from such an intervention, only findings pertaining to the theme "Potential use" was reported (in paper III). All subsequent data analyses (steps 2–4 of the systematic text condensation process) were related to this theme. The other three identified themes were handled elsewhere (i. e., master thesis, project report).

Step two in STC is to identify meaning units in the transcripts, which involves reviewing the material line by line. A meaning unit is a sentence or part of the text, which somehow informs the research question. This review of material was based on the preliminary theme, as described in step one. The meaning units were thus identified and coded through derivation of text fragments which specifically could inform the research question in paper III. In step three, the meaning units were condensed

into sub-groups, and finally in step four, the sub-groups were synthesised into the two main categories which are presented in paper III.

The analytical process is demonstrated in appendix 6.

3.7 Research quality

The research quality of the thesis is concerned with aspects related to the *trustworthiness* of the thesis' findings. The three "gold criteria" generalisability, validity and reliability are illuminated here, being "gold criteria" to apply in principle to assess quality for both quantitative and qualitative research (Leung, 2015; Meetoo & Temple, 2003). As the thesis has employed a multi-method approach, the three aspects will be reflected upon the quantitative and qualitative approach respectively, and ultimately some reflections upon the multimethod approach in itself.

Generalisability
Generalisability describes the extent to which research findings can be applied to settings other than that in which they were originally undertaken. Another term used is external validity, which imply that the study should describe the true state of affairs outside its own setting (Winter, 2000). Generalisability of qualitative research findings is usually not an expected attribute (Leung, 2015), but one way to provide more useful information for generalising is to provide sufficient descriptions of an intervention and context. In this thesis, the aim is to inform an intervention, and by explicating the various methodological steps, (i. e., design, sampling, data collection and data analysis), one can better argue the levels of support and evidence for claims, and further the degree of coherence between data, the interpretation and finally the conclusions (Dixon-Woods, Shaw, Agarwal & Smith, 2004; Øvretveit, 2011). Hence, the aspect generalisability pertains to both the qualitative and quantitative approaches. The interview guides applied in one sub-study (paper II) were developed with the MUSIQ framework as a backdrop, reflecting the direction of the study and our underlying

assumptions when developing research questions, data analysis and interpretation of findings.

As explained previous in this section, one sub-study (paper I) in this thesis applied a quantitative approach which describes the frequency of hospitalisations for a selected population, namely home-dwelling persons aged 67 years or more, receiving community care. This has of course several implications, including issues of generalisability and representativity. Even though the study was undertaken in a municipality which demographic profile closely matches the general Norwegian proportion of older persons, we have not matched the study cohort with the population of home-dwelling older persons receiving community care on a national level. The study cohort is consequently not necessarily representative, and our findings consequently have limited degree of generalisability.

Validity
Still, the statistics applied in the thesis (paper I) should nevertheless provide information about whether the findings are due to chance, and the study cohort (sample size) is judged to be large enough to provide sufficiently robust data and the following results (i.e., not due to random variation). In other words, this part of the thesis qualifies to be valid, as it presents accurately those features of the phenomena, which it is intended to describe (Hammersley, 1990; Polit & Beck, 2004).

As regards the qualitative approach in the thesis (paper II and III), the validity of the study can be evaluated by reviewing whether the research question is valid for the desired outcome, the design is valid for the methodology, the choice of methodology is appropriate for answering the research questions, the sampling and data analysis is appropriate, and finally the results and conclusions are valid for the sample and context in the study (Leung, 2015). It is also important to be aware of the researchers' own preconceptions and backgrounds in the undertaken research (Lincoln & Guba, 1985). To ensure validity of the qualitative

analysis, triangulation is suggested in relation to choice of methods, triangulation of sources, analyst triangulation and theory triangulation.

In this thesis, triangulation was principally obtained by employing multiple data sources (managers and health care personnel), different data collection methods (individual interviews and focus group interviews), and triangulation during the analytical process (multiple analysts, analytical methods) (Patton, 2014).

Both the individual interviews and the focus group interviews undertaken in the thesis followed interview guides which were developed with the chosen theoretical framework (MUSIQ) as a backdrop. Such a theoretical driven approach can remind the researcher of the overall direction of the project (Morse & Niehaus, 2009), and also provide information about the researchers' underlying assumptions when developing research questions, data analysis and interpretation of findings. More specifically, the interview guides were developed through a discussion between me as a PhD student and my supervisors, about the various contextual factors included in MUSIQ, and agreeing on a strategy on how to proceed with the interviews. The interview guide for the individual interviews had a more in-depth approach than the interview guide employed in the focus group interviews (see appendix 4 and 5).

In accordance with Malterud (2012) who also argues that the data analysis benefits from being conducted by more than one researcher (i.e., triangulation), all authors read all interview transcripts to get an overall impression of the full data material. In the further analysis, both for paper II which applied a template analysis and for paper III, which applied Systematic Text Condensation (STC), member checks was part of the analysis process. The latter involved presenting early interpretations and conclusions to my supervisors (IT, SW), to confirm, clarify and develop the identified themes (Lincoln & Guba, 1985).

Reliability

The reliability of a study often refers to the degree of consistency and accuracy in chosen measurements, so that the same results could be obtained in another, similar study (Polit & Beck, 2004).

For the qualitative approach in paper II and III, my stance in research is to assume that there are multiple interpretations to be made of the studied phenomenon of adopting ALTs in community care, and they depend upon the position of the researcher and the context of the research. Hence, concern with reliability is therefore not a core concept in qualitative research; instead, issues such as the reflexivity of the researcher, the attempt to approach the topic from differing perspectives, and the richness of the description produced, are important requirements. Reliability pertaining to the qualitative approach is to evaluate whether the data collection processes, the findings and results in the thesis are consistent and dependable (Zoharbi, 2013).

The researcher should be cognizant of the fact that values and attitudes play an important role in determining 1) what research question to ask; 2) what type of data to use; and 3) the type of methods, analysis and interpretation that shape an understanding of the research problem. It is important to be aware of these factors, as one might unconsciously follow the dominant paradigm of our discipline without a critical assessment of the values and attributes following this paradigm (Rødne 2009). Lincoln & Guba (1985) say that underlying a researcher's methodological preferences are a set of values, assumptions, or axiology, that we bring to a social inquiry from our own lives. As they permeate the entire process concerning study design, data collection and –analysis, the researcher must be aware of the implications these assumptions have regarding the research process.

Onwuegbuzie and colleagues (2009) have provided much evidence of the important role that group dynamics play in determining group outcomes. They imply that it is reasonable to expect the composition of

the focus group to influence the quality of responses given by one or more of the participants. Focus groups which are heterogeneous with respect to demographic characteristics, educational background, knowledge, experiences, and the like, are more likely to affect adversely a member's willingness, confidence, or comfort to express their viewpoints (Sim, 1998; Stewart & Shamdasani, 1990). Thus, it is important that the moderator and assistant moderator document and monitor the group dynamics continuously throughout each focus group session. In the focus group interviews undertaken in this thesis, we had one moderator who observed the informants and took notes about non-verbal communication.

3.8 Ethical considerations

Any research activities that involve humans must consider ethical issues, as stated in the Declaration of Helsinki (WMA 2008). Access to individual medical records included in a study cohort should as a main rule be based on consent. The Regional Ethical Committee for Medical and Health Research Ethics (REC) evaluated the study to be useful for society, but that it would be too comprehensive to collect individual consents to access registry data for the study cohort. The project was thus granted exemption from the duty of confidentiality from REC for the quantitative study. The study design for the quantitative approach (Paper I) was approved by REC South East (No. 2013/1070) and the University Hospital's Data Protection Officer (No. 2013/21) (see Appendix 1).

The qualitative approach (Paper II and III) was approved by the University Hospital's Data Protection Officer (No. 341) (see Appendix 1). Prior to data collection, participants in this part of the study received written information about the study, including the possibility to withdraw at any time. All participants provided an informed written consent. Any names mentioned in the interviews were rendered anonymous. Transcripts of focus group interviews applied letter codes from A to F to label the informants.

Discussions about using technological applications in caring for patients in community care have identified pros and cons worldwide. In a nursing context, caring is a pivotal matter. Caring for patients is about closeness and having the available time when needed (Martinsen, 2006). Several nurses state that the nature of their nursing profession and values are threatened because remote caring will keep them away from the bedside or face-to-face meetings with patients. In addition, the consequence for older people can be increased isolation (Sandelowski 2000, Mair et al. 2008, Milligan et al. 2011).

4 Results

Three papers constitute the thesis. In this chapter, a summary of the results from the papers I, II and II is presented respectively, with an initial repetition of the specific objectives and research questions.

4.1 Paper I

Characteristics and predictors for hospitalisations of home-dwelling older persons receiving community care: a cohort study from Norway. (Gjestsen, Brønnick & Testad, 2018).

This study aimed to identify reasons for referral to hospital for home-dwelling older persons (>67 years of age) receiving community care, and further to describe the prevalence and correlates associated with admissions to hospital for this population in a Norwegian municipality. The ultimate goal was to identify ways of preventing hospitalisations with the use of ALT, and in order to do so we first identified a potential patient group for which such an intervention could be aimed.

We identified a total of 1457 admissions, represented by 729 unique individuals from the study cohort (n = 1531), out of which 64% were women. The estimated mean age was 83 years.

The most common reason for referral was the need for further medical assessment due to general decline, based on symptoms such as pain / unspecified dyspnea / dehydration / anemia (334 referrals = 23%). 303 referrals related to infections (ICD-10 chapter A J K L N) constituted nearly 21% of overall admissions, while falls caused 13% (191 referrals) of the hospitalisations for the study cohort. The most common reason for referral within infections were related to the respiratory system (e.g., pneumonia), urinary tract infections and skin infections (e.g., erysipelas). There were associations between increasing age and hospitalisations due to physical general decline, and associations between male gender and

hospitalisations due to infections (e.g., airways infections, urinary tract infections).

We found a higher admission rate in the lowest age group (67–79 years), compared to the other two age groups. I. e., the annual admission rate varied with age, but there was a statistically significant negative correlation between age and annual admission rate (Spearman's rho=.-117, CI -.186- -.041, $p = .002$).

In this study, we identified patients groups with a high frequency of hospitalisations. This information is vital in the context of applying ALTs in community care, as they can be used to track changes in the patients' vital signs and health condition.

4.2 Paper II

What are the key contextual factors when preparing for successful implementation of ALT in primary elderly care? A case study from Norway. (Gjestsen, Wiig & Testad, 2017)

This paper focused on identifying the main contextual factors pertaining to different organisational levels in the studied municipality. By applying The Model for Understanding Success in Quality (MUSIQ) framework as a guide in the data analysis, we identified external motivators and project sponsorship as key factors on macro level, while leadership, workforce focus and maturity were factors pertaining to the meso level. The latter as well as motivation to change were key factors pertaining to the micro level.) At macro level, the external environment, represented by several reports to the Parliament, was an incentive for leaders in the municipality to translate the national targets to local initiatives, by being an external motivator. Furthermore, exercised the Directorate of Health (DoH) a role as project sponsor, as it provided funding for ALT projects led by the municipality.

At the meso level, quality improvement (QI) leadership and maturity were the two main factors as leaders in the municipality had to align the local QI work with the national priorities and focus areas (as defined in macro level policy documents). The senior leaders regarded it as their responsibility to be familiar with and committed to ongoing projects involving the use of ALTs.

Maturity as a key factor involved data infrastructure, resource availability and QI workforce focus. These factors are an expression for organisational readiness, thus telling something about an organisation's maturity. Therefore maturity – or the lack of such –was a key contextual factor at the meso level.

We also identified challenges related to implementation and integration, as the lack of guidelines from national authorities regarding financial

issues, standardisation of technological platforms / infrastructure / cyber security, legal issues, organisational aspects and ethical considerations were an expression for the lack of organisational maturity. Thus maturity emerged as a key factor at the meso level regarding both organisational readiness, data infrastructure and challenges related to the lack of guidelines from national authorities.

At the micro level, motivation to change and maturity were the two main contextual factors. Motivation to change is pertaining to the potential benefits that could arise from using ALTs. Healthcare professionals were motivated to use ALTs in daily care, if there was a practical benefit for it; the technological solutions had to function properly in the day-to-day work.

All in all, the findings in this study imply that issues concerning implementation and organisational factors related to the integration of ALTs in home-based care must be taken into account when considering ALTs in community care. At the time the study took place, the municipality lacked a sophisticated enough data infrastructure to be ready for integration of ALTs in the care services.

4.3 Paper III

Health care personnel's perspective on potential eHealth interventions to prevent hospitalizations for older persons receiving community care. A case study. Gjestsen, MT, Wiig, S., Testad, I.

This study aimed to identify and explore the perspectives of managers and health care personnel in community care regarding the use of ALTs in terms of preventing hospitalizations for home-dwelling older persons receiving community care. Data analysis of focus group interviews and individual interviews resulted in two categories: Potential technological applications and potential patient groups. These two categories focus on which ALTs that are considered as appropriate in order to prevent hospitalisations, and a health care personnel's perspective on which patient groups hospitalisations potentially can be prevented.

Health care personnel warranted technological tools and measures to enhance and document their clinical observations in contact with patients. By doing so, they saw the potential of saving a trip to the outpatient emergency clinic for the patient, and they could provide better quality of the home-care.

They had several suggestions in this matter; the possibility of drawing blood for a C-reactive Protein test (CRP) was suggested on the grounds that this was the first thing the doctor asked for when they made contact for an assessment of a patient. Since they did not have the equipment to do this procedure/test, the patients had to book an appointment either at their GP, or at the outpatient emergency clinic.

They also discussed the possibility of applying a video link to a doctor as a tool for the doctor to observe symptoms related to respiration and swollen legs/ peripheral oedema.

Furthermore, the participants in the focus group interviews wished to be equipped in a manner that made them more self-sufficient in providing

high quality care, and in this context. They suggested for example the use of a bladder scanner as a tool, in relation to a problem with re-occurring urinary tract infections (UTIs), as well as the use of a tablet in the day-to-day practice in community care. A tablet installed with the quality/record system used in community care would enable the health care personnel to enhance and document their clinical observations in contact with patients.

Another type of technological applications both the informants in the individual interviews and informants in the focus group interviews discussed were more related to a safe home environment, and the potential for the patients to increase the degree of self-management, using automated devices (smart house technology), alarms and reminders.

The informants in the focus group interviews started off discussing various clinical conditions and patients that they viewed did not necessarily need the competence provided in specialised health care services that a hospital represents. If a patient was to be hospitalised due to dehydration, they considered the "treatment" or intervention initiated at the hospital to be rather short and simple, implying that this sort of intervention did not require specialised health care.

Another group of patients who they discussed was those who have Chronic Obstructive Pulmonary Disease (COPD). In their experience, these patients had frequent re-admissions to hospital, not necessarily due to the clinical condition itself, but because of the anxiety that often follows having respiratory problems, implying that many of the (re-) hospitalisations potentially could have been prevented through a follow-up after discharge.

The informants in this study were quite clear about which technological applications they considered potentially useful in their practice. They also discussed which patients groups whom hospitalisations potentially could be prevented. There was however not a clear connection between

the suggested technological applications and the identified patient groups. The results are discussed against relevant literature, providing suggestions for future intervention research.

4.4 Summarise of results

In this thesis, we identified potential patient groups for which an intervention ALT intervention in community care could be aimed (Paper I and III). The most common reason for referral to hospital was general decline, followed by infections and falls. Men were more at risk for hospitalisations, especially when presenting symptoms associated with infections. The eldest of the studied cohort (aged 90+) were more prone to admissions due to general decline.

Furthermore, we have explored which technological applications that potentially could be employed by health care personnel in community care in order to prevent hospitalisations for home-dwelling older persons. Various technological tools and applications were suggested as a mean to enhance and document health care personnel's observations in their day-to-day practice.

Ultimately, we have identified key contextual factors that are believed to have an impact on the implementation of ALTs in community care.

5 Discussion

The overall aim of this thesis is to inform a future ALT intervention in community care, aiming to prevent hospitalisations for home-dwelling older persons receiving community care. The main findings are pertaining to i) identification of patients groups *who* potentially could benefit from an intervention (Paper I and III); ii) identification of *what* ALTs are considered by health care personnel to be appropriate in terms of preventing hospitalisations for home-dwelling older persons (Paper III); and iii) identification of key factors which may have an impact on *how* implementation of ALT in community care can be performed (Paper II). Findings are discussed separately in the three papers, and in this section, we discuss the synthesis of findings in accordance with the research questions addressed, and in the light of previous research and the theoretical perspectives and framework presented in this thesis.

5.1 Patients likely to profit from an assistive technology living intervention

As described in paper I, we identified patients groups who had a high frequency of hospitalisations. Furthermore, we described for what reason older persons receiving community care were referred to hospital for, and characteristics associated with frequency of hospitalisations for this population, during the one-year study period. Out of our study cohort (1531 persons), 729 persons were hospitalised during a one-year period, 64 percent were women. The 729 persons had a total of 1457 admissions to hospital, where 53 percent of them were admitted only once during the study period. 23 percent were admitted twice, 11 percent were admitted three times, while 13 percent were admitted more than four times during the one-year study period. However, in terms of predicting future admissions to hospital, there is discrepancy in findings related to whether frequency of hospitalisations is a predictor. While some studies found that a previous hospital admission was associated with a higher

risk to be re-hospitalised (Crane et al., 2010; Epstein, Jha & Orav, 2011), one study found that having two or more admissions one year, proved to have a low sensitivity in detecting older patients who would have high admissions in the following year (Roland, Dusheiko, Gravelle & Parker, 2005). In order to have an appropriate rationale for tailoring interventions which ameliorate the resource challenge the health care services currently is facing (i.e., the rising demand for acute hospital beds alongside a dwindling proportion of health care personnel), it is necessary to look beyond the frequency of hospitalisations for this age group.

The fact that a proportion equivalent to just less than half of the study cohort was hospitalised more than one time during the one-year study period, can indicate that many of them had chronic diseases which made recurrent hospitalisations necessary, due to exacerbations. For example, have other studies found that the severity of disease and the burden of comorbidity are strong predictors of hospitalisations (Gamper et al., 2011; Landi et al., 2004). However, it can also indicate that the older person presented with diffuse and general symptoms when in contact with a doctor, so that the doctor assessed and evaluated that hospitalisation was necessary in order to find out what was wrong (Purdy & Huntley, 2013; Soria-Aledo et al., 2009). The latter seem to be relevant in our study, as the most common reason for referral was the need for further medical assessment due to general decline, based on symptoms such as pain / unspecified dyspnoea / dehydration / anaemia (334 referrals = 23 percent). Dyspnoea symptoms are especially noteworthy in terms of hospitalisations, as a previous study have shown a positive correlation between increasing degree of dyspnoea and risk of hospitalisation (Fortinsky, Madigan, Sheehan, Tullai-McGuinness & Kleppinger, 2014). The second most frequent reason for referral to hospital was related to infections (respiratory system (e.g., pneumonia), urinary tract infections and skin infections (e.g., erysipelas); they

constituted nearly 21 percent of overall admissions, while falls caused 13 percent (191 referrals) of the hospitalisations for the study cohort.

Based on the findings in our study (paper I), where conditions associated with increased frequency of hospitalisations were identified, it is paramount that personnel in community care are vigilant observers and good clinical practitioners. The potential for preventing hospitalisations for these patient groups lies in discovering and addressing the patients' symptoms before the illness progresses. This way ensures proper treatment and care for the most vulnerable. Persons with chronic conditions and/or multi-morbidity could be supported by community care, which potentially can reduce the risk of hospitalisations (Eron, 2010; Kang et al., 2010).

This was further described in the interviews (paper III), where the informants discussed which patient groups who potentially could profit from an ALT intervention aiming at preventing hospitalisations. Dehydration, was commonly agreed, could have been treated outside speciality care. The informants agreed that the "treatment" or intervention initiated at the hospital to handle dehydration, did not require specialised health care. Another group of patients who they discussed was those who have Chronic Obstructive Pulmonary Disease (COPD). In their experience, these patients had frequent re-admissions to hospital, not necessarily due to the clinical condition itself, but because of the anxiety that often follows having respiratory problems, implying that many of the (re-) hospitalisations potentially could have been prevented through a follow-up after discharge. COPD as reason for referral constituted only 2.5 percent of the hospitalisations, but this could be due to the fact that many patients with this chronic condition are hospitalised due to air ways infections, and not solely because of an exacerbation of the condition in itself.

The informants further agreed that hospitalisations due to Urinary Tract Infections (UTIs) could have been prevented provided that the nurses

had proper equipment to monitor the situation concerned with residual urine in the bladder. UTIs was one of the conditions for which a large proportion of the hospitalisations scrutinised in paper I was responsible. Nearly 21 percent of the hospitalisations was related to infections (respiratory system (e.g., pneumonia), urinary tract infections and skin infections (e.g., erysipelas).

This heterogenic picture in terms of health status and age-related conditions represent a challenge for isolating clinical aspects relevant for preventing hospitalisations for home-dwelling older persons receiving community care. The findings presented in this thesis demonstrate however, that personnel in community care are clinically observant, but are not necessarily familiar with risk factors as described in the body of research concerning hospitalisations of older persons receiving community care. The main focus of the health care personnel was the clinical aspects in their day-to-day practice, and the awareness related to risk factors combined with the clinical aspect, was not so evident.

In addition, the aspect of isolating concrete risk factors is challenging, as previous studies on this issue have reported different findings, and there is a discrepancy in the findings. For example, some studies have found that men above the age of 80 had approximately 25% more inpatient stays than women in the same age group (Galdas, Cheater & Marshall, 2005; Juel & Christensen, 2008; Statistics Norway, 2007). Others find that being female, increasing age and low socio-economic level are factors associated with an increased risk of hospitalisation due to multi-morbidity (Corrao et al., 2014). In our study, men had a higher annual admission rate compared both to the female proportion and to the entire study population (1.1 vs .9 and .95 respectively). Furthermore, male gender was a predictor for hospitalisations due to infections (e.g., airways infections, urinary tract infections), but were not associated with hospitalisations related to falls or general decline. This may suggest that men perhaps disregard early signs of disease and postpone going to the doctor until the later stages of disease development, thus health care

personnel in community care must be especially aware of men in the context of prevention of hospitalisations (Galdas et al., 2005).

In regards to age as a risk factor, we found a higher admission rate in the lowest age group (67–79 years), compared to the other two age groups, i. e., there was a statistically significant negative correlation between age and annual admission rate (Spearman's rho=.-117, CI -.186- -.041, p = .002). However, there were associations between increasing age and hospitalisations due to physical general decline. All of these associated factors are important, as they potentially can help us to target a patient group which is fit for purpose.

5.2 Assistive living technology applications which potentially can prevent hospitalisations

In the interviews (paper III), the informants discussed technological applications which potentially could be useful for the purpose of preventing hospitalisations for home-dwelling older persons in community care. One suggestion in this matter was the possibility of drawing blood for a C-reactive Protein test (CRP), as this was the first thing the doctor asked for when they made contact for an assessment of a patient. Since they did not have the equipment to do this procedure/test, the patients had to book an appointment either at their GP, or at the outpatient emergency clinic. If they could have done the test in community care, they saw the potential of saving the patient a trip to the outpatient emergency clinic for the patient, and they could provide better quality of the home-care. Drawing blood is not an ALT intervention, but together with the other suggestions discussed in the focus group interviews, it has the potential to be part of a package which enables health care personnel in community care to provide a more accurate description of the problem(s) when contacting a doctor. This implies that there is a potential to increase the quality of community care.

They also discussed the possibility of applying a video link to a doctor. In a recent study by Greenhalgh et al. (2018), they found that when clinical, technical, and practical preconditions were met, video consultations appeared safe and were popular with some patients and staff. However, some clinicians would adopt readily to the use of video outpatient consultations, whereas others needed incentives and support. In this thesis (paper III), the video link application was suggested as a mean to support health care personnel's' observations. In an intervention study, comprising an online eHealth intervention for patients with diabetes findings indicated that participants missed face-to-face encounters with the nurse when communicating asynchronously via secure messages in the intervention (Lie, Karlsen, Oord, Graue & Oftedal, 2017). They stated that they found it easier to discuss a variety of issues with the nurse and avoid misunderstandings when meeting face-to-face In our study however, the video link was suggested as a communication tool between health care professionals, as it was suggested as a mean for the doctor to assess a patient's condition, without being face-to-face. More specifically, they suggested using video link as a tool for the doctor to observe symptoms related to respiration and swollen legs/ peripheral oedema.

Furthermore, the participants in the focus group interviews suggested for example the use of a bladder scanner as a tool, in relation to a problem with re-occurring urinary tract infections (UTIs). This finding is in concordance with the finding described in the previous section. The use of ALTs can thus have a potential positive impact, as one aim of such interventions is for health care personnel to use various sensors and monitors to track changes in a patient's health and vital signs (May et al., 2011; McLean et al., 2011).

Informants in both the focus group interviews and individual interviews suggested the use of a tablet in the day-to-day practice in community care. To date of the data collection, the personnel documented the clinical assessments on paper, which they would plot once they came to

the home-care base (office) where they had access to a computer and the patients' record. As such, a tablet installed with the quality/record system could be used in community care, to enable the health care personnel to enhance and document their clinical observations in contact with patients. According to Nagel and Penner's conceptual model (2016), knowledge - pertaining to the dimension *Nursing Competencies* in the model, and in the *Clinical Decision*-making process, where nursing diagnoses are placed in a prioritised order, and the ability to combine clinical experience with telehealth and ethical awareness are attributes and competencies that are viewed as paramount when nurses employ ALTs in their work (van Houwelingen et al., 2016). The ability of the nurse to construct a holistic image of the person is an intentional act of care entailing more than just knowledge, skills, and ability to use technology, assess, and communicate with the person—it also requires active engagement with the person, sense of presence, synthesis of multiple data sources, and creativity (Nagel & Penner, 2016).

These findings presented in the last two sections can inform us on where to aim an intervention, based on knowledge concerning which patient groups who might benefit from an ALT intervention, and suggestions as to which technological applications health care personnel in community care evaluate to be potentially appropriate in this context.

From a methodological perspective, the work undertaken to identify relevant patient groups and potential applications, can be placed in the first phase (Development), as described in the MRC Complex Intervention framework. In this phase, identifying a relevant, existing evidence base and theoretical understanding of the likely process of change should be done. Even though the MRC framework recommend to undertake a systematic review in this phase, components of an intervention can also be identified through focus group interviews with patients or health care personnel (Richards, 2015). In this thesis, identifying issues and needs in practice is viewed to be of vital importance to inform an ALT intervention. This can be translated into

the importance of identifying patients who might benefit from an intervention, and to have a clear defined role of an technological application (whether it is a new application, a new clinical tool or a new system for delivering care remotely), are factors paramount for acceptance and adoption of an intervention (Broderick & Lindeman, 2013; Taylor et al., 2015). In parallel, it is of vital importance that the involved stakeholders (e.g., researchers, policy makers, health care personnel, patients, carers) are able to judge the value of an ALT intervention in its own right (Greenhalgh et al., 2012; Richards, 2015).

In this thesis, we employ empirical data for the purpose of informing an ALT intervention in community care. The preparation which is embedded in this work, is extremely important as it is increasingly recognised that health care personnel's acceptance of the technological application itself remains a key challenge in adopting an intervention (Brewster et al., 2014; Catwell & Sheikh, 2009; Hendy et al., 2012). The latter perspective is especially important, as May and colleagues identified (May et al., 2011) problems in terms of health care professionals in community care to be indifferent and sometimes even hostile to the implementation of telecare systems. As pointed out in many studies before, the complexity characterising the implementation of ALTs in health care, requires acknowledgement of technologies, humans and its social environment to be interdependent and mutually reinforcing, as they can simultaneously be members of several interrelated systems (Aarts & Gorman, 2007; Bowes & McColgan, 2013; Cohn et al., 2013; Coiera, 2004; Li, 2010).

Previous research has pointed to a poorly founded rationale for the use of an ALT intervention as a reason for slow and fragmented uptake and use of ALTs in community care (Greenhalgh et al., 2016; Taylor et al., 2015). It is thus of vital importance to develop interventions which are considered to be useful and fit for purpose by the actual users, or else will there be continuous reluctance regarding adoption of technologies in health care (Catwell & Sheikh, 2009).

5.3 Caring for home-dwelling older persons using ALTs

Information gathered using the suggested technological applications, must be related to the individual context of the patients in order to be made clinically relevant. Even the most exact measurements only get their clinical significance when related to the situation of an individual (Pols, 2010). Best practice to individual patients can be operationalised through the nursing process (Wilkinson, 2007), where the first phase is to assess the patients' physical condition and collect vital signs data (Greenberg, 2009). In the context of preventing hospitalisations, monitoring symptoms such as identified in this thesis (paper I), can be done through the use of ALTs, as they allow a close and continuous monitoring of symptoms, systematic follow-up by health care personnel, and a proper response (Eron, 2010; Kang et al., 2010). Based on information gathered in the first phase, nurses use a diagnostic reasoning process to draw conclusions about the patient's health status and decide whether nursing intervention is needed. A holistic assessment is defined as an ongoing information-gathering process that attends to all dimensions of a person's health patterns, utilising interpersonal interactions and sensory perception of the nurse to arrive at mutual nurse-person goals, where the person being assessed is considered the primary source of information and interpreter of meaning (Potter & Frisch, 2007). This process provides the basis for giving individual care, and nurses in community care should view the use of ALTs as a supplementary tool in the nursing process.

In accordance with Nagel & Penner's (2016) conceptual model of Telehealth Nursing, these two phases in the nursing process can be translated into General Skill, or Clinical Contextual factors in relation to the implementation of ALTs.

5.4 Contextual factors relevant for the uptake and implementation of ALTs in community care

Although having a proper rationale for adopting an ALT in community care is of vital importance, many describe implementing an application as the crux. We have thus identified key factors, so that uptake and implementation of a future ALT intervention could be optimised. The findings in paper II is especially important, as the use of ALTs in Norwegian policy documents advocate the use of ALTs to improve adaptation of peoples' homes, and that health care services must be organised in a manner that support and stimulate the patients' own resources, their families and social networks (Directorate of Health, 2014; Report to Parliament No. 29 (2012-2013); *Official Norwegian Reports NOU 2011:11,* 2011). Furthermore, to innovate community care in a way that the objectives related to prevention and early intervention to halt the development of disease can be achieved.

The Hagen committee (*Official Norwegian Reports NOU 2011:11,* 2011) proposed that the Government should establish an incentive structure which promoted innovation within community care, and further to develop an infrastructure for research, development and innovation in the care services. Consequently, the Directorate of Health introduced the national programme for development and implementation of ALTs in community care in 2013. In our study, we found that the policy documents were incentives for leaders in the municipality to translate the national targets to local initiatives. For example, exercised the Directorate of Health (DoH) a role as project sponsor towards the municipality, as it provided funding for ALT projects led by the municipality. Despite of these external motivated incentives, through the interviews with municipal managers, we discovered several concerns about whether the municipality was ready to implement ALTs. The framework applied in our study (MUSIQ) underscored how factors in the health care system are interdependent, e.g., that external motivators at the macro level will be an incentive for leaders at the meso level to

translate national QI priorities into local initiatives at the micro level. Many aspects remained unclear in the macro-meso relationship, such as further financing of ongoing projects, and legal and technological aspects, because there were no guidelines from the macro level addressing these issues. The lack of such alignment between levels could represent a challenge when preparing for successful implementation of ALTs in community care, as these elements are interdependent and mutually reinforcing. This finding illustrates what previous research has described as challenging, when technologies, humans and its social environment which can simultaneously be members of several interrelated systems (Cohn et al., 2013).

A similar challenge can be seen between the meso level and micro level entities in our study, as micro level findings revealed that health care professionals were not very conscious about other factors than the practical use of ALTs. On the basis of a socio-technical perspective, initiatives at the macro system must be linked to initiatives at the meso level for particular care groups and populations, and at the micro level for individual service users and carers (Juhnke, 2012). In this regard, understanding how organisational, social, political and policy context include interdependencies is crucial, as it has become increasingly clear that issues pertaining to various levels in an organisation are critical to effective implementation (Aarons et al., 2012; Rafferty et al., 2013).

While organisational maturity and readiness to implementation is of vital importance, the actual use of the technology takes place on micro level – in the provision of care for older persons. This imply that health care personnel must be ready for the change that follows as a consequence of adopting ALTs in community care (Greenhalgh et al., 2004). This dimension was identified in the focus group interviews, where the informants talked about the potential benefits that could arise from using ALTs. They actually warranted the use of technological applications in their work, implying that they regard the use of ALTs as integral to their nursing practice in community care. This perspective is in contrast to

what May and colleagues found in their study from 2011, where they identified problems in terms of health care professionals in primary home care to be indifferent and sometimes even hostile to the implementation of telecare systems. From an implementation view point, readiness for change serves as a key construct for the success of a change effort (Rafferty et al., 2013). The informants in our study (paper II), were motivated to use ALTs in daily care, provided there was a practical benefit for it. A main finding in the thesis is that at the time of the study, integration of technological applications into community care was more a vision than a reality because of a low level of organisational readiness. Uncovering these factors is important, as they can inform us how to increase the likelihood of successful implementation of ALTs in the future.

Today, more than 200 out of Norway's 422 municipalities are involved in projects employing ALTs through the National programme, but when we conducted this study, the piloted technological solutions, and the gained experiences therefrom were not as comprehensive. That might explain why we found that the municipality was organisational immature, with a lack of technological infrastructure and uncertainty about guidelines from national entities.

5.5 Methodological considerations

Combining various methods can lead to a more in-depth and detailed information about the researched topic (Morgan, 1997). In the empirical work undertaken in this thesis, we applied several methodological approaches to inform an ALT intervention to prevent hospitalizations for home-dwelling older persons. Several strengths and limitations must be addressed when assessing the findings in this thesis.

It is essential that the development of a complex intervention, such as an ALT intervention in community care, is based on a theoretical understanding of key aspects relevant to both the intervention itself, as

well as the system in which the intervention is planned to be applied. In this respect, the MRC framework (Craig et al., 2008) provided a systematic and robust guidance on how to undertake the empirical work in the thesis. More specifically, both the quantitative study (paper I) involving mapping of hospitalizations of home-dwelling older persons and the qualitative exploration of managers and health care personnel's perspective regarding potential technological applications and potential patient groups (paper III) have provided a rationale for how a future intervention could be employed in community care. The qualitative data material have also provided insight into factors relevant for the implementation of a future intervention (paper II). These aspects are highly relevant for developing an intervention which is suited to accommodate the practical needs in community care, and how to increase the likelihood of a successful implementation. The latter is however still premature, as processes and outcomes must be modelled before proceeding with feasibility and piloting an intervention, as described in the MRC framework.

The theoretical understanding and more specifically the use of a specific theoretical framework (MUSIQ) when developing interview guides and in the data analysis in paper II are obviously reflected in the findings. The choice to apply a-priory defined themes to the analysis serves the purpose of identifying issues in the data material specifically relevant for the theoretical understanding of the issue at hand – namely to identify key contextual factors that are vital when an intervention. In this process, we could have missed out on themes relevant for the planning of an assistive living intervention in community care.

Another major limitation in the thesis is the unilateral focus on health care personnel and managers in the qualitative data. To ensure a person-centred, holistic and ethically based approach, thus optimising the likelihood of a successful adoption and use of an ALT intervention in community care, all stakeholders must be involved – individual users,

service providers and technology suppliers. Such co-production should be addressed in future research.

The sample size in the qualitative study may be considered as a limitation. However, the included 5 managers held key competence about the municipality, such as strategic knowledge on plans, decision-making, funding, and vulnerability in infrastructure. The sample of 12 health care personnel in community care could have been larger, but they had daily patient contact, and represented future users of ALTs. Hence, their perspectives may be transferable to other similar contextual settings as described in this thesis.

Mapping hospitalisations in the Norwegian health care system may have limitations regarding transferability of results to other countries. As the Norwegian health care system is different in terms of financial arrangements and organisational structures compared to other countries, the results pertain primarily to the studied municipality and hospital in Norway. However, focussing on the actual clinical reasons for referral to hospital, which are more or less independent of how the system works, the findings may be of interest for health care personnel (or alike) who have daily contact with home-dwelling older persons in community care.

As a PhD student, I am a novice in research and the empirical work undertaken in this thesis. This is a limitation which must be taken into consideration when the choice of methods, the fieldwork and the presentation of results is assessed and evaluated. However, being part of a scientific milieu at SESAM, with support from senior researchers, both locally and internationally can partly compensate the beginners' ignorance. Also ensuring consistency in terms of one person conducting all the interviews, triangulation and member checks with more senior researchers (i.e., my supervisors) in the data analysis, as well as transparency in reporting methodological aspects, will perhaps extenuate the limitation of being a novice.

6 Conclusion

In this thesis, we have identified for *whom* an ALT intervention, which aim to prevent hospitalisations, could be appropriate. Furthermore, we have explored *which* technological applications are viewed to be appropriate in order to prevent hospitalisations for the defined patient group. Ultimately, we have identified key contextual factors that are believed to have an impact on the implementation of ALTs in community care, hence we have explored *how* ALTs can be adopted and integrated.

The findings in this thesis provide insights on how to inform an intervention in comparable settings. The results illustrate that the rationale for an ALT intervention in community care to prevent hospitalisations, has to be based on assessments of actual needs in practice, and an identification of which patient group(s) and technological interventions should be targeted.

The thesis also underpins that development of an ALT intervention in community care should take existing theories into account, as well as contextual factors relevant to the health care system in which the intervention is planned implemented. This way, potential obstacles and incentives associated with implementation of an ALT intervention in community care, can be taken into account.

All of these aspects are highly relevant, as successful implementation depends on whether technology is *usable*; the *users* of a technological application perceive it to be *useful*, and whether the organisation has the readiness and maturity to actually adopt and implement ALTs in community care.

6.1 Implications for practice

As technology has become a part of healthcare services, it is important to investigate the point of intersection between technology and care (Solli, Bjørk, Hvalvik, & Hellesø, 2012). The uniqueness of individual needs, as well as the importance of a careful assessment of the social context into which ALTs would be introduced are vital dimensions when talking about preventing hospitalisations of home-dwelling older persons by the use of an ALT intervention. Based on the findings in the thesis, there are some key implications:

Technological applications can be used to track changes in the patients' vital signs and health condition, consequently preventing hospitalisations. The potential for preventing hospitalisations for home-dwelling older persons receiving community care lies in discovering and addressing the patients' symptoms in an early stage, so the condition or disease not progresses in a manner, which leads to such a severe state of illness that hospitalisation is perceived as the only solution by admitting instances.

Needs in practice is paramount for acceptance and adoption of a future intervention. The generated empirical knowledge about which ALTs that potentially could prevent hospitalisations for home-dwelling older persons receiving community care is rooted in needs in practice.

Aligning interests across multiple stakeholders and organisational immaturity (in the municipality) represent a challenge when planning for a future ALT intervention in community care. In a Norwegian context, this challenge can be met by developing a clear framework and action plan within community care. This includes clearly defined roles and responsibilities, and to incorporate specific guidelines and assessment for ALTs into service provision.

5.1 *Future research*

The experiences and results gained through this thesis indicate that developing an ALT intervention in community care is extremely demanding in terms of necessary competence and resources. This must be taken into account when planning a future project, and can perhaps partly explain why the use of ALTs has not developed at the pace and scale anticipated. Even though national authorities and vendors are eager to recommend the use of technological applications to improve, simplify and enhance the efficiency of service provision in community care, this study underpins the need for aligning interests among a multitude of stakeholders in order to succeed with adoption and implementation of ALTs. More specifically, this thesis provides strategies for how an ALT intervention could be developed in order to prevent hospitalisations for home-dwelling older persons receiving community care. Based on the rationale developed in this thesis, the next step would be to proceed with piloting an intervention, and test its feasibility using the MRC complex intervention framework. This includes the development phase of modelling assessments and outcomes. Although it is useful to think in terms of phases in the framework, in practice these may not follow a linear or even a cyclical sequence (Craig et al., 2008). However, after the development phase, feasibility, and piloting, the framework recommend interventions should be evaluated before implementation.

Future research should consider these aspects in order to optimize an intervention. This can ultimately lead to a more usable technological solution, which is more acceptable to more users in similar contexts. Thus, the use of ALTs will be more commonplace in community care.

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PART II

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Paper I

BMC Geriatrics

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Characteristics and predictors for hospitalizations of home-dwelling older persons receiving community care: a cohort study from Norway

Martha Therese Gjestsen[1,2*], Kolbjørn Brønnick[3,4] and Ingelin Testad[1,5]

Abstract

Background: Older persons are substantial consumers of both hospital- and community care, and there are discussions regarding the potential for preventing hospitalizations through high quality community care. The present study report prevalence and factors associated with admissions to hospital for community-dwelling older persons (> 67 years of age), receiving community care in a Norwegian municipality.

Methods: This was a cohort study of 1531 home-dwelling persons aged ≥67 years, receiving community care. We retrospectively scrutinized admissions to hospital for the study cohort over a one-year period in 2013. The frequency of admissions was evaluated with regard to association with age (age groups 67–79 years, 80–89 years and ≥ 90 year) and gender. The hospital admission incidence was calculated by dividing the number of admissions by the number of individuals included in the study cohort, stratified by age and gender. The association between age and gender as potential predictors and hospitalization (outcome) was first examined in univariate analyses followed by multinomial regression analyses in order to investigate the associations between age and gender with different causes of hospitalization.

Results: We identified a total of 1457 admissions, represented by 739 unique individuals, of which 64% were women, and an estimated mean age of 83 years. Mean admission rate was 2 admissions per person-year (95% confidence interval (CI): 1.89–2.11). The admission rate varied with age, and hospital incidents rates were higher for men in all age groups. The overall median length of stay was 4 days. The most common reason for hospitalization was the need for further medical assessment (23%). We found associations between increasing age and hospitalizations due to physical general decline, and associations between male gender and hospitalizations due to infections (e.g., airways infections, urinary tract infections).

Conclusions: We found the main reasons for hospitalizations to be related to falls, infections and general decline/pain/unspecified dyspnea. Men were especially at risk for hospitalization as they age. Our study have identified some clinically relevant factors that are vital in understanding what health care personnel in community care need to be especially aware of in order to prevent hospitalizations for this population.

Keywords: Hospitalizations, Elderly, Community care, Assistive living technology, Prevention

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Background

The global phenomena of ageing populations (> 65 years) [1] alongside reduced number of personnel available for both formal and informal care [2], may threaten the sustainability of the health care systems [3, 4]. Persons over 65 years of age are substantial consumers of both hospital- and primary care [5, 6], and a peak in hospitalization rates for both men and women can be seen in all European countries through the age group 80 and over [1]. In Norway, 35% of all individuals over 80 years were hospitalized in 2013 and 68% of these also received community health- and care services [6]. Also, older persons over 65 years accounted for nearly 27% of all overnight stays, while only comprising 11% of the population, and an increase in over-night stays from 17.8% in 2003, to 19.6% in 2013 were shown within this population [5]. The proportion of increasing age is thus associated with an increasing demand for specialized health care [7, 8], and this rising demand for acute hospital beds leads to a strong policy interest in identifying interventions which are effective in reducing avoidable hospital admissions [9–13].

Previous studies on factors predicting hospitalizations of older persons have reported different findings, but there is a discrepancy in findings regarding risk factors associated with hospitalizations for older persons. Whereas quite a few studies have found that a previous hospital admission were associated with a higher risk to be re-hospitalized [12, 14, 15], Roland and colleagues [16] found that having two or more admissions one year, proved to have a low sensitivity in detecting older patients who will have high admissions in the following year. Several studies underline that the severity of disease and the burden of comorbidity are strong predictors of hospitalizations [11, 12, 15, 17], and also that functional disability, cognitive impairment, as well as factors related to living conditions (i.e., low socio-economic level and social deprivation) also seem to play a part in frequency of hospitalizations for older persons [15, 18, 19].

Gender differences in health care utilization are illustrated in several studies, but are inconclusive as to whether being male or female is a risk factor [12]. Some studies found that men above the age of 80 had approximately 25% more inpatient stays than women in the same age group [20–22] but others find that female sex is associated with multi-morbidity, and consequently have an increased risk of hospitalization [23].

A literature review [24] identified nine predictors which were independently associated with unplanned admissions to hospital in older people aged over 75 years: male gender, history of falls in the previous 12 months, ischaemic heart disease, respiratory disease, atrial fibrillation, cancer, having leg ulceration, living alone without help and having difficulty with mobility. Other studies have identified that emergency hospital admissions often occurs when an older person has reached a point of crisis, due to a combination of circumstances; such as an exacerbation of a chronic condition, change in social setting, or a cascade of symptoms due to multi-morbidity and frailty [12, 17, 25, 26].

The various risk factors related to hospitalizations for older persons, as identified in previous research, are summed up in Table 1.

It is an ongoing discussion whether a proportion of the hospital admissions among older persons could have been prevented in primary treatment and care [7, 27, 28]. Studies from Scandinavia have found that older persons are hospitalized due to lack of an appropriate alternative in primary care [28, 29], however a Norwegian study found no association between the volume of municipality general practitioners provided (in a universally accessible healthcare system) and unplanned hospitalizations of the entire elderly population (aged ≥65 years) [8, 30]. The picture concerning the prevention of hospitalizations within this age group is thus not clear; heterogeneity in terms of health status and age-related conditions, as well as numerous contextual factors related to the health care system, represent a challenge for isolating factors concerning the matter. It is therefore of vital importance to understand the actual clinical reasons for hospitalization in order to develop more timely and appropriate care services interventions [9, 15, 31], as well as the impact of policy efforts to reduce and prevent avoidable hospitalizations [10].

Part of the policy efforts is to shift resources from hospitals to the community care setting, and in this context the use of assistive living technologies is suggested to help monitor and treat degenerative and chronic diseases through the use of sensors, alarms and reminders [32, 33]. In a review by Purdy & Huntley [27], the use of

Table 1 Various risk factors associated with hospitalizations for older persons

Risk domain	Specific risk factors
Age	Increasing age
Frequency of hospitalizations	Previous hospitalization
Gender	Male Female
Health-related conditions	Severity of disease Comorbidity Functional decline/disability Respiratory disease Ischaemic heart disease Atrial fibrillation Cancer Leg ulcers
Living conditions	Low socio-economic level Deprivation Living alone, without help
Behavioral factors	Lack of exercise Falls Poor nutrition

automated vital signs monitoring and telephone follow-up by nurses was promising with regards to preventing and reducing avoidable emergency admissions.

Previous research underlines that more studies are needed to assess outcome and effectiveness related to the use of assistive living technologies in the context of preventing hospitalizations for older persons [34, 35], but there is a potential to do so by providing early warnings of exacerbation events or deterioration. This is a significant issue in regard to both quality and cost [24, 32].

This knowledge can further contribute to develop appropriate assistive living technology interventions, thus focussing on timely interventions in primary care together with understanding the actual clinical reasons for hospitalization.

Therefore, to identify ways to prevent hospitalizations with the use of assistive living technology, the aim of this study is to identify the reason for referral to hospital, and further to describe the prevalence and correlates associated with admissions to hospital for home-dwelling older persons (> 67 years of age) receiving community care in a Norwegian municipality.

More specifically, we will

i. Describe the frequency related to reasons for referral, and characteristics of hospital admissions of home-dwelling older persons receiving community care.
ii. Describe the associations between demographic characteristics and admission to hospital.

Methods

Study design and setting

This is a descriptive, cohort study of 1531 home-dwelling persons aged ≥67 years, receiving community-based care in a Norwegian municipality. Demographic characterisitics of the study cohort are presented in Table 2. According to the World Health Organization (WHO), the age cut-off is 60+ years to refer to the older or elderly persons [36]. This

Table 2 Demographic characteristics of study cohort

Selected variables	% of total (N = 1531)	Mean ± sd
Gender:		
Male	32.6	
Female	67.4	
Age:		*Male (% within age group)*
67–79	27.1	40.7
80–89	43.3	31.9
90 +	29.6	24.9
Mean age		83.7 ±
		7.435

Sd standard deviation

study however, has applied the age-cutoff as provided by Statistics Norway, because when extracting information about health service provision in Norway, 67 years of age is the standard age-distinction. The study was carried out in a municipality where 10.4% of the population is ≥67 years of age [37]. The number of cases in this cohort was determined by the number of hospitalizations during the one-year study period and thus, they are mirroring the influence of ageing on hospital admissions, as they closely match the current age structure of the Norwegian population receiving community care [38]. We retrospectively scrutinized admissions to hospital for the study cohort between April 1st 2012 and March 31st 2013. Data were collected electronically from existing registries. The studied hospitalizations stems from a hospital located in an urban area, it is the only hospital within an 80 km radius and serves approximately 365,000 persons.

Community care

Community care represents the lowest level of care services provided by the municipality and there are few formal demands required in order to receive community care in Norway. The proper instance in the health- and social district one geographically belongs to, defines the need for assistance and/or care, together with the person seeking help. Referrals to hospital are made either from patients' general practitioner, or from an out-of-hours community-based emergency department. The persons included in our study received services from the municipality, including medical care provided by nurses (medication, wound/ulcer dressing, personal hygiene) and practical home care provided by formal carers (not necessarily nurses).

Variables and data analysis

The variables entered into the analysis were selected primarily for their clinical importance, based on previous research to be essential [9, 39–41], and included gender, age and reason for referral. The primary reason for referral to hospital was retrieved through hospital-based patient records, based on the International Classification of Diseases version 10 (ICD-10) main chapters. When reason for referral to hospital was inexplicit (i. e., to clarify whether the patient was referred either for COPD exacerbation or pneumonia), the first author checked the patients' hospital records to identify the most accurate reason for referral. A second rater evaluated the reasons for referral to hospital for 141 randomly selected cases, and then we performed an agreement-testing, using Cohen's Kappa (κ) to test interrater reliability [31]. The coefficient was 0.7, which supports the reliability and validity of the rating procedure. Length of stay (LoS) was calculated from admission to discharge date and

presented in days; for persons who had less than 6 hours at the hospital, LoS is calculated to be 0 days.

Continuous variables are described as means and standard deviations, while categorical variables are reported as frequencies.

The hospital admission incidence was calculated by dividing the number of admissions by the number of individuals included in the study cohort, stratified by age and gender (Table 3). Frequency of admissions was evaluated separately for each reason for referral for the age groups 67–79 years, 80–89 years and ≥ 90 year using Z-tests for testing differences of admission proportions in each age group for each reason for referral to hospital. Confidence intervals are also reported for each age group. A multinomial logistic regression analysis was then performed in order to investigate the partial, independent effects of age and gender on the most common reasons for referral to hospital (fall, infections or general decline) The dependent variable was categorical, i.e., fall, infections or general decline using no hospitalizations as a reference group. Age and gender were entered as predictor variables. Alpha level was set at $p < .05$. All statistical analyses were conducted using SPSS Release 23.0.0.0 (IBM, Inc., Chicago, IL, USA).

Results
Demographic and frequencies related to hospitalizations
We identified a total of 1457 admissions, represented by 729 unique individuals from the study cohort ($n = 1531$), out of which 64% were women. The estimated mean age was 83 years. 384 persons (53%) of the hospitalized individuals ($n = 729$) were admitted only once during the study period. 169 individuals (23%) were admitted twice, 78 (11%) were admitted three times, while 98 persons (13%) were admitted more than four times during the one-year study period. The mean admission rate was 2 admissions per person-year (95% confidence interval (CI): 1.89–2.11). The overall median length of stay was 4 days (mean = 7.21, SD ± 9.9, range 1–138, interquartile range (IQR) =7). The most common reason for referral was the need for further medical assessment due to general decline, based on symptoms such as pain/unspecified dyspnea/dehydration/anemia (334 referrals = 23%).

303 referrals related to infections (ICD-10 chapter A J K L N) constituted nearly 21% of overall admissions, while falls caused 13% (191 referrals) of the hospitalizations for the study cohort. The most common reason for referral within infections were related to the respiratory system (e.g., pneumonia), urinary tract infections and skin infections (e.g., erysipelas). These results are depicted in Table 4. Some hospital admissions were associated with age, whilst others were associated with gender.

Age as a predictor for hospitalization
We found a higher admission rate in the lowest age group (67–79 years), compared to the other two age groups; the youngest had a mean admission rate of 1.0, which is slightly higher than the mean annual admission rate for the whole study population (.95) (see Table 3). I. e., the annual admission rate varied with age, but there was a statistically significant negative correlation between age and annual admission rate (Spearman's rho = .-117, CI -.186- -.041, $p = .002$). We investigated this issue further by testing differences in proportions of hospitalizations in the three age groups related to the various reasons for referral to hospital using Z tests. We found that in connection to hospitalizations due to fall and infections, there was a statistically significant difference in proportions between the lowest and the highest age group (Fall $p < .01$; infections $p = .02$), and likewise between the middle age group and the highest age group (Fall $p < .01$; Infections $p = .04$), but not between the lowest and the middle age group (Fall $p = .82$; infections $p = .65$). As for general decline/pain/unspecified dyspnea as a reason for hospitalizations, we found a statistically significant difference in proportions between both the lowest and the middle age group ($p < .01$), as well as between the lowest and the highest age group ($p < .01$), but not between the middle and the highest age group ($p = .08$). The results are depicted in Table 4.

Gender as a predictor for hospitalization
Overall, men had an annual admission rate of 1.1, while the corresponding rate for women was .9. The mean hospital admission rate for the entire study population was .95 (see Table 3). We found that hospital incidents rates were

Table 3 Hospital incidence rate for the study cohort, stratified on gender

Total			Men			Women		
Persons Total cohort	Admissions (*n*)	Mean annual admission rate	Persons - age	Admissions (*n*)	Mean annual admission rate	Persons - age	Admissions (*n*)	Mean annual admission rate
1531	1457	0.95	494	566	1.1	1038	891	0.9
67–79 years	415	426	1.0	169	210	1.2	246	216	0.9
80–89 years	664	655	0.98	212	254	1.2	452	401	0.9
90+ years	453	377	0.83	113	102	0.9	340	274	0.8

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Table 4 Differences in age groups for different reasons for referral to hospital

Reason for referral		A: 67–79 years	B: 80–89 years	C: 90+ years	*p*-value*
	Frequency of admissions (%)	426 (29.2)	655 (45.0)	376 (25.8)	
Fall/accident	191 (13.1)	36 (8.5)	77 (11.8)	78 (20.7)	
Z-score (C.I.)		0.083 (0.062–0.115)	0.118 (0.095–0.144)	0.207 (0.169–0.251)	A vs B = .82; A vs C < .01; B vs C < .01
Infection	303 (20.8)	98 (23.0)	143 (21.8)	62 (16.5)	
Z-score (C.I.)		0.23 (0.193–0.272)	0.218 (0.188–0.252)	0.165 (0.131–0.206)	A vs B = .65; A vs C = .02; B vs C = .04
General decline/pain/ unspecified dyspnea	334 (22.9)	65 (15.3)	159 (24.3)	110 (29.3)	
Z-score (C.I.)		0.153 (0.122–0.189)	0.243 (0.211–0.277)	0.293 (0.248–0.340)	A vs B < .01; A vs C < .01; B vs C = .08
Unspecified chest pain	90 (6.2)	29 (6.8)	41 (6.3)	20 (5.3)	
Z-score (C.I)		0.068 (0.048–0.096)	0.063 (0.046–0.084)	0.053 (0.035–0.081)	A vs B = .72; A vs C = .38; B vs C = .54
Heart attack	43 (3)	8 (1.9)	22 (3.4)	13 (3.5)	
Z-score		0.019 (0.009–0.037)	0.034 (0.022–0.050)	0.035 (0.020–0.058)	A vs B = .15; A vs C = .16; B vs C = .94
Congestive heart failure	58 (4)	15 (3.5)	25 (3.8)	18 (4.8)	
Psychiatry	41 (2.8)	38 (8.9)	2 (0.3)	1 (0.3)	
Old age psychiatry	32 (2.2)	7 (1.6)	16 (2.4)	9 (2.2)	
Neurology	91 (6.2)	20 (4.7)	47 (7.2)	24 (6.4)	
Cancer	137 (9.4)	68 (16.0)	56 (8.5)	13 (3.5)	
COPD	37 (2.5)	17 (4.0)	18 (2.7)	2 (0.5)	
GI symptoms	100 (6.9)	25 (5.8)	49 (7.5)	26 (6.9)	
Total (%)	1457 (100)	426 (29.2)	655 (45.0)	376 (25.8)	

higher for men in all age groups, and further a statistically significant negative correlation between female gender and frequency of admission to hospital with a correlation coefficient (Spearman's rho) of −.088 (CI 95%.157- -.017, *p* = .018). This implies that in our study, being female was not associated with higher hospitalization rate, thus not presenting as a risk factor for admission to hospital.

The final prognostic index included age (categorized as 67–79, 80–89, ≥ 90), gender and reason for referral. We applied a multinomial logistic regression analysis to investigate whether age or gender were associated with admission to hospital (reason for referral) due to falls, infection or general decline (see Table 5). The results depicted in Table 5 shows the odds ratios for hospitalizations due to falls, infection or general decline vs. the reference group of no hospitalizations in the model.

Age was not a statistically significant predictor for hospitalization due to fall or infections, but we found that increasing age was associated with hospitalization due to general decline (*p* = .001). With regards to gender, we found that being male increased the odds for hospitalization when presenting symptoms related to

infections by a factor of .5, being statistically significant (*p* < .001). As for associations between gender (=being male) and hospitalizations due to fall or general decline, the slightly increased odds were not statistically significant in either groups.

We further investigated whether there was a difference in the three age groups related to the various reasons for referral to hospital. In relation to hospitalization due to fall, we found a statistically significant difference (*p* = .01) between the youngest of age (age group A: 67–79 years) and the eldest (age group C: 90+), and also between the eldest (age group C) and age group B (80–89). There was no difference between age group A and B in this matter.

Also for hospitalizations due to an infection we found a statistically significance between the same age groups as for fall as reason for referral to hospital, i. e., between age groups A and C, and B and C.

Hospitalizations due to general decline had a slightly other expression; here we found a difference between age group A and B, and also between A and C, but not between B and C. The first and the latter result differ from the other two reasons for referral.

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Table 5 Predictors for hospitalization by multinomial logistic regression; demonstrating whether age or gender were associated with admission to hospital (reason for referral) due to falls, infection or general decline

Fall			Infection			General decline		
	OR (95% CI)	*P*-value		OR (95% CI)	P-value		OR (95% CI)	*P*-value
Age	1.03 (1.00–1.05)	.044		0.99 (0.97–1.02)	.469		1.04 (1.02–1.06)	**.001**
Gender	1.2 (0.77–1.86)	.418		0.47 (0.38–0.69)	**.000**		0.65 (0.45–0.93)	.017

OR Odds ratio, *CI* Confidence Interval. Alpha level 0.05. Bold values indicate variables that reached statistical significance. Reference group: No hospitalizations

Discussion

We found that 50% of the study cohort had at least one hospitalization during a one-year period, and that age and gender were associated with some hospitalizations. The most common reasons for referral were the need for further medical assessment, based on symptoms related to general decline, such as unspecified dyspnea/dehydration/anemia (23%), and referrals related to infections (21%) and falls (13%). More specifically we found that age was a predictor for hospitalization ($p \leq .001$) due to general decline, whereas in relation to falls and infections, we found no association between age and hospitalizations. We found that male gender was a predictor for hospitalizations due to infections ($P \leq .000$), but were not associated with hospitalizations related to falls or general decline. Several findings are noteworthy, especially in the context of current efforts using assistive living technologies to prevent hospitalizations for older persons.

First, the 50% admission rate we found highlight the point that this population is prone to conditions for which a doctor evaluates that a hospitalization is required. This is noteworthy in itself, but previous research have shown that taking only the frequency of admissions for older persons into account when predicting future admissions, have a low sensitivity [16]. We have therefore looked more into for which conditions older persons are hospitalized.

The most frequent reason for referral we identified in our study was general decline/pain/unspecified dyspnoea. This substantiate an already well-known perception that older persons often present general and diffuse symptoms before the doctor, and often may be in a severe state of illness [42]. Symptoms related to general decline/pain/unspecified dyspnoea could be related to non-communicable and chronic diseases, thus potentially preventable. However, these hospitalizations are often appropriate due to the degree of severity and the need for further assessment and examinations which only could be performed, in specialized health care [11, 15, 27]. The line of argument that follows the trajectory that high quality primary care prevents hospitalizations related to the reported symptoms, indicate that vigilant health care personnel in community care is a prerequisite for timely and accurate observations. The potential for preventing hospitalizations for this patient group lies in discovering and addressing the patients' general decline and/or pain

and/or unspecified dyspnea before the state of illness, where hospitalization is the only appropriate option for assessment, treatment and care. According to Fortinsky and colleagues [19], an increase on a dyspnea severity scale conferred an additional 18% greater likelihood of hospitalization, thus there could be a particular potential for preventing hospitalizations due to dyspnea symptoms. Moreover, monitoring such symptoms can be done through the use of assistive living technologies, as they allow a close and continuous monitoring of symptoms, systematic follow-up by health care personnel, and a proper response [43, 44].

The potential for preventing hospitalizations related to the second most frequent reason for referral as identified in the present study is even greater. Referral to hospital due to infections in the respiratory system (e.g., pneumonia), urinary tract infections and skin infections (e.g., erysipelas) is reported to be conditions causing inappropriate hospitalizations, and for which interventions in primary care should prevent such [11, 18]. Diffusion of community care programs and services that aim to strengthen both patients and health care personnel on how to observe early signs of clinical and functional decline on a systematic basis is one potential strategy to reduce hospital use among older persons. In this regard, the use of assistive living technologies can have a potential positive impact, as the aim of such interventions is to both strengthen the self-management of chronic diseases, and for health care personnel to use various sensors and monitors to track changes in a patient's health and vital signs [32, 45]. Lewin and colleagues [33] expect to see a shift from alarm-based telecare systems to systems including more continuous life style monitoring over the next years. This will release a potential for more vigilant and precise follow-up of patients, but the ethics and safety concerning such comprehensive monitoring of persons are a concerns which many stakeholders are addressing now.

In our study cohort, there were substantially fewer men (33%) then women, but men still had a higher annual admission rate; men had an annual admission rate of 1.1, compared to women who had a rate of .9. The mean hospital admission rate for the entire study population was .95. This finding is in accordance with official Norwegian statistics and previous research [21, 22].

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However, a study which focused on reduction of inappropriate hospital use, based on analysis of the causes, found no significant differences when comparing the results of inappropriate admission by gender (male/female) [46]. In our study, we found that male gender was a predictor for hospitalizations due to infections, but were not associated with hospitalizations related to falls or general decline. This is supported by a strand of research literature which suggest that men are generally physically stronger and report fewer diseases and have lower levels of primary care use, but higher hospitalization rates and have higher mortality at all ages compared with women: the so-called male-female health-survival paradox [23, 47]. This may suggest that men perhaps disregard early signs of disease and postpone going to the doctor until the later stages of disease development, thus health care personnel in community care must be especially aware of men in the context of prevention of hospitalizations [21].

In our study, we found that age was a predictor for hospitalizations due to general decline, but were not associated with hospitalizations related to falls or infections. This is harmonized with a common understanding that the most problematic expression of an ageing population is the clinical condition of frailty [26]. For this population, it is of vital importance to apply a systematic approach in community care, in order to reduce the use of inappropriate procedures, iatrogenic diseases and nosocomial infections, which are associated with hospitalization [29, 48].

Urgent and emergency services have been the subject of a wide range of policy discourse and decisions over the years, all over Europe. In general, socio-demographic (i.e., age, social deprivation, levels of morbidity, area of residence) factors are associated with increased rates of admissions [18]. These are factors which are highly relevant in understanding other reasons than the clinical conditions for hospitalizations, but in terms of potentially preventing an admission to hospital for the individual patient, it is paramount that personnel in community care are vigilant observers and good clinical practitioners. Proper treatment and care for the most vulnerable, with a view to managing their conditions at home and/or supported by community care, can potentially reduce the risk of hospitalizations, but it also implies to shift resources from hospitals to the community setting, thus reducing the disruptive impact of acute unscheduled hospital admissions [9]. Our study have identified some clinically relevant factors that are vital in this context.

Limitations
We should mention a number of limitations of the present study. First, we cannot draw any gender-specific conclusion in the present study, due to heterogeneity among populations. Second, diseases with no treatment and asymptomatic conditions could be missed by doctors when recording a medical history, as well as the raters in this study. Third, the findings in this study pertain to the studied municipality in Norway, thus limiting the generalizations of the findings, as financing and organization of health care in Norway is different compared to other countries.

Conclusions
The potential for preventing hospitalizations for home-dwelling elderly receiving community care lies in discovering and addressing the patients' symptoms so early that they don't come to a severe state of illness that requires hospitalization. The most common reasons for referral to hospital were the need for further medical assessment, based on symptoms related to general decline, such as unspecified dyspnea/dehydration/anemia, and referrals related to infections and falls. Our study shows that men are especially at risk for hospitalization with increasing age. This information is vital when vigilant health care personnel in community care make timely and accurate observations. The appliance of assistive living technologies in this context can have a positive impact, as they can be used to track changes in the patients' vital signs and health condition, but further investigation is needed in this regard.

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Paper II

BMJ Open

What are the key contextual factors when preparing for successful implementation of assistive living technology in primary elderly care? A case study from Norway

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ABSTRACT

Objective To identify contextual factors at different organisational levels to guide the implementation of an assistive living technology intervention in Norwegian primary home care.

Design A single embedded case study design was carried out in an urban municipality in Western Norway to get an overview of key contextual factors from the municipality's perspective.

Data collection and analysis The data collection was based on a triangulation of methods involving document analysis, semi-structured individual interviews and focus group interviews to get a broad insight when preparing for an intervention. Data were collected on three levels of the healthcare system: (1) national policy documents and regulations (macro), (2) five individual interviews with senior managers and municipal strategy documents (meso) and (3) two focus group interviews with nurses and nurse managers in direct patient care (micro). The Model for Understanding Success in Quality framework was used as a guide in the data analysis.

Results The main contextual factors identified were external motivators and project sponsorship (macro level); leadership, workforce focus and maturity (meso level);and motivation to change and maturity (micro level). Strategies developed in policy documents affected upper management in the municipality, but healthcare personnel at the micro level were not so familiar with strategies and emphasis on assistive living technologies. Healthcare personnel in our study were motivated to use technological solutions, but lack of data infrastructure and resource availability hindered this.

Conclusions Aligning interests across multiple stakeholders remain a challenge when planning for an assistive living technology intervention in primary care. In the studied municipality, integration of technological solutions into healthcare services was more a vision than a reality because of a low level of organisational readiness.

Strengths and limitations of this study

► Applies a multilevel approach to acknowledge the organisational, social, political and policy context in which assisted living technologies are planned to be implemented.
► Provides rich, qualitative data from three levels of the healthcare system: (1) national policy documents and regulations (macro), (2) individual interviews with senior managers and municipal strategy documents (meso) and (3) focus group interviews with nurses and nurse managers in direct patient care (micro).
► The use of the Model for Understanding Success in Quality framework in the data analysis provides empirical content to the model, which can help operationalise factors in the framework.
► The intended user's perspective of a technological solution is not integrated in the study.
► Sample size is small; other municipalities, countries and settings may illustrate different opportunities and challenges.

INTRODUCTION

In times of demographic changes, the use of assistive living technologies is suggested to help monitor and treat degenerative and chronic diseases that follows an ageing society,[1-4] through the use of sensors, alarms and reminders.[5] One context in which the use of assistive living technologies has been heralded as a solution is prevention of hospitalisations.[6 7]

Older persons are substantial consumers of both hospital care and primary care services,[8 9] and a continuous discussion questions if a proportion of hospital admissions could have been prevented in primary treatment and care.[10 11] Previous research stresses that more studies are needed to assess outcome and effectiveness related to the use of assistive living technologies,[12-14] but there is a potential to prevent hospitalisations by providing early warnings of exacerbation events or deterioration. This is a significant issue in regard to both quality and cost.[1]

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Despite its potential to improve primary healthcare, the success rate for implementing assistive living technologies has been low.[15–18] This could be explained by previous research failing to consider critical issues in the use of these technologies. In particular, there is a need to consider the wider social framework within which the new technologies would operate and how the technology could be integrated into a complex healthcare system.[4 19]

There is a general interest in the role of context in understanding variation of success in quality improvement (QI), but this focus is lacking in research regarding implementation of assistive living technologies in primary care.[18–22] Little evidence exists for approaches to improve the implementation process of assistive living technology, and studies to date have been limited in their design.[18 21 23 24] A systematic review found that studies in this field were heterogenic and applied multiple measures of a given contextual factor and tested the associations between these measures and multiple measures of QI success.[22] Other studies argue that the use of traditional controlled trial efficacy research design provides limited information about the mechanisms that produced the outcomes, and why an intervention varies by setting.[25 26] This implies that few studies have been designed to assess how different contextual factors, such as external environment, organisational issues, technological infrastructure and human actions, interact with each other to influence the implementation process.[22 25 26]

In order to increase the likelihood of successful implementation, it is crucial to address elements at the micro level (human decisions and actions), as well as the wider context in the meso level (the organisation in which the humans interact) and at the macro level (national policy on assistive living technologies). Based on the notion that

elements at the micro level can both influence and be influenced by elements at the meso level and macro level, more knowledge is needed for where to direct efforts and resources, in order for professionals and organisations to prepare a more optimised implementation of assistive living technologies in primary care.[26–28]

Conceptual framework

In the literature, diverse QI frameworks (eg, Model for Improvement,[29] PARIHS,[30] ARCHIE[4]) and implementation models (eg, PRIME[31]) exist. In this study, we apply the Model for Understanding Success in Quality (MUSIQ),[32] as it is in the forefront of incorporating contextual factors in QI processes. Kaplan et al[22] identified a need for a conceptual model that builds on existing implementation frameworks and developed MUSIQ using a systematic review and structured input from a diverse panel of QI experts.[32 33] The MUSIQ framework[32] as described in figure 1, is a comprehensive conceptual framework for approaching and studying an implementation process in healthcare. It offers an opportunity to formally evaluate the contextual factors involved in implementation of new measures within healthcare, and is therefore chosen as an appropriate and helpful framework to inform the planning phase of an assistive technology intervention to prevent inappropriate hospital admissions for older adults receiving home-based care.

MUSIQ shows how context influences the success of individual QI projects and hypothesises that the implementation of a system, the process changes and the associated outcome improvements are influenced directly by microsystem and QI team factors, which are interdependent and mutually reinforcing. The identified contextual factors are organised based on the level

Figure 1 The MUSIQ framework is a comprehensive conceptual framework for approaching and studying an implementation process in healthcare. QI, quality improvement. *Copyright © BMJ Publishing Group Ltd and the Health Foundation. All rights reserved. Reuse licence number 3785340881529.*

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Table 1	Data material	
System level	**Data**	
Macro level	Documents: 6 (national policy documents)	ONR 2011:11[2]; Report No. 9 (2012–2013) to the Storting[38]; Report No. 10 (2012–2013) to the Storting[39]; Report No. 29 (2012–2013) to the Storting,[40] Report No. 11 (2014–2015) to the Storting[41]; Care Plan 2 02[42]
Meso level	Interviews: 5	Assistant director, project manager, adviser in municipal administration, head of health and welfare department, head of home-based care
	Documents: 2	Municipal strategy plan for implementing assistive living technologies, report on use of resources in municipal healthcare services
Micro level	Focus group interviews: 2 (n=12)	Six informants in each group; nurses in direct patient care and nurse managers

of the healthcare system in which they are believed to operate, including the micro level, the organisational or meso level and the external environmental or macro level. Factors operating within the macro level are external incentives, such as new national policy documents or sponsored projects. At the organisational level, QI leadership (senior management) directly influences leadership at the micro level. For example, external motivators can put pressure on senior management in an organisation to support a particular QI project. This could then lead to support and training for healthcare personnel involved in the particular QI project, which in turn will increase the likelihood of successful implementation of the QI project.

The aim of this study was to identify contextual factors at the macro, meso and micro levels to guide the implementation of an assistive living technology intervention in Norwegian primary home care that would prevent inappropriate hospital admissions. To achieve this aim, specific objectives were to increase knowledge about:

1. Policy makers' view of the implementation of assistive living technology in primary care
2. Primary care organisations' and management's perspectives regarding the implementation of assistive living technologies
3. Healthcare personnel's perspective regarding the uptake and use of assistive living technologies.

METHODS
Setting
The study was carried out in an urban municipality in Western Norway. Healthcare service delivery in this municipality was divided into four geographically organised units and comprised 1600 elderly recipients of home-based care. This study involved two of these units, with 800 elderly receiving home-based care. The municipality was in the process of integrating assistive living technologies in primary care during the next few years[34] and was involved in the national programme for telehealth, together with 31 of Norway's 428 municipalities.

Design
A single embedded case study design[35] was employed to get an overview of key contextual factors from

the municipality's perspective, thus getting a better understanding of which factors could be targeted when planning an assistive living technology intervention in primary care. The case was defined as the municipality. The embedded design included macro (policy), meso (organisation) and and micro (clinical team in home care) levels in the data collection and analysis.

Data collection
The data collection was based on a triangulation of methods involving document analysis, semistructured individual interviews and focus group interviews to get a broad insight when preparing for an intervention.[36] Data were collected on three levels of the healthcare system: (1) national policy documents and regulations (macro), (2) individual interviews with senior managers and municipal strategy documents (meso) and (3) focus group interviews with nurses and nurse managers in direct patient care (micro). Informants for the individual interviews were chosen based on purposeful sampling,[37] seeking informants who were most able to inform us on the research question. Senior managers were selected because they held major roles in the municipality's work with implementing assistive living technologies in primary care and were in the best position to validate and provide relevant information for the study.

An overview of data material is depicted in table 1.

Macro-level data collection: acquisition of documents
The data collection at the macro level involved acquisition of relevant national policy documents (eg, national care plan and white papers) developed by the Ministry of Health and Care Services.[2] [38–42] These documents were included because they provide information about macro level entities' vision and ideas concerning the use of assistive living technologies in healthcare. Macro level data are referred to as 'external environment' in the MUSIQ framework.[33] All documents are publicly available on the internet and downloaded from: https://www.regjeringen.no/en/find-document/id2000006/?ownerid=421.

Meso-level data collection: semistructured interviews and acquisition of documents

Five individual semistructured interviews were conducted with senior managers in primary care. These managers were all having a key strategic position within the municipality with important oversight of the decision-making processes related to assistive living technologies. Individual interviews were employed to ensure a more in-depth understanding of the leaders' roles in the implementation of assistive living technologies in elderly primary care. Recruitment was initiated through the study's working group members by asking them for a recommendation as to who could best explicate the aspects of interest. MTG then asked potential informants face to face about participation; all accepted. There was no relationship between informants and interviewer prior to study commencement. The interviews were conducted by the same person (MTG) for consistency, took place at the respective informants' office, with only the informant and interviewer present, and lasted approximately 60 min. A semistructured interview guide was developed based on MUSIQ, focusing on organisational structures and processes for managing quality, and the leader's role in QI work. The interviews were audiotaped and transcribed verbatim. The municipality's strategic plan for implementing assistive living technologies[34] and a report on the use of resources in municipal health and care services[43] were included to provide additional perspectives about key issues and to serve as a supplementary source for understanding discrepancies among informants.[44]

Micro-level data collection: focus group interviews

Two focus group interviews were conducted (n=*12*) in 2014. Maximum variation sampling[37] was employed to identify a sample of healthcare professionals who represented different lines of work at the micro level. Administrative personnel in the municipality, who otherwise were not involved in this study, recruited informants; 12 healthcare professionals who worked either in direct patient care or administered care services for the elderly were invited by mail to participate in the interviews; all agreed. Eleven women and one man in the age between 30 and 55 years, who had worked in primary care for more than 5 years, participated. None of the informants were directly engaged in the work with assistive living technologies. A thematic interview guide was developed for the purpose of exploring aspects related to implementation of assistive living technologies. Focus group interviews were employed so that participants could discuss perceptions, opinions and thoughts related to the abovementioned topic.[45] The interviews were led by a moderator (MTG) to ensure rich and relevant data[46]; there was no relationship between informants and interviewer prior to the interviews. A co-moderator made notes on observations and impressions during the interviews. Both interviews took place at the informants'

work place and lasted approximately 90 min. Interviews were audiotaped and transcribed verbatim.

Data analysis

The MUSIQ framework was used as a guide in the data analysis, by providing a priori themes in advance of the analysis process. This is described by Crabtree and Miller[36] as a template organising style. With the template (theory-based) analysis style, the text is organised according to pre-existing theoretical or logical categories to provide new descriptions of previously known phenomena.[47] Three data sources were analysed; at the macro level, we analysed[48] national policy documents to map the stated governmental expectations related to implementation of assistive living technologies in Norwegian municipalities. The role of the macro-level data is to link the governmental expectations concerning the use of assistive living technologies in municipal elderly healthcare, and how these are addressed by the municipality at meso and micro levels. At the meso level, we analysed key documents from the municipality and transcripts from individual interviews; and at the micro level, the units of analysis were transcripts from focus group interviews.

We read meso-level and micro-level transcripts repeatedly to gain familiarity, and then discussed the emerging findings as a team whose backgrounds spanned health and social science (MTG: nurse/PhD candidate; IT nurse/postdoctor; SW: social scientist/professor; all females). Data material was analysed thematically,[36] using the MUSIQ theoretical framework. Data were analysed iteratively within our research team until no new themes emerged. Table 2 illustrates the analytical process. Study participants were not involved either in the analysis process or provided direct feedback on the findings but to ensure trustworthiness in the analysis, analyst triangulation and member checks were applied.[37 49 50]

RESULTS

The main contextual factors identified in this study were external motivators and project sponsorship (macro level); leadership, workforce focus and maturity (meso level); and motivation to change and maturity (micro level). The results are depicted in figure 2.

Macro level

Document analysis of national policy documents showed that external motivators and project sponsorship were the main contextual factors at the macro level. Six white papers[2 38–42] state in various ways that telehealth/telecare should be integrated in the healthcare services. The Norwegian government established a national programme for development and implementation of assistive living technologies, which the main objective is that assistive living technologies are integrated in primary care services by 2020 (Care plan 2020, p28).[42] Expectations are stated

Table 2 Data analysis process

	Data source		Findings	Factors in MUSIQ
Macro level	Care plan 2020	'Main aim in the National programme for development and implementation of assistive living technologies is that assistive living technologies are integrated in primary care services.[43]	Governmental expectations related to implementation of assistive living technologies, as an integrated part of municipal services	External motivator
Meso level	Head of health and social welfare department	'I don't quite know how, and this is probably the big challenge; how will the municipality build a system concerning this?'	Organisation is still immature	Maturity
Micro level	Nurse, focus group 2	'I think that Skype could be a tool between accident and emergencies department, general practitioners and home-based care. One thing is to describe it over the phone, it's completely different to show how the situation really is; we could provide blood pressure, pulse, O_2 saturation and such…'	Healthcare professionals motivated to use assistive living technologies in daily care	Motivation to change

in a direction of more user-oriented healthcare services (Future Care, p40),[40] and that the uptake and use of assisted living technologies are part of an innovative and provident healthcare system (Future Care, p55).[40]

In this, it was demonstrated that the external environment, represented by several reports to the Parliament, was an incentive for leaders in the municipality to translate the national targets to local initiatives by being an external motivator. Furthermore, the document analysis showed that the Directorate of Health (DoH) exercised a role as project sponsor, as it provided funding for assistive living technology projects led by the municipality. For example, the municipality had a project as part of the national programme, involving the transition of analogue personal alarm systems to digital solutions, which was funded by the DoH.
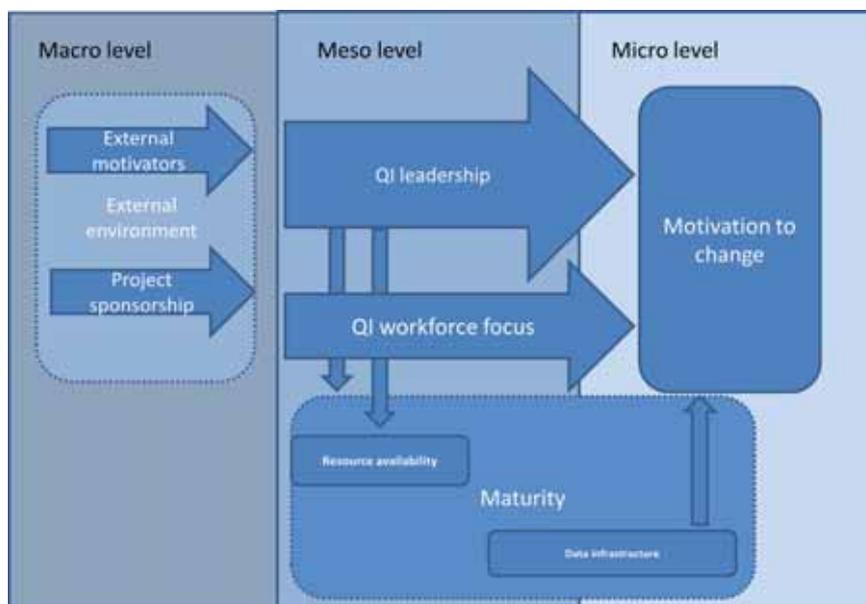
Figure 2 Results organised on different levels: the main contextual factors identified in this study were external motivators and project sponsorship (macro level); leadership, workforce focus and maturity (meso level); and motivation to change and maturity (micro level). The results are depicted in figure 2. MUSIQ, model for understanding success in quality; QI= quality improvement.

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Meso level

QI leadership and maturity were the two main factors identified at the meso level. In the interview material, it became evident that the leaders in the municipality had to align the local QI work with the national priorities and focus areas, as defined in macro level policy documents.

> We are part of the National programme, which focuses on safety alarms; therefore, we have two projects concerning safety. First and foremost we must prioritize this work. The national directions are clear about which activities the municipalities should prioritize.— Project manager

In terms of leadership, the senior leaders regarded it as their responsibility to be familiar with and committed to ongoing projects involving the use of assistive living technologies. Furthermore, leadership emerged also as a factor in the interview material by various expressions about how QI work was of great importance in the municipality. The assistant director made it clear that anchoring of projects was a necessity for ongoing projects and that there was a system for QI work in the municipality:

> It's my responsibility to attain goals and measures which are defined in the strategy, and to follow up on all the ongoing projects. It must be anchored in the management – we know that for everything we do! - Assistant director

> We've had focus on QI since we got re-organized, arranging semi-annual dialogue gatherings in a quality network, where the employees in the health and care districts can give input on how to succeed. - Assistant director

Nothing explicit regarding leadership was identified through document analysis of the municipality's strategic plan,[34] but leadership was implicit when organisational issues were described. QI workforce focus, data infrastructure andresource availability were contextual factors that emerged in meso-level interviews. The latter factors were an expression for organisational readiness and tell us something about an organisation's maturity. Maturity—or the lack of maturity—emerged as a key contextual factor at the meso level. Findings from individual interviews addressed several concerns about whether the municipality was ready to actually implement assistive living technologies. One informant expressed such a concern:

> We have actively recruited participants in the project related to personal alarm systems, but that raises a lot of questions: Does the municipality want to take on more tasks? Who will provide service functions related to this? What will it cost…? There are ethical issues…I wish more of this was clarified before we started… - Head of Health and Social Welfare Department

Maturity regarding municipal data infrastructure was also addressed in the interview material. It was still unclear if and how the municipality was prepared for the integration of assistive living technologies in the care services:

> I don't quite know how, and this is probably the big challenge; how will the municipality build a system concerning this?

> Today we have a system, and a dedicated QI-team, perhaps it will be IT… but I think it has to be part of our system. - Head of Health and Social Welfare Department

Document analysis of the municipal strategic plan[34] identified challenges related to implementation and integration. The challenges were related directly to the lack of guidelines from national authorities regarding financial issues, standardisation of technological platforms/ infrastructure/ cyber security, legal issues, organisational aspects and ethical considerations:

> …financing is still undetermined. Several prerequisites must be clarified in order for the municipality to use assistive living technologies. Issues concerning legislation, ethics, cyber security, technology requirements and safe operations need to be addressed.

These challenges were also an expression for the lack of organisational maturity, thus maturity emerged as a key factor at the meso level regarding both organisational readiness, data infrastructure and challenges related to the lack of guidelines from national authorities.

Micro level

At the micro level, motivation to change and maturity were the two main contextual factors that emerged from the focus group interviews. Motivation to change was identified in both focus group interviews, where the informants talked about the potential benefits that could arise from using assistive living technologies:

> We would like to have this (assistive living technologies)! (Laughter and talking) …we require equipment to do INR (International Normalized Ratio=blood test for regulating anticoagulation treatment), bladder scan, oxygen saturation…and CrP (C-reactive Protein=blood test indicating infections (laughter from several). - Several nurses, focus group 1

> I think that Skype could be a tool between accident and emergencies department, general practitioners and home-based care. One thing is to describe it over the phone, it's completely different to show how the situation really is; we could provide blood pressure, pulse, O_2 saturation and such… - Nurse, focus group 2

Analysis of the interviews revealed that healthcare professionals were motivated to use assistive living technologies in daily care, if there was a practical benefit for it. However, the informants did not address leadership as a focal point when asked what it would take to integrate assistive living technologies in the care services. Leadership did, however, emerge as a factor, but related to a lack of trust in the local leader's impact on decision making, with respect to the uptake of assistive living technologies:

> I don't think the local leaders have a say in this. It is the municipality's administration who writes the budget. I believe that they decide which tools to use. If they decide we should have tablets, then that would be implemented in all districts. - Nurse, focus group 2

All in all, the results showed that issues concerning implementation and organisational factors related to the integration of assistive living technologies in home-based care were addressed only to a small degree. The main finding at the micro level was that the technological solutions had to function properly in the day-to-day work. They described experiences with the opposite and that dysfunctional technology was discouraging and frustrating in their line of duty. This implies that maturity was also a key finding at the micro level. For example, the lack of data infrastructure was regarded as a hindrance for successful integration:

In the rest of Europe, they have a standard for everything, and they are able to integrate things much more easily. Here, each GP have their own computer system, and each municipality has their own computer system… - Adviser

The municipality lacked a sophisticated enough data infrastructure to be ready for integration of assistive living technologies in the care services.

DISCUSSION

Based on document analysis and interviews with both leaders and healthcare personnel, this study identified several of the contextual factors in the MUSIQ framework. More specifically, the study revealed that external motivators and project sponsorship at the macro level represented expectations from outside entities that guided senior leaders in defining a local mission and vision related to use of assistive living technologies for the municipality. These expectations were reflected in the findings at the meso level, where the senior leaders were well aware of the agenda set from above. However, many aspects still remained unclear in the macro–meso relationship, such as further financing of ongoing projects, and legal and technological aspects, because there were no guidelines from the macro level addressing these issues. Micro-level findings revealed that healthcare professionals were not very conscious about other factors than the practical use of assistive living technologies.

Previous studies in this field have used various theoretical frameworks to identify and explore factors that influence adoption, implementation and continued use of assistive living technologies. Sugarhood *et al*[23] concluded that successful implementation of telecare very much depends on to what degree contextual factors are specified, understood and addressed. Greenhalgh *et al*[18] have developed a study programme called 'SCALS', which focuses on assistive living technologies in their organisational, social, political and policy context, using a systems approach that includes interdependencies. There are no publications from the 'SCALS' programme to date (other than the referred study protocol), but the programme seems to be based on the same notion as our study, namely that contextual factors play a pivotal role for the understanding of implementation and integration of a technological solution into a complex healthcare system.

The framework applied in our study (MUSIQ) can help us understand how factors are interdependent; for example, that external motivators at the macro level will be an incentive for leaders at the meso level to translate national QI priorities into local initiatives at the micro level. This hypothesis is partially supported by our findings. We found that the strategies developed in policy documents affected the upper management in the municipality, but healthcare personnel at the micro level were not so familiar with strategies and emphasis on assistive living technologies. The lack of such alignment between levels could represent a challenge when preparing for successful implementation of assistive living technologies in primary elderly care. A report from The King's Fund[51] summarises relevant evidence regarding integration of care from a multilevel perspective. In relation to interdependent factors, they underline that initiatives at the macro system must be linked to initiatives at the meso level for particular care groups and populations and at the micro level for individual service users and carers. Organisational maturity and readiness to implementation is of vital importance, but the actual use of the technology takes place on micro level—in the provision of care for the elderly. Thus, it is necessary to address this implementation gap in order to deliver the expected outcomes related to the uptake and use of assistive living technologies.

Despite of this implementation gap, the healthcare personnel (micro-level focus group interviews) in our study were motivated to change their daily practice by using technological solutions, but the lack of data infrastructure and resource availability hindered such a change. From previous research, we know that lack of organisational readiness for change is an important factor in understanding why implementation efforts fail.[52]

Uncovering these factors has important implications in how to increase the likelihood of successful implementation of assistive living technologies, which in turn potentially could reduce unnecessary cost and burden on overstretched health services.

Strengths and weaknesses

This case study does not formulate a solution for how to implement assistive living technologies, but the insights from the study could be used in comparable settings. One premise in this paper is to acknowledge the organisational, social, political and policy context in which assisted living technologies are implemented. The findings underpin the premise that people and technologies are linked in a dynamic healthcare system made up of multiple interacting stakeholders. We have not focused on the 'user system', that is, the intended user of a technological solution. This needs to be addressed for successful adoption. The implementation process should be informed by all stakeholders—individual users, service providers and technology suppliers—to ensure a person-centred, holistic and ethically based

approach. Such co-production should be addressed in future research.

The findings from this case study pertain to the particular organisation and context prevailing in the included Norwegian municipality; other municipalities, countries and settings may illustrate different opportunities and challenges. Data collection at the macro level was not standardised and only comprises documents and not interviews. The identified documents are all valid for Norwegian municipalities working with assistive living technologies in healthcare. Moreover, the documents reflect directions and expectations that municipalities must comply with and therefore provide information paramount to understand the external environment in the study. It could be argued that our sample of informants including 17 primary care managers and healthcare professionals should have been larger. However, the involved informants represent senior managers at the meso level with the key competence that were needed to be mapped in our study, such as strategic knowledge on plans, decision making, funding and vulnerability in infrastructure. The sample of 12 healthcare professionals have daily patient contact and represents future users of the assistive living technology with similar competence and experience with such technology. Hence, their perspectives may be transferable to other similar contextual settings as described here. Still, the analysed data were rich and represented three levels (macro, meso and micro).

Another limitation is the use of the MUSIQ framework in the data analysis; because of the a priori defined themes, we could have missed out on themes relevant for the planning of an assistive living intervention.

Implications

Through this study, we have generated empirical knowledge about contextual factors that can influence the implementation of assistive living technologies in primary home care. The study already positions assistive living technologies as an innovation whose success depends on the social and organisational context. Two key implications are evident from our study. First, we have shown that various contextual factors existing in a complex healthcare system (represented by a municipality) are present and need to be addressed in order to optimise the likelihood for successful implementation. Low levels of uptake and use may be explained in part by organisational immaturity and different focus of the various stakeholders; thus, aligning interests across multiple stakeholders remains a challenge when planning for an assistive living technology intervention in primary care. Second, our findings suggest that the challenge lies in the implementation process and in the integration of assistive living technologies in municipal care service provision, beyond the initial adoption. For the municipality, there is uncertainty about guidelines from national entities, and concerted and ongoing efforts are required to integrate assistive living

technologies as a routine and sustained part of primary care services. Evidence-based implementation strategies (eg, PRIME[31] and CFIR[53]) support the notion that context affects organisational change, dissemination, innovation, implementation and knowledge translation. In a Norwegian context, it will be of vital importance to develop a clear framework and action plan within primary care in order to address the different focus of the various stakeholders involved in the implementation process. This includes clearly defined roles and responsibilities. Moreover, is it important to incorporate specific assessment for assistive living technologies into service provision; the guidelines from national authorities must be clear and unambiguous. Future studies are advised to take these aspects into consideration when planning for an assistive technology intervention in primary elderly care.

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What are the key contextual factors when preparing for successful implementation of assistive living technology in primary elderly care? A case study from Norway

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Paper III

Original paper:

Title: Health care personnel's perspective on potential eHealth interventions to prevent hospitalizations for older persons receiving community care. A case study.

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ABSTRACT

Background: The use of assistive living technologies are suggested to help monitor and treat degenerative and chronic diseases through the use of sensors, alarms and reminders, and can potentially prevent hospitalizations for home-dwelling older persons receiving community care. It is increasingly recognized that health care personnel's acceptance of a technological application remains a key challenge in adopting an intervention, thus interventions must be perceived to be useful and fit for purpose by the actual users.

Objective: To identify and explore the perspectives of managers and health care personnel in community care regarding the use of assistive living technologies in terms of prevention of hospitalizations for home-dwelling older persons receiving community care.

Methods: A case study with a qualitative approach was carried out in community care in a Norwegian municipality, comprising individual interviews and focus group interviews. Five individual interviews and two focus group interviews (*n=12*) were undertaken in order to provide a health care personnel's and managers' perspective regarding the use of assistive living technologies which potentially could prevent hospitalizations for home-dwelling older persons receiving community care. Data were analysed by way of systematic text condensation, as described by Malterud.

Results: The data analysis of focus group interviews and individual interviews resulted in two categories: Potential technological applications and potential patient groups. Discussions in the focus groups generated several suggestions and wishes related to technical applications they could make use of in their day-to-day practice. Health care personnel warranted tools and measures to enhance and document their clinical observations in contact with patients. They also identified patient groups, such as patients with Chronic Obstructive Pulmonary Disease or dehydration or urinary tract infections, for whom hospitalizations potentially could have been prevented.

Conclusions: We have shown that health care personnel in community care warrant various technological applications, which have the potential to improve quality of care and improve resource utilization in the studied municipality. By identifying needs an important matters in practice we have identified factors paramount for acceptance and adoption of an intervention.

INTRODUCTION

The global shift in demographics represents an epidemiological transition from a predominance of infectious diseases to non-communicable diseases (ischemic heart disease, stroke and chronic lung disease) [1]. The use of eHealth is suggested to help monitor and treat degenerative and chronic diseases through the use of sensors, alarms and reminders [2-5].

The underlying assumption is that the use of digital technologies potentially can redesign care pathways in a way that will improve monitoring and treatment of degenerative and chronic diseases, encourage better self-management of health problems, and alert professional support if devices signal a problem [2, 3, 6-9], ultimately reducing the disruptive impact of acute unscheduled hospital admissions for, for example for older persons [10]. The latter aspect is especially important, as previous research has revealed that hospitalizations pose risks to older adults (>65 years of age) because it involves confinement, immobility, diagnostic testing, and treatments [11-13]. Other studies have identified that emergency hospital admissions often occur when an older person has reached a point of crisis, due to a combination of circumstances, such as an exacerbation of a chronic condition, change in social setting, or a cascade of symptoms due to multi-morbidity and frailty [14-17]. The use of assistive living technologies could thus be applied as a tool to prevent a severe state of illness that requires hospitalization, by discovering and addressing the patients' symptoms at an early stage.

Also from a resource perspective, the prevention of hospitalizations for older persons has gained much attention the last decade [14, 15, 18, 19]. Persons over 65 years of age are substantial consumers of hospital care; there is a peak in hospitalization rates for both men and women through the age group 80 and over, in all European countries [20]. In Norway, older adults over 65 years accounted for nearly 27% of all overnight stays, while only comprising 11% of the population. Within this population, there was also an increase in over-night stays from 17.8% in 2003, to 19.6% in 2013 [21]. Increasing age is thus associated

with an increasing demand for specialized health care [22, 23], and this may threaten the sustainability of the health care systems [24, 25].

Despite the rhetoric associated with the benefits of adopting assistive living technologies in community care to prevent hospitalizations, the use of assistive living technologies has not developed at the pace and scale anticipated [26]. This could be due to a lack of consideration regarding the wider social context within which the new technologies would operate, and how the technology could be integrated into a complex health care system [27-29], but it could also be due to a poorly founded rationale for the use of such technologies [30, 31]. Although the resource and safety challenges are appropriate and well-rehearsed incentives to adopt certain technology interventions, it is of vital importance that the involved stakeholders (e.g., researchers, policy makers, health care personnel, patients, carers) are able to judge the value of an eHealth intervention in its own right. It is increasingly recognized that health care personnel's acceptance of the technological application itself remains a key challenge in adopting an intervention [32-34], underlining the pivotal role their perspective play in this matter. Conversely, until we develop interventions which are considered to be useful and fit for purpose by the actual users, there will be reluctance regarding adoption of technologies in health care [34, 35].

A review by Joseph and colleagues [36] identified seven key challenges related to development and implementation of telehealth projects, where identifying issues and needs in practice were two. This imply that identification of patients who might benefit from an intervention, and a clear defined role of a technological application (whether it is a new application, a new clinical tool or a new system for delivering care remotely), are factors paramount for acceptance and adoption of an intervention [26, 37]. These aspects are however not described in the body of research concerning development of eHealth interventions in community care. Consequently, knowledge concerning health care personnel and managers in this context care is scarce.

Based on the notion that managers and health care personnel in community care play a pivotal role in informing an eHealth intervention, it is of vital importance to explore their perspectives, thus gaining a better understanding of which technology-based interventions deemed to be more appropriate, and for which patient groups an intervention could target.

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Ultimately, this knowledge can contribute to a more optimized intervention, by increasing the probability for staff acceptance, as the intervention is developed on the basis of needs and suggestions defined by managers and health care personnel in community care.

Informing an eHealth intervention in community care

Assistive living technologies interventions are suggested as a mean to improve efficiency, quality and safety of care [28, 38]. They are adopted and implemented in a complex health care system, which previous research have proved to be challenging. In complex systems, elements are interdependent and mutually reinforcing; they interact with other systems in unexpected ways, as they comprise technologies, humans and its social environment which can simultaneously be members of several interrelated systems [39, 40]. This socio-technical perspective recognizes that people, technologies, organisations and process of care interact in complex ways [41-43]. It is therefore argued that it is required to evaluate eHealth interventions while they are being developed and deployed [44], in a circular approach, and not a linear process [31].

The nursing process is another circular approach which is relevant in the context of utilizing assistive living technologies in community care. This is a systematic problem-solving process that guides all nursing actions [45], and encompasses five phases: 1) Assessment; 2) Diagnosis; 3) Planning outcomes; 4) Planning interventions and 5) Evaluation. Nurses who provide care using assistive living technologies must be well-grounded in general nursing knowledge, theory, practice competencies and should furthermore have clinical experience and capacity to possess attributes of intuition and creativity to enhance a holistic care [46]. The unique competence nurses are in possession of should be taken into account in order to optimize the uptake and use of an eHealth intervention. By nature the intervention is intimately and reciprocally entwined with the professional skills and networks that support the technology use, the development of community care services, and with local, national and transnational policy on technological innovation and assisted living [41, 47, 48].

On this backdrop, this paper focusses on building a rationale for adopting an eHealth intervention in community care, by exploring the perspectives provided by health care personnel and managers in community care. The UK Medical Research Council's (MRC) framework for development and evaluation of complex interventions [49, 50] has guided the

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building of a rationale for adopting assisted living technologies in community care. The MRC framework is recommended for the development of interventions containing several interacting components. The study reported in this paper pertains to the first step in the framework, which is Development. It encompasses identifying a relevant, existing evidence base, ideally by carrying out a systematic review [50]. However, components of an intervention can also identified through focus group interviews with patients or health care personnel [31].

Aim and research questions

The aim of this study was to identify and explore the perspectives of managers and health care personnel in community care about the use of assistive living technologies to prevent hospitalizations for home-dwelling older persons receiving community care.

Two research questions have guided the study:
1. Which assistive living technologies do health care personnel identify as appropriate to apply in order to prevent avoidable hospitalizations of home-dwelling older persons receiving community care?
2. From health care personnel's perspective; for which patients could hospitalizations potentially be prevented?

METHODS

Context

The study was carried out in an urban municipality in Western Norway. Community care in this municipality is organized into four geographically-based units, and comprised 1600 older persons. This study involved two of these units, with 800 older persons receiving community care. The municipality was in the process of integrating assistive living technologies in community care during the next few years.

This study was undertaken as a work package (WP) in a larger project; "Development and Implementation of assistive living technologies in Municipalities" (DIALT). The overall aim of the DIALT project was to explore and identify barriers, possibilities and solutions related to implementation of assistive living technologies in the community care. The WP reported

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from in this paper, aimed at 1) identifying relevant patient groups who could potentially take advantage of assistive technology in community care; 2) identify health care personnel's and managers' perspective of- and readiness to use eHealth in community care; and 3) based on findings in 1 and 2, suggest an eHealth intervention for the case municipality.

Design

The study design was a single embedded case study with a qualitative approach, comprising 1) individual interviews and 2) focus group interviews. A case study approach is particularly useful to employ when there is a need to obtain an in-depth appreciation of how assistive living technologies could be used in community care in order to prevent hospitalizations for home-dwelling older persons, in its natural real-life context [51, 52]. The case is defined as community care in a Norwegian municipality.

Recruitment and data collection

Five individual interviews and two focus group interviews (*n=12*) were undertaken in order to provide a health care personnel's and managers' perspective regarding the use of assistive living technologies which potentially could prevent hospitalizations for home-dwelling older persons receiving community care. We conducted five individual semi-structured interviews with senior managers in the municipality, applying a semi - structured interview guide which focussed on potential use of assistive living technologies in community care. Using purposeful sampling [53], we sought informants who were most able to inform us on the research question. Senior managers were selected because they held major roles in the municipality's work with assistive living technologies in community care, and were in the best position to validate and provide relevant information for the study. Recruitment was initiated through the study's working group members, by asking them for a recommendation as to who could best explicate the aspects of interest. MTG asked potential informants face-to-face about participation, all accepted. There was no relationship between informants and interviewer prior to study commencement. The interviews were conducted by the same person (MTG) for consistency and took place at the respective informants' office, with only the informant and interviewer present. The interviews lasted approximately 60 minutes and were audiotaped and transcribed verbatim.

We used focus group interviews to explore health care personnel's perceptions of uptake and use of assistive living technologies which potentially could prevent hospitalizations. The focus group method is a useful data collection technique when the aim of the research is to explore attitudes, experiences, beliefs and concerns [54]. Two focus group interviews (6+6 informants, *n=12*) were undertaken in 2014 by the author (MTG) as moderator, to ensure rich and relevant data [16]. A co-moderator made notes on observations and impressions during the interviews. Both interviews lasted approximately 90 minutes and were audiotaped and transcribed verbatim. A thematic interview guide was developed for the purpose of exploring aspects related to uptake and use of assistive living technologies, including thoughts concerning which technological solutions they would have liked to have in their day-to-day practice, implementation and implications of assistive living technologies in community care. To reduce the risk of any predetermined responses, participants did not see the interview guide prior to the interviews, thus also increasing the chance of open focus group discussions. In order to take advantage of homogeneity, shared experiences, and existing group dynamics each focus group consisted of healthcare personnel in direct patient care or nurse managers in community care. Administrative personnel in the municipality, who otherwise were not involved in this study, recruited informants. The studied municipality was in the process of integrating various technological applications in community care, consequently we were not in a position to seek participants who had operational experience of assistive living technologies in their daily activities. To ensure appropriately experienced health care professionals, working 'on the ground', we identified a maximum variation sample; 12 health care professionals were invited, all agreed. 11 women and 1 man in the age between 30-55 years, who had worked in community care for more than five years, participated in the interviews.

DATA ANALYSIS

Qualitative data were analysed by way of systematic text condensation [55], as it is well-suited to analyse the multifaceted phenomena of assistive living technologies. This approach involves the following steps in the analysis process: (1) establishing an overall impression of the data material and identifying preliminary themes; (2) identifying and sorting units of meaning into code groups; (3) condensing the contents of each of the coded groups into subgroups; and (4) summarizing and re-contextualizing the contents of each code group to

generalize descriptions and concepts, in this case related to the uptake and use of assistive living technologies in community care. Malterud argues that the data analysis will benefit from being conducted by more than one researcher, thus all authors read all interview transcripts to get an overall impression of the full data material, cf. step (1) above. This step of the analysis requires the researcher to read with an open mind from a bird's-eye perspective all pages with transcripts, and then ask which preliminary themes (usually four to eight themes) can be identified in the material. We identified four preliminary themes: Factors related to implementation, ethical aspects, training, and potential use.

This paper reports on findings related to the theme "Potential use". (An analysis of contextual factors related to implementation has been published elsewhere [29]). All subsequent data analysis (steps 2–4 of the systematic text condensation process) the first author (MTG), with input from the co-authors, undertook pertaining to the 'Potential use' theme. The analytical process is demonstrated in Table 1.

Table 1: Analytical process

Meaning units (selected)	Subgroups	Categories
Dehydrated; they are admitted for a short time, have some IV and then sent home.	Short stay Simple intervention	Identification of potential patient groups
COPD patients are left to themselves when they are discharged, and then the anxiety comes…	Discharged without support	
A lot of UTIs…many men who are catheterized for 1,5-2 litres. If we had a bladder scanner, we could have solved it ourselves…instead of going to the A & E.	Potentially preventable hospitalization	
We don't have a bladder scanner, consequently we have to catheterize more often to be on the safe side, but then there is an infection and another hospitalization because of the infection	Use of technology in order to potentially prevent hospitalization	Identification of potential technological tool
A swollen leg, or whatever…there is much that could have been done if you could provide a picture or a video.	Video or photo as a tool for providing info about clinical condition	
… then we postpone, and eventually they are in such a bad shape that we have to call A & E.		

ETHICS
This project has been approved by the Norwegian Data Protection Official (Approval ref# 21/2013).

RESULTS

The data analysis of focus group interviews and individual interviews resulted in two categories: Potential technological applications and potential patient groups. These two categories correspond with the research questions, on which assistive living technologies that are considered as appropriate in order to prevent hospitalizations, and a health care personnel's' perspective on which patient groups hospitalizations potentially can be prevented. Content from step (4) in the analysis (re-contextualization) is presented as analytical text with category heading respectively, and assembled with quotes, which are representative of the category.

Potential technological applications
Discussions in the focus groups generated several suggestions and wishes related to technical applications they could make use of in their day-to-day practice. Findings from the individual interviews identified several technology applications that could be useful in community care, but one manager expressed an important aspect:

> *"It is very important to differentiate between the various types of technological applications; what can be useful in the day-to-day practice, for both the patients and the health care personnel in community care, in order to prevent hospitalizations and out-patient visits."*

> Head of health and social welfare department

The findings pertaining to this category demonstrates that health care personnel warranted tools and measures to enhance and document their clinical observations in contact with patients. By doing so, they saw the potential of saving a trip to the outpatient emergency clinic for the patient, and they could provide better quality of the home-care.

In Norway, general practitioners (GPs) and doctors at the outpatient emergency clinic are obliged by law [56] to offer home visits to patients who are not fit to meet for a consultation at the doctor's clinic, or when it is deemed necessary in order to provide sufficient treatment and care. The focus group participants described a practice where home visits were seldom undertaken, because either way the patient had to go to the clinic in order to take the

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necessary tests. If, however, home care personnel could have done the tests, they would both have saved the patient for a potentially strenuous transportation to the doctor's clinic, and at the same time report much more precise clinical data. They had several suggestions in this matter; the possibility of drawing blood for a C-reactive Protein test (CRP) was suggested on the grounds that this was the first thing the doctor asked for when they made contact for an assessment of a patient. Since they did not have the equipment to do this procedure/test, the patients had to book an appointment either at their GP, or at the outpatient emergency clinic. In their experience, this often also involved the use of an ambulance for transportation. One situation they described was when they would contact the outpatient emergency clinic (in night-time and/or weekends) and they could only provide a diffuse description of the patient's condition, as they did not have access to measures that could help be more precise in the description:

> *"I'm calling the outpatient emergency clinic and report a patient who's had a general decline throughout the week, and the personnel there say that we have to take a blood sample (C-reactive Protein=CrP) and oxygen saturation… we can't perform this and consequently they are picked up by an ambulance…..We should have had the possibility to do these measures…*
>
> Several nurses, focus group interview 2

They also discussed the possibility of applying a video link to a doctor. This application could support their observations, as well as providing a possibility for the doctor to assess a patient's condition, without being face-to-face. They suggested using video link as a tool for the doctor to observe symptoms related to respiration and swollen legs/ peripheral oedema. Furthermore, the participants in the focus group interviews wished to be equipped in a manner that made them more self-sufficient in providing high quality care, and in this context, they suggested for example the use of a bladder scanner as a tool, in relation to a problem with re-occurring urinary tract infections (UTIs):

> *"If we had a bladder scanner, we could have solved it ourselves…instead of going to the outpatient emergency clinic."*
>
> Nurse, focus group interview 1

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This was discussed in the context of patients who had been hospitalized due to UTIs, and had been scanned and/or catheterized several times per day during their hospital stay, while as when they were discharged from the hospital to their home; the home care personnel had no tools to help them observe the phenomenon of residual urine. This is a crucial observation for the prevention of UTIs [57].

Informants in both the focus group interviews and individual interviews suggested the use of a tablet in the day-to-day practice in community care. A tablet installed with the quality/record system used in community care would enable the health care personnel to enhance and document their clinical observations in contact with patients. To date of the data collection, the personnel documented the clinical assessments on paper, which they would plot once they came to the home-care base (office) where they had access to a computer and the patients' record. The informants expressed a clear potential to work safer, in terms of clinical measures being transmitted directly in the patients' record, as contrary to first record the measures on paper, bring it to the home care base, and manually plot them in the record.

In the focus group interviews, the use of a tablet was also discussed as a mean to be more prepared when there was an emergency call-out. Emergency call-outs were a daily activity, as most patients had a safety alarm which would alert health care personnel in community care if they activated it (i.e., pushed a button/pendant alarm). A typical situation would be if a patient had fallen, but it could also be that they were tired of waiting for their medication, or wanted help to get to the toilet etc. However, the health care personnel would only receive an alarm signal, and the first step in the response was to receive a phone call from an emergency dispatcher who provided information about the patient's name, address and phone number. If the alarm concerned a patient who they were not familiar with, they had no possibility to check the patient's record for relevant information:

> "One is always out driving, on the way from one patient to another, and then you
> have to stop the car, receive information about which patient – their name, address
> and phone number, by phone and write it down. It would be much easier to receive a

text message with this information, and then log on to the patient's record on a

tablet. I would like our quality system to be an application installed on a tablet!"

<div align="right">Nurse, focus group interview 2</div>

Another type of technological applications both the informants in the individual interviews and informants in the focus group interviews discussed were more related to a safe home environment, and the potential for the patients to increase the degree of self-management, using automated devices (smart house technology), alarms and reminders. More concretely, they suggested that the safety alarm could be ha hub for various types of applications, such as reminders for when to take their medication and when it was time to eat, and movement-based light sensors located near the floor. The latter was suggested as mean to prevent patients from falling when they had to go to the toilet during the night.

Potential patient groups

Findings pertaining to this category represent a direct response to the question about for which patients hospitalizations could be prevented. The findings stemming from the individual interviews bear a notion of managers being motivated by national policy regarding the resource utilization. Norwegian policy documents emphasize that a major response to the resource challenge in health care is to enable / empower people to live in their own home for as long as possible, as well as provide timely treatment interventions at the proper level in the health care system. The Government introduced the Coordination Reform January 1st 2012, which represents a transition in responsibility for providing health care services, where the municipalities are to play a much larger role in meeting the demand for services [58-60]. In the reform, the preventative perspective in health care is of great focus, where an important assumption is that there is a potential for preventing hospital admissions for the older persons receiving community care. The managers did not talk about specific patients groups, but had a more general approach to preventing hospitalizations for home-dwelling older persons, which they described to be an appropriate task for the municipality/community care to undertake.

> *"We have to look at possibilities for how to follow up on home-dwelling patients –*
> *they should not be admitted to hospital! We should be able to draw blood in their*
> *home and do measurements in their home…"*
>
> Assistant director

The informants in the focus group interviews started off discussing various clinical conditions and patients that they viewed did not necessarily need the competence provided in specialized health care services that a hospital represents. If a patient was to be hospitalized due to dehydration, they considered the "treatment" or intervention initiated at the hospital to be rather short and simple, implying that this sort of intervention did not require specialized health care.

> *"Dehydrated patients; they are admitted for a short time, have some intravenous fluid*
> *(IV) and then sent home."*
>
> Nurse, focus group interview 2

Another group of patients who they discussed was those who have Chronic Obstructive Pulmonary Disease (COPD). In their experience, these patients had frequent re-admissions to hospital, not necessarily due to the clinical condition itself, but because of the anxiety that often follows having respiratory problems, implying that many of the (re-) hospitalizations potentially could have been prevented through a follow-up after discharge.

> *"COPD patients are left to themselves when they are discharged, and then the*
> *anxiety comes…the use of a telemonitoring device for promptly measures is neat."*
>
> Nurse, focus group interview 1

The informants agreed that a clinical condition described as potentially preventable was Urinary Tract Infections (UTIs). Especially male patients were characterized as vulnerable in this context, as the personnel had to perform what they described as excessive catheterizations for men who had problems with residual urine in the bladder:

"A lot of UTIs…many men who are catheterized for 1,5-2 litres. We have to cathertize more often to be on the safe side, but then there is an infection and then they are hospitalized again due to this… "

<div align="right">Nurse, focus group interview 1</div>

As demonstrated above, the informants in this study are quite clear about which technological applications they consider potentially useful in their practice. They also discussed which patients groups whom hospitalizations potentially could be prevented. There was partly a connection between the suggested technological applications and the identified patient groups. The results are discussed against relevant literature, providing suggestions for future intervention research.

DISCUSSION

From a health care personnel's perspective, the main incentive to adopt assistive living technologies in community care was the practical use in daily care. The various technological applications as well as different patient groups were identified, where the use of technological applications potentially could provide a more precise clinical assessment of home-dwelling older persons receiving care services.

Findings from this study revealed that health care personnel in community care were vigilant in observing clinical decline, but lacked tools to measure this decline. More specifically, they actually warranted the use of technological applications in their work, implying that they regard the use of assistive living technologies as integral to their nursing practice in community care. This perspective is in contrast to what May and colleagues found in their study from 2011 [2], where they identified problems in terms of health care professionals in community care to be indifferent and sometimes even hostile to the implementation of telecare systems. Also a more recent study by Greenhalgh et al. [4] found that some clinicians would adopt readily to the use of video outpatient consultations, whereas others needed incentives and support.

However, May and colleagues [2] also found that some health care professionals adopted the telecareservice regardless, given that they perceived it as effective. Based on interviews

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with potential users of assistive living technologies (i.e., health care personnel), our findings suggest that such applications have the potential to enable the nurses in community care to provide a more accurate description of the problem(s) when contacting a doctor. This implies that there is a potential to increase the quality of community care, through the use of the warranted technological applications. Moreover, the likelihood of successful adoption is increased as the interventions are considered to be useful and fit for purpose by the actual users [2, 35, 36]. Thus, the approach applied in our study provides great value in terms of developing appropriate interventions to prevent hospitalizations for home-dwelling older persons receiving community care, as it identifies issues and needs in practice [26, 36, 37].

The latter aspect is extremely important as it is increasingly recognized that health care personnel's acceptance of the technological application itself remains a key challenge in adopting an intervention [32-34]. Furthermore, the informants in our study suggested the use of a video link to facilitate remote consultations with a doctor to deal with some of the non-urgent inquiries and potentially reduce the use of specialized health care services. Greenhalgh et al. [4] found that video outpatient consultations appeared safe, effective, and convenient to use when the clinicians judged the patients to be clinically appropriate, but such situations were merely a fraction of the overall clinic workload. Although the use of a video link is perhaps not efficient in terms of reducing the workload, the informants in our study expressed an interest in saving patients for a potentially strenuous transportation to the doctor's clinic. This is an important care aspect, even though it cannot compromise the appropriate health care interventions to be undertaken. The finding must be seen in concordance with the previous aspect; they saw the potential of providing improved quality of care, both in terms of making precise clinical assessments and caring for a patient´s resources. This holistic care practice is an expression of nurses who are well-grounded in general nursing knowledge, theory, practice competencies and clinical experience, and furthermore possess attributes of intuition and creativity to enhance a holistic care by the use of assistive living technologies [46].

Previous research have identified that emergency hospitalizations of older persons often occur when the patient has reached a point of crisis, such as an exacerbation of a chronic condition, change in social setting, or a cascade of symptoms due to multi-morbidity and frailty [14-17]. The use of technological applications as suggested by health care personnel in

our study could potentially prevent a severe state of illness that requires hospitalization, by discovering and addressing the patients' symptoms at an early stage. This is important with regards to both quality of care and resource utilization [13, 19].

Limitations

This case study does not formulate a solution for how an eHealth intervention should be developed, but the insights from the study could inform a future intervention in comparable settings. One premise in this paper is to acknowledge that people and technologies are linked in a dynamic health care system made up of multiple interacting stakeholders. We have not focused on the patients as intended users of a technological solution. This needs to be explored for building an even more solid rationale for applying a technological application in community care. An intervention should be informed by all stakeholders – individual users, service providers and technology suppliers, to ensure a person-centered, holistic and ethically based approach. Such co-production should be addressed in future research.

The findings from this case study pertain to the particular community care and context prevailing in the included Norwegian municipality. Other municipalities, countries and settings may illustrate different opportunities and challenges, which should be explored. It could be argued that our sample of informants including 17 community care managers and health care personnel should have been larger. However, based on the study's rather narrow aim and the use of theory to extend the sources of knowledge beyond the empirical interview data, the sample offered sufficient information power, as described by Malterud and colleagues [61]. The sample of 12 health care personnel had daily patient contact and represent future users of assistive living technologies. Hence, their perspectives may be transferable to other similar contextual settings as described in this study.

Conclusion

Through this study, we have generated empirical knowledge about which assistive living technologies that potentially could prevent hospitalizations for home-dwelling older persons receiving community care. By identifying issues and needs in practice we have identified factors paramount for acceptance and adoption of an intervention [26, 37]. We have shown that health care personnel in community care warrant various technological applications,

which have the potential to improve quality of care and improve resource utilization in the studied municipality.

Previous research has pointed to a poorly founded rationale for the use of an eHealth intervention as a reason for slow and fragmented uptake and use of assisted living technologies in community care [26, 48]. The findings in this study can specifically inform future interventions aiming to prevent hospitalizations for home-dwelling older persons in community care, as the identified potential applications are considered useful and fit for purpose. Furthermore, by providing a description of the development phase of a future intervention as described in the MRC framework [50], it adds significantly to the general body of knowledge regarding developing eHealth interventions in community care.

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Appendices

Appendix 1 – Ethical approvals

Stavanger Universitetssjukehus
Helse Stavanger HF
Forskningsavdelingen

Notat

Til:
Ingelin Testad

Kopi til:
Fagsjef Sølve Braut
Divisjonsdirektør Psykiatrisk divisjon

Dato: 11.09.2013
Fra: Forskningssjef Inger Økland
Arkivref: 2010/3039 - 40910/2013

Godkjennelse av forskningsprosjekt - ID341

Forskningsprosjektet: «Kartlegging av innleggelse i sykehus for hjemmeboende personer som mottar helsehjelp.»

Det vises til søknad vedrørende oppstart av ovennevnte forskningsprosjekt. Prosjektet har vært vurdert av forskningsansvarlig og prosjektet er registrert i vår database med intern id: ID341.

Nødvendige tillatelser foreligger. Basert på disse og forskningsprotokoll godkjennes oppstart av prosjektet.

Forskningsavdelingen ønsker å minne om at:
– prosjektet må gjennomføres i henhold til protokollen og ved endringer må endringsmelding sendes
– dersom prosjektet er godkjent av REK, må søknad og godkjennelse av REK følges
– foreligger det godkjennelse fra Personvernombud må likeledes denne følges
– behandling av helse- og personopplysninger skjer i samråd med og innenfor det formål som er beskrevet
– ved tilgang til registre, skjer dette i overensstemmelse med taushetspliktbestemmelsene
– data lagres avidentifisert på helseforetakets forsknings/kvalitetsserver etter de regler som gjelder for bruk av denne
– dersom innhenting av pasientopplysninger baserer seg på samtykke, må samtykkeskjemaet oppbevares
– data skal slettes eller anonymiseres ved prosjektslutt

Dersom prosjektet ikke starter og/eller blir avbrutt må melding sendes til Forskningsavdelingen. Likeledes sendes en kort sluttrapport. Forskningsavdelingen ønsker lykke til med gjennomføring av prosjektet.

Personvernombudet

Ingelin Testad
SESAM
Psykiatrisk divisjon

Intern ID	Ephorte saksnr	Saksbehandler:	Dato:
2013/21	2013/18	Irene Mathisen, tlf 5151 3675	05.09.2013

—

Kartlegging av innleggelse i sykehus for hjemmeboende personer som mottar helsehjelp.

Viser til innsendt melding om behandling av personopplysninger / helseopplysninger. Det følgende er en formell anbefaling fra personvernombudet. Forutsetningene nedenfor må være oppfylt før innsamlingen av opplysningene / databehandlingen kan begynne.

Med hjemmel i Personopplysningsforskriftens § 7-12 jf. Helseregisterlovens § 36 har Datatilsynet ved oppnevning av Irene Mathisen som personvernombud for Helse Stavanger HF, fritatt helseforetaket fra meldeplikten til Datatilsynet. Behandling og utlevering av person-/helseopplysninger meldes derfor til helseforetakets personvernombud.

Viser til svar fra REK –sør øst 2013/1078 der det beskrives at personvernombudet må gjøre en vurdering om tilgang og utlevering av data i forbindelse med forskningsprosjektet.
Etter personvernombudets oppfatning er dette et prosjekt som kan vurderes ut fra Personopplysningsforskriftens §7-27.
 Prosjektet er av en slik størrelse at det ikke er nødvendig med konsesjonsbehandling (ca 1000 pasienter fra 67 år og oppover).
 Det er heller ikke beskrevet at det er særlig sensitive data som skal samles inn.
 Prosjektet er beskrevet avsluttet innen 2018 og er derfor ikke av lengre varighet.
Med bakgrunn i overnevnte kriterier har personvernombudet ingen innvendinger til at prosjektet gjennomføres.
Saken oversendes forskningsavdelingen for videre behandling.

Med vennlig hilsen

Irene Mathisen

Irene Mathisen
personvernombud

Kopi:
Divisjonsdirektør
Jan Erik Nilsen

Region:	Saksbehandler:	Telefon:		Vår dato:	Vår referanse:
REK sør-øst	Tor Even Svanes	22845521		28.06.2013	2013/1070/REK sør-øst C
				Deres dato:	**Deres referanse:**
				28.05.2013	

Vår referanse må oppgis ved alle henvendelser

Ingelin Testad

2013/1070 Kartlegging av innleggelse i sykehus for hjemmeboende personer som mottar helsehjelp

Prosjektleder: Ingelin Testad
Forskningsansvarlig: Stavanger Universitetssjukehus

Vi viser til søknad om forhåndsgodkjenning av ovennevnte forskningsprosjekt. Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK sør-øst) i møtet 13.06.2013. Vurderingen er gjort med hjemmel i helseforskningsloven (hfl.) § 10, jf. forskningsetikklovens § 4.

Prosjektomtale
Studien skal kartlegge innleggelser til sykehus av personer 67 år og eldre som mottar hjemmetjenester og er bosatt i en av fire bydeler i Stavanger kommune. Målsettingen er å identifisere brukergrupper som har en høy andel av innleggelser som muligens kan unngås ved målrettete intervensjoner. Faktorer som skal kartlegges er antall innleggelser, hvem som legger inn, tidspunkt og ukedag, pårørendes rolle eller rolle til hjemmesykepleien, innleggelsesårsak og diagnose, lengden på sykehusopphold, mortalitet under sykehusopphold. Studien er del av et doktorgradsprosjekt som skal evaluere bruk av velferdsteknologi. Hypotesen er at velferdsteknologi kan forhindre unødvendige innleggelser på sykehus. Den omsøkte kartleggingsstudien vil danne grunnlag for planlegging av intervensjonen ved å identifisere brukergruppe (f. eks spesielle diagnoser som KOLS, eller sosiale faktorer som personer som bor alene m.m.). Samtidig vil studien danne grunnlag for senere måling av effekt.

Data vil samles inn fra kommunens registreringssystem CosDoc og fra sykehusets registreringssystem DIPS (pasientjournal) og NIMES (administrative data). Utvalget vil bestå av ca. 1000 pasienter fra 67 år og oppover, som mottar hjemmesykepleie og er i bosatt i enten bydelen Hinna, Hillevåg, Eiganes eller Tasta.

Det søkes om dispensasjon fra taushetsplikt for å gjennomføre prosjektet.

Vurdering
Komiteen vurderer dette prosjektet som nyttig helsetjenesteforskning, hvor det er faktorer relatert til samhandling og rehabilitering i fire bydeler med ulik demografisk sammensetning som skal undersøkes. Hypotesene i prosjektet er blant annet knyttet til bruk av velferdsteknologi. Det er ikke ny kunnskap om helse eller sykdom i seg selv som er formålet med prosjektet, og det gjør at studien slik sett faller utenfor bestemmelsene i helseforskningsloven, jf. helseforskningslovens § 2, jf. helseforskningslovens § 4.

Man er imidlertid avhengig av en relativt omfattende dispensasjon fra taushetsplikt for å få tilgang til det kildematerialet som skal benyttes. Både administrative data og journaldata skal hentes ut og sammenstilles i prosjektet.

Besøksadresse:
Gullhaugveien 1-3, 0484 Oslo

Telefon: 22845511
E-post: post@helseforskning.etikkom.no
Web: http://helseforskning.etikkom.no/

All post og e-post som inngår i saksbehandlingen, bes adressert til REK sør-øst og ikke til enkelte personer

Kindly address all mail and e-mails to the Regional Ethics Committee, REK sør-øst, not to individual staff

I henhold til *Forskrift 2009-07-02-989: Delegering av myndighet til den regionale komiteen for medisinsk og helsefaglig forskningsetikk etter helsepersonelloven § 29 første ledd og forvaltningsloven § 13d første ledd*, er REK gitt kompetanse til å vurdere om det skal gis dispensasjon fra taushetsplikt for opplysninger som er underlagt taushetsplikt etter helseregisterloven § 15, jf. forvaltningsloven § 13 til bruk i forskning.

Komiteen mener dette prosjektet kan ha stor samfunnsmessig nytte, både med tanke på erfaringer med velferdsteknologi, men også fordi det er viktig med kunnskap om reduksjon av sykehusinnleggelser for den aktuelle gruppen. Formålet med innsamlingen og bruken av data kan dermed komme til reell nytte. Data vil presenteres på en måte som ikke gjør at den enkelte vil kunne bli gjenkjent, i tillegg til at materialet er stort; vel 1000 personer vil kartlegges. Den omsøkte variabellisten anses ikke som veldig sensitiv.

Komiteen har etter en helhetsvurdering kommet til at vilkårene for å gi dispensasjon fra taushetsplikten foreligger. Komiteen har valgt å innvilge dispensasjon fra taushetsplikt for tilgang til- og bruk av journalopplysninger, i tråd med søknad og protokoll.

I forskningsprosjekter som ikke er underlagt forhåndsgodkjenningsplikten etter helseforskningsloven § 9, jf. § 2, tar REK kun stilling til spørsmålet om tilgang og utlevering av opplysningene som skal benyttes i forskningsprosjektet. Søker må avklare med personvernombud (PVO)/NSD om prosjektets behandlingsgrunnlag kan gis i form av meldeplikt etter personopplysningsloven § 31 eller konsesjonsplikt etter personopplysningsloven § 31. Komiteen forutsetter at gyldig behandlingsgrunnlag blir innhentet før opplysningene gjøres tilgjengelig for forskergruppen.

Når det gjelder utlevering av administrative data fra Stavanger kommune, har ikke komiteen hjemmel til å vurdere dette. Det legges derfor til grunn at slik tilgang innvilges av rett instans.

Vedtak
Med hjemmel i *Forskrift av 2.7.2009 nr. 989, Delegering av myndighet til den regionale komiteen for medisinsk og helsefaglig forskningsetikk etter helsepersonelloven § 29 første ledd og forvaltningsloven § 13d første ledd*, har komiteen besluttet å gi fritak fra lovpålagt taushetsplikt.

Dispensasjonen fra taushetsplikt gjelder utlevering av helseopplysninger fra Stavanger Kommunes registreringssystem (CosDoc) og Stavanger Universitetssjukehus pasientjournalsystem (DIPS), til bruk i prosjektet.

Dispensasjonen fra taushetsplikt gjelder til 31.12.2018.

Dispensasjon er gitt under forutsetning av at prosjektet gjennomføres slik det er beskrevet i søknad og protokoll.

Komiteens avgjørelse var enstemmig.

Komiteens vedtak kan påklages til Den nasjonale forskningsetiske komité for medisin og helsefag, jf. helseforskningsloven § 10, 3 ledd og forvaltningsloven § 28. En eventuell klage sendes til REK sør-øst C.

Klagefristen er tre uker fra mottak av dette brevet, jf. forvaltningsloven § 29.

Vi ber om at alle henvendelser sendes inn via vår saksportal: http://helseforskning.etikkom.no eller på e-post til: post@helseforskning.etikkom.no

Vennligst oppgi vårt referansenummer i korrespondansen.

Med vennlig hilsen

Arvid Heiberg
prof. dr.med
leder REK sør-øst C

Tor Even Svanes
seniorrådgiver

Kopi til: forskning@sus.no,

post@helse-stavanger.no

Appendix 2 – Information letter to informants in individual interviews

Forespørsel om deltakelse i forskningsprosjektet:

UTVIKLING OG IMPLEMENTERING AV VELFERDSTEKNOLOGI TIL ELDRE SOM HAR HJEMMEBASERTE TJENESTER

Dette er et spørsmål til deg om å delta i en forskningsstudie ved Helse Stavanger HF / Stavanger universitetssjukehus (SUS), som gjennomføres i samarbeid med Stavanger kommune. Vi ønsker å finne ut om bruk av velferdsteknologi i forhold til eldre brukere av hjemmebaserte tjenester kan bidra til å redusere antall unødvendige innleggelser. I dette skrivet gjør vi rede for hva deltakelse i dette forskningsprosjektet innebærer for deg, som mulig deltaker i studien. Dersom noe er uklart, eller om du du ønsker mer informasjon, er det kontaktinformasjon på slutten av dette skrivet.

Hva innebærer studien?
Hensikten med studien er å finne ut mer om hvordan velferdsteknologi kan brukes i hjemmebaserte tjenester med tanke på å redusere antall unødvendige innleggelser for eldre mennesker. En del av studien innebærer å intervjue ledere og personalet i hjemmebaserte tjenester for å få deres beskrivelse av hvordan dette kan gjøres. Dersom du ønsker å delta i forskningen, innebærer det å dele dine synspunkter relatert til ulike aspekter ved bruk av velferdsteknologi i et intervju. Intervjuet vil bli gjennomført av en forsker og ta cirka 1 ½ -2 timer. Vi vil gjerne ta opp intervjuet på diktafon, slik at vi får en nøyaktig oversikt over det som blir formidlet. Vi vil be deg om å signere et samtykkeskjema hvor du aksepterer deltakelse i intervjuet.

Mulige fordeler
Du får ingen direkte personlige fordeler ved å delta. Deltakelsen kan imidlertid være et viktig bidrag i arbeidet med å øke forståelsen for utvikling og bruk av velferdsteknologi i hjemmebaserte tjenester.

Hva skjer med data fra intervjuet?
Det er frivillig å delta i studien. Om du nå sier ja til å delta, kan du senere når som helst og uten å oppgi noen grunn, trekke tilbake ditt samtykke. Data som kommer fram gjennom intervju skal kun brukes slik som beskrevet i hensikten med studien. Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger gjennom en navneliste, som oppbevares separat og lagres i låst arkivskap eller på en passordbeskyttet datamaskin, som er sikret mot uautorisert tilgang.

Opptakene blir transkribert og anonymisert senest ved prosjektslutt 31.12.2015. Opptakene blir slettet etter at de er transkribert, senest 31.12.2015. Dataene blir deretter analysert av

et forskningsteam. Med din tillatelse blir de anonymiserte dataene arkivert i opptil tre år etter at prosjektet er fullført, slik at de kan brukes av andre forskere, til andre formål. Det vil ikke være mulig å identifisere deg i resultatene av studien når disse publiseres.

Informasjon om utfallet av studien

Resultatene fra prosjektet kan brukes som grunnlag for fremtidige strategier for bruk av velferdsteknologi i Stavanger kommune, publiseres i akademiske tidsskrifter og/eller presenteres på faglige og akademiske konferanser. Anonymiserte utdrag fra intervjuene kan brukes i publikasjoner som er baserte på forskningen, men rapporter eller artikler vil ikke identifisere noen av deltakerne. Årsrapporter som presenterer resultater fra forskningsprosjekter tilknyttet Stavanger Universitetssjukehus er offentlig tilgjengelige på http://forskningsprosjekter.ihelse.net/. Vi viser også til våre forskningsnettsider på: http://www.sus.no/forskning/.

Forskningsetiske godkjennelser

Denne studien er vurdert og tilrådd av Personvernombudet for forskning på Stavanger Universitetssjukehus, ID341.

Organisering og finansiering av studien

Forskningsprosjektet eies av Stavanger kommune, med midler fra Regionalt forskingsfond Vest og gjennomføres av doktorgradskandidat ved Senter for eldremedisin og samhandling på Stavanger Universitetssjukehus og Universitetet i Stavanger. Disse partene finansierer studien med ulike deler.

Mer informasjon

Takk for at du tok deg tid til å lese denne informasjonen. Hvis du ønsker mer informasjon, eller har spørsmål knyttet til forskningsstudien, kan du ringe eller sende e-post til: Martha Therese Gjestsen martha.therese.gjestsen@sus.no, 51515619, Ingelin Testad ingelin.testad@sus.no, 51514747 på Senter for eldremedisin og samhandling (SESAM) på Stavanger Universitetssjukehus (SUS).

HELSE STAVANGER
Stavanger universitetssjukehus

Skjema for samtykke til deltakelse i forskningsprosjekt
- Voksne over 16

Prosjekttittel	Prosjektnummer
Utvikling og implementering av velferdsteknologi til eldre som har hjemmebaserte tjenester	341

Prosjektleders navn	Klinikk/avdeling
Ingelin Testad	SESAM

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Jeg er villig til å delta i forskningsprosjektet:

Navn med blokkbokstaver	Fødselsnummer (11 siffer)

Dato	Underskrift

Fylles ut av representant for forskningsprosjektet

Jeg bekrefter å ha gitt informasjon om forskningsprosjektet:

Dato	Underskrift	Brukerkode (4-tegnskode)

Eventuelle kommentarer:

Appendix 3 – Information letter to informants in focus group interviews

Informasjonsskriv for ansatte

Forespørsel om deltakelse i forskningsprosjektet:

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Mulige fordeler
Du får ingen direkte personlige fordeler ved å delta. Deltakelsen kan imidlertid være et viktig bidrag i arbeidet med å øke forståelsen for utvikling og bruk av velferdsteknologi i hjemmebaserte tjenester.

Hva skjer med data fra intervjuet?
Det er frivillig å delta i studien. Om du nå sier ja til å delta, kan du senere når som helst og uten å oppgi noen grunn, trekke tilbake ditt samtykke. Data som kommer fram gjennom intervju skal kun brukes slik som beskrevet i hensikten med studien. Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger gjennom en navneliste, som oppbevares separat og lagres i låst arkivskap eller på en passordbeskyttet datamaskin, som er sikret mot uautorisert tilgang.

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Informasjon om utfallet av studien
Resultatene fra prosjektet kan brukes som grunnlag for fremtidige strategier for bruk av velferdsteknologi i Stavanger kommune, publiseres i akademiske tidsskrifter og/eller presenteres på faglige og akademiske konferanser. Anonymiserte utdrag fra intervjuene kan brukes i publikasjoner som er baserte på forskningen, men rapporter eller artikler vil ikke identifisere noen av deltakerne. Årsrapporter som presenterer resultater fra forskningsprosjekter tilknyttet Stavanger Universitetssjukehus er offentlig tilgjengelige på http://forskningsprosjekter.ihelse.net/. Vi viser også til våre forskningsnettsider på: http://www.sus.no/forskning/.

Forskningsetiske godkjennelser
Denne studien er vurdert og tilrådd av Personvernombudet for forskning på Stavanger Universitetssjukehus, ID 341.

Organisering og finansiering av studien
Forskningsprosjektet eies av Stavanger kommune, og finansieres av Stavanger kommune, Regionalt forskingsfond og Universitetet i Stavanger. Prosjektet gjennomføres av PhD stipendiat ved Regionalt kompetansesenter for eldremedisin og samhandling (SESAM), Stavanger Universitetssjukehus (SUS).

Mer informasjon
Takk for at du tok deg tid til å lese denne informasjonen. Hvis du ønsker mer informasjon, eller har spørsmål knyttet til forskningsstudien, kan du ringe eller sende e-post til: Martha Therese Gjestsen martha.therese.gjestsen@sus.no, 51515619, Ingelin Testad ingelin.testad@sus.no, 51514747 på Regionalt kompetansesenter for eldremedisin og samhandling (SESAM) på Stavanger Universitetssjukehus (SUS).

HELSE STAVANGER
Stavanger universitetssjukehus

Skjema for samtykke til deltakelse i forskningsprosjekt
- Voksne over 16

Prosjekttittel	Prosjektnummer
Utvikling og implementering av velferdsteknologi til eldre som har hjemmebaserte tjenester	341

Prosjektleders navn	Klinikk/avdeling
Ingelin Testad	SESAM

Det er frivillig å delta i studien. Dersom du ønsker å delta, undertegner du denne samtykkeerklæringen. Om du nå sier ja til å delta, kan du senere når som helst og uten å oppgi noen grunn, trekke tilbake ditt samtykke uten at det påvirker din øvrige behandling. Dersom du senere ønsker å trekke deg eller har spørsmål til studien, kan du kontakte prosjektleder.

Jeg er villig til å delta i forskningsprosjektet:

Navn med blokkbokstaver	Fødselsnummer (11 siffer)

Dato	Underskrift

Fylles ut av representant for forskningsprosjektet

Jeg bekrefter å ha gitt informasjon om forskningsprosjektet:

Dato	Underskrift	Brukerkode (4-tegnskode)

Eventuelle kommentarer:

Appendix 4 – Interview guide to individual interviews

Semi strukturerte intervjuer – meso-nivå

Utvikling og implementering av velferdsteknologi til eldre som har hjemmebaserte tjenester

Takk for at du tok deg tid til å delta i dette forskningsprosjektet. Dette prosjektet eies av Stavanger kommune, og gjennomføres av Senter for eldremedisin og samhandling (SESAM) på Stavanger Universitetssjukehus sammen med Universitetet i Stavanger. Det fokuserer på velferdsteknologi, og hvordan dette kan tas i bruk for å sikre god kvalitet på de kommunale helse- og omsorgstjenestene. Målsettingen er å identifisere hva som må være tilstede for at kommunen kan bruke teknologien på en hensiktsmessig måte. Mer spesifikt skal vi gjennom prosjektet identifisere en pasientgruppe som kan nyttiggjøre seg en velferdsteknologisk løsning ved å finne ut hvem som er utsatt for unødvendige innleggelser til sykehus, og deretter å implementere en teknologisk løsning hos denne pasientgruppen for å se hvilken effekt dette har på antall unødvendige innleggelser, og på kvaliteten på tjenestene som ytes.

Dette skal vi gjøre ved å kartlegge innleggelser til sykehus, intervjue ledere i kommunen, samt ansatte i hjemmebaserte tjenester. Hensikten med intervjuet er å få en bedre forståelse for hvilke faktorer som spiller en rolle i forhold til utvikling og implementering av velferdsteknologi i kommunen.

PAUSE TIL SPØRSMÅL OG KOMMENTARER
- **Er det noen spørsmål knyttet til det jeg har fortalt om prosjektet?**
- **Kontroller at samtykkeskjemaet er lest og forstått.**
- **Er det ok at vi fortsetter med intervjuet nå?**

Dette intervjuet blir tatt opp på diktafon. Samtalen blir sammen med de andre intervjuene vi gjør transkribert og analysert av et forskningsteam på SESAM. Svarene dine blir ikke delt med noen utenfor forskningsteamet, eller med andre ansatte i kommunen. Opptakeren er på.

Oppvarmingsspørsmål
- Hvor lenge har du jobbet i kommunen?
- Hvilken rolle har du hatt og hvilken rolle har du nå?
- Hva er hovedansvarsområdet?

Velferdsteknologi
- Historisk kontekst; kjenner du til noen velferdsteknologiprosjekter i regi av kommunen?
  a. Hvordan ble disse gjennomført?
- Hvorfor skal velferdsteknologi være en del av kommunens helse- og omsorgstilbud?

- Hvordan ser du for deg at velferdsteknologi kan brukes som en del av kommunens helse- og sosialtjenester?
- Vet du om kommunens strategi ift velferdsteknologi?
- Er det noe ved denne kommunen som skiller seg ut fra andre kommuner når det gjelder velferdsteknologi?

Kvalitet
- Hvordan passer velferdsteknologi inn som en del av kvalitetsarbeidet i de kommunale helse- og omsorgstjenestene?
- Er det et system for å evaluere hvilken effekt velferdsteknologi kan ha på tjenestetilbudet?

Organisasjon
- Hvordan fattes beslutninger som angår de kommunale helse- og omsorgstjenestene når det gjelder velferdsteknologi?
- Hvilke forhold / faktorer spiller inn på hvordan teknologi kan brukes i helsetjenestene i kommunen;
  - a. Lovendringer
  - b. Ressurser
  - c. overordnet styring
  - d. omorganisering
  - e. kompetanse
  - f. vilje til å ta i bruk teknologien hos ansatte
  - g. bruker / pasientinvolvering
- Hvordan må ledelsen tilrettelegge for at teknologien skal implementeres i helse- og omsorgssektoren?
  - a. Rammebetingelser
  - b. Ressurser
  - c. Nettverk
  - d. Omorganisering
  - e. Systemendringer
  - f. Opplæring
  - g. IT-support

Samarbeid
- Er det nøkkelpersoner eller - organer knyttet til velferdsteknologi i kommunen?
  - a. Også utenfor kommunen?
    - i. Teknologileverandører
    - ii. nettverk
- Hva er det som driver arbeidet med velferdsteknologi i kommunen framover?
- Hvem er tatt med i dette arbeidet?
  - a. Brukere
  - b. Teknologileverandører
  - c. Politikere
  - d. ledere i helsetjenestene
- Er det noe du vil si før vi slutter av?

Appendix 5 – Interview guide to focus group interviews

INTERVJUGUIDE FOKUSGRUPPEINTERVJUER

Utvikling og implementering av velferdsteknologi til eldre som har hjemmebaserte tjenester

Takk for at dere har tatt dere tid til å delta i dette forskningsprosjektet. Prosjektet eies av Stavanger kommune, og gjennomføres av Senter for eldremedisin og samhandling (SESAM) på Stavanger Universitetssjukehus, sammen med Universitetet i Stavanger. Det fokuserer på velferdsteknologi, og hvordan dette kan tas i bruk for å sikre god kvalitet på de kommunale helse- og omsorgstjenestene. Mer spesifikt skal vi gjennom prosjektet identifisere hvilken pasientgruppe som kan nyttiggjøre seg en velferdsteknologisk løsning ved å finne ut hvem som er utsatt for unødvendige innleggelser til sykehus, og deretter implementere en teknologisk løsning hos denne pasientgruppen for å se hvilken effekt dette har på antall unødvendige innleggelser, og på kvaliteten på tjenestene som ytes.

Dette skal vi gjøre ved å kartlegge innleggelser til sykehus, intervjue ledere i kommunen, ansatte kommunens helse- og sosialdistrikt og i hjemmebaserte tjenester. Hensikten med intervjuet er å få en bedre forståelse for hvilken type teknologi som kan bidra til å redusere antall uønskede innleggelser, samt hvordan velferdsteknologi kan tas i bruk på en hensiktsmessig måte i hjemmebaserte tjenester.

Underveis i intervjuet kan dere tenke på velferdsteknologi som 4 ulike typer teknologi:
- Trygghets- og sikkerhetsteknologi (f eks. trygghetsalarm, alarmsensorer)
- Velvære – og kompensasjonsteknologi (f eks. fjernstyring av lys, memo ved redusert hukommelse)
- Teknologi for sosial kontakt (f eks. videotelefoni)
- Teknologi for behandling og pleie (f eks. fjernmonitorering av blodsukkerverdier, BT)

PAUSE TIL SPØRSMÅL OG KOMMENTARER
- **Er det noen spørsmål knyttet til det jeg har fortalt om prosjektet?**
- **Kontroller at samtykkeskjemaet er lest og forstått.**
- **Er det ok at vi fortsetter med intervjuet nå?**

Dette intervjuet blir tatt opp på diktafon. Samtalen blir sammen med de andre intervjuene vi gjør transkribert og analysert av et forskningsteam på SESAM. Svarene dine blir ikke delt med noen utenfor forskningsteamet, eller med andre ansatte i kommunen. Opptakeren er på.

Tar en runde rundt bordet, slik at informantene får presentert seg med navn og hvor lenge de har jobbet i hjemmebaserte tjenester.

Velferdsteknologi
Hva legger dere i begrepet?
        Hvilke muligheter
        Hvilke utfordringer

Hvordan vil dere beskrive dagens teknologiske løsninger?

Har noen erfaring med bruk av velferdsteknologi?

Hvilken pasientgruppe blant de eldre som mottar hjemmebaserte tjenester kan tenkes å nyttiggjøre seg velferdsteknologi?

Hva skal til for at teknologi tas i bruk i hjemmebaserte tjenester?
        Teknisk support
        Forankring i ledelsen

Etiske aspekter ved bruk av teknologi for hjemmeboende eldre

Kultur / kvalitet
Kan bruk av velferdsteknologi påvirke kvaliteten på tjenestene dere yter?

Hvordan samarbeider dere?
        Helse- og sosialkontor vs hjemmebaserte tjenester
        Støtte og respekt
        Kommunikasjonsflyt
        Tverrfaglig arbeid og avhengighet mellom kollegaer

Er det andre instanser utenfor denne enheten som dere samarbeider med?

Uønskede innleggelser
Hva forstås med dette; er det noen innleggelser som kunne vært unngått?
        Hvilke pasientgrupper er utsatt for unødvendige innleggelser?
        Hvordan kunne de vært unngått?
        Hvordan kan en teknologisk innretning spille en rolle?

Forslag til type teknologi?
        Teknologisk hjelpemiddel for å bedre kommunikasjonen mellom
        hjemmesykepleier, legevakt og sykehus?
        Hva kan være til hjelp for å ta beslutninger når pasienter er dårlige/vurderes for
        innleggelse?

Hvordan påvirker bruk av teknologi i hjemmebaserte tjenester sikkerheten til pasientene?
        I hverdagen
        Ved akutte tilstander
        Ved vurdering for innleggelse

Appendix 6 – Example of qualitative analysis

Analyseskjema		
Preventing hospitalizations for elderly		
Research question	Which assistive living technologies do health care personnel identify as appropriate to apply in order to prevent hospitalizations of home-dwelling elderly receiving community care?	
	Potential use	Warranted measures
Themes		
Subgroups		
Codes	Relevant patient groups	Wishful thinking
Meaning units	Må ihverfall ha klare kriterier for kem d e tenkt for! Dehydrerte.. så e di litt på sjukehuset og får litt intravenøst, og så kjeme dei heim. KOLS-pasient der e ingen som kontakte de der når de komme hjem, når de fyste blir sittande aleina og angsten kommer. eit hovent bein, eller ka det sko ver … det e mye som kunne vert gjort, kunne fått et bedre bilde, eller video som kunne.. vært et godt hjelpemiddel noen gonger Havne på legevakten møje UVI hatt nokså mange menn som har blitt tømte for 1,5 – 2 liter. Det va det som va problemet… (utydelig)… hadde me hatt det då,… kunne me løyst det sjøl! siden der ikkje e blærescanner.så må ein sikra seg…og så blir det oftere enn nødvendigt… så blir det ny sykehusinnleggelse på grunn av…ja.. infeksjon.. og	ønske e å ha en CostDoc-app på ein iPhone og bare trykka inn og finne alt! Jeg tenker at Skype kunne vært et godt hjelpemiddel. Imellom legevakt, fastlege og hjemmetjenesten. Nå tror jeg ikke at det er så realistisk at de eldre får seg datamaskin og Skyper selv, men kanskje via oss? At vi kunne brukt et nettbrett og Skypet for dem? En ting er å beskrive via telefonen, en annen ting er å vise det, hvordan det faktisk er. At vi kunne overlevert blodtrykk, puls og O2-metning og sånne ting og. en sensor som slår på lyset når de står opp midt på natten ikke det er dumt det med at de kan bli opplyst om at det er natt. Spesielt midt på sommeren og midt på vinteren, da blir folk døgnville.	CRP.. og infeksjon.. og metning. så om me kunne få lest av dei målingene som me ikkje har mulighet te å ta. me sko absolutt hatt metningsmåler med video.. der hadde en jo kunne ringt hjemme hos pasienten og de kunne sjølv sett, lytta om der e god respirasjon, brystet, lyder som kommer…vurdert litt mer. hørtes veldig flott ut med det blodsukkerapparatet, har aldri hørt om det Blærescanner e jo og noge som e veldig nyttigt me kunne hatt et apparat te blodprøver me vil ha te INR, blærescanner, te metning og CRP det hadde vært greit med en dispenser på kjøkkenet. Der en bare får ut morgenmedisinen sin om morgenen, og ikke tar sovetabletten tidlig.