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## Velferdsteknologi i Sentrum

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The Introduction of Personal  
Connected Health and Care  
in the Central Districts of Oslo

A survey of outcomes. Revised version of  
interim report 2 of 2.  
October 2016

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# 1. Summary

The districts of St. Hanshaugen, Gamle Oslo, Sagene and Grünerløkka launched the personal connected health and care in Central Oslo project – *Velferdsteknologi i Sentrum* (VIS) – in early 2014. Intro International in association with Oslo School of Architecture and Design (AHO) were selected as partners to research the impacts of the project as it progressed. The first interim report was completed in April 2015. This gathered data from before the intervention (baseline data) and from shortly after the intervention. The data were analysed and the outcomes for a limited number of end users were reported on. In the second interim report, the number of end users was extended and long-term effects were included. The study contains a quantitative section and a qualitative section. Intro International were responsible for the quantitative section and AHO for the qualitative section.

The quantitative section analysed changes in the end users’ utilisation of hospital services and home nursing services before and after the intervention. As a revised version of that section, the present report also includes the end users’ utilisation of emergency department services (*legevakt*)/clinical observation unit services and access to the municipal emergency care unit (*Kommunal Akutt Døgnenhet*).

The study also surveyed relevant projects in Norway and conducted a systematic review of international studies.

The systematic review indicates that personal connected health and care reduces the need for health services in the form of a reduction in emergency department attendances, hospital admissions and hospital bed-days. International studies also indicate that personal connected health and care is conducive to increased patient participation in decisions concerning their medical condition. While there is no evidence for direct clinical benefits, several of the studies demonstrate that personal connected health and care helps to maintain quality of life in an end-user group whose health deteriorates over time. According to one study, personal connected health and care also results in improved coordination between the end users and the primary and specialist health service. Two studies also demonstrate that training of the end users and home care staff is a critical success factor.

## Results of the quantitative analysis

Quantitative data were gathered from: registry data (DIPS – the leading supplier of eHealth systems to Norwegian hospitals); from Norway’s largest private hospital,

Lovisenberg Diakonale sykehus; from registry data from the 4 participating districts’ home nursing service’s EHR system; and from registry data from Oslo University Hospital (Aker site). Data on a total of 95 users of hospital services were analysed together with data on 172 users of home nursing services. In addition, data on 87 users of emergency department services/observation unit services and municipal emergency care unit services were analysed.

## Reduction in hospital services

The number of outpatient consultations per month after the intervention was reduced by an average of 34.3% compared with prior to the intervention. The number of hospital admissions and the number of hospital bed-days were also substantially reduced following the intervention. The reduction averaged 18.7% for the number of admissions and 33% for the number of bed-days.

As shown in the table below, the reduction in utilisation of hospital services is lower shortly after (1-3 months) the intervention, and greater long after (4-6 months) the intervention. The difference may be attributable to there being a transitional and adjustment period before the full benefits of the technology are realised.

	Reductions after	
	1-3 months	4-6 months
Outpatient consultations	26.9%	41.8%
Number of admissions	5.1%	32.3%
Bed-days	27.0%	39.1%

## Reduction in utilisation of home nursing services

There was a reduction in use of the home nursing services following the intervention. The number of home visits decreased by 5% shortly after (up to 2 months) and by 34% long after (6 months or more) the intervention.

The time spent by nurses with the end users (traditional face-to-face time) was reduced by 31.5% shortly after and by a full 59.3% long after the intervention.

## Cost-benefit

The savings for society of implementing personal connected health and care are substantial, and notably after it has had time to take effect for the end users. The reduction is an annualised average of NOK 72,503 per end user (31.7%) or NOK 106,127 per end user (46.5%) long after the intervention. The savings apply to all stakeholders. After 4 months and beyond, the private hospital, Lovisenberg Diakonale sykehus, was saving NOK 6,732 per end user per annum (16.9%), City of Oslo (the local authority) NOK 85,488 per end user per annum (43.4%) and the end users themselves NOK 576 each per annum (39.0%).

## Results of the qualitative analysis

Semi-structured interviews were conducted in two rounds at an interval of 12 months with 12 end users and two relatives. Information was obtained regarding the impact of personal connected health and care on the end users' sense of safety, control over own personal health, sense of empowerment, motivation, activity level and quality of life.

Several of the respondents describe that personal connected health and care in the form of remote care assistance reduced distress concerning their state of health and that this gave them a greater sense of safety. It is worthy of note that, over time, this perceived effect changed in a couple of the end users as they progressed to the end-stage of COPD. Receiving confirmation that their values were poor, and frequent phone calls from the home nursing services was distressing in this stage rather than reassuring. This demonstrates that personal connected health and care must be followed up continuously and adjusted in step with changes in end user care needs over time. It is important to construct a robust system around the technology to take changes into account, such as the need to change the intervals of the remote care assistance and ensure that the home care team do not make needless telephone calls. System failures have adverse effects.

End users report the sense of the community nurse being "present" in the home via the technology and that they do not have to feel they are coping alone with their medical condition, because someone is monitoring their values and checking that they are taking their medication. A number of end users also describe that having to read off values themselves has taught them to recognise their own body signals and plan their day better in accordance with their condition at the time. This information is also valuable in communication with relatives because it is factual:



*Researchers visited 12 end users and interviewed them about how they benefited from personal connected health and care.*



the end user can inform others about their condition with objective evidence, rather than seeming to be ‘bemoaning’ a subjective state. Relatives also perceive personal connected health and care as reassuring, and ask how the patient is getting along with the measurements or medication. For one of the relatives, the personal alarm is the only way her husband, who has dementia, can make contact with her. If the technology fails and triggers false alarms or skips an update, then the effect is the opposite and the equipment causes more distress and anxiety.

The end users describe personal connected health and care as an important part of their daily lives, and a number of them relate the devices to their identity. This is conveyed by statements and by the focal position occupied by the devices, in some instances specially accessorised with a knitted bag or coverlet. This integrative relationship can be perceived as a tendency to become emotionally dependent on the assistive technology. This dependency points to a potential for positive effects, but also to the vulnerability of the system. If it fails, it may potentially adversely affect the end user’s sense of personal identity.

There were clear indications that a number of the end users felt empowered by personal connected health and care. This may be due to end users becoming more knowledgeable about their own state of health or gaining greater control over everyday routines. It may also be due to the opportunity to be involved in something new, and pride in participating in the project. The end users also receive a good deal of attention and social contact with the project owner, and this reinforces the positive effect of being involved in the project. However, this effect makes it difficult to assess the extent to which the technology might actually result in reduced social contact in the event of larger-scale roll-out.

Measuring motivation in relation to a person’s activity level before and after the intervention is a particular challenge. There is as yet no evidence that personal connected health and care substantially improves an end user’s level of activity. The end users’ activity level was unchanged or reduced due to exacerbations in their medical condition during the project period.

Based on the information obtained, one might say that there is potential for qualitative benefit to be derived from personal connected health and care. Such benefit would span a wide range of diagnoses, ages, circumstances and personalities. This makes it difficult to identify specific personal qualities or circumstances that might make some people more suited to personal connected health and care. On further roll-out of personal connected health and care in Norway, it will be important to work systematically, and on a broad front, on end user mapping.

## Some limitations

The analysis might have been more complete had it comprised data concerning a change in use of a regular GP, use of a day centre, reablement services, practical assistance in the home and the like, before and after the intervention.

The methodology employed did not include a control group, as this would have been extremely demanding owing to the difficulty of finding a representative group among the end users.

The reasons for the observed changes in the use of health services after the intervention may be attributable to factors other than the technologies it involved. The study does not analyse possible causal factors – it exclusively examines the effect of the intervention itself. We have also not studied the clinical effects of the intervention – only how a sample of the end users perceive the intervention.



*Based on the information obtained, there is no evidence that the intervention was decisive for a change in activity level.*

## 2. Project organisation

The Norwegian Directorate of Health oversees a National Personal Connected Health and Care Programme enshrined in a white paper from the Ministry of Health and Care Services on future care services: *Morgendagens Omsorg* (St. meld nr. 29 (2012–2013)). This programme is designed to ensure that personal connected health and care is made an integrated component of health and care services by 2020. The personal connected health and care in Central Oslo project – *Velferdsteknologi i Sentrum (VIS)* – was established in mid-2014 on the basis of this objective. The annual ministerial letter of allocation (no. 18/11–2913) from the Directorate of Health makes execution of the project subject to performance of formative dialogue research to document the effects of personal connected health and care within the home care services.

The evaluations of benefit are to form the basis for any subsequent implementation of the project on a permanent basis in the 4 districts, and for any diffusion of it to other districts and other municipalities. The evaluations are required to follow the project while in progress from April 2014 until spring 2016.

Intro International has primary responsibility for the formative dialogue research which it conducts in association with the Oslo School of Architecture and Design's DOT – Design for Public Services research unit. Intro examined the quantitative effects of personal connected health and care via registry data, while DOT was responsible for measuring qualitative benefit in a sample of end users.

The contracting client is Sven Bue Berger, manager of the St. Hanshaugen district's welfare and healthcare department, who represents all 4 districts. Pia Skobba, special consultant to the St. Hanshaugen district's welfare and healthcare department, is the project coordinator.

The company Dignio developed and supplied the personal connected health and care system used and was an active R&D partner in the process. The technology company also provided information and instruction in use of the system together with clinical care expertise. It assisted in the practical implementation by means of service design and project support.

### District project managers

- **Petter Wolden**, occupational therapist from the start and until autumn 2015 and from then on **Maria Helseth Greve**, district nurse in the Gamle Oslo district

- **Hanne Eggen**, district nurse, Grünerløkka district
- **Cathrine Einarsrud**, occupational therapist, Sagene district
- **Mads Herfndal Haakonsen**, physiotherapist, from the start until winter 2015 and from then on **Kristin Skrede**, occupational therapist from the St. Hanshaugen district

The project managers contributed critical information and structuring, obtained the informed consent from the end users together with end user data and performed administrative tasks in this formative dialogue research project.

### The research team

The research team was headed up by **Nils-Otto Ørjasæter**, professor at BI Norwegian Business School, and partner in Intro International and **Kaja Misvær Kistorp**, head of DOT at the Oslo School of Architecture and Design. Kaja is responsible for the qualitative part of the formative dialogue research. Other participants in the research team are:

- **Linn Støme**, Master of Economics, Intro International and from 1.1.2016 PhD student at University of Oslo through Centre for Connected Care, Oslo University Hospital
- **Fridtjof Scheie**, MSc Business economics, partner Intro International
- **Lise Amy Hansen**, PhD in interaction design, Oslo School of Architecture and Design
- **Frida Almqvist**, PhD student, Oslo School of Architecture and Design
- **Emilie Strømmen Olsen**, until December 2014 Oslo School of Architecture and Design, thereafter Designit





### 3. Introduction

The districts of St. Hanshaugen, Gamle Oslo, Sagene and Grünerløkka in Oslo, Norway launched the personal connected health and care project – *Velferdsteknologi i Sentrum* (VIS) – in early 2015. This gathered data from before the intervention (baseline data) and from shortly after the intervention. The data were analysed and the outcomes for a limited number of end users were reported on.

A report (report 2) was prepared in April 2016 in which the number of end users was increased and the long-term effects included. Both reports contain an analysis of the end users' utilisation of hospital services and home nursing services. The analysis includes a cost-benefit analysis of the intervention for the healthcare stakeholders and society at large. In addition, it contains findings from in-depth interviews with end users, relatives and health professionals, together with a survey of relevant projects in Norway and a systematic review of international studies.

As a revised version of the previous intervention report (report 2), the present report includes the end users' utilisation of emergency department services (*legevakt*) and municipal emergency care unit (*Kommunal Akutt Døgnetenhet*) services in a period 6 months before and 6 months after the intervention.

Informed consent was obtained from all end users included in the analysis.

The causes of changes recorded before and after the intervention may be attributable to factors other than the intervention itself. Possible causal factors are not addressed in this study; only the effects registered for the intervention as a whole. Any clinical effects are likewise not addressed – the study limits itself to eliciting a sample population's subjective perceptions of the intervention's clinical effects.

The research group presented in Chapter 2 was also commissioned to conduct formative dialogue research for the Directorate of Health's project on remote care assistance under the Norwegian National Programme for Personal Connected Health and Care. An initial report from this project is due in April 2017. This report will present a sample of end user perceptions of the personal connected health and care services and an updated systematic review.



St. Hanshaugen is one of the four participating districts. The other districts are Gamle Oslo, Sagene and Grünerløkka.

## 4. The project: Personal connected health and care in Central Oslo

Four districts within the City of Oslo local health authority (St. Hanshaugen, Gamle Oslo, Grünerløkka and Sagene) are participating in Norway's national programme for the development and implementation of personal connected health and care financed under the National Budget through the Directorate of Health.

The health and care services in the four districts changed their routines and practices in 2014. The concept of reablement is focal. The aim is for the end user to regain the ability to carry out everyday activities such as personal care, cooking, cleaning etc. The end users are to be coached in coping with everyday life. Personal connected health and care is part of the 'toolkit' of interventions and solutions to aid user empowerment.

The four districts are demographically diverse:

- **Gamle Oslo** has a large proportion of inhabitants with low incomes, short educations and immigrant backgrounds. There is high net migration and a high rate of movement within the district generally.
- **St. Hanshaugen** also has many inhabitants of immigrant origin, but here the proportion with short education is smaller and the employment rate is higher than the Oslo average. The district has a high proportion of young adults (age 25–34).
- **Grünerløkka** has a high population growth rate and is also a district with many young adults. The proportion of the population with disabilities is lower than in Oslo generally.
- **Sagene** also has a high proportion of young adults. It has a lower proportion of people with a short education than in Oslo generally.

Source: <https://www.oslo.kommune.no/politikk-og-administrasjon/etater-og-foretak/utviklings-og-kompetanseetaten>

### Personal connected health and care in the project

Dignio was selected as the technology supplier for the project. The company supplies integrated personal connected health and care solutions, and supplied three solutions for this project:

- **Electronic drug dispenser** (Pilly)
- **Mobile personal alarm**
- **Remote care assistance** (adapted to different needs)

These are linked to Dignio Prevent, a software platform that handles alerts reliably and also serves as a platform for clinical decision-support.

Remote care assistance comprises one or more of the following solutions: Blood-glucose meter, spirometer, pulse oximeter, blood pressure reader, temperature reader, weight and individualised clinical questions. The distribution of the technological solutions among the sample of 172 end users in the intervention is shown in Table 4.1.

Many of the end users (51%) use the Pilly electronic drug dispenser. 9% use a mobile personal alarm, while 33% use one or more of the options for remote care assistance. Some of these also have Pilly and/or a mobile personal alarm.

End users (N)	172	
Technology	Number	Percentage
Pilly	87	35%
Blood glucose	10	4%
Pulse oximeter	3	1%
Spirometer	13	5%
Blood pressure	16	7%
Temperature	9	4%
Weight	48	20%
Alarm	16	7%
Questions	44	18%
More than one technology	56	23%
Total number in-home	246	100%

Table 4.1 1 Distribution of personal connected health and care among the end users (N=172) in the intervention



The electronic drug dispenser SMS (Figure 4.1) is configured to alert the end user when their medication is due to be taken by means of sound and light. The end user takes the medication by turning the dispenser upside down. The electronic drug dispenser SMS communicates with the Dignio Prevent software platform over the mobile network. Settings for the number and timing of daily doses are entered in Dignio Prevent. If the end user fails to take the medication as prescribed, alerts are sent to the home nursing service's stationary computers, tablets or duty phone. Dignio Prevent generates reports and provides an overview of the district's electronic drug dispenser SMS end users.

The mobile personal alarm (Figure 4.2) is a basic mobile phone with GPS with an attached panic button which the end user wears as a pendant or attaches like a wristwatch. Alerts are sent with map references by SMS to relatives and/or nursing and care workers.



Figure 4.1  
Electronic drug dispenser  
(Pilly - Dignio.no)



Figure 4.2  
Mobile personal alarm



Figure 4.3  
Remote care assistance tailored  
for end users with COPD  
(Dignio.no)

Remote care assistance (Figure 4.3) is a mobile solution for monitoring people who are chronically ill and monitor their condition by means of an individualised range of medical measuring instruments or set of devices. The end users also answer clinical questions on a tablet. They receive receipts for measurements completed, check the results of the measurements as they come in and can extract trend reports. The alerts and the trends are linked to core data on the end user's illness, clinical condition and medication. The data are registered via an app on a tablet (MyDignio App), and transferred in realtime to health professionals and also stored in a secure database (Dignio Prevent).

End users, relatives and/or health professionals can access these data to monitor the end user's condition and the health professionals' updates in the end user's electronic health record. If the data collected by the app are outside the set thresholds, an alert is sent to the health professionals and, if applicable, relatives, friends or neighbours, who then contact the end user, while the health professionals provide follow-up and advice or visit the end user as an emergency. The purpose of remote care assistance is primarily to achieve proactive and preventive monitoring of end user health by means of early detection of any exacerbation and by providing preventive follow-up and advice. The technology also gives the end users the option of written communication by email, which is stored directly in the end user's electronic health record.

Administration of personal connected health and care varies somewhat between the 4 districts, i.e. in terms of which internal units are responsible for monitoring and follow-up (response centre) based on the end user data; see Figure 4.4.

## The end users

As at December 2015, a total of 172 of the end users had consented to the collection of registry data and interviews. The average age of these was 72.25, and the median age was 75. The youngest was 19, the eldest 98, and 98 were women and 74 were men. 45 of the end users resided in the St. Hanshaugen district, 50 in the Gamle Oslo district, 40 in the Grünerløkka district and 37 in the Sagene district.

Common to the end users is that they have a chronic disease, and many have more than one (multimorbidity). The main diagnoses were:

- 28 Heart failure or stroke**
- 27 Cognitive impairment**
- 20 Mental disorder**
- 16 COPD**
- 13 Diabetes**
- 12 MS or physical impairment**
- 7 Cancer**
- 5 Fractures**
- 4 Parkinson's**



*Figure 4.4*  
Personal connected health and care network  
(Dignio.no)

## 5. Formative dialogue research in the intervention

The object of formative dialogue research in the intervention was to study the benefit of introducing personal connected health and care for certain care service user groups. The evaluations are to form the basis for any subsequent implementation of the project on a permanent basis in the 4 districts, and for any diffusion of it to other districts and other municipalities in Norway.

### Research questions

The benefit evaluation addresses the following research questions:

1. **What qualitative effects has personal connected health and care had for the user after more than a year of use?**
2. **What quantitative effects has personal connected health and care had for the 4 districts, in relation to the hospitals and the users in terms of a change in utilisation of health services before, shortly after, and long after the intervention?**
3. **What cost benefits has personal connected health and care had in the short term and longer term?**

### General methodology

Data gathering was subject to a combined qualitative and quantitative methodology. Intro International examined the quantitative effects of personal connected health and care, and did so via registry data from the hospital and home nursing services. Oslo School of Architecture and Design was responsible for measuring the qualitative benefit among a sample of users.

A total of 209 users consented to collection of registry data and interviews, and of these, 37 were excluded because they died in the project period, moved out of the district or were no longer using personal connected health and care.

The methodology employed did not include a control group, as this would have been extremely demanding owing to the difficulty of finding a representative group among the end users.

The end users who form the basis for the study have progressive conditions that

tend to exacerbate over time. It is thus reasonable to assume that they increase their utilisation of health services over time. This has not been factored into the study, as it would require a control group.

### Quantitative methodology

Quantitative data were collected through registry data (DIPS – the leading supplier of eHealth systems to Norwegian hospitals); from Norway's largest private hospital, Lovisenberg Diakonale sykehus; from the 4 participating districts' home nursing service's EHR system; and registry data from the Aker site of Oslo University Hospital's emergency department. These data were used for analysing the cost-benefit of the intervention for the end users, the districts, the hospital and society generally.

### Hospital data

Data on the intervention's end users' utilisation of hospital services (outpatient consultations, number of hospital admissions and number of hospital bed-days) from the private hospital Lovisenberg Diakonale sykehus were obtained monthly via their DIPS e-Health system in the time period 6 months before and 6 months after the intervention. All the end users were enrolled in the intervention at different times in the period from 2014 to 2015. We therefore chose to take as the baseline the date on which each individual started using systems and devices in the intervention. We then set -1, -2, -3 etc. as the months before and +1, +2, +3 as the months after the intervention. Many of the end users were not enrolled in the intervention until late 2015. At the time of data collection, 95 out of 172 end users had received personal connected health and care for 6 months or longer.

By using a baseline for all end users, we corrected for any confounding factors in possible seasonal variation in use of health services. This design made it possible to compare every month from before, with every month from after, the intervention.

The inclusion of a control group would have been extremely demanding as it is difficult to find a representative group among end users treated by the private hospital Lovisenberg Diakonale sykehus and who do not receive personal connected health and care. The inclusion of a representative control group would have provided a basis for correcting for the intervention sample's general deterioration in health even after being enrolled in the intervention. The findings should therefore be seen as conservative.



## Data from the home nursing services

The project managers from the four districts collected data on the end users' utilisation of home nursing services per month before, shortly after, and long after the intervention. 'Shortly after' is defined as up to 2 months from the intervention, while 'long after' is more than 6 months. A total of 172 end users were registered, of which 95 still received personal connected health and care after 6 months. Data on the actual time spent by the home nursing services on each end user in-home per month and the number of visits to that end user were extracted by the project managers for the 4 districts. The data were extracted from the 'BUM' (requisition-provider model) report in the home nursing service's EHR system.

Again, no control group was included in this study, as this would also have been demanding. The findings must be seen as conservative, since in this case also, no allowance is made for the fact that the end users' health deteriorates over time.

## Data from the emergency department services (*legevakt*) and access to the municipal emergency care unit (*Kommunal Akutt Døgnenhhet*)

Data on the intervention's end users' utilisation of emergency department services and their use of municipal emergency care units (number of admissions and bed-days) were obtained from professionals at Aker hospital. The data were extracted in the period 6 months before and 6 months after the intervention.

In the analyses, we opted, as for the hospital data, to set a baseline from when the individual end user was enrolled in the intervention. We then set -1, -2, -3 etc. as the months before and +1, +2, +3 as the months after the intervention. Data were extracted for a total of 87 unique end users in the Aker hospital registries.

## Qualitative methodology

The qualitative evaluation is based on changes as perceived by the end users. Their 'voice' is the basis for the analysis, defined as:

*"information about a specific end user's preferences and perspectives provided orally or in writing, through observation of activities or through other media relating to an end user's preferences or perspectives"* (unofficial translation of Langergaard 2011: 227)

The qualitative study involved several types of personal connected health and care. This means that an end user perception of personal connected health and care is considered generally in terms of how it affects everyday life, and does not concern one particular technology or its design.

The technology is evaluated as a service – i.e. as devices in service and as components in a care system with follow-up. The work of project preparation, conducting interviews and data analysis was informed by the principles of the discipline called service design. The purpose of this discipline is to design services that are useful and attractive from the end user's perspective and effective and innovative from the provider's perspective (Mager & Sung, 2011).

In the intervention, the four districts used service design as an approach to understanding end user needs and to designing the services and organisation around personal connected health and care. Service design methodologies are focal in the Norwegian national programme for personal connected health and care (also referred to as 'Samveis'). By introducing personal connected health and care, the object is to raise the profile of service design aided by insight, cooperation, holistic thinking and benefit realisation. The Norwegian Association of Local and Regional Authorities (KS) has created an introduction to service design which states that its use in innovation processes can enhance quality and the user experience (KS, 2015). A selection of municipalities used this approach to improve service design, planning and organisation. By including the end users' needs and voice in service design, organisations are challenged to think differently and innovate.

## Health as a measurable qualitative state

Evaluation of benefit is based on the following definition of personal connected health and care:

*"technology-enabled assistance that facilitates greater safety, security, socialisation, mobility and physical and cultural activity, and which boosts the individual's capacity for self-reliance in everyday life in spite of illness and social, mental or physical disability. Personal connected health and care can also serve as technological support for relatives and otherwise facilitate enhanced accessibility, utilisation of resources and care quality"* (unofficial translation of Norwegian Official Report (NOU), 2011).

Based on this definition and the objects of personal connected health and care, we examined the factors of safety, security, socialisation, mobility and physical and cultural activity, empowerment, and involvement of relatives.

These factors are examined in the following way:

Safety is evaluated in terms of the end user's perception of the predictability of care provision: *"a perceived, essentially subjective feeling of physical predictability in the surroundings, and which comprises physical, mental and social factors linked to the individual and society, such as inclusion, empowerment and quality of life"* (unofficial translation, Norwegian Safety Forum, 2016).

Security is defined on the basis of how the patient feels he or she is provided for in the system, and it is evaluated on the basis of whether the personal connected health and care is perceived as disrupting or aiding care:

*"a state characterised by fairly extensive control over physical, material or psychosocial threats that creates a sense of protection and reduced risk of adverse events"* (unofficial translation, Norwegian Safety Forum, 2016).

Socialisation, mobility and physical and cultural activity are considered in terms of descriptions of any change in everyday life; whether the personal connected health and care has facilitated a change in relationships with other people and whether it has increased or reduced the person's level of daily activity.

Empowerment is evaluated on the basis of the end users' perceived ability to cope independently with daily domestic routines and tasks.

Involvement of relatives is considered from the end user's perspective, in terms of how the personal connected health and care affects dialogue and interaction with relatives.

Evaluation of the end user's perceptions is considered in the context of the notion that the personal connected health and care is only one element in the end user's overall experience. We applied the definition by Dodge et al. (2012: 230) of wellbeing as a dynamic state based on three aspects of its conceptualisation: (1) that there is a state of wellbeing (2) that there is a balance point (3) that challenges and resources are 'see-sawing' (see Figure 5.1).

This model directs focus at wellbeing as an activity or an active state that can be stabilised by the end user independently. It also positions personal connected health and care as just one element in a complex and dynamic picture in which the sum of a person's resources can create wellbeing but contingent on changing personal and external challenges.



Figure 5.1 Illustration based on Dodge et al. (2012). The challenge of defining wellbeing. *International Journal of Wellbeing*, 2(3), 222–235.

### End user samples

In order to be able to comment generally on the benefit of providing personal connected health and care across different types of devices, individuals and clinical conditions, the emphasis was on obtaining an end user sample that would be as representative as possible. At the time of selection in 2014, the four districts had a total of 50 end users who were using a drug dispenser, mobile personal alarm and remote care assistance. These were existing service users who had previously received traditional home nursing services. In order to achieve a widely representative sample, 12 service users were selected with variation in age, gender, living situation (single or co-habiting), physical ability, diagnosis, state of health, age and allocated equipment. In order to examine barriers, it was also relevant to interview one who declined to use personal connected health and care. Several of the end users were interviewed with relatives present in order to assess how the personal connected health and care affected *their* daily lives too.

The end user sample was originally composed of six men and eight women aged 30–97. They were evenly distributed across the four districts and have the following diagnoses:

- Alcoholism
- Paranoid schizophrenia
- Cognitive impairment
- Anxiety disorder
- COPD
- Mental disability
- Alzheimer's
- Hearing impairment
- Physical disability

The relative of an end user (12) shows Kaja Misvær Kistorp how a mobile personal alarm with GPS works.



## Execution

The end users were interviewed in two rounds during the project period (September 2014 - April 2016). The first round measured the short-term effect (2-9 months' use) and the second measured the long-term effect exactly 12 months later. In December 2014, two researchers paid visits to 12 end users. Two of the end users are married to each other and were interviewed together, and two other end users were interviewed with their cohabiting partner/spouse as relatives.

In December 2015, interviews were conducted with 10 of the same end users as in the previous year. One end user had passed away and one was in hospital. The same researchers conducted these interviews, and a couple of the interviews were attended by health professionals.

Evaluation of benefit was limited in that end user responses to questions based on the defined factors were obtained in semi-structured interviews and could therefore not be verified by nurses, relatives or doctors. The limited sample of end users also represents different devices and diagnoses (COPD, dementia, anxiety disorder, paranoid schizophrenia, multimorbidity). While the differences provide a broad picture of needs and changes, they limit the scope for generalising. In the chapter on qualitative findings, we provide a picture of the effect of implementing personal connected health and care on their state of health and the care they received.

In December 2014, the four project managers and 12 employees from different occupational groups and districts were interviewed. The object was to gain insights into their thoughts surrounding the anticipated effect, potential and challenges of personal connected health and care. These interviews provided many inputs which we have compiled under the topics presented in Interim Report 1. The topics also form the basis for a number of the main findings presented in this report.



## 6. Personal connected health and care nationally

In recent years, a number of initiatives have been started in Norway by both national and local authorities, but also by research institutes and private-sector actors. We traced Norwegian activities geared to telemedicine and personal connected health and care as far back as to the 1990s in, for example, the Telemedicine Project in Tromsø ([http://apps.who.int/iris/bitstream/10665/50073/1/WHF\\_1993\\_14\(1\)\\_p71-77.pdf?ua=1](http://apps.who.int/iris/bitstream/10665/50073/1/WHF_1993_14(1)_p71-77.pdf?ua=1)). Appendix 2 lists initiatives in recent years. A condensed list of these is provided below.

### Status in Norway

The Norwegian Association of Local and Regional Authorities (KS) believes that “increased use of personal connected health and care in nursing and care services may be an important contribution to meeting society’s care-giving needs. In order to meet future care challenges, local authorities will need to find new solutions both in the organisation of their services and in adoption of new technology. Increased use of technology-enabled care is not an end in itself, but a means of realising important values for end users and the services.” (ks.no/fagomrader/utvikling/innovasjon/velferdsteknologi).

The independent research organisation SINTEF and NOVA – Norwegian Social Research were commissioned by KS to design a personal connected health and care roadmap. The roadmap describes how personal connected health and care projects can be run in practice.

The Norwegian Directorate of Health and the new Norwegian Directorate of eHealth (NDE) are heading up a Norwegian National Programme for Personal Connected Health and Care enshrined in the white paper on future care services: *Morgendagens Omsorg* (St.meld nr. 29 (2012–2013)). The programme operates with a local-authority perspective in which service innovation is a primary instrument. As at the time of writing, 31 local authorities are engaged in a total of 18 projects. These projects are in a pilot phase until the end of 2016 when they transition to an escalation phase until 2020. The object is for personal connected health and care to be an integral element in Norwegian health and care services by the time the programme is concluded (Directorate of Health, 2014).

Through the Norwegian National Programme for Personal Connected Health and Care, the local authorities have engaged in design and testing of personal connected health and care. In addition, the programme aims to ensure knowledge-sharing and competence-building. The solutions currently being trialled are as follows:

- **Personal safety packages** (implemented with the phase-out of the analogue phone network)
- **GPS** (tracking and alarm technology)
- **Alert receiving units**
- **Electronic door locks**
- **Solutions in nursing homes**
- **Route scheduling for effective and reliable home-based services**
- **Electronic drug dispensers**
- **Digital night-time monitoring**

The initial report from the programme points to the potential for significant benefits from implementing personal connected health and care solutions, and in 2014, the Directorate of Health provided recommendations for the transition from analogue to digital personal alarms. In addition, it recommends the following solutions:

- **Localisation technologies** (GPS)
- **Electronic drug administration aid** (electronic drug dispenser)
- **Electronic door locks** (e-locks)

Another important task is in standardisation: to ensure that personal connected health and care is implemented in Norway on the basis of internationally accredited standards. This will ensure the connectivity of devices and solutions to enable effective collection and sharing of data on personal connected health and care. The Norwegian Directorate of eHealth has created a reference architecture and a plan for realisation of this project. Phase 1 focuses on personal safety technologies and Phase 2 on supported living technologies (medical measurements). The Directorate’s architecture is based on the Continua Design Guidelines with the necessary adaptations. The Directorate is a member of Personal Connected Health Alliance which administers and elaborates on the Continua Design Guidelines and collaborates with the Nordic countries on establishing pan-Nordic requirements and recommendations regarding the adoption of standards.

Several Norwegian local authorities have laid down objectives and strategies for personal connected health and care. Trondheim and neighbouring local authorities have conducted several pilot projects, and the local authorities of Bærum, Oslo, Drammen, Larvik and Skien have likewise carried out pilots with their neighbouring local authorities. The Norwegian Association of Local and Regional Authorities mentions several of the pilots on its website.

On 1 January 2016, the Norwegian Directorate of eHealth was created with the following mandate: “To contribute to an integrated and evidence-based health and care service that utilises technological capabilities and involves citizens in order to achieve better public health, better healthcare outcomes and better capacity utilisation.”

## Reablement

In the City of Oslo generally and in the four intervention districts in particular, reablement is focal in the piloting and introduction of personal connected health and care. The health and care services in the four districts changed their routines and practices in 2014. The emphasis is on a shift away from pure in-home nursing & care in favour of motivation & empowerment. Service users are to be coached and motivated to take more responsibility for their own health. To that end, personal connected health and care is an integral component of the methods and tools available to the districts for empowering end users to achieve greater self-reliance and peace of mind living in their own homes.

Reablement in Norwegian home care has been inspired by several projects in Denmark. Fredericia Municipality in Denmark designed an organisational model for reablement called *Længst mulig i eget liv* ('Lifelong Living – Maintaining Everyday Life as Long as Possible') (Kjellberg et al., 2011). The Fredericia project has come to form the basis for a set of recommendations from the Danish Health Authority. Four tools for needs mapping are employed in assessing the end user's mobility (DEMMI and WHODAS), emotional and social loneliness (UCLA Loneliness Scale) and the end user's self-perception of performance in everyday living, over time (COPM). The intervention has not employed such measures.

In the wake of the financial crisis in 2009/2010, a shortfall in tax revenues coincided with increased demand for health and care services. To meet this need in a constrained financial situation, Odense Municipality in Denmark established a project for reablement and empowerment, *Ny virkelighet – Ny velfærd* ('New Reality – New Welfare') (Krogsrud, 2014).

## End user participation and service design

End user participation is typically described as both a right and an instrument in projects to design and enhance services affecting the end users' everyday living. Within IT and system design, participatory design has been under development since the early 1980s in Denmark and Norway (Nygaard, 1975; Bjerknes & Bratteteig, 1995). Key elements are mutual learning through needs mapping, service design and collaboration.

A distinctive aspect of the service design methodology is that it is centred around the end user's needs. Service designers often work closely with both employees and end users in order to include the context and 'invisible' elements (Polaine et al., 2013). The object is to transfer value – from hospital to patient, from caseworker to applicant, from mobile operator to customer – efficiently and holistically. A service may be defined

as 'a series of more or less intangible activities that normally, but not necessarily always, take place in interactions between the customer and service employee and/or physical resources or goods and/or systems of the service provider, which are provided as solutions to customer problems' (Grönroos, 1990: 27). To achieve this, a systematic effort must be made to understand the context, identify end user needs and generate new insights.

In Norway, the Oslo School of Architecture and Design (AHO) has researched and taught service design since 2005. Various methods are used for mapping the end user's role, needs and options. In the intervention, AHO drew on its service design expertise to engage end users in dialogue: formative dialogue research may be defined as a 'formative, dialogue-based process analysis' (Baklien, 2000: 37). We conducted semi-structured interviews to elicit the end user's perception of: sense of safety, responsibility for personal health, control over own health, communication and dialogue between patient/relatives and health professionals, service provision, motivation and empowerment, wellbeing and health literacy.

By interviewing the end users in their own homes and through observation and photographs, we can also reflect on the place of the technology in the end user's home and life generally. The object is to understand the end user experience, and in some instances to identify areas with potential for service innovation. Communication between citizens and authorities has the potential to create added value for society and for the citizens themselves (Bason, 2010). Through interviews, individual routines in services provided by the health and care services can be mapped and outlined.

The parallel application of the qualitative methodology offers a broad-based approach, and makes it possible to identify possible directions for the next stage of the research project.

A roadmap for service innovation was published on [www.samveis.no](http://www.samveis.no) in 2015 and is the unified electronic tool for service innovation from initial concept through the innovation phase to roll-out and realisation of benefits. The roadmap was designed within the framework of the Norwegian National Programme for Personal Connected Health and Care in association with the Norwegian Association of Local and Regional Authorities and local authorities. Other roadmap partners are the independent research organisation SINTEF, PA Consulting, Making Waves and Oslo School of Architecture and Design.

The core feature of the tool is that it bases innovation on both the end users' and the local authorities' need to use service design and assists the authorities in working to effective processes for service design and enhancement. The methodology is general and can be applied to all branches of service design.

## 7. Personal connected health and care internationally: a systematic review

Searches were performed in the Medline, Cochrane Library, Pubmed and Bibsys Ask databases. The following search terms were used; home, dwell, independent, copd, pulmonary, lung, respiratory, telehealth, telemedicine, telecommunication, technology, smart, self-help, computer and monitor.

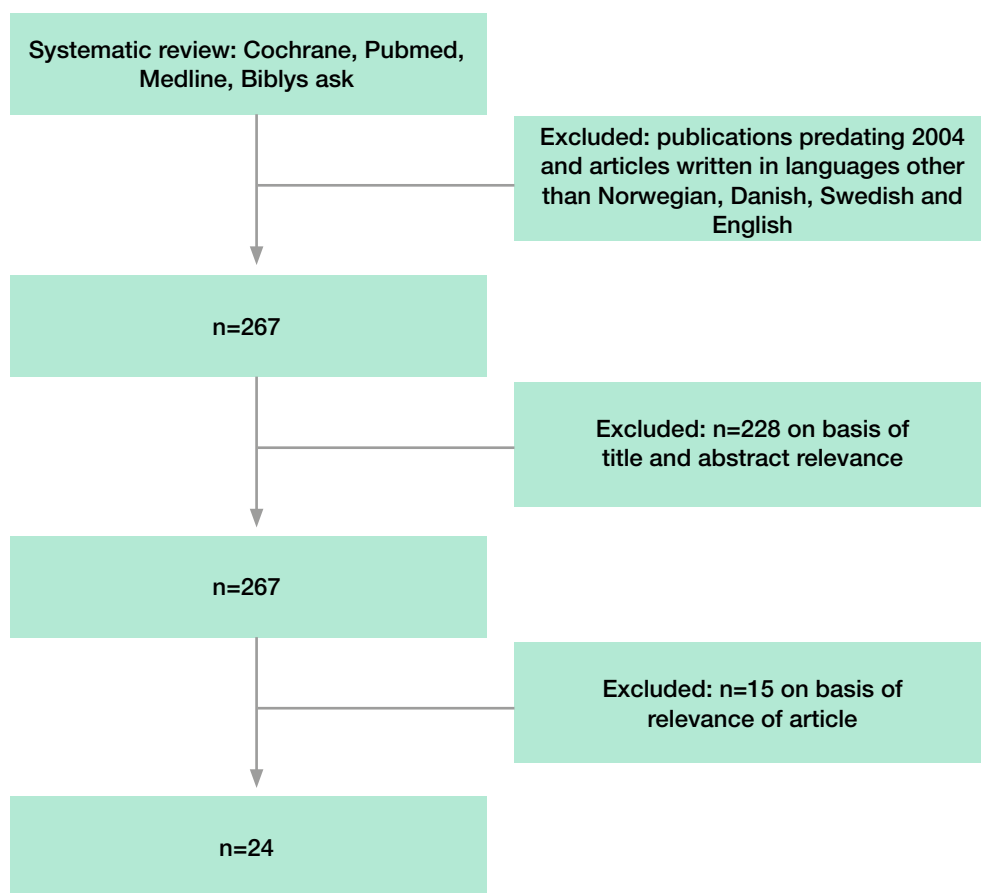


Figure 7.1 Search strategy for the systematic review

All articles published before 2004 were excluded and only articles written in Norwegian, Danish, Swedish or English were included. This search strategy produced 267 articles, 39 of which were included based on the relevance of the title and abstract. After the initial screening, the 39 articles were reduced by a further 15 articles based on relevance, such that 24 articles were included in the systematic review; see Figure 7.1.

This report presents a summary of the findings from this systematic review. The systematic review in its entirety is provided in Appendix 1.

### Organisation

The international literature reveals that the implementation of personal connected health and care for service users with chronic or long-term medical conditions can have the effect of strengthening the link between the primary and secondary health services. It can also foster a more informative relationship between patients and health professionals. We see consistent evidence in the literature that personal connected health and care reduces demand for health services in the form of a reduction in emergency department attendance, hospital admissions and hospital bed-days. Martin-Lesende et al. document this in a randomised study conducted within the primary health service in Spain in 2013, in which the intervention group received personal connected health and care. This corresponds with findings by Segrelles Calvo et al. in a randomised study of patients with severe COPD in 2014 in Spain. Similarly, Polisena et al. observed a consistent reduction in emergency department attendance and hospitalisations in COPD patients in a meta-analysis from 2010. The literature also points to greater involvement of end users in self-management of their condition, which promotes greater self-reliance in everyday life and improved quality of life. The implementation of different personal connected health and care programmes in primary and secondary health care is contingent on financial investments to guarantee reliable training of patients and associated health professionals, and robust technological solutions.

### Patients

Increased clinical benefit is paramount in health innovations. The measurement of clinical benefit from personal connected health and care varies significantly between different studies. This was particularly the case for end users representing a range of chronic conditions. The benefit appears to be contingent on the end user's medical condition. A number of studies indicate that greater benefits may be



detected in end users with no cognitive impairments. This end user group appears to understand and utilise the new technology satisfactorily and to draw benefit from the independence offered by the innovation although a combination of personal connected health and care and conventional home visits would be preferred by many. The end users reported greater insights into their own clinical symptoms, which in turn enabled them to take more responsibility for their own care. The main criterion for implementation of personal connected health and care is that the care and treatment provided are consistent with conventional in-home care or hospital procedures and requirements for quality of care. The international studies are unable to demonstrate clear-cut clinical benefits from implementing personal connected health and care, but conversely, are not able to demonstrate a reduction in clinical benefits. None of the studies demonstrate a statistically significant relationship between improved quality of life and personal connected health and care. A number of the studies did, however, find that personal connected health and care helps to maintain constant quality of life in end user groups who generally suffer exacerbations over time.

### **Cost-benefit**

A number of articles conclude that telemedicine is a viable care option that has significant effect in reducing the scale of health service utilisation. A majority of the international studies included in this systematic review argue that implementation of personal connected health and care for service users with diverse medical conditions reduces utilisation of health services. Telemedicine is reported as conducive to early-stage detection of disease exacerbations, which results in fewer hospitalisations. Alrajab et al. observed a 71.5% decrease in healthcare utilisation in a retrospective cohort study from 2012 in which service users were offered telemonitoring in Louisiana. In a randomised study from 2013 by De San Miguel, personal connected health and care was introduced for COPD patients in Australia. This study documented an annualised net saving of \$2,931 (€2,425) per patient in the intervention group. A randomised study conducted in Denmark in 2012 by Dinesen et al. shows a cost saving of approx. 24% from offering in-home telerehabilitation to service users with chronic disease. The literature reviewed here indicates that personal connected health and care reduces the need for health services in the form of reduced emergency department attendances and hospitalisations, but also in the form of reduced home nursing service visits during daytime hours. The expectation is thus of a substantial cost saving in relation to numerous resource-intensive service user groups.

### **Barriers**

Two articles in the present systematic review raise questions as to the asserted benefits of personal connected health and care in previously published studies. It is important to emphasise that these evaluations of the international literature concerning personal connected health and care were published in 2011 and 2012, respectively. Much has happened since then. In many parts of the world, personal connected health and care is only just emerging. Some have made more progress than others, and we have much yet to learn. Although these studies were published some years ago, their message is still valid: more research is needed on larger patient cohorts, with follow-up beyond just a single project period, and not least more disease- and technology-specific studies. The socioeconomic impact of telemedicine also needs to be better documented and compared between a more diverse range of health system types in different countries.

## 8. Analysis and results of the quantitative study

User data and registry data were selected for a cohort of end users. User data were obtained from a total of 172 end users, of whom 95 were receiving personal connected health and care 6 months after it was implemented.

Personal connected health and care implemented for end users

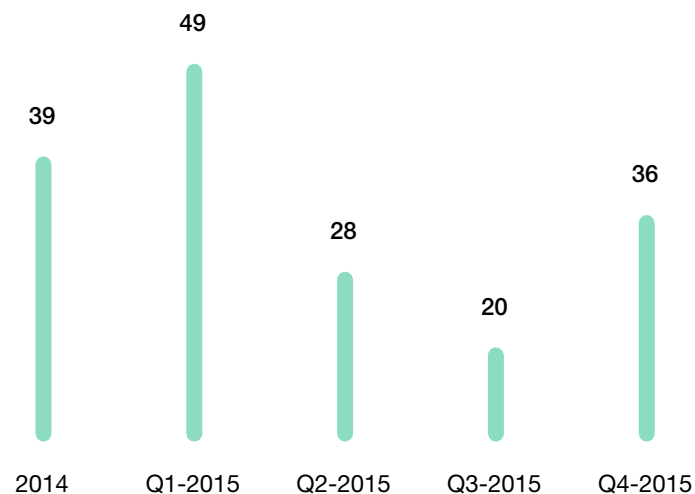


Figure 8.1 Time of personal connected health and care implementation in end users' homes

### End user utilisation of hospital services

Data on end user utilisation of hospital services were extracted from the private hospital Lovisenberg Diakonale sykehus DIPS eHealth system in the period from 2013 to the end of 2015.

The number of outpatient consultations per month after the intervention was reduced by an average rate of 34% relative to before the intervention; see Figures 8.2 and 8.3.

Outpatient consultations before and after intervention

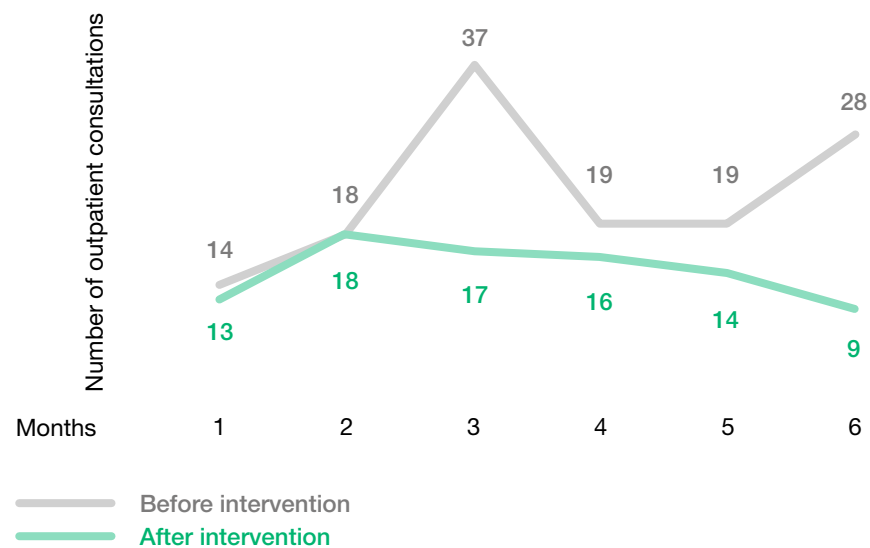


Figure 8.2 Number of outpatient consultations over 12 months for N=95 end users. The blue graph shows the number of outpatient consultations before the intervention, and the red graph shows the number of consultations after it.

Average number of outpatient consultations per month per end user

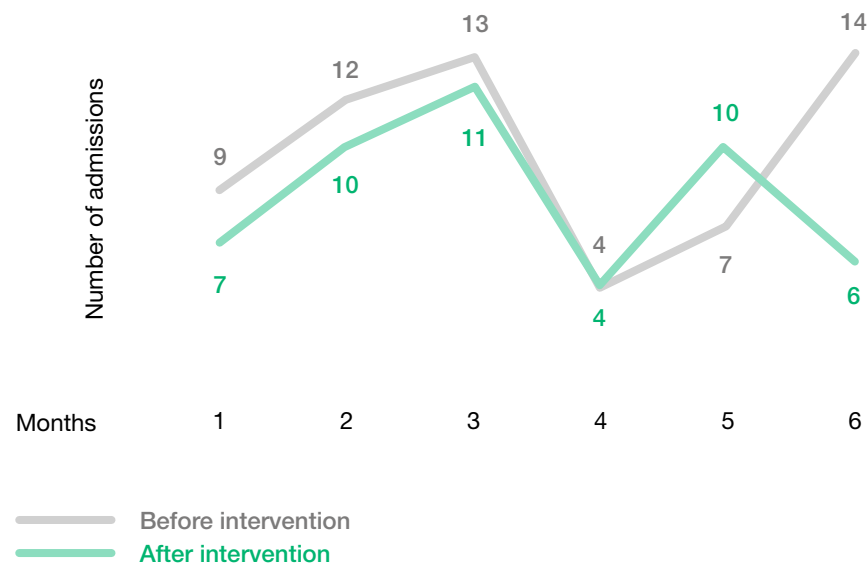


**Figure 8.3** Average number of outpatient consultations per month per end user before, shortly after (1–3 months) and long after (4–6 months) the intervention. N=95

‘Shortly after’ in the study is defined as 1–3 months after the intervention, and ‘long after’ is 4–6 months after the intervention.

The number of hospital admissions and the number of hospital bed-days also decreased substantially after the intervention; see Figures 8.4, 8.5, 8.6 and 8.7. The reduction is an average of 18.6% for the number of hospital admissions and 33% for the number of hospital bed-days.

Admissions before and after intervention



**Figure 8.4** Number of admissions over 12 months for N=95 end users. The grey graph shows the number of admissions before, and the green graph shows the number after the intervention.

**“I haven’t been hospitalised at all over the last year. Before, the hospital was my first home, and my own home my second one.”**

End user 3 with COPD (remote care assistance)

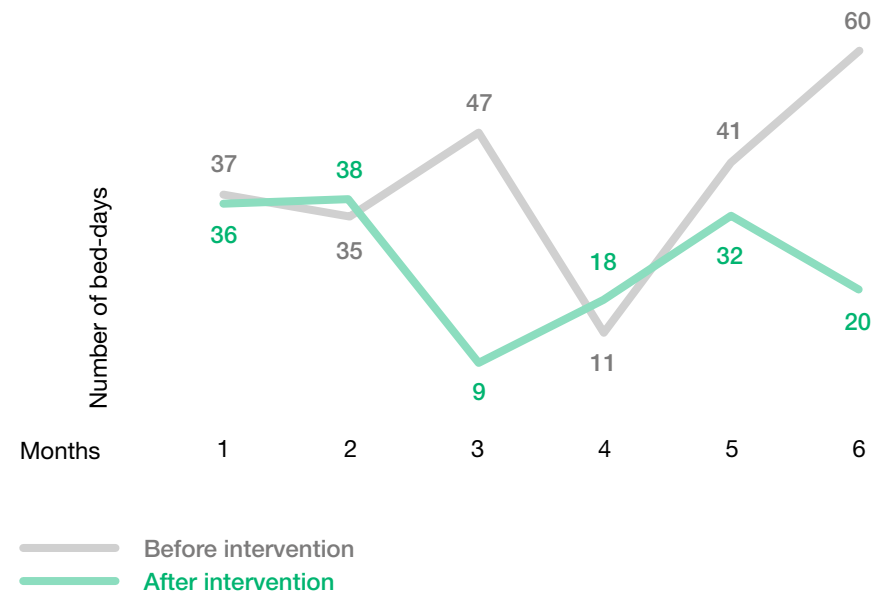


Average number of admissions per month per end user



*Figure 8.5* Average number of admissions per month per end user before, shortly after (1-3 months) and long after (4-6 months) the intervention. N=95

Hospital bed-days before and after intervention



*Figure 8.6* Number of hospital bed-days over 12 months for N=95 end users. The grey graph shows the number of hospital bed-days before and the green graph shows the number of bed-days after the intervention.

### Average number of bed-days per month per end user

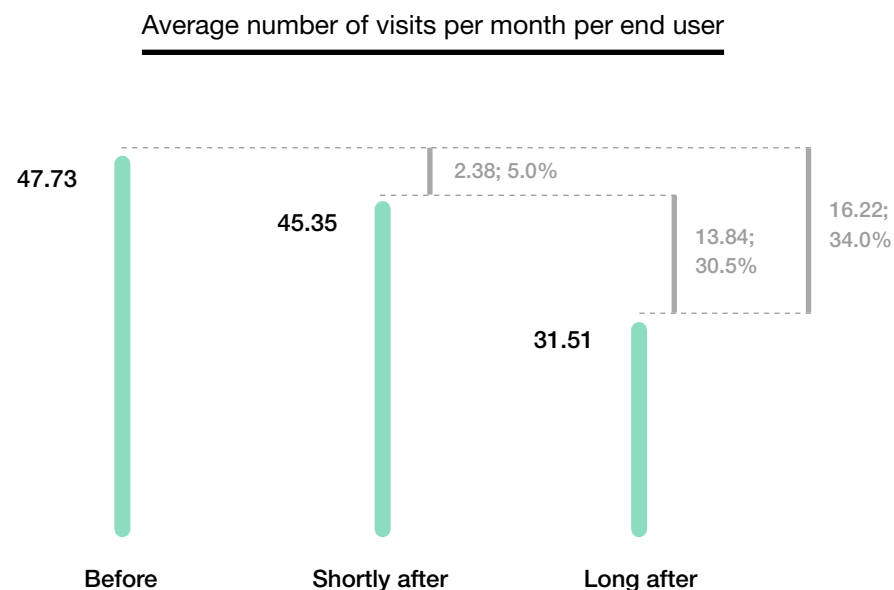


*Figure 8.7* Average number of hospital bed-days per month per end user before, shortly after (1-3 months) and long after (4-6 months) the intervention. N=95

The reduction in utilisation of hospital services is lesser shortly after (1-3 months) the intervention, and greater long after (4-6 months). This may be attributable to a transitional and adjustment period before the benefits of personal connected health and care are fully obtained.

### End user utilisation of home nursing services

The project managers from the four districts registered the number of visits to end users and the time spent in their home before, shortly after and long after the intervention; see Figures 8.8 and 8.9. Here, 'shortly after' is up to 2 months after the intervention and 'long after' is more than 6 months after.



*Figure 8.8* Average number of visits per month per end user before, shortly after (up to 2 months) and long after (6 months or more) the intervention. N=172

Average time spent per visit per month per end user

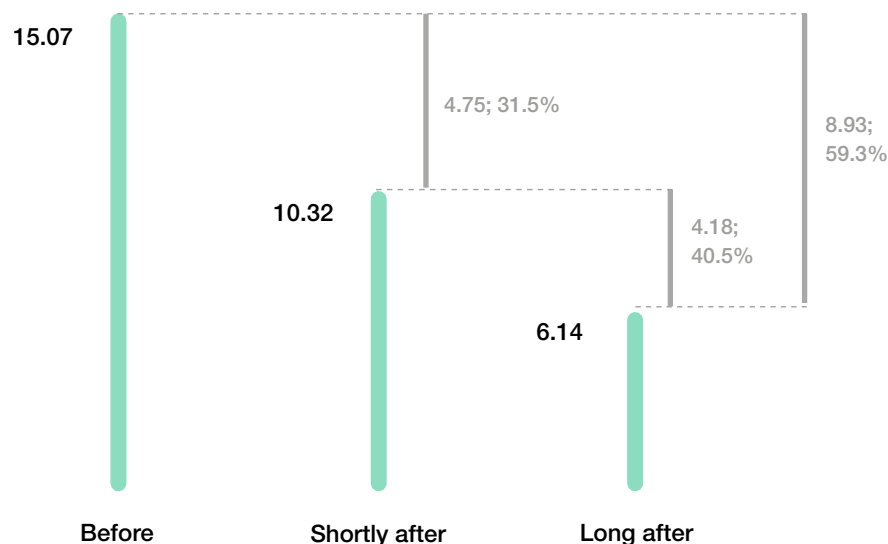


Figure 8.9 Average time spent per visit per end user per month before, shortly after (up to 2 months) and long after (6 months or more) the intervention. N=172

There was a reduction in use of the home nursing services following the intervention. The number of home visits was reduced by 5% shortly after (up to 2 months) and by 34% long after (6 months or more) the intervention.

The time spent by nurses/care workers with the end users (traditional face-to-face time) was reduced by 31.5% shortly after, and by a full 59.3% long after the intervention.

The observed post-intervention reduction may in part be attributable to factors other than the intervention itself. However, it is reasonable to assume that the changes are largely due to the new practices surrounding personal connected health and care.

Table 8.1 shows the change for the Pilly drug dispenser and for remote care assistance.

	Percentage reduction			
	Before - Shortly after		Before - Long after	
	Visit/month	Hours/month	Visit/month	Hours/month
Pilly (N=75)	12%	29%	35%	39%
Remote care assistance (N=80)	1%	33%	37%	30%

Table 8.1 Reduction in home nursing care before (up to 2 months) and long after (6 months or more) the intervention.

Remote care assistance comprises a range of technologies (blood glucose meter, spirometer, blood pressure meter, temperature meter, weight and questions); see Chapter 4. There are relatively marked reductions for both types of systems, and no significant differences between them. For the mobile personal alarms, there are few end users, which makes it difficult to draw robust conclusions.

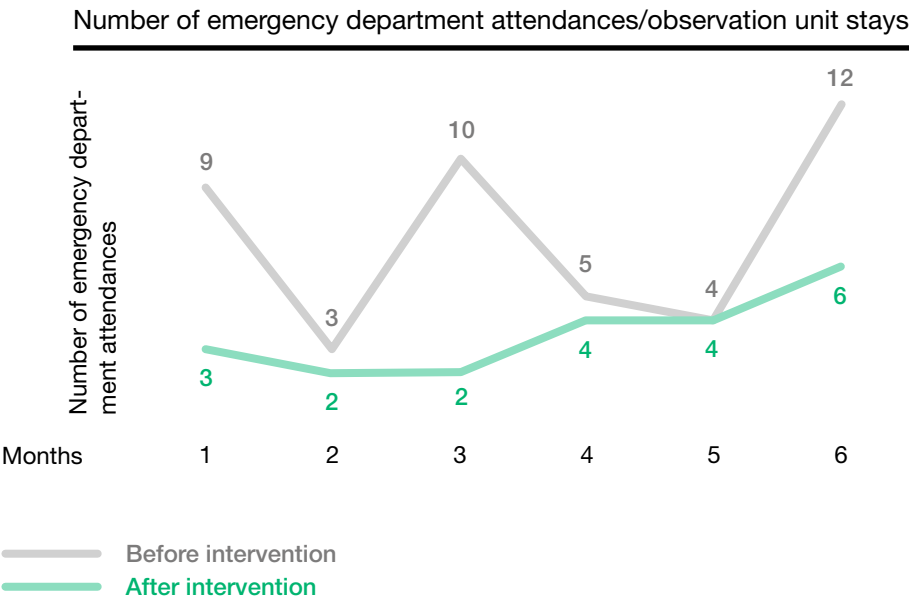
**“It’s better to have Pilly than to have to wait for the home care service”**

– End user 2 (39) with paranoid schizophrenia

### End user utilisation of emergency department and observation unit services

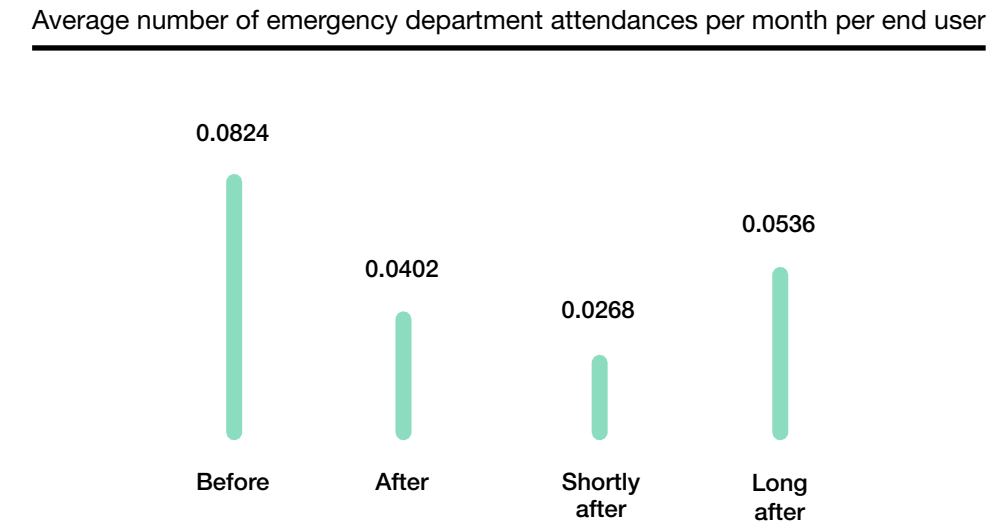
Data on the intervention's end users' utilisation of emergency department/observation unit services was recorded by clinical staff at Aker hospital. The data were recorded in the period 6 months before and 6 months after the intervention. Data were gathered on a total of 87 unique end users.

The number of emergency department attendances/observation unit stays per month per end user was reduced by an average of 51.2% after the intervention; see Figures 8.10 and 8.11. The reduction was a full 67.4% shortly after the intervention (1-3 months) and 34.9% long after (4-6 months). The reduction was thus greatest shortly after – unlike the changes in utilisation of hospital and home nursing services, where the reductions were greatest long after the intervention.



**Figure 8.10** Reduction in emergency department attendances/observation unit stays per month per end user before (1-3 months) and long after (4-6 months) the intervention.

It is difficult to account for the difference relative to the utilisation of hospital and home nursing services. However, there were relatively few attendances/stays in the period: 7 shortly after (1-3 months) and 14 long after (4-6 months) compared with 43 in the 12 months before the intervention. This means that slight changes will produce relatively high change rates (%).



**Figure 8.11** Average number of emergency department attendances/observation unit stays per end user before, shortly after (1-3 months) and long after (4-6 months) the intervention. N=87



### End user utilisation of municipal emergency care unit services

Data on the intervention’s end users’ utilisation of municipal emergency care unit services were recorded by clinical staff at Aker hospital. Again, data were recorded in the period 6 months before and 6 months after the intervention. Data were recorded for a total of 87 unique end users.

The utilisation of municipal emergency care unit services was very limited. This was the case both before and after the intervention. Unlike the other health services, utilisation increased after the intervention, and notably long after (4–6 months). This increase was expected, however, since the local authority, City of Oslo, gained an increase in unit beds in the post-intervention period. In addition, City of Oslo intensified its efforts to encourage the districts to make use of the municipal emergency care unit services over the project period. However, utilisation of these services remained insignificant for the end users compared with their utilisation of hospital services and home nursing services.

	After			
	Before	After	Shortly after	Long after
No. of emergency care unit admissions	1	3	1	2
No. of emergency care unit bed-days	2	8	1	7

*Table 8.2* Change in utilisation of municipal emergency care unit services before and after the intervention. Shortly after (1–3 months). After and long after (4–6 months), After the intervention. N=87

## 9. Cost-benefit analysis

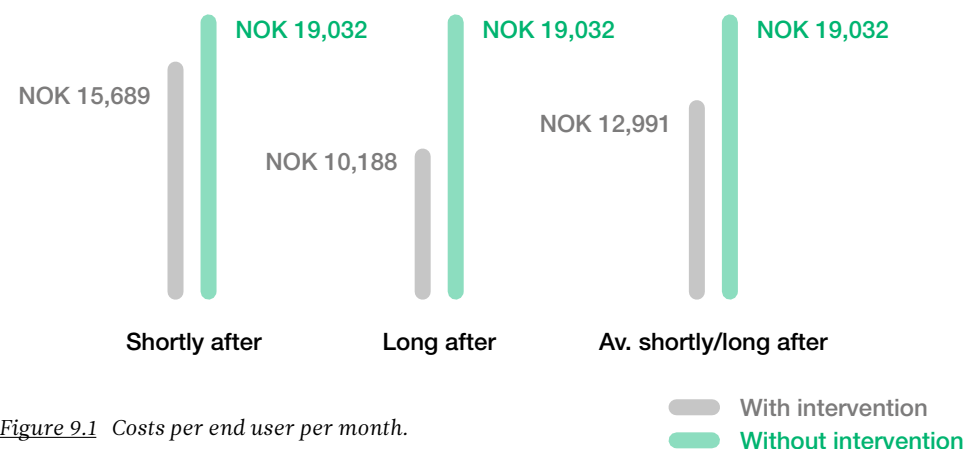
A cost-benefit analysis was performed based on the changes in utilisation of hospital and home nursing services. The changes are summarised in Table 9.1.

	Average per month per end user	Shortly after per month per end user	Long after per month per end user
<b>Home nursing services</b>			
Reduction in number of visits	9.3	2.38	16.22
Reduction in hours spent	6.84	4.75	8.93
<b>Hospital services</b>			
Reduction in number of outpatient consultations	0.0807	0.0632	0.0983
Reduction in number of hospital admissions	0.0194	0.0053	0.0334
Reduction in number of hospital bed-days	0.1334	0.1088	0.1579
<b>Municipal emergency care unit</b>			
Number of admissions	0.0019	0.0038	0.0077
Number of bed-days	0.0038	0.0038	0.0268

*Table 9.1 Reduction in utilisation of hospital and home nursing services after the intervention per month per end user.*

Based on these changes, we calculated the cost savings for the public sector shortly after and long after the intervention; see Figure 9.1 and Table 9.2.

**Cost-benefit of the intervention per end user per month**



*Figure 9.1 Costs per end user per month.*

The table also shows the average saving shortly after/long after the intervention. The cost-savings are calculated per end user per month.

	end user/month	Reductions end user/year	%
Shortly after	NOK 3,313	NOK 39,755	17.5%
Long after	NOK 8,844	NOK 106,127	46.5%
Av. shortly/long after	NOK 6,042	NOK 75,503	31.7%

*Table 9.2 Economic benefit of personal connected health and care per end user per month.*

The economic gains are substantial, and especially after some time has elapsed from when personal connected health and care was implemented for the end users. The savings for society are 46.5% after the intervention has had a chance to ‘settle’, or an average of 31.7%. It is interesting to note that the end users themselves are generally pleased with the intervention. The intervention was in many respects carried out according to the “lean startup” (Eric Ries, 2011) and “effectuation” (Saras Sarasvathy, 2009) principles. Relatively limited resources were used for advance analyses, organisation and planning for the project. The solutions were therefore distributed to end users to best ability and adjustments were made along the way according to a more ‘just-do-it’ strategy.

As good as these results are, additional gains are likely to be achieved by perfecting service provision and service organisation.

The savings apply to all the stakeholders (Table 9.3).

Effects of intervention as a function of duration of use

	Av. short/long		Shortly after		Long after	
<b>Hospital</b>						
Savings for hospital, incl. lost DRG-based revenue per user per month	NOK 473	14.2%	NOK 386	11.6%	NOK 561	16.9%
<b>Local authority (City of Oslo)</b>						
Savings for local authority incl. reduced end user transports to hospital	NOK 4,884	29.4%	NOK 3,022	16.0%	NOK 7,124	43.4%
<b>Service user</b>						
Savings for end user per month	NOK 37	29.7%	NOK 25	20%	NOK 48	39%

Table 9.3 Savings for the various stakeholders in the intervention. Figures stated in NOK per end user per month.

The City of Oslo made the greatest savings. The figures for the City of Oslo include changes in utilisation of home nursing services, emergency department services, municipal emergency care unit services and savings based on reduced travel to hospital.

The reduction in hospital bed-days and outpatient consultations results in increased hours for the home nursing service. This calculation allows for this effect in that the figures used represent the actual time spent in-home with the end users in the period before and after the intervention.

The basis for the calculation also takes account of the following factors over and above the basic assumptions shown in Tables 9.4 and 9.5:

- On average, 68.4% of in-home visits to the end users took place in the daytime, and the remaining 31.6% in the evening.
- For each hour spent in-home with the end users (traditional face-to-face time), an overhead time of 47% was added to allow for the time spent on travel, documentation, telephone calls and general training.
- A further 5% of in-home time was added for alarm call-outs.
- A further 5% of in-home time was added for in-service training in personal connected health and care for employees.
- The cost of running the municipal emergency care unit was set at NOK 4,200 per day.
- The cost of providing emergency department services was set at NOK 1,000 per consultation.
- Travel for emergency department services and municipal emergency care unit services was costed at NOK 350 per call-out.

Unit costs used as basis for costing in NOK

	Users with intervention	Users without intervention
Direct end user time, daytime NOK/hour (in-home)	NOK 426.80	NOK 426.80
Direct end user time, evening NOK/hour (in-home)	NOK 582.50	NOK 582.50
Indirect end user time (contact by phone, preparing medication, dealing with alerts over the phone)	NOK 426.80	NOK 0.00
Average subscription costs (telecomms, licenses, support etc. depending on type of equipment) NOK/month	NOK 303.16	NOK 0.00
Training of employee and end user NOK/hour	NOK 426.80	NOK 0.00
Investment in personal connected health and care per end user per month (written down within 1.5 years)	NOK 291.84	NOK 0.00
Travel to end user (Av. travel expense/visit)	NOK 100.00	NOK 100.00

Table 9.4 Basic assumptions for calculation of the economics of implementing personal connected health and care based on data from the home nursing services.

Unit costs taken as the basis for costing in NOK

	Users with intervention	Users without intervention
<b>Hospital</b>		
Cost per bed-day	NOK 8,000	NOK 8,000
Cost per outpatient consultation	NOK 400	NOK 400
<b>Transportation</b>		
<del>Ambulance per trip</del>	<del>NOK 1,000</del>	<del>NOK 1,000</del>
Home care service per trip	NOK 100	NOK 100
Escorted travel NOK/hour	NOK 600	NOK 600
User-fee	NOK 320	NOK 320
Car mileage expense per trip	NOK 100	NOK 100

*Table 9.6 Basic assumptions for calculation of the economics of implementing personal connected health and care based on hospital data.*



## 10. Analysis and results of the qualitative study

In the first interim report shortly after implementation, the effect of personal connected health and care was described with reference to the dimensions of sense of safety, wellbeing, sense of empowerment, motivation, control over own personal health and activity level. In addition to these dimensions, further observations were described. One of these was that a number of end users linked their identity to the personal connected health and care, and that most of them had a fixed base in their home where the devices were given pride of place. In this final interim report long after the intervention, we outline the main outcomes, and the overall qualitative benefit assessment is described with reference to nine main findings.

These findings are based on semi-structured interviews with 12 end users and two relatives. The first round of interviews was in December 2014 and the second in December 2015. By the second round, one end user had passed away, and one was in hospital. Two of the end users are married to each other and were interviewed together, while two other end users were interviewed with their cohabiting partner/spouse as relatives.

### Findings

The qualitative benefit assessment is presented with reference to nine main findings:

- 01 **Reliable equipment for the user requires robust systems at the local authority end**
- 02 **What worked before may not necessarily work now**
- 03 **Coaching in recognising the body's signals and managing own health**
- 04 **Personal connected health and care provides a sense of safety through perceived presence**
- 05 **Not a problem to be solved, but everyday life to be lived**
- 06 **From casual chatting about illness to informed dialogue**
- 07 **It's not personal connected health and care that gets you out of the house**
- 08 **End user mapping is an open (and uncharted) landscape**

### Overview of end users and relatives

- **End user 1** (65) with disabilities and alcoholism. Has tried Pilly.
- **End user 2** (39) with paranoid schizophrenia. Has had Pilly since August 2014.
- **End user 3** (65) with COPD. Has received remote care assistance with a spirometer and temperature measurement since September 2014.
- **End user 4** (30) with mental disability. Uses Pilly.
- **End user 5** (87) with anxiety disorder. Uses Pilly.
- **End user 6** (97) with disabilities and impaired vision. Has had a personal alarm since July 2013. Married to end user 7.
- **End user 7** (93) with back pain. Has had a personal alarm since September 2014. Married to end user 6.
- **End user 8** (67) with COPD. Has received remote care assistance with a spirometer and temperature recording since 2013. Stopped receiving remote care assistance in September 2015.
- **End user 9** (71) with COPD. Has received remote care assistance with a spirometer, temperature and weight recording since January 2013. Adjusted follow-up in autumn 2015. Interviewed with live-in partner.
- **End user 10** (58) with multimorbidities, physically disabled and hard of hearing. Has had a personal alarm since October 2014.
- **End user 11** (84) with cognitive impairment. Has had Pilly and received remote care assistance with weight recording since September 2014.
- **End user 12** (58) with Alzheimer's. Has had a personal alarm and Pilly since July 2014. Interviewed with spouse.

## 01 Reliable equipment for the end user requires robust systems at the local authority end

An end user's first encounter with personal connected health and care services generally is all-important for their subsequent attitude to the personal connected care. This first impression influences what role personal connected health and care plays in their life and what effect it has. In one instance, there was defective follow-up concerning a personal alarm when the home care service interpreted the battery failure signal as a triggered alarm. This gave rise to lack of confidence and scepticism on the end user's part. The home care service rectified the problem and a year later, the end user regards the alarm as reassuring.

End users who do not understand the technology or experience failures at the outset can quickly lose confidence. The local authority's procedures for follow-up and development of the frameworks around personal connected health and care are consequently important. It is crucial for the local authority to continuously develop and adapt the service to the end user's needs. This applies to everything from introduction of personal connected health and care to training, follow-up and adjustments for safety and technical reliability.



***“One time, the home nurse got the dose wrong.  
That was unsettling”.***

*– End user 2 (39) with paranoid schizophrenia*



## 01 Reliable equipment for the end user requires robust systems at the local authority end

***“The mobile (personal alarm with GPS) is like last year’s... It’s a bit frustrating. Defective battery and GPS error.”***

– End user 2 (39) with paranoid schizophrenia

•

***“The first time I waited for them to call to tell me it wasn’t working. But they didn’t, so I had to make the call myself.”***

– End user 4 (30) with mental disability

***“Then there was the time I was just standing in the hallway taking my coat off when the alarm went off again. If it’s going to be like that all the time, I don’t want it.”***

– End user 7 (93) with back pain  
(at first interview round)

***“Sense of safety? It’s worked wonders. Before, I had no proof of how I was doing – I could only rely on myself. So I don’t want it not to work. The anxiety could hit me right away.”***

– End user 3 (65) with COPD (remote care assistance)

***“I used Pilly for a few days. There was something wrong with the dispenser. I phoned for help, but nobody answered. Told the home nurse I didn’t want it. It was such a hassle.”***

– End user 1 (65) with disabilities and alcoholism  
(at first interview round)

•

## 02 What worked before may not necessarily work now

Two of the end users suffered an exacerbation of their COPD between the two interview rounds, and both of them stated that the function of the personal connected health and care (remote care assistance) changed as their values deteriorated. The short-term benefit for both of them was considerable in that they found it very reassuring to be able to monitor their values and check that they were stable. They were able to adapt their level of activity and were less distressed.

A year later, both were in the end-stage of the disease and no longer had the same benefit from the technology; on the contrary, they now found it distressing to have the home care service phoning them daily to check how they were doing. This was seen as confirmation of the exacerbation of their condition, in addition to seeing their progressively poor values.

Both have had close dialogue with the home care service and adjusted monitoring as needed. One takes measurements twice a week and the home care service calls every fortnight. The intervals have been adjusted and the staff are well-informed of his condition and needs. The other end user decided that she no longer benefited from the technology and does not measure her values. She explains that personal connected health and care taught her to understand her own body and signals, and she doesn't need to know her values in order to be able to adapt her level of activity.

We have seen that it is crucial to recognise that the end user's condition is subject to constant change and that the function and value of personal connected health and care also changes over time. Continual and systematic evaluation is required, together with close dialogue with the end user to ensure the high standard of the service. It may be helpful to inform end users, relatives and health professionals that this change may occur when personal connected health and care is introduced.



***“I’m not in as good shape as I used to be. They (the home care service) have to take care to adjust the values. If the values go down, it gets worse. That’s just the way it is”.***

*– End user 9 (71) with COPD*



## 02 What worked before may not necessarily work now

***“His values are so bad they were phoning all the time. I’ve had to tell them to stop, and that they don’t need to call”.***

– Relative of End user 9 (71) with COPD

•

***“I felt the remote care assistance was making me out to be even more poorly than I am”.***

– End user 8 (67) with COPD

***“I think it’s great to be able to check up on my values. Because if, say, I see that my values are not so good that day, then I can take it easy for a while”.***

– End user 8 (67) with COPD (at first interview)

### 03 Coaching in recognising the body's signals and managing own health

After a while, some features of personal connected health and care are managed by the end users themselves. This would apply to the drug dispenser's facility for reminding the end user to take their medication. Several end users describe that the set times have now become part of their everyday routine so that the reminder is no longer needed. Remote care assistance gradually became superfluous for one end user who has learned to interpret her body's signals and adjust her level of activity accordingly. This training and insight has given her a sense of empowerment and control over her own life.

Although some features of personal connected health and care become redundant because the end users have been 'coached' by them, personal connected health and care is still of value as the perceived presence of the home nursing service. The drug dispenser and remote care assistance device are linked up to the home nursing service in the same ways as the mobile personal alarm. For many of the end users, it means a great deal to know that the home nursing service is monitoring that they take their medication and reading their values and asking how they are doing. This is also seen as reassuring for the relatives.

***“Remote care assistance has taught me a lot. It was able to confirm what I was feeling, wasn't it?”***

*– End user 8 (67) with COPD*



***“If you don't have remote care assistance you go in for a checkup every 6 months – meaning that in between you don't have a clue how you're doing.”***

*– End user 9 (71) with COPD (at first interview)*

## 04 Personal connected health and care provides safety through perceived presence

The end users describe that personal connected health and care gives them greater peace of mind in between visits from the home care service. It is reassuring for them to know that the home nursing service is continually monitoring them remotely, and they are confident that help would come if anything unexpected were to happen. They no longer feel they have to cope alone with their condition. It is very important that the care service presence is genuine and that the local authority has systems in place to ensure that the end users receive the follow-up and assistance they need. If the service or the devices malfunction, the technology could be giving end users a false sense of security.

The end users in the sample have had personal connected health and care on trial and are accepting of 'teething problems'. They are in close contact with the project owner and provide feedback along the way.

***“What’s it like them not being here in person? I think it’s all right. They needn’t visit me if I don’t need it. I know they’re there if I do”.***

*– End user 3 (65) with COPD  
(remote care assistance)*



***“Now that I receive remote care assistance, I don’t have to cope all on my own. Remote care assistance is like a hotline to the home care service”.***

*– End user 3 (65) with COPD*

## 04 Personal connected health and care provides safety through perceived presence

***“We still feel more secure with it (remote care assistance), although we only take readings two or three times a week. You see, he’s in the end-stage”.***

– Relative of End user 9 (71) with COPD

***“Pilly does NOT send a message to my wife’s phone like it’s supposed to.”***

– End user 12 (58) with Alzheimer’s

•

***“Sometimes I forget to take the readings because I have to cough everything up and take the medicines. Aren’t they suppose to phone me if I’ve forgotten to take them? It’s a bit strange, but it doesn’t matter.”***

– End user 8 (67) with COPD (at first interview)



## 05 Not a problem to be solved, but everyday life to be lived

The personal connected health and care devices become an integral component of the end users' everyday lives. Like anything from the TV set and remote control to their mobile phone and computer, it becomes part of their technical environment. The addition of personal connected health and care systems makes this technical environment not only a source of entertainment and social contact, but also a source of support in monitoring their condition.

This is clearly apparent from the prominence given to the devices and their use as part of the fixed 'base' in the home. This is something we also observed from the first interview round, where we described the 'command centre'. All of the end users have a fixed base in their home – the place where they spend a lot of time. In addition to their medication and measuring their values, this place is used for watching TV, dining, handicrafts, crosswords or computer gaming.

For the 'right' people, personal connected health and care can become a key part of daily life – to the point that their daily rhythm almost revolves around it. This general picture merits inclusion in the evaluation because personal connected health and care affects the end user's daily rhythm, social contact and way of dealing with their condition. The technology is a structural 'instrument' in all aspects of daily life and also becomes part of the end user's identity. In the first round, we met an end user who had knitted a special bag for the drug dispenser, and another end user had a special little coverlet on which the dispenser was given pride of place. The employees describe that on several occasions they were surprised by people they didn't imagine would be willing or able to deal with the technologies of personal connected health and care actually benefiting hugely from the devices and allowing them to change their everyday lives. Conversely, others surprised staff with their resistance to using the devices. One person had no interest in using the drug dispenser; this emerged when he complained over how it worked, saying that it was difficult to get at the pills while he was holding his cigarette.

We see it as imperative to establish effective routines for identifying and trying out likely candidates for personal connected health and care.



***“Pilly is my best friend”***

*– End user 4 (30) with mental disability*



## 05 Not a problem to be solved, but everyday life to be lived

***“Pilly is always out on the coffee table”***

– End user 2 (39) with paranoid schizophrenia

***“Pilly also works like an alarm clock”***

– End user 4 (30) with mental disability  
(from first interview)

***“It’s usually there on the coffee table. It’s my buddy. I want a new table with a shelf underneath where I can keep the equipment. I want it near me.”***

– End user 3 (65) with COPD (remote care assistance)

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## 06 From casual chatting about illness to informed dialogue

Through personal connected health and care, and especially remote care assistance, the end users discover that they have a tool for communicating their condition to their relatives without it seeming like they are 'bemoaning' illness. This is seen as a common communication platform for providing shared knowledge of the disease. The end users see it as a relief to have an easy way of communicating their current condition based on objective measurements of vital signs.

The end users report that they have good contact with their relatives and that the systems and devices are often a topic of conversation. They report that family members appreciate personal connected health and care and often ask about how the latest readings have been, and if they are doing OK with the drug dispenser.

The personal alarm, drug dispenser and remote care assistance are reassuring for relatives because they know that the condition of their loved one will be followed up and that they have an easy way of summoning assistance if needed. Some end users' personal alarm is only linked up to their relatives, and in this set-up it helps to simplify and reinforce the line of communication. For an end user with Alzheimer's for example, the alarm is not only used in emergencies, but also as a way of getting hold of his wife, as he is unable to read the numbers.

Where the end user has a live-in partner, this person is actively involved in use of the personal connected health and care solution. For those living alone, there is some suggestion that personal connected health and care has a negative effect on the frequency of visits by relatives. Is it the case that they visit less because they know that the end user is being monitored remotely by the local authority? Or is it that the visits are more 'quality time' because they are not based on dutiful relatives checking to see that all is well.



***“My grandchildren ask:  
how were your readings today?”***

*– End user 3 (65) with COPD (remote care assistance)*



## 07 It's not the personal connected health and care that gets you out of the house

The object of the personal alarm and drug dispenser is to facilitate greater freedom and activity, but this does not appear to be what determines whether the end users engage in more or less activity outside their home.

The general impression is that the level of activity among the interviewees is the same or reduced after one year because their condition is unchanged or exacerbated. In addition to the effects of their medical condition, it appears as if their level of activity is influenced by their personality, motivation and social network. Personal connected health and care does not appear to influence these three factors to any significant extent.

In the instances where personal connected health and care contributes to delaying an exacerbation of their condition (e.g. by avoiding hospitalisation for COPD patients), one could say that it has indirect influence on the patient's level of activity. It is easier to be active when living at home and the end users can maintain their everyday life with the type of activity they prefer and can cope with. One example is an end user with COPD who, after receiving remote care assistance, has not been hospitalised a single time. As she herself puts it "before, the hospital was my first home, but happily that's not the case anymore". Instead, she can now walk the dog every day and is in contact with her neighbours and other people in the community.

Although having personal connected health and care is not what gets the end users out of the house, we find that it enables them to stay living at home (instead of in a nursing home or hospital).



***"I don't see well,  
so I don't get out that much anymore."***

*– End user 6 (97) with impaired vision (personal alarm)*



## 07 It's not the personal connected health and care that gets you out of the house

***“I had decided to apply for a place in a nursing home until I started receiving remote care assistance”***

– End user 3 (65) with COPD (remote care assistance)

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***“It hasn't affected how much I get out.”***

– End user 7 (93) with back pain (about alarm)

•

***“I'm not in as good shape as I used to be. I can't go out on my own, but I do move around in my flat”***

– End user 10 (58) with multimorbidity  
(Personal alarm and drug dispenser)

***“It's winter now, so I can't go out because of the air.”***

– End user 9 (71) with COPD (remote care assistance)

•

***“Hasn't changed – I still do the same as I used to. I don't go out. The kids take me out for a ride, but I prefer to be at home. I can't be doing with too much talking. I have a lot of old books I'm sorting out.”***

– End user 8 (67) with COPD  
(at first interview)



## 08 End user mapping is an open (and uncharted) landscape

The landscape of candidates for benefiting from personal connected health and care is currently unknown, and it would be worth operating with a low threshold for testing it out. Several employees report being surprised by who benefited greatly from personal connected health and care and who declined this form of care. Good dialogue between the stakeholders, with the end user and relatives will be crucial. The same applies to close follow-up upon introduction and a low threshold for handing back the equipment.

When considering a potential wider roll-out of personal connected health and care, the project staff emphasise that a method of mapping candidate end users who would benefit from personal connected health and care will be crucial. In the intervention, the end user sample is drawn from existing recipients of home nursing services. In order to ensure a preventive effect, there are plans for service users to be recruited in consultation with the hospital, primary care physician and other parts of the health service before they come into contact with the home nursing service. This will entail comprehensive coordination between the local authority, hospital and primary care physician. Internally within the local authority, it will also be important for the home-care allocations office to be actively involved in the mapping project. This will require routines for assessing interventions including personal connected health and care. In one of the districts, staff at the home-care allocations office currently have to justify why personal connected health and care is NOT merited for a given service user. A routine of this nature is informed by the policy that everyone stands to benefit from personal connected health and care rather than a select few.



***“I’m an electro-mechanical engineer by trade. I still have the old knack. Which is probably why I had no issue with the gadget (Pilly). I enjoy getting a thing like that to tinker with. When I went into hospital, everyone was trying to have go of it. So I said I’d show them how.”***

– End user 11 (84) with cognitive impairment (from first interview)



## 08 End user mapping is an open (and uncharted) landscape

**“Some are immensely motivated; others you have to spend a lot of time coaching and motivating. We have a lot of substance abusers in this district, and they are a challenge to deal with and motivate. Many of them say they want to change, but when it comes to the crunch, they don’t seem so keen after all.”**

– Occupational therapist (1)

•  
**“Assessing candidates for Pilly can be a challenge. They may be at a stage that makes them eligible, but it’s not necessarily the best thing for them. There was one I had to assess for Pilly who said ‘don’t take the home nurse visits off me’.”**

– Occupational therapist (2)

•  
**“There are many end users I thought it wouldn’t work out for, and where it didn’t. But it’s worth trying.”**

– Nurse (1)

**“The end users are quick to put all the responsibility on ‘us’. The team has to call various units, relatives, the welfare department, the Fountain House rehab centre etc. The end users don’t take much initiative themselves. Some of them object when they’re told they have to do something themselves.”**

– Occupational therapist (1)

•  
**“I’m quite impressed by the older generation, the over-70s. They’re not familiar with the latest technology. You step into a flat frozen in time since the 60s, but when you think that they have taken on board something this advanced and are over the moon and curious about how it works – that gives you a kick. There is this tendency to think they are too old and unwilling to learn anything new, but then it turns out they do, which is a turn up!”**

– Care assistant

**“The challenge of using personal connected health and care is to find candidates who will actually benefit from it. We’ve had service users we never imagined would be able to use devices, but then it worked out ever so well.”**

– Nurse (1)

# Concluding discussion

## Effect of participating in the project

For several of the end users, simply being part of the project feels important and meaningful. Combined with the personal connected health and care, project participation presumably has a positive effect on their sense of empowerment. This means that some of the effect of personal connected health and care is attributable to participation in the project rather than the personal connected health and care in itself.

The sample of end users in the intervention appear to have a good deal of contact with the home nursing service concerning the technology. They receive frequent follow-up as test subjects and in that way benefit from social contact. It is therefore not possible to assess whether personal connected health and care might result in reduced social contact and greater seclusion. This could, however, be assessed in a subsequent roll-out where there would be less contact with project owners. The reduction in social contact resulting from provision of personal connected health and care is a factor of concern for several of the employees. It will be important to address this, and possibly reassign resources to interventions to counter loneliness.

*“From working with this so many years, I know that patients have a great need for human contact. Some patients don’t have so many people around them, so there’s a great need for personal contact. The dispenser (Pilly) doesn’t give them that personal contact. (...) but it (personal connected health and care) is great for a lot of people.”*

– Male nurse (2)

Most of the end users in the sample appear to welcome the chance to try out technology and be part of something new. They feel that they have been specially selected and that their views and feedback matter. Presumably, this reinforces the sense of empowerment provided by the technology.

## Existing service users

In the benefit assessment, the sample is based on existing users of the home nursing services. This means that they previously received traditional care and visits before the intervention. The change is assessed with reference to how they previously received care, and the change they experience compared with this.

In a potential larger-scale roll-out of personal connected health and care, the service users will be new to the system and the benefit assessment will then be different because it will be based on the change from not having any need for supported living to receiving personal connected health and care.

## Changes in the intervention

The findings are not related to a change in interventions over the study period. We have not defined benefits according to particular interventions. The four districts have different systems that have been altered during the period under review.

## Medical follow-up

Based on our interviews, one conclusion is that when personal connected health and care works as intended, all of the 12 end users we interviewed rate the service as satisfactory. They feel safe and reassured that their condition is under supervision. The evaluation has not, however, rated the medical follow-up, and the clinical data in themselves, and is therefore unable to conclude that the service is clinically reliable. To include this in the evaluation, it will be important to work closely with the hospital and primary care physician.

## Relatives

Two of the end users were interviewed with their relatives and two are married and are each other’s ‘next of kin’. The end users were interviewed about their relationships with their relatives. In future, it would be helpful to interview more relatives about their role. The impression here and now is that dialogue between the end users and their relatives is better informed and that the relatives also see personal connected health and care as reassuring. The question is whether interaction with the end user changes in frequency and duration? And indeed, quality? Are there fewer phone calls or visits when they know that personal connected health and care is helping to keep them safe so that they are no longer as concerned? Or are conversations and time spent together more in the nature of ‘quality time’?

## Employees

In December 2014, 12 representatives of the local authority care service allocation office, physiotherapists and home nursing staff in the four districts were interviewed to elicit attitudes to personal connected health and care (see

first interim report). This measure was not surveyed in the next round due to project parameters. In the project going forward, it will be helpful to examine whether employee attitudes change over time. It will also be key to look at how altered care-provision routines as a result of personal connected health and care affect the working conditions of care staff.

Below is a selection of statements from December 2014 that tell us something about service employees' attitudes and expectations.

*“My first thought was that this is a lot of arm-waving. Mostly by management.”*

*– Male physiotherapist*

*“In a way we’re here to assist people in coping by themselves. Physiotherapists can do that, but also the opposite. Dependency on things. It could go the same way with personal connected health and care. That we force things on them they might have got by without further down the road. (...) One service user takes a multidose – he manages that unaided even though he’s had a stroke. It’s better he does that instead of him getting a technical doodah that’s going to fail now and then. The thresholds for when to use personal connected health and care are tricky. I’m worried we’re going to go overboard on it and have too much of it, when it’s actually better if you can manage without.”*

*– Male physiotherapist*

*“Changes in attitude don’t happen overnight; they take time. Not everyone is equally committed; there are a lot of untrained care assistants. This is going to be a challenge in the future. Staff who lack commitment just do what it says on their list and don’t see the bigger picture.”*

*– Female occupational therapist (1)*

*“It took some time to change my view that elderly people who need a lot of assistance can do more themselves. I’ve also started thinking more in terms of economics. The positive knock-on effects are so clear – that others lose out (if you put too much effort into one person it’s at the expense of others). Effort and effect – we don’t have the resources to go all-in with everyone.”*

*– Female occupational therapist (2)*

*“Many employees are sceptical; taking something new onboard in the stresses of the day-to-work is demanding.”*

*– Male nurse (2) about the attitude of other employees to personal connected health and care*

*“We’ve been very driven to help, but now people are given more responsibility themselves. We often do too much for people at the outset, and from then on the home care order just continues from there without being reassessed. The home care service requisitions reassessments. On a more rigorous basis now. “The thing is, we’ve got to make a lot of cutbacks next year.”*

*– Female healthcare consultant*

## The value of the benefit assessment

The purpose of the benefit assessment is to provide decision support for any future roll-out of personal connected health and care. It is intended to provide a broad picture through figures and insights into end user experiences and usage. We present the main, general findings across various types of technologies, service systems and medical conditions. This offers some indication of the scope and potential effects of a large-scale roll-out. To that end it would serve to aid decisions on focus areas and adjustments.

The impact of personal connected health and care is wider in scope than we originally anticipated. There is potential for cost savings, and it influences end user identity, everyday routines and dialogue with relatives. But the study also shows that it is a distinctly vulnerable system and that focused efforts will be needed beyond the initial introduction of personal connected health and care in order to realise its potential benefits. Our findings point to the importance of concentrating efforts on selection, follow-up and adjustment. This will require a robust system of follow-up that can be adjusted on a needs basis.



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## Appendix 1.

# Systematic literature review: Implementation of personal connected health and care

## Summary

### Organisation

The international literature reveals that the implementation of personal connected health and care for service users with chronic or long-term medical conditions can have the effect of strengthening the link between the primary and secondary health services. It can also foster a more informative relationship between patients and health professionals. We see consistent evidence in the literature that personal connected health and care reduces demand for health services in the form of a reduction in emergency department attendance, hospital admissions and hospital bed-days. Martin-Lesende et al. document this in a randomised study conducted within the primary health service in Spain in 2013, in which the intervention group received personal connected health and care. This corresponds with findings by Segrelles Calvo et al. in a randomised study of patients with severe COPD in 2014 in Spain. Similarly, Polisena et al. observed a consistent reduction in emergency department attendance and hospitalisations in COPD patients in a meta-analysis from 2010. The literature also points to greater involvement of end users in self-management of their condition, which promotes greater self-reliance in everyday life and improved quality of life. The implementation of different personal connected health and care programmes in primary and secondary health care is contingent on financial investments to guarantee reliable training of patients and associated health professionals, and robust technological solutions.

### Patients

In the implementation of healthcare innovations, cost savings are not necessarily the primary objective; more significant is to achieve healthcare benefits. The benefits of using personal connected health and care for patients with chronic conditions vary between studies. The benefit may in addition be contingent on the end user's specific medical condition. A number of studies indicate that greater benefits may be detected in end users with no cognitive impairments. This end user group

appears to understand and utilise the new technology satisfactorily and to draw benefit from the independence offered by the innovation although a combination of personal connected health and care and conventional home visits would be preferred by many. The end users reported greater insights into their own clinical symptoms, which in turn enabled them to take more responsibility for their own care. The main criterion for implementation of personal connected health and care is that the care and treatment provided are consistent with conventional in-home care or hospital procedures and requirements for quality of care. Personal connected health and care yields a limited increase in clinical benefit, but more significantly, there is no evidence of disbenefit from using it. None of the studies demonstrate a statistically significant relationship between improved quality of life and personal connected health and care. A number of the studies did, however, find that personal connected health and care helps to maintain constant quality of life in end user groups who generally suffer exacerbations over time.

### Cost-benefit

A number of articles conclude that telemedicine is a viable care option that has significant effect in reducing the scale of health service utilisation. A majority of the international studies included in this systematic review argue that implementation of personal connected health and care for service users with diverse medical conditions reduces utilisation of health services. Telemedicine is reported as conducive to early-stage detection of disease exacerbations, which results in fewer hospitalisations. Alrajab et al. observed a 71.5% decrease in healthcare utilisation in a retrospective cohort study from 2012 in which service users were offered telemonitoring. In a randomised study from 2013 by De San Miguel, personal connected health and care was introduced for COPD patients in Australia. This study documented an annualised net saving of \$2,931 (€2,425) per patient in the intervention group. A randomised study conducted in Denmark in 2012 by Dinesen et al. shows a cost saving of approx. 24% from offering in-home telerehabilitation to service users with chronic disease. The literature reviewed here indicates that personal connected health and care reduces the need for health services in the form of reduced emergency department attendances and hospitalisations, but also in the form of fewer home nursing service visits during daytime hours. The expectation is thus of a substantial cost saving in relation to numerous resource-intensive service user groups.

### Barriers

Two articles in the present systematic review raise questions as to the asserted benefits of personal connected health and care in previously published studies.

It is important to emphasise that these evaluations of the international literature concerning personal connected health and care were published in 2011 and 2012, respectively. Much has happened since then. This type of modern medicine is only just emerging in many parts of the world, and while some have made more progress than others, we still have much to learn. Although these two systematic reviews were published some years ago, their message remains valid: more research is needed on larger patient cohorts, with follow-up beyond just a single project period, and not least more disease- and technology-specific studies. The socioeconomic impact of telemedicine also needs to be better documented and compared between a more diverse range of health system types in different countries.

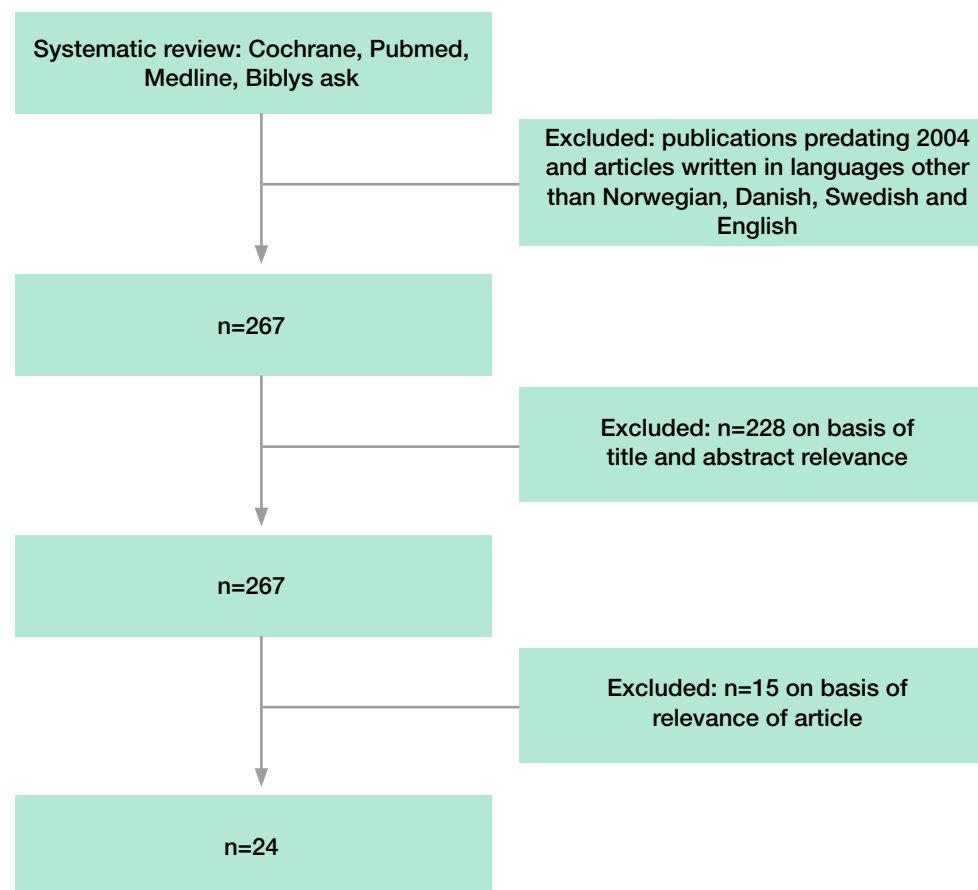
## Methodology

Searches were performed in the Medline, Cochrane Library, Pubmed and Bibsys Ask databases using the search terms; home, dwell, independent, copd, pulmonary, lung, respiratory, telehealth, telemedicine, telecommunication, technology, smart, self-help, computer, monitor.

All articles published before 2004 were excluded and only articles written in Norwegian, Danish, Swedish or English were included. This search strategy yielded 267 articles, 39 of which were included, based on the relevance of the title and abstract. After the initial screening, the 39 articles were reduced by a further 15 articles, based on relevance. 24 articles were included in our systematic review.

## Organisation

An important starting point for assessment of implementation of personal connected health and care for service users with lifestyle or other chronic diseases is to examine what type of organisational change it will entail for the health service. A systematic review conducted by Bartoli et. al in 2009 addresses the main aspects of this with reference to telemedicine services for patients affected by COPD. (Bartoli, Zanaboni, Masella, & Ursini, 2009). The article concerns how the redistribution of roles within the health service can result in a more user-centric network. Bartoli et. al. explain that organisational change of this nature will potentially strengthen the links between primary and specialist health care. It will also serve to improve disease management between the patients and home care service and resolve clinical problems addressed by nurses and physicians. The introduction of telemedicine holds scope for patients to assume a greater role in managing progressive disease on a more informed basis. Personal connected health and care fosters greater trust between physicians and nurses and lodges greater responsibility for treatment with nurses. This is because the nurses are able to assist and treat the patient at



home, contacting the doctor at the hospital only in emergencies. Bartoli et al. emphasise that this change in treatment strategy will result in a need for new legal and organisational frameworks.

Fitzsimmons et al. conducted a randomised pilot study within the UK National Health Service to investigate whether the implementation of personal connected health and care for COPD patients could reduce the rates of hospital admissions and emergency department visits and improve quality of life for service users (Fitzsimmons, Thompson, Hawley, & Mountain, 2011). Experiences from this project indicate that the implementation of personal connected health and care for service users with COPD required substantial changes to established care procedures and organisation. In the start-up period, it became evident that the

project lacked satisfactory funding and experience for installation and monitoring of the technology. The implementation of personal connected health and care is a challenging process in which initial financing and planning are crucial for the effectiveness of the innovation.

Horton et al. report on some of the same difficulties (Horton, 2008). In a study conducted in the UK, consultations with a focus group composed of home care teams and six case studies were used in analysing the implications of introducing personal connected health and care. The interviews revealed that the technology needed to be improved and made more robust and reliable, as both health professionals and patients reported problems using it. The patients included in the study were transferred directly from hospital to participate in the project; in that context, the focus group reported that better outcomes would have been expected if the sample population had come from the home care service. The implementation of personal connected health and care can create a new role for home care services and thereby strengthen their relationship with the specialist health service.

In this way, healthcare provision can be made more personalised and flexible. This will require extensive changes in the organisational structure of the home care service in which health professionals and end users have to learn from each other. To achieve this form of collaboration, Horton et al. stress the importance of proper training of health professionals in order to overcome lack of technical know-how and build confidence in relation to telecare.

The organisational impact of personal connected health and care has been documented in studies conducted by Martin-Lesende et al. on personal connected health and care introduced in primary care in Spain. (Martin-Lesende et al., 2013). The authors measured utilisation of health services in a randomised study comprising an intervention group and a control group. The study demonstrated a reduction in the number of hospital admissions and home nursing visits in the intervention group, although without statistical significance. The number of hospital bed-days was also reduced in the intervention group, but again, without statistical significance. Patients in both the control group and in the intervention group had access to a 24-hour telephone helpline at the hospital staffed by nurses and doctors. Use of this helpline was more frequent in the intervention group compared with the control group, such that this variable showed statistical significance. The implication is that by identifying potential issues at an early stage, it may be possible to prevent challenges arising that require more home visits or even hospitalisations. In this study, telemedicine was introduced in primary care in such a way that the technology became part of the end user's daily routine. Compared with similar interventions

in hospital-based care, this solution is likely to have the greatest benefit, as the innovation is conducive to improvements in primary care.

A meta-analysis of international literature conducted by Polisena et al. addresses variations in admissions, emergency room attendance and hospital-bed days from the introduction of personal connected health and care for COPD patients (Polisena et al., 2010). The analysis found a consistent reduction in emergency room attendance and hospital admissions in patients using personal connected health and care, but the number of hospital bed-days varied between the studies.

This meta-analysis also shows an increase in the mortality rate for the intervention group, but the number of studies identifying this were limited in scale and their cohorts limited in size. In relation to organisation and implementation, the authors assert that the implementation of personal connected health and care can be a costly and labour-intensive measure.

Segrelles Calvo et al. conducted a randomised controlled study in elderly service users with severe COPD in Spain in which the users were randomised to an intervention group and a control group (Segrelles Calvo et al., 2014). The users in the intervention group recorded their vital signs daily in a database for transmission to a monitoring centre; any anomalies in the transmitted data triggered an emergency visit to the patient. The results of this study point to reduced utilisation of health services from installing personal connected health and care for older adults with COPD. The reduction in utilisation of health services consisted of a reduced rate of emergency room attendance, hospital admissions and shorter hospital stays. This study reported a lower mortality rate among users in the intervention group. The study shows that monitoring of users with COPD by means of personal connected health and care provides the same sense of personal safety as daily follow-up by the home care service.

Users with COPD require pulmonary rehabilitation following relapses and stays in hospital. Unfortunately, there is inadequate capacity to offer pulmonary rehabilitation to the entire population of service users with COPD. Stickland et al. compared the quality of telerehabilitation in 147 end users with COPD with a group of 260 service users who received conventional rehabilitation in Canada (Stickland et al., 2011). The study demonstrated that telerehabilitation was an effective means of boosting rehabilitation capacity, since the end users achieved improved quality of life and self-reliance compared with service users rehabilitated by conventional methods.

Similar outcomes were observed in a study conducted by Vontetsianos et al. in Greece, in which a group of 18 service users were offered in-home telecare and then followed up over a period of nine months (Vontetsianos et al., 2005). A nurse visited the patients in their own home equipped with a laptop computer and the necessary medical devices for measuring the patient's vital signs. Over the nine-month intervention period, the study recorded a reduction in utilisation of health services. This is consistent with the findings of other similar studies. In this intervention, the patient's disease knowledge and self-management also improved. The study recorded a reduction in symptoms, complications and disablement and increased capacity for coping with everyday life.

The international literature reveals that the implementation of personal connected health and care for service users with chronic or long-term medical conditions can have the effect of strengthening the link between the primary and secondary health services. It can also foster a more informative relationship between patients and health professionals. We see consistent evidence in the literature that personal connected health and care reduces demand for health services in the form of a reduction in emergency department attendance, hospital admissions and hospital bed-days. The literature also points to greater involvement of end users in self-management of their condition, which promotes greater self-reliance in everyday life and improved quality of life. The implementation of different personal connected health and care programmes in primary and secondary health care is contingent on financial investments to guarantee reliable training of patients and associated health professionals, and robust technological solutions.

## Patients

In the implementation of healthcare innovations, cost savings are not necessarily the primary objective; more significant is to achieve healthcare benefits. Botsis et al. studied the effect of personal connected health and care on end user and employee satisfaction in a meta-analysis of telemedicine for elderly patients with chronic diseases (Botsis & Hartvigsen, 2008). The study was performed in Norway, but examines international literature. The analysis found that the benefit of personal connected health and care varied greatly between diseases. End users with Alzheimer's Disease for example did not perceive the innovation as helpful, as many had great problems in learning to use the technology. End users with non-cognitive diseases such as heart failure, COPD and diabetes reported that the technology was easy to use and helpful in self-management of their chronic disease. The end users had a sense of better goal attainment and benefit from their daily online clinical assessments. They also expressed great satisfaction with obtaining data on their vital signs. However, the end users were reluctant to lose face-to-

face contact with health personnel, conveying that a combination of 'warm hands' and personal connected health and care was preferable.

Dinesen et al. documented the attitude of chronically ill service users to telerehabilitation in a case study in Denmark (Dinesen, Huniche, & Toft, 2013). The majority of the patients described that the personal connected health and care platform used in the study facilitated communication and knowledge exchange between end users and health professionals.

The study reported that the end users altered their behaviour following the introduction of telerehabilitation, becoming more aware of changes in their symptoms and were thereby able to seek assistance before their condition exacerbated. This is consistent with findings made by Gellis et al. in a randomised controlled study of a control group and an intervention group in homebound older adults with heart or chronic respiratory failure (Gellis et al., 2012). The study investigated the impact of a multifaceted telehealth intervention on the end users' general health, mental health and service utilisation outcomes. The outcome in the intervention group was a reduction in symptoms of depression and a marked improvement in social functioning and general health. The study also reported a reduction in health-service utilisation among patients in the intervention group.

The clinical effect of implementing in-home telemedicine was investigated in a 4-month study by Jensen et al. in Denmark (Jensen et al., 2012). Clinical parameters for the 57 end users enrolled in the study were recorded before and after the project period. Variations in the clinical parameters were then tested for significance. The P-values from the test data showed significance for a reduction in antibiotics-prescribing for the intervention group, and the same end users had lower blood pressure and fewer GP consultations. After the project period, the finding was respiratory improvement, improved life capacity, a steadier pulse and lower blood pressure; these variables, however, had no statistical significance.

A Cochrane study by Mclean et al. performed a meta-analysis of randomised studies to investigate the effect of telehealthcare on the quality of life of end users with chronic diseases (McLean et al., 2011). It emerged from several studies that the implementation of telehealthcare for this service user group resulted in improved quality of life as compared with conventional care. Personal connected health and care is a complex intervention that requires extensive training and follow-up. It is unclear whether the studies in this meta-analysis were corrected for this in offering the conclusion on improved quality of life. It is difficult to distinguish between the effect of the increased attention and follow-up inherent in a project period, and the effect of the intervention itself.



To investigate whether telemedicine could improve quality of life in end users with COPD, a randomised controlled study was conducted by Lewis et al. (Lewis et al., 2010). In a six-month project period, 40 service users were assigned either to a control group that received standard rehabilitation or to an intervention group that also received home telemonitoring. The end users in the intervention group monitored their vital signs such as blood pressure, temperature and pulse daily and also had access to 24-hour telephone contact with the hospital. At the end of the intervention period, quality of life among service users in the two groups was rated using the qualitative instrument 5Q-5D. The outcomes were clinically significant improvements in both groups who participated in rehabilitation, but no difference between the intervention group and control group over the project period or post-project. The technology was, however, perceived as easy to use, as it was not connected to the internet, which the end users reported meant greater flexibility. This study indicates that telerehabilitation is a safe alternative to standard rehabilitation of COPD patients, but was not associated with improved quality of life in the end users.

Similar results are also found in the quasi-experimental retrospective and prospective study conducted by Sicotte et al. on a control group and an intervention group of end users with COPD in Canada (Sicotte, Paré, Morin, Potvin, & Moreault, 2011). The study measured user care satisfaction, patient empowerment and improved quality of life. In this study, the Cochrane one-to-five rating scale was used as a qualitative instrument. In the scores for care satisfaction and patient empowerment, there was no difference between the two groups, but the patients had a high score on the scale in both categories. In terms of quality of life, the intervention group maintained stable quality of life throughout the project period, while the control group showed deterioration over the period. Although no variations were found in care satisfaction and empowerment between the groups, the study indicates that the introduction of assistive devices in the home serves to maintain a high standard of care quality. In terms of quality of life, the study was unable to demonstrate improvements, but it is important to bear in mind that this patient group is affected by progressive disease, so the fact that personal connected health and care maintained stability of quality of life is a positive effect in itself.

The benefits of using personal connected health and care for patients with chronic conditions vary between studies. The benefit may in addition be disease-specific, with the greatest benefit observed in patients with no cognitive limitations. This group of patients appears to understand and utilise the new technology well and to benefit from the independence afforded by the intervention, even if a combination of technology and standard home visits would have been preferable to many end users. The patients reported greater insights into their medical condition, a fact

which empowered them to take greater responsibility for their own care. The main criterion for implementation of personal connected health and care is that the care and treatment provided are consistent with conventional in-home care or hospital procedures and requirements for quality of care.

Personal connected health and care yields a limited increase in clinical benefit, but more significantly, there is no evidence of disbenefit from using it. We were unable to find statistically significant improvements in quality of life in service users who received remote care, but we did find that personal connected health and care helps to maintain constant quality of life in a group of end users whose condition generally deteriorates over time.

### **Cost-benefit**

With growing expertise in diagnosing and treating life-threatening diseases, the number of health service users with costly chronic diseases is set to increase in the coming years. It will consequently be of great interest to investigate the extent to which personal connected health and care can reduce health service demand. To that end, Alrajab et al. conducted a retrospective cohort study using the Veterans Health Administration database of COPD patients enrolled in the Care Coordinator Home Telehealth (CCHT) programme in Louisiana. The study compared healthcare utilisation by patients who received personal connected health and care with patients receiving conventional home care. To that end, numbers of emergency department visits, urgent care visits, and hospitalisations were measured before and after enrolment. Of 369 patients, 71.5% had a significant reduction in the number of urgent care visits and exacerbations resulting in hospitalisation.

The study concluded that home telemonitoring may result in a reduction in health service utilisation. This is consistent with the results of a study by De San Miguel et al. to address health service utilisation in users with COPD. In this randomised controlled study, an intervention group monitored its vital signs daily, including blood pressure, weight, temperature, pulse and oxygen saturation levels (De San Miguel, Smith, & Lewin, 2013). The data recorded were transmitted automatically to a shared database where they were monitored by health professionals. In the study, the number and duration of hospitalisations and emergency room presentations were compared with a control group. After the project period, the study recorded a decrease in health service utilisation among the end users in the intervention group, although this reduction was not statistically significant. The reduction in health service utilisation was, however, significant in terms of cost savings, with annualised savings for the intervention group, compared with the control group, of \$2,931 (€2,425) per patient.



The randomised controlled study by Dinesen et al. also identified cost savings from offering home telerehabilitation in service users with chronic diseases. The intervention group cost per patient averaged €3,461 per hospitalisation compared with the control group average of €4,576 (Dinesen et al., 2012). This is a reduction of around 24% for the intervention group. The study finds a significant reduction in hospitalisations, but the cost savings show no significance in this study. Another study conducted by Zanaboni et al. in Northern Norway to investigate the viability of long-term rehabilitation of COPD patients also demonstrated a reduction in health service utilisation (Zanaboni, Lien, Hjalmsen, & Wootton, 2013). The users in this study were given devices for home exercise, for telemonitoring and for educational purposes. In addition to increased user satisfaction, the telerehabilitation resulted in a 27% reduction in hospital costs.

To study health service utilisation associated with the implementation of various types of telemedicine for users with COPD in Japan, Kamei et al. conducted a meta-analysis of randomised and non-randomised studies on this topic (Kamei, Yamamoto, Kajii, Nakayama, & Kawakami, 2013). Here the authors compared the effect of in-home telemedicine with reference to health outcomes and the rate of health service utilisation with conventional care. The systematic review examined a wide range of indicators of health service utilisation such as emergency department visits, hospitalisations and exacerbations. The study also surveyed the number of bed-days, the mortality rate and quality of life. The conclusion was that telemedicine is a viable care option with significant effect on reduction in the rate of health service utilisation. With regard to health outcomes, the study indicates an improvement in quality of life in patients with severe COPD, but with no effect on mortality. Similar findings were made in a study by Noel et al. in which elderly high-resource service users with complex co-morbidities were randomised to an intervention group and a control group (Noel, Vogel, Erdos, Cornwall, & Levin, 2004). The study demonstrated that linking data from homebound patients with the health institution's electronic database provides mechanisms for early detection and intervention and a means of devising effective care strategies and reducing unnecessary resource utilisation. Users in the intervention group showed a reduction in related costs of 58% during the project period, but this did not include start-up costs for installation of the new technology. The reduction was attributed to reduction in hospitalisations and emergency room visits plus reduced utilisation of home care employees. The users in this study were also followed up using qualitative scales of satisfaction and quality of life. The study found no change in satisfaction as an effect of the intervention in itself.

However, in the project period, video conferences were held between the patients and nurse stationed at the health centre and this contact with health professionals was a source of added satisfaction for patients in the intervention group. Other studies emphasise that a combination of independent personal connected health and care in the home and constant contact with health professionals either over the phone, by video or in person appears to provide the best qualitative outcomes. The outcomes of this particular study appear to be consistent with this theory.

Although the cost-benefit analyses in the studies above point to savings from implementing personal connected health and care for service users with various medical conditions, it is important to evaluate the associated up-front costs. Paré et al. conducted a quasi-experimental cost-minimisation study with a positive outcome. The study demonstrates net savings of 15% for end users in the intervention group (Paré, Sicotte, St-Jules, & Gauthier, 2006). However, the majority of the savings on reduced health service utilisation in this study were effectively cancelled out by heavy investment in the start-up phase and by increased telephone contact with health professionals in the intervention group. In a subsequent study from 2013 by Paré et al, the technology expense accounted for 38% of the costs of implementing personal connected health and care for users with chronic diseases (Paré, Poba-Nzaou, & Sicotte, 2013). Here, the cost-minimisation analysis demonstrates positive outcomes due to reduced hospitalisations, home visits and emergency department attendances following implementation of personal connected health and care.

A number of articles conclude that telemedicine is a viable care option that has significant effect in reducing the scale of health service utilisation. A majority of the international studies included in this systematic review argue that implementation of personal connected health and care for service users with diverse medical conditions reduces utilisation of health services. Telemedicine is reported as conducive to early-stage detection of disease exacerbations, which results in fewer hospitalisations.

The literature reviewed here indicates that personal connected health and care reduces demand for health services in the form of reduced emergency department attendances and hospitalisations, but also in the form of a reduction in home nursing service visits during daytime hours. The expectation is thus of a substantial cost saving in relation to numerous resource-intensive service user groups.

## Barriers

The sections above have provided a picture of the benefit of personal connected health and care for several patient groups in terms of organisation, patient-related outcomes and cost to the health service. It is, however important to view the international literature with a critical eye. In 2011, Bolton et al. performed a systematic review to evaluate the quality of the literature on telemedicine for COPD patients (Bolton et al., 2011). In the systematic review, the authors examined two randomised studies and four other studies. The conclusion was that the studies show extensive heterogeneity in the patient groups and a general lack of intervention descriptions with respect to technology and organisation. The samples in several of the studies were also too small in size. The interventions varied considerably in type and many included educational elements which in themselves were likely to have positive effects. The quality of the literature was generally low and several studies were conducted by persons biased towards telemedicine, which may have influenced the reported outcomes. The authors conclude that the benefits of personal connected health and care have yet to be proven and that more research is needed in this field.

This was confirmed in a systematic review conducted by Franek in 2012 in which the authors question the benefit of personal connected health and care compared with conventional care (Franek, 2012). The study points to great heterogeneity in the methods and patient samples in the literature. However, this review of the literature still asserts that there is a trend in reduced utilisation of health services from implementation of telemedicine, while emphasising the need for more randomised studies of better quality. Personal connected health and care is contingent on local monitoring, infrastructure and health professionals, and a generalisation of the findings may thus impact the quality of the study.

Two articles in the present systematic review raise questions as to the asserted benefits of personal connected health and care in previously published studies. It is important to emphasise that these evaluations of the international literature concerning personal connected health and care were published in 2011 and 2012, respectively. Much has happened since then. This type of modern medicine is only just emerging in many parts of the world, and while some have made more progress than others, we still have much to learn. Although these systematic reviews were published some years ago, their message is still valid: more research is needed on larger patient cohorts, with follow-up beyond just a single project period, and not least more disease- and technology-specific studies. The socioeconomic impact of telemedicine also needs to be better documented and compared between a more diverse range of health system types in different countries.

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## Appendix 2.

### Norwegian pilot projects

A range of projects have been conducted to pilot and trial personal connected health and care in Norway. The main ones are listed below.

- Examples from Norwegian local authorities: Norwegian Association of Local and Regional Authorities – Health and Personal Connected Health and Care
- Trygge Spor (2011–2012). Funded by the regional research fund Oslofjordfondet, carried out by the independent research organisation SINTEF. A research project involving 55 service users + relatives and nursing and care workers. Demonstrates increased quality of life (peace of mind, freedom, flexibility) for people in their own homes or residing in institutions
  - Challenge: Reception and response → centralised alarm receiving unit. Resolving ethical concerns.
- Aktive Spor (SINTEF, 2014): This project designs apps for smartphones for people with early-stage dementia and their relatives. The aim of the project is for people who have problems finding their way around to benefit from reassurance, freedom and independence when out and about, and for relatives to benefit from a user-friendly tool for supporting this activity. The apps are developed in close collaboration with the end users.
- “Sikker legemiddelhåndtering for den aldrende befolkning” (Safe medication for the ageing population) (Innomed, 2012)
- “Sikker medisiner i hjemmet” (Safe medication at home) will be developing an innovative, quality-assured local authority service for supervision of persons taking prescription medicines (SINTEF, 2014).
- “Trygghetsspakke for hjemmeboende” (Safe-at-home package) (Bærum Municipality and Innomed, 2012)
- Trondheim Municipality: Following a series of pilot projects, this local authority devised goals and strategies for delivery of personal connected health and care in association with the neighbouring municipalities of Malvik, Klæbu, Melhus and Midtre Gauldal (Feb 2014)
- The Central Norway Personal Connected Health and Care Project – projects financed via the county authority. Sporing, Spill, trygg medisinering, memo-plater ved kognitiv svikt (Tracking, Gaming, Safe Medication, Memo-Disc for citizens with cognitive impairment) (Final Report 2014)
- Bærum Municipality: Kristin Standal
- Trondheim Municipality: Kirsti Fosslund Brørs
- Grimstad Municipality: Silje Bjerkås

- Skien Municipality: Has established a demo apartment (Gamle Egdal new homes). Has also conducted a pre-study (InnoMed 2012 report available here).
- Drammen Municipality: Arena Helseinnovasjon/Caretech (personal connected health and care); DRIV Inkubator (start-up incubator) (Hege Eiklid)
- Steinkjer Municipality: “Velferdsteknologisk laboratorium” 2012 – 2015 (personal connected health and care lab). A party to the Central Norway Personal Connected Health and Care Project, and from 2014, the Central Norway Personal Connected Health and Care Network.
- Lister Municipalities – Fyrtårnet Lister (lighthouse project). A consortium of the municipalities of Flekkefjord, Hægebostad, Kvinesdal, Farsund, Sirdal and Lyngdal. In 2014, focused specifically on personal alarms and alarm response centres.
- Larvik Municipality on procuring projects. Service design.

Trondheim Municipality has devised goals and strategies for personal connected health and care (Feb 2014) in association with the neighbouring municipalities of Malvik, Klæbu, Melhus and Midtre Gauldal. The motivation for targeting personal connected health and care is described as follows:

- a key resource in responding to the future’s demographic challenges.
- Preventing falls, loneliness, and cognitive impairment.
- Helps to empower individuals to cope with everyday life and health, on their own terms.
- Can assist people who require health and care services to stay living at home for longer and thereby postpone the time they would otherwise have to move into a nursing home for shorter or longer periods.
- Underpins the objective of universal design throughout Norway by 2025.
- Can improve the quality of services, increase flexibility and contribute to better occupational health and safety.
- Promotes innovation in health and care services and creates new arenas for co-creation with communities, relatives, volunteers, non-profits, academia and business and industry.
- Helps to drive innovation and better coordination and service delivery between local authorities and other welfare services providers.
- Fosters public- and private-sector value creation and has the potential to evolve into a new and significant domestic and international export industry.
- Has the potential to benefit the national economy.



## Appendix 3.

### Learning from Denmark

Fredericia Municipality in Denmark designed an organisational model for reablement called *Længst mulig i eget liv* ('Lifelong Living – Maintaining Everyday Life as Long as Possible') (Helene Bækmark). The local authority established a special unit for reablement of new citizens with reablement potential. This was found to have a positive effect and is commonly used as a best-practice standard for reablement in Norwegian local authorities. The local authority of City of Odense elaborated on the model.

“The project concerns a newly established specialised home care unit with a large team of therapists assigned to reablement of new citizens with reablement potential”.

‘Lifelong Living’ and reablement services aim to empower the future elderly population for greater self-reliance.

- Center for Personal Connected Health and Care, City of Odense
- Fremtidens plejehjem, Et blikk inn i fremtiden fra Danmark (Nursing homes of the future; looking to the future from Denmark)
- Århus kommune, Velfærdsteknologi (City of Aarhus, personal connected health and care unit)

## Appendix 4.

### Privacy policy

Data retention in the project is for the purposes of research and statistics.

Data processing in the project is exempt from the entailed licensing obligation in accordance with Chapter 7 of the Regulations on the processing of personal data (*Personopplysningsforskriften*) because the data are to be used for preparation of statistics (Section 7-25); are to be used for a research project; and the personal data in the dataset will be pseudonymised and de-identified (Section 7-27).

Over the course of the project period, personal data will be pseudonymised (Norwegian Official Report 2009:1). This is taken to mean that personal data are to be erased and linked to a unique synonym to make it possible to follow individuals and their relatives over time through the healthcare system without disclosure of their identity. Upon conclusion of the project period, all personal data will be

de-identified. This means that the data that enable pseudonyms to be matched with personal data will be erased.

In order to be able to contact individuals for follow-up interviews, it will be necessary to create a list of addresses in which pseudonyms can be matched with the subjects' name and address. In order to preserve the confidentiality of the address list, the following precautionary measures will be implemented.

A data controller subject to a nondisclosure agreement will ensure secure retention of the address list. The address list will be encrypted and retained in a single instance by the data controller. The address list will be erased after 2 years to ensure de-identification of personal data.

#### The following personal, non-sensitive data will be retained:

- Name and address: Pseudonymised and de-identified The data controller retains an address list to enable individual cases to be followed up during the project period. The address list in which pseudonyms will be identifiable will be erased after two years.
- Sex, age, non-Norwegian first-language (if relevant)
- Diagnosis and or healthcare needs (principal diagnosis). Solely diagnoses that make the service users eligible for use of an assistive device (for example COPD, mobility impaired)

The purpose of the research project is a benefit evaluation of personal connected care used to promote personal safety. The end users (patients, relatives and health professionals) will be interviewed about their experiences of using the technology. In other words, no health data will be retained. The data obtained will be used for statistical purposes and in certain cases, individuals will be referred to under pseudonyms as illustrative examples.

The interviews will require private visits. The interviewer (data controller) will therefore need to know the name and address of the interviewees. In interview notes and in all reports, personal data will be pseudonymised. Individuals will, however, need to be able to be followed up over time and follow-up interviews will be conducted with, for example, “Patient A”, “Patient A’s relative”, “Patient A’s occupational therapist”. It will thus be necessary to maintain a table of personal data and their unique pseudonyms for the purposes of such follow-up.

The data controller, Intro International, will create an address list in which names and addresses are linked to a unique pseudonym for use in follow-up interviews with, for example, “Patient A” after 12 months. Only a single copy of the address list shall be retained and stored in encrypted format by the data controller.

### **Informed consent form:**

All interviewees in the address list are required to sign an informed consent form. Consent is “a voluntary, explicit and informed declaration by the data subject that he or she agrees to processing his or her personal data”. The informed consent form states explicitly the nature of data that may be retained, what such data may be used for, and that identifiable data will be omitted from all reports and notes in the project.



## Contact details

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