
Smart Living in Dementia Care

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Abstract

In order to provide adequate care and housing to the growing number of people with dementia, new technologies are necessary to provide good care and reduce the costs for these care services. Numerous technologies are available, which decrease the need for care and increase the self-reliance of clients and support relatives or professional carers. This chapter discusses the use and implementation of e-health technologies and provides an overview of recommendations on how to start using

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technology for people with dementia in an efficient and effective way. E-health technologies may reduce the number of falls and improve one's quality of life, both for people with dementia and their family carers. For family carers, the technology makes life easier and accounts for a reduction of time spent on caring, improved independence, and a diminished occurrence of depressive feelings. In the field of work satisfaction of professional carers, little research has been done. There are many design and implementation challenges concerning technology for people with dementia, which can lead to the success or failure of technology in dementia care.

Keywords

Dementia • Alzheimer • Ageing-in-place • Nursing home

Introduction

Dementia is an umbrella term for different types of progressive brain disorders, which cause a person to encounter a serious loss of cognitive ability and functional loss in daily life. Dementia affects a person's memory, thinking, behavior, and ability to cope with everyday activities. There are about 45 million people with dementia worldwide, and this number will increase to an estimated 75.6 million in 2030 and 135.5 million in 2050. Much of this increase can be found in the developing countries. Already 62 % of people with dementia live in developing countries, but in 2050 this will have risen to an estimated total of 71 %. The fastest growth in the older population is taking place in China, India, and their South-Asian and Western-Pacific neighbors (Prince et al. 2013).

In order to provide adequate care and housing to this growing number of people with dementia, new technologies and innovations are necessary to provide good care and reduce the costs for these care services. In addition, there is a trend in the developed countries to stimulate people to continue living in their own homes for as long as possible. In the case of dementia, this creates a high burden for family carers, who are the ones who have to step in for additional support that can be considered as very stressful. Over the last decade, different technologies indeed have been developed for the support of care for people with dementia. The aim of these technologies is to decrease the need for care, increase the self-reliance of clients and to support relatives or professional carers. Advanced forms of technology are not used by residential care settings only but also at people's own homes.

This chapter discusses the use and implementation of e-health technologies and provides an overview of recommendations on how to start using technology for people with dementia in an efficient and effective way.

Possibilities of Emerging Technologies

In 2013, Nijhof (2013) published studies on a wide array of technologies that are used for the administration of e-health (Kort and van Hoof 2012) to people with dementia in home-based and residential care:

- Sensor and signaling technology, which generates an alarm when a dangerous situation occurs. Examples are emergency response systems or sensors which register if someone leaves the gas stove on or falls down.
- Social contact technology (related to social behavior). Examples are video contact systems, social robots, and games using technology or a multimedia system.
- Monitoring technology (registering behavior patterns of people). Examples are GPS-based (global positioning system) technologies and sensor technology. Another example is the Actiwatch, a watch which can measure the sleep and wake pattern by the movement of the hands, the body temperature, and heartbeat.

The work encompassed a literature study (Nijhof et al. 2009) which covered 18 international and 8 national studies. Several studies showed effects on behavior (fewer falls) and improved quality of life, both for people with dementia and their family carers. For family carers, the technology makes life easier and accounts for a reduction of time spent on caring, improved independence, and a diminished occurrence of depressive feelings. In the field of work satisfaction of professional carers, little research has been done. To sum up the results of the studies, national studies do not show any effects, and some international studies show some small changes in work satisfaction with the use of technology in a nursing home. Several problems have been identified for the early phases of a project, including high investment costs for the technology, the occurrence of failures and interruptions, and a lack of a successful overall implementation.

An additional four case studies were carried out in which e-health solutions for people with dementia were evaluated (Nijhof et al. 2012, 2013a, b, c) (Text Box 1). The evaluated e-health technologies can be divided into social contact technologies on the one hand and monitoring technologies on the other hand. The monitoring technology used in a situation at one's own home was a preventive sensor technology system. The other monitoring technology in residential care was a smart watch which measured one's sleep-wake pattern. The social contact technology at one's own home was a supportive touch screen, and in residential care an interactive game was used to stimulate social contact between the people with dementia. The first results of the use of e-health for people with dementia in home-based and residential care are positive. Technologies were shown to support the well-being of people with dementia and that of their family carers. In addition, improvements in the care tasks of professional carers were observed. Furthermore, cost savings were achieved by letting people age-in-place for a longer period of time. The overall implementation was, however, not well organized in many of the projects and needs more attention.

**Box 1 Four Evaluations of e-Health Technologies from the Netherlands
Preventive Sensor Technology for Dementia Care**

A commercially available monitoring system (ADLife by Tunstall, Fig. 1) for older people with dementia living at home was evaluated (Nijhof et al. 2013a).

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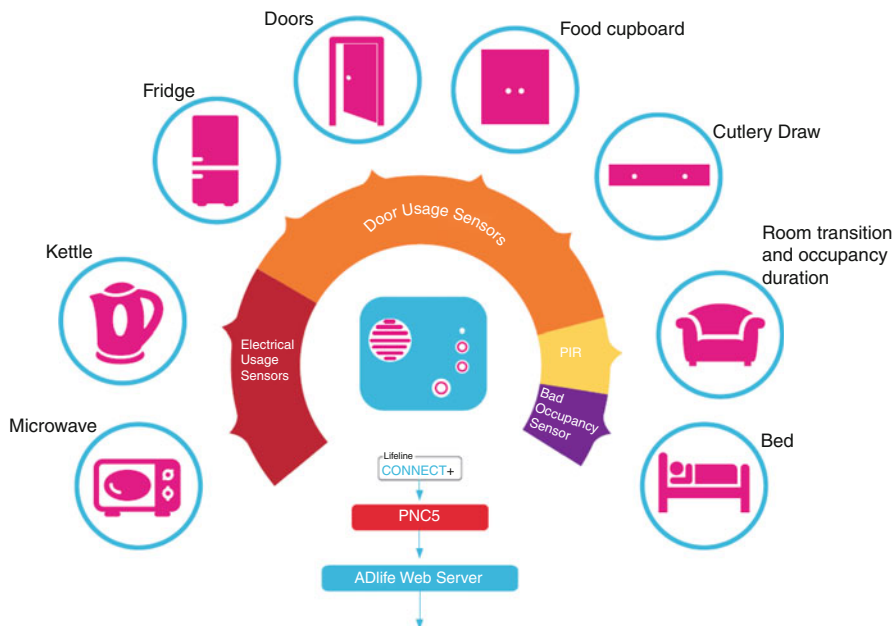


Fig. 1 Schematic overview of the ADLife system

The system was designed to detect problems before they require crisis intervention. Fourteen clients from two healthcare organizations used the system over a 9-month period. The formal and informal carers were interviewed, project group meetings were observed, nurse diaries were analyzed, and a cost analysis was performed. Clients and informal carers reported enhanced feelings of safety and security as a result of having the system installed in the home. The system appeared to reduce the burden of care on the informal carer and had the potential to allow people to live at home for longer. There were financial savings for clients staying at home with the technology compared with the costs of staying in a nursing home: for ten clients living at home for 2 months, the savings were € 23,665. The study showed that the monitoring system represents a potentially useful early warning system to detect a situation before it requires emergency intervention.

The Use of Smart Watches in Nursing Homes to Monitor Sleeping Behavior

The effects of a smart watch measuring the sleep-wake rhythm of residents with dementia were evaluated (Nijhof et al. 2012). The IST Vivago Watch (Fig. 2) was worn on the wrist and measures micro and macro movement, skin

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Fig. 2 The Vivago Watch being worn by an older user



temperature, and skin conductivity. Measurements for sleep monitoring given include measurements of sleep time and circadian rhythmicity. For the study, seven nursing home residents with severe dementia and a disturbed sleep-wake rhythm wore the Vivago Watch for 6 months. In addition, carers were asked to keep a diary for 3 months to provide insights into the use, usability, interventions, and effects of using the watch. A carer was also studied during a normal weekday, while a researcher kept a descriptive log of events, and interviews were conducted by the researcher with five carers, to gain insights into research questions regarding the introduction of the watch, its usage and usability, interventions taken based on using the watch, and the effects of the device on the sleeping behavior of the residents. Interventions based on the watch showed generally positive results in the sleep time period and circadian rhythm for the residents. Carers found that the watch made it easier to coordinate care during day and nighttime, including the administering of sleep medication and the coordination of care activities.

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Fig. 3 The PAL-4 system

A Personal Assistant for Dementia to Stay at Home Safe at Reduced Cost

The commercially available PAL4-dementia system (Fig. 3), a supportive touch screen for people with dementia, was evaluated (Nijhof et al. 2013b). The main purpose was to study the advantages and disadvantages of the system from the perspective of the client, family, and professional carer and the potentials to upscale its use. The evaluation was conducted over 9 months with 16 clients of two healthcare organizations. A mixed-method design was used in this pilot, involving log files of system use, interviews with family carers, a focus group made up of professional carers, observations of project group meetings, and a cost analysis. Clients and family carers reported good support of daily life activities. They thought the system could help the client to live at home for a longer period of time. The cost analysis showed monthly savings per client as compared to living in a nursing home ranging from around € 820 (10 clients) to € 860 (50 clients). Despite these positive results, numerous problems were detected: (i) interruptions of technology, (ii) insufficient operation knowledge of professional caregivers, (iii) insufficient active involvement of family carers, and (iv) limited user-friendliness of the layout.

The Chitchatters: A Technology-Supported Leisure Activity

A technology-supported leisure game for people with dementia, called The Chitchatters (Fig. 4), was evaluated in relation to the stimulation of social behavior (Nijhof et al. 2013c). The technology-supported game aimed to stimulate social behavior and interaction among participants via its design features, including a TV, radio, telephone, and treasure box. The additional

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Fig. 4 The prototype of the game activity in use at the care center for psychogeriatric clients

impact of the game activity on behavioral outcomes of people with dementia in a nursing home and daycare setting was evaluated in comparison to a traditional leisure activity. A mixed-method research design was applied. Ten participants were observed in multiple rounds of observations. In addition, interviews with the activity facilitators were conducted. Social behavior was found to occur more often than nonsocial behavior during the sessions, in particular, due to making comments by the participants. Participants with progressed stages of dementia scored higher for nonsocial and nonverbal behavior. Female participants scored higher for social behavior than males. Activity facilitators stated that the technology-supported leisure activity helps them with their professional tasks. A technology-supported game can stimulate communication and social behavior among players with dementia. Moreover, it helps activity facilitators in making activities more person centered.

Critical Approach Towards the Use of Technology

Although there are reasons to be optimistic given some of the preliminary positive results listed above, there is still room for improvement. In the field of technology for people with dementia, there are numerous initiatives, using technologies that can sometimes yield unwanted side effects, such as confusion and unwanted behaviors, or using technologies that do not work at all in practice (Van Hoof et al. 2011). For instance, we see several examples of automatic curtains opening and shutting seemingly without an operator, or lighting switching on and off automatically,

which sometimes creates confusion, restless behavior, or feelings of anxiety among people with dementia. This may, at the same time, also lead to diminished self-care capacities among people with dementia. The wrong use of technology, which can be caused due to a lack of skills among carers, can contribute unfavorably to a project's success. This is particularly the case for the older carers; younger people tend to be more experienced in, and more open and embracing towards, the use of modern technologies. A professional carer may come up with critical feedback, which sometimes leads to changes in the system, but more often to not using the technology at all, as a result of dissatisfaction, stress, or irritation.

Three reasons exist for the problems mentioned above. Only a small number of systematic studies have been conducted worldwide, which dealt with the effects of technology for people with dementia, even though several good arguments exist for the use of technology. Most of the design guidelines that are currently used by developers of new technologies are not more than a collection of practical experiences of pioneers. A second cause is the technology push that can be witnessed in society and which is embraced by a multitude of enterprises selling technologies on the marketplace. This technology push is also caused by the urgency of cost savings and shortages of skilled professional carers on the labor market. Technology is seen as an attractive product which can support care and well-being, even though the evidence base for technological interventions is weak, albeit on the rising. The last cause is the fact that the technology is not implemented in the proper way, even though millions of euros are spent on technological interventions in healthcare. Arguments heard in healthcare are that including the technology creates additional work and tasks, healthcare becomes less personal, the implementation of technology is costly, technology malfunctions most of the time, and so on. These arguments are often rooted in a poorly organized implementation procedure. A well-organized support or backup system is essential for a successful implementation of technology in dementia care. The technology is often implemented in addition to existing care regimens, instead of an implementation within the existing care regimens. In other cases, the situation is even worse, when technology is used, but without any clarity which problem the technology is going to fix in the first place, or what the direct goals of the use of technology are. Examples of such goals are that the five persons working during the night shift should be brought back to three or that the score for quality of life for persons living in residential care should be improved by 20 %. In conclusion, the implementation of technology in healthcare is not just a matter of product innovation but even more a matter of basic service innovation.

How to Use Technology in Practice?

There are many recommendations for the successful use and implementation of smart home technologies in dementia care. First of all, it is necessary to make a distinction between the use in residential care and in the home environment. The use of technology in these two places is quite different, mainly because of the various stages of dementia and the accompanying problems which occur.

When considering the use of technology in residential care, there are many ethical considerations concerning the use of surveillance technologies. These considerations are described by Niemeijer et al. (2011). Apart from the ethical considerations, there are other recommendations that can be followed. For instance, it is of the utmost importance to choose a set of technology which requires no learning by the client on how to use the system. The new technology should look familiar, not take away control from the user and just have a minimum of interaction with the user. The technology should reassure the user, for example, by showing a green light when someone did the right action (Orpwood et al. 2005). Complex technology should not be visible and the effects of technology should not be invasive or unrecognizable. The technology should be integrated into a design which resembles an item from one's past. For instance, a toilet which flushes automatically should still have a pull cord which people can use to flush the toilet. Despite the emergence of tablet computers which increasingly replace touch screens, it is not always evident for people with dementia that they can operate a system by touching a screen when they are not assisted by a relative or a professional carer. For technology used at home, the user-friendliness and ease of use are extremely important. The design of technology should ideally be done together with family carers and people with dementia in so-called co-creation sessions in order to optimize this ease of use.

In addition to the technology itself, the implementation is equally important. In residential care, the care processes should be redesigned, and professional carers should be educated in order to see the benefits of the use of technology and in order to be able to use technology within the required set of tasks. The involvement of professional carers right from the beginning can optimize the implementation process and prevent feelings of irritation or frustration afterwards. At home, a support system is essential in the early phases of the implementation of technology, including a help desk and a service worker. Having access to a professional carer who has experience with people with dementia and is skilled (and regularly trained) in the use of technology is a precondition for a successful implementation.

A natural way of getting people with dementia and their spouses acquainted with new technologies is to start using technologies which aim to improve well-being and comfort. This could, for example, be a wake-up light, which stimulates waking up with the use of light. One step further is monitoring technology, which can monitor the activities of daily living of a user and any deviations of regular patterns. The next step would be technologies that can be used for the support of the person with dementia, for example, a GPS-based track and trace system in case of wandering behavior. The fourth step would be technologies that substitute human activities, including automated curtains, which can be installed when a user is no longer able to move around freely. Ideally, the four types of technology should be integrated with existing household appliances, in order for a person to be able to use these technologies without having to learn how to do so or without the need for buying new technologies. For instance, a regular lamp could be used as a wake-up light. Moreover, the lamp could be used to monitor if someone gets up in the morning and turns on the light, and thereafter, the lamp will create a day and night rhythm for the user if it registers a deterioration in the sleep and wake cycle.

Adlam et al. (2004) identified a number of recommendations for the work of installers. Whenever a professional with a background in technology installs technology, it is important that all questions from the user (even the ones that are repeated) will be answered and that the installer listens carefully and considers the whole client system (wishes from the client, professional, and relatives). Additionally, it is necessary to train the installers in the heterogeneity and health problems of the older population, including the specific needs related to dementia. Furthermore, people with dementia need a quick response if interruptions in the technology occur, because they are not able to understand these interruptions and cannot get around them. In order to create a successful use of technology, it is necessary to train all the involved users. Installers should also realize that the technologies they install for the benefit of the person with dementia may not be enough to meet all needs. Simple and more complex home modifications may be necessary as well, in order for people to move around the house or care facility or receive support of activities of daily living, for instance, bathing (van Hoof et al. 2011).

In conclusion, the right design and a well-organized implementation and installation are essential elements for the right use of e-health technologies in dementia care.

References

- Adlam T, Faulkner R, Orpwood R, Jones K, Macijauskiene J, Budraitiene A (2004) The installation and support of internationally distributed equipment for people with dementia. *IEEE Trans Inf Technol Biomed* 8(3):253–257
- Kort HSM, van Hoof J (2012) Telehomecare in The Netherlands: barriers to implementation. *Int J Ambient Comput Intell* 4(2):64–73. doi:10.4018/jaci.2012040105
- Niemeijer AR, Frederiks BJM, Depla MFIA, Legemaate J, Eefsting JA, Hertogh CPM (2011) The ideal application of surveillance technology in residential care for people with dementia. *J Med Ethics* 37:303–310. doi:10.1136/jme.2010.040774
- Nijhof N (2013) eHealth for people with dementia in home-based and residential care. Dissertation, University of Twente, Enschede, The Netherlands
- Nijhof N, van Gemert-Pijnen JEW, Dohmen D, Seydel ER (2009) Dementie en technologie. Een studie naar toepassingen van techniek in de zorg voor mensen met dementie en hun mantelzorgers. *Tijdschrift voor Gerontologie en Geriatrie* 40(3):113–132. doi:10.1007/BF03079573
- Nijhof N, van Gemert-Pijnen JEW, de Jong GEN, Ankoné JW, Seydel ER (2012). How assistive technology can support dementia care: a study about the effects of the IST Vivago watch on patient's sleeping behavior and the care delivery process in a nursing home. *Technol Disabil* 24(2):103–115. doi:10.3233/TAD-2012-0339
- Nijhof N, van Gemert-Pijnen JEW, Woolrych R, Sixsmith A (2013a) An evaluation of preventive sensor technology for dementia. *J Telemed Telecare* 19(2):95–100. doi:10.1258/jtt.2012.120605
- Nijhof N, van Gemert-Pijnen JEW, Burns CM, Seydel ER (2013b) A personal assistant for dementia to stay safe at home and reduce costs. *Gerontechnology* 11(3):469–479. doi:10.4017/gt.2013.11.3.005.00
- Nijhof N, van Hoof J, van Rijn H, Gemert-Pijnen JEW (2013c) The behavioral outcomes of a technology-supported leisure activity in people with dementia. *Technol Disabil* 25(4):263–273. doi:10.3233/TAD-140398

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- Orpwood R, Gibbs C, Adlam T, Faulkner R, Meegahawatte D (2005) The design of smart homes for people with dementia – user-interface aspects. *Univ Access Inf Soc* 4(2):156–164
- Prince M, Guerchet M, Prina M (2013) Policy brief: the global impact of dementia 2013–2050. Alzheimer’s Disease International, London
- van Hoof J, Kort HSM, Rutten PGS, Duijnste MSH (2011) Ageing-in-place with the use of ambient intelligence technology: perspectives of older users. *Int J Med Inf* 80(5):310–331. doi:10.1016/j.ijmedinf.2011.02.010