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# To Use or Not to Use: The Design, Implementation and Acceptance of Technology in the Context of Health Care

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## Abstract

Technology in general, and assistive technology in particular, is considered to be a promising opportunity to address the challenges of an aging population. Nevertheless, in health care, technology is not as widely used as could be expected. In this chapter, an overview is given of theories and models that help to understand this phenomenon. First, the design of (assistive) technologies will be addressed and the importance of human-centered design in the development of new assistive devices will be discussed. Also theories and models are addressed about technology acceptance in general. Specific attention will be given to technology acceptance in healthcare professionals, and the implementation of technology within healthcare organizations. The chapter will be based on the state of the art of scientific literature and will be illustrated with examples from our research in daily practice considering the different perspectives of involved stakeholders.

**Keywords:** technology use, technology acceptance, human-centered design, healthcare professionals

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## 1. Introduction

In order to face the challenges of demographic changes [1], i.e., an aging population and the high prevalence of chronic diseases, smart digital solutions are promising. However, implementing technological innovations in the domain of health and well-being has been found to be difficult [2, 3]. Difficulties in the implementation at scale are related to barriers at three levels: a macro level, such as market readiness and national policies [3, 4], a meso level, in

which industry and health service readiness are main themes [3]. The focus of this chapter is on technology adoption at the third level, that is, the micro level, which is the level of the actual user. Assistive technology has two main user groups, i.e., healthcare professionals and patients/clients. Therefore, we will discuss issues around technology adoption in general *and* with specific focus on healthcare professionals, as they are usually facilitators for the uptake of technology in care practices. In Section 2, we will first discuss challenges in the design and implementation of assistive technology, including the vision of human-centered design, followed by theories on technology acceptance *in general*, and the readiness of technology uptake of healthcare professionals. In Section 3, we will present some examples of recent practice based research to illustrate the presented theories and elaborate on the perspectives of different stakeholders and their mutual relationships in the use of technology in health care.

## 2. Challenges in the design and implementation of technology in health care

### 2.1. Human-centered design of assistive technology

In order to ensure an optimal match between the technological product or service and the person who will use it (or is otherwise affected by the technology), it is important that all stakeholders are involved in the whole process of design, development and implementation. Over the last decades involving users and other stakeholders already in the design of new products and services has become standard and is commonly denoted as human-centered design [5, 6], participatory design [7], or co-design [8, 9].

Central in any human-centered design approach are the following aspects: empathy, collaboration and experimentation [5, 6]. *Empathy* is our ability to see the world through the eyes of someone else, to see what they see, feel what they feel and experience things the way they do [10]. The ability to be empathic is vital in order to not project one's own preconceived ideas to the design of new products and services, but really incorporate the (sometimes latent) needs and wishes of the people designed for. Empathizing with the users, understanding them and bringing them along in the design process are essential basic principles of any human-centered design process.

*Collaboration.* The challenges in our current society (also for the design of new assistive technology) are so complex that they cannot be solved by a single designer. Instead, they require a design team consisting of specialists with different backgrounds, not only interaction designers or industrial designers, but also psychologists, engineers, business people, care professionals and the intended users.

*Experimentation.* When solving complex issues it is unlikely that the design team will come up with the optimal solution at the first guess. Therefore, experimentation is central in the human-centered design process. The process entails multiple cycles of ideation, refining and improving the design, allowing the design team to have multiple ideas, to try out various approaches, to be creative and to arrive at successful solutions more quickly. Very early in the design process a first prototype of the design is built and tested. Watching users interact with the prototype and asking them what they think and experience while using it, provides relevant feedback on

the basis of which improvements can be made to the design. This learning-by-doing approach to design allows new ideas to be tried out without running too much risk. It ensures that the design optimally matches the wishes and needs of the users.

Human-centered design will lead to products and services that better match the needs and wishes of the users, and thus will be purchased easier and create more impact. Moreover, involving patients and care professionals as well as other stakeholders in the development process, also creates more support among them for the product or service. When they play a role in the development process, they will be more inclined to act as ambassadors and to stimulate others to use the product.

In the human-centered design process three main phases can be distinguished: the *inspiration phase*, the *ideation phase* and the *implementation phase* [6]. Each human-centered design process will go through each of these three phases at least once. However, the process is not always sequential, rather it may consist of several iterations of going back and forth through the different phases while rethinking and refining the design, based on feedback of the people designed for.

The *Inspiration phase* is about empathizing with the people designed for, getting to know them and trying to understand what they feel, think and experience. In this phase the design team will be talking to people and observing them in their own context.

In the *Ideation phase* creative solutions are generated for the design opportunity that has been identified in the inspiration phase. Still early on in the design process, one or two of the most promising ideas will be concretized into a prototype. The prototypes are tested and feedback is collected from users, which will be the basis for another iteration of refining the idea, prototyping and testing.

In the *Implementation phase* the end product or service is developed and put to use with real users. In this phase the product or service is also evaluated: does the product do what it is supposed to do, is it effective? In the implementation phase it becomes apparent whether the technology is accepted by the users or not.

## 2.2. General models explaining the use of technology

In this section *general* models that explain factors and circumstances influencing the use of technology, are presented. Although mostly developed within general workplace situations, they can also help to understand acceptance of assistive technologies in specific contexts, e.g., within healthcare situations.

With the exponential growth of the use of technology in several domains, specific models have been developed to explain technology use. The most important and well known models are the Technology Acceptance Model (TAM) [11] and the Unified Theory of Acceptance and Use of Technology (UTAUT) [12]. The core of the TAM is the perceived *usefulness* and *ease of use* of the to be used technology. In several domains, up to 40% of the variance of the intention to use technology in several domains, including health care, is explained by the TAM [13].

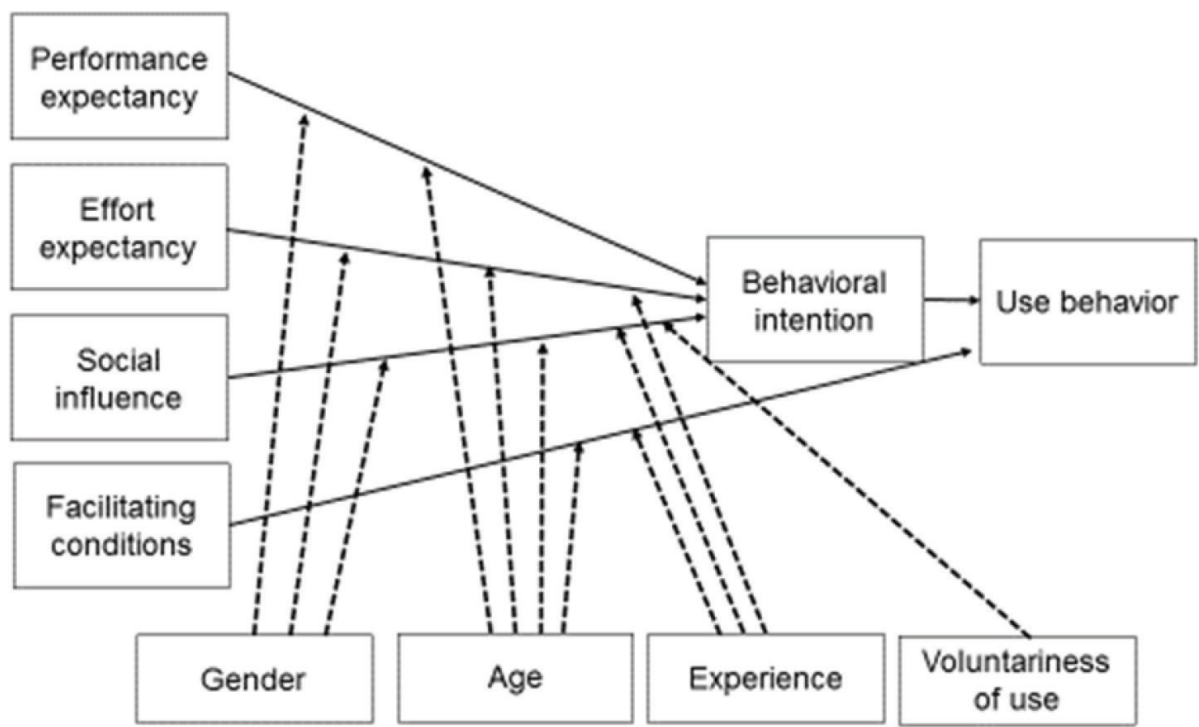
In UTAUT [12, 14], the TAM was further refined into a model that could explain up to 70% of the variance of the acceptance and use of technology. The UTAUT not only includes ease of use (redefined as 'effort expectancy') and usefulness (redefined as 'performance expectancy')

as explanatory factors, but also social influence. These three factors influence behavioral intention and thus, indirectly, use behavior. Apart from that, facilitating conditions are defined, which directly influence use. Finally, a set of five moderating factors are distinguished, being gender, age, experience (with technology) and voluntariness of the use of the technology (Figure 1) [12].

Of these factors, *performance expectancy*, is the strongest predictor. Performance expectancy refers to the degree in which a person expects technology to be helpful for doing a job. *Effort expectancy* indicates how easy a person thinks that the technology is in its use. *Social influence* refers to the degree in which an individual thinks important others think he or she should use the technology [12]. *Facilitating conditions* are supportive infrastructures (both organizational and technical) that facilitate the use of the technology.

2.3. Technology acceptance and implementation in healthcare organizations

In the adoption of assistive technology, the views of many stakeholders influence the ultimate successful implementation of technology and the delivery of technology at scale. In this section, we will describe the perspective of healthcare professionals (Section 2.3.1) and we will describe the Normalization Process Theory as the theoretical framework to explain how individual professionals within healthcare organizations understand and integrate new technologies into their own daily practice (Section 2.3.2) [15, 16].



Source: Venkatesh et al, User Acceptance of Information Technology: Toward a Unified View; MIS Quarterly, Vol. 27, No. 3 (2003), p. 447 [11]

Figure 1. The Unified Theory of Acceptance and Use of Technology (UTAUT) [12].



### *2.3.1. Acceptance by individual healthcare professionals*

Many healthcare professionals working in healthcare practice nowadays, do not consider technology routinely as an important solution for health problems [17]. Several factors can explain this often problematic adoption of technology [18]. One main factor is the fear that technology interferes with the relationship with the patient [18]. Care professionals worry about, e.g., the quality of the contact with patients through eHealth. Professionals who are familiar with this form of caregiving, are far more positive, although they approve contact with a 'well-known' professional in a blended construction over purely digital relationships, e.g., exclusively via a call center [19].

Another important barrier for the uptake of technology in healthcare practice is the change in work processes that it requires. In practice, new technologies are often introduced as pilot projects [18]. These projects are in most cases temporary, and therefore they are not integrated into daily routine. As a consequence, professionals perceive these new technologies as something extra on top of their work, thus mainly increasing their work load. EHealth technology is also considered to cause additional responsibilities rather than provide an opportunity to do the care work in a more efficient manner. For instance, the introduction of telemonitoring in the care practice for patients with chronic heart failure poses the question of responsibility between patients and professionals: who is responsible for which data and how and when should one react [20]?

The reconsideration of patient-professional relationships is another barrier, closely related to the issues concerning changed work processes and responsibility. The use of self-monitoring technology leads to a shift towards patients' self-management, which leaves professionals worried about patient safety. Especially with vulnerable patients, professionals are hesitant to rely on technology and prefer face-to face contact [21].

Finally, technical issues interfere with the uptake of technology by healthcare professionals, such as interoperability, installation issues, and user friendliness [22].

There are also factors that facilitate the implementation of technology by healthcare professionals. Facilitators of technology uptake are the so called 'clinical champions', enthusiastic ambassadors and leaders of innovations within an organizations [18, 23]. Apart from leadership, also training and support of professionals are important, in order to develop confidence in the technology and the accompanying changes in work process and role [22, 24]. Finally, involving relevant stakeholders in the *design* of technology, especially patients or citizens and healthcare professionals, improves the adoption of technology and facilitates the process of implementation and transformation into self-management by patients [18, 22]. In Section 3, 'human-centered design', we will elaborate on this topic.

### *2.3.2. Implementation of technology within healthcare organizations: normalization process theory*

As described in Section 2.3.1, there are many factors influencing the intention to use and the actual use of assistive technologies by care professionals. In this section, we will describe the dynamics of technology use in health care explained by a sociological theory, the Normalization

Process Theory (NPT) [25], in which these, partly interdependent factors, can be summarized into a framework.

NPT describes what actually happens in practice, not the behavioral intention for using a (technological) innovation. The NPT comprises four constructs, being: *Coherence*, *Cognitive participation*, *Collective action* and *Reflexive monitoring* [15, 26].

*Coherence* is the extent to which professionals working together with the technology attribute the same meaning or importance to the system; do they have the same values or ideas about the (new) system and are they aware of changes in their individual work processes?

*Cognitive participation* refers to the work that is done to enhance the engagement and involvement of all relevant stakeholders and their motivation to stay involved. This means that great effort has to be taken, especially at the start of a program, to invest in good leadership and ambassadors, and the continuous involvement of everybody.

*Collective action* means what is actually done in practice while working with the technology, to facilitate the use of it. Several factors play a role here, e.g., financial support or time investment and sufficient management support. Also a workable system, a good help-desk and other technical support, as well as training, is crucial. And, most importantly, transparency on responsibilities of all involved professionals.

*Reflexive monitoring* is the final construct of the NPT, which in practice is often forgotten or neglected. It refers to the evaluation after implementation of the technology: has it brought what was expected for all stakeholders, what are elements that need improvement, are all stakeholders still involved?

### 3. Examples of practice-based research

#### 3.1. Introduction

In this section, we will show examples from recent research at Fontys University of Applied Sciences, nursing faculty that illustrate the theory presented in Sections 2 and 3 and add practice based knowledge to these theories from a multi-perspective view. As has been illuminated in Section 2, the uptake and use of technology in health care, can be explained by several general models such as MAO, TAM, UTAUT and the Normalization Process Theory. It was pointed out that the strongest predictor for the use of the technology is the degree in which the user expects technology to be helpful for doing a job (performance expectancy). Users of technology in the context of health care are mainly healthcare professionals, care recipients but also significant others such as managers and next of kin.

Since in the adoption of technology in daily practice the views of the users of technology are critical, we aimed to expand the knowledge on users' views on the impact of technology. Apart from considering factors such as usefulness and ease of use, and changes in professional roles and care processes, we also explicitly wanted to include the patient-healthcare professional relationship and also refer to important others who are close to patients. It is important to acknowledge that technology can change relationships between healthcare professionals

and care recipients and their loved ones [17, 27]. These changes can create opportunities for new and meaningful connections between them, but they also pose moral questions that may interfere with successful implementation of technology in practice.

Research questions formulated were:

1. How does the introduction of new technology change relationships between healthcare professionals, service users and significant others?
2. What values and beliefs do healthcare professionals, service users and significant others have, related to technology?
3. What kind of dilemmas arise when using technology, for instance when technology interferes with certain values?

### 3.2. Methods

Nine studies focusing on the implementation phase were carried out, aiming to expand our knowledge on the impact of technology in care and wellbeing and how it contributes to the relationships between different stakeholders. We collected evidence, in and from practice, related to the personal perspectives of healthcare professionals and primary service users (patients, citizens, clients) as well as significant others (managers, next of kin), with regard to the use of assistive technology. Three different applications of eHealth were involved: telecare, telemonitoring and the use of surveillance technology.

A qualitative design, using interviews, as well as focus groups, was used. This enables revealing subtle changes in relationships and is helpful in exploring beliefs and values of healthcare professionals and service users. In each study data from interviews and focus groups were audio recorded and transcribed verbatim, with the interviewer keeping additional field notes. Member check was carried out by means of summaries to assess the researchers' understanding and interpretation of the input of the participants. Data were analyzed using thematic analysis by Braun and Clark [28]. In order to generate initial codes, in each project two researchers coded the transcripts independently. One of the researchers had not collected data and acted as peer reviewer to warrant trustworthiness. Once all data had been initially coded, the different codes were sorted into potential themes. After construction of concept themes, the themes were refined based on the criteria that all data within themes should cohere, while there should be clear and identifiable distinctions between themes [28]. In the last phase themes were defined by describing the meaning, the scope and content in a couple of sentences.

### 3.3. Telecare

Five qualitative studies focused on the beliefs and values about, and experiences with telecare for, mostly elderly, people who live independently at home.

Telecare in these studies involved real-time contact between a home-dwelling service user and a healthcare professional using a display screen with an audio-visual connection (see **Figure 2**). The service offered practical support, such as medication intake, or cues for day structure, exercises, reminders for toileting or food intake, as well as emotional support with



respect to symptoms of depression. Data in these studies about telecare come from interviews with 36 healthcare professionals, 31 service users and nine managers. The level of experience of the respondents with telecare varied (**Table 1**).



Illustration by Mariëlle Rosendaal

**Figure 2.** Impression of telecare.

Topics	Experience with telecare within the organization	Method	Population
Experiences with and beliefs about telecare	Over 10 years of experience	Semi-structured interviews with healthcare professionals and service users	Seven healthcare professionals and eight service users
Hopes, fears and expectations about telecare	No experience with telecare	Two focus groups with healthcare professionals and semi-structured interviews with service users	Fourteen healthcare professionals and five service users
Experiences with and beliefs about telecare	Experience varies between organizations (from no experience till over 10 years of experience)	Semi-structured interviews with managers	Nine managers
Experiences with and beliefs about telecare	4 Years of experience with telecare	Semi structured interviews with healthcare professionals and service users	Six healthcare professionals and eight service users. Of these respondents four healthcare professionals and four service users had experience with telecare
Experiences with and beliefs about telecare	2 Years of experience with telecare	Semi structured interviews with healthcare professionals and service users	Nine healthcare professionals and 10 service users. Of these respondents four healthcare professionals and eight service users had experience with telecare

**Table 1.** Qualitative studies on telecare (between 2015 and 2017).

First of all the results revealed that the introduction of telecare does change relationships between healthcare professionals, service users and significant others. Results showed that telecare influences relational connectedness between healthcare professionals and service users, but also the distribution of control within that relationship. The results showed the potential of telecare to strengthen relational connectedness or at least respondents claimed that personal contact between healthcare professionals and service users and significant others did not necessarily suffer from telecare. According to service users it could even help them in engaging more with significant others, who live at a distance. This connectedness is illustrated by a respondent who claims that *'FaceTime is easily accessible and feels less distant compared to making a telephone call'*. Also interviews with healthcare professionals illustrated that the interaction using telecare was experienced as real with the argument that *'it forces to make eye contact'*. Also healthcare professionals mentioned that telecare offered the opportunities for *'reassuring service users at a distance'* or *'having short conversations'* which were seen as helpful in preventing loneliness. It was however remarkable that beliefs differed depending on whether telecare was already used in practice or not. Healthcare professionals who had not used telecare were much more skeptical about the possibilities to realize values such as compassion, compared to practitioners who already used it.

With regard to values and beliefs, related to telecare, it was reported by most service users who used telecare that they felt more safe thanks to telecare, e.g., it offered an alternative for *'having to open the door late at night'*. Moreover, service users claimed that it made them feel safe that there always was someone for them to call when they needed it. Other values that were identified when using telecare were autonomy, freedom and dignity. Some service users and healthcare professionals claimed that *'people may experience a higher degree of freedom since it allows them to call for support whenever it fits their needs and agenda'*. It was argued that because telecare provides flexibility one can take into account the preferences, needs and values of each individual and those who care for them.

Notwithstanding the perceived opportunities for strengthening relational connectedness and enhancing safety, some difficulties and dilemmas were noted in practice. For example, respondents noted that although, telecare offered possibilities to service users to exercise some control of their own agenda, fixed schedules set by the healthcare professionals was still common practice. Another dilemma that appeared concerned an issue about who is responsible for the safety of a client. It was remarkable that especially healthcare professionals voiced the need to use telecare for supervision of their clients. As one professional stated: *'taking care of a patient is one of our core values, with this technology we are able to regularly check up on a person'*. Although healthcare professionals appreciated that telecare allowed them to regularly check up on a person, for example to make sure that medication was administered in the right way, some service users expressed that they did not like *'unsolicited supervision'* if it was not agreed upon with them. So this raised the dilemma whether using telecare for the sake of reassurance of the safety of service users, is really in line with values of autonomy.

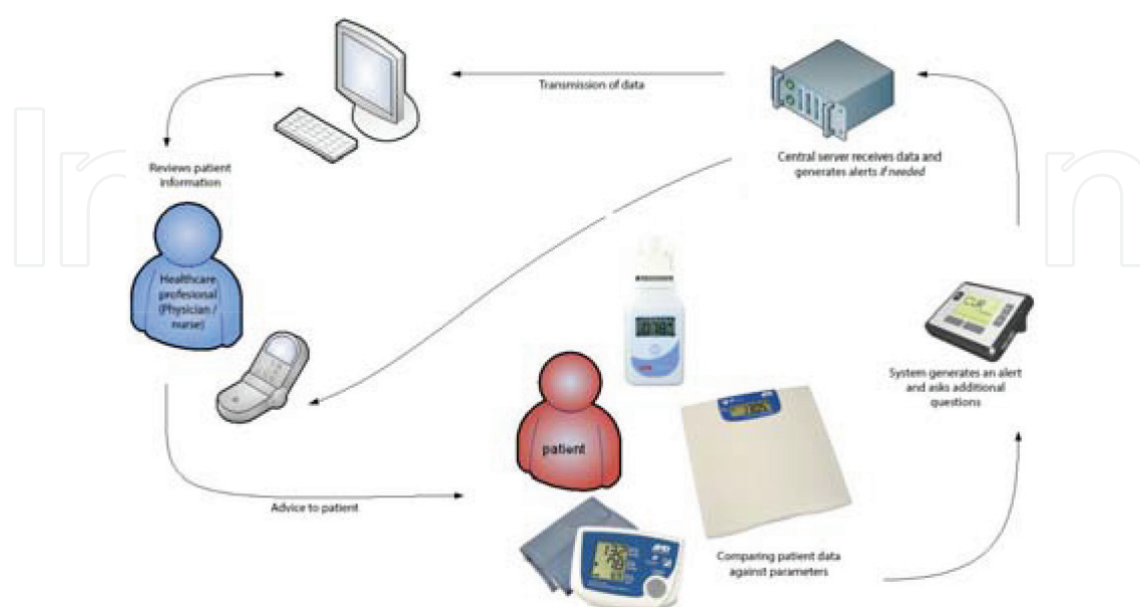
### 3.4. Telemonitoring

One qualitative study focused on the service users' and healthcare professionals' experiences with telemonitoring in care practices. In this study telemonitoring was used for monitoring the clinical status of people suffering from heart failure.

The telemonitoring with regard to heart failure concerned pilots of two different hospitals which took place in 2012 (H1) and 2015 (H2) respectively (see **Figure 3**). In both pilots the telemonitoring enabled the service users daily self-assessment of blood pressure, weight, pulse rate and oxygen saturation. Data were sent to a central server, via a tablet or PC. Patient data were compared by dedicated software to parameters set by healthcare professionals. If data passed a threshold, the system activated an alert, which was shared online with the service user and the healthcare professionals. For example when blood pressure data was outside the parameters, the system would generate an alert and the service user was asked to answer some additional questions. The alerts and additional information from questions, was also sent to the healthcare professionals, allowing them to identify potential risks and to take action. The idea was that on the longer run, trends found in the data set can provide more detailed insights in the development of the disease and allows to advice on future disease management and intervene in a more pro-active manner. In pilot H2 telemonitoring offered additional functionalities such as video interaction, a chat modus and an educational content to support patients' self-management.

In this study, in-depth interviews were held with six service users (age 64–77) using telemonitoring for heart failure. Two service users had participated in pilot H1 for 1,5 years and four service users had participated in H2 for 3 months. Moreover three healthcare professionals (two nurse practitioners and one nurse specialist) of H1 and H2 were interviewed.

The results showed that the introduction of telemonitoring, comparable to what was found for telecare, seemed to change relationships between healthcare professionals, service users and significant others. According to the results from the studies it created opportunities for improving engagement, not only between healthcare professionals and service users but also between the latter and their next of kin. Also, the contact between healthcare professionals and service user in telemonitoring via a display screen, was experienced as 'real' contact. As a



**Figure 3.** Telemonitoring the clinical status of people with heart failure in H1.

healthcare professional remarked *'Actually you make more eye contact when using a display screen than when someone is actually in your office'*. According to one of the service users, the feedback of the telemonitoring system, such as *'charts of data'* added to the understanding of the next of kin who claimed that it had helped her *'to learn more about my husband's disease'* (next of kin). It was explained that *'diagrams or graphs make it more visual what is going on'* and thereby can act as an enabler in the communication between service users and next of kin.

With regard to values and beliefs, telemonitoring was associated with enhanced feelings of safety among service users. All the service users who were interviewed appreciated the reassurance of feeling constantly *'watched over by care professionals'* and mentioned feelings of security and safety *'knowing that I am constantly being monitored'* (service user). Finally, healthcare professionals claimed that telemonitoring enabled service users *'to be in the lead'*. As one healthcare professional stated *'it stimulates consciousness, such as 'I gained some weight, what is the reason?'*. This was supported by quotes of service users, *'These daily charts show me when I need to take action, such as this physical effort was too high or that food was too salty'*.

Despite these benefits, telemonitoring also showed some *dilemmas*. With respect to the relational connectedness, interacting using a display screen in telemonitoring had its limitations according to healthcare professionals. For example they did not perceive this device appropriate for discussing difficult or emotional topics such as *'financial problems, aspects around sexuality or about bringing treatment to an end'*. More important, professionals claimed that although telemonitoring could enable self-management, in practice this did not always happen. As a professional stated *'its success in the end depends a great deal on people who are willing to take responsibility for their own part instead of passing it on to their caretaker'*. In many cases service users adopted some practical tasks such as measuring, but remained dependent on the expertise of the healthcare professionals to interpret the data and actually manage their disease. In other words: the ownership of the self-management agenda was led and controlled by the healthcare professionals and not by the service users themselves. This surfaced the dilemma on sharing responsibilities.

### 3.5. Surveillance technology

Three qualitative studies focused on the experiences of healthcare professionals and service users and their families in care practices when using surveillance technology for people living with dementia. This research took place in two different nursing homes and in residential care and also involved residents living independently at home. Types of surveillance technology included: tag and tracking systems such as GPS and the use of motion sensors (fall detection).

The use of a GPS system was initiated recently in a nursing home as a pilot to enhance service users' independence and freedom of choice (see **Figure 4**). As a pilot the GPS system was offered to service users who lived in a nursing home, who had mild dementia but also experienced agitation in the enclosed space of the nursing home and who were expected to benefit from exploring new spaces outside the nursing home. The use of motion sensors had been implemented in a nursing home for some years to enable remote monitoring of fall incidents. Recently, in a pilot, a sensor had also been used for some service users with mild cognitive impairment living independently.





**Figure 4.** An example of a GPS device (photo: Angela Aprea).

In these studies six in-depth interviews were held with residents living at home together with eight family members. Apart from that 12 focus groups with three to six participants were conducted with healthcare professionals in long term residential homes and in residential care.

With respect to relationships between healthcare professionals, service users and significant others, there was insufficient information in the data to identify any changes which were consistent throughout the data. However, concerning values and beliefs, the results showed that healthcare professionals, service users and their next of kin certainly valued surveillance technology for offering opportunities to enhance autonomy and independence of a person. For example the use of GPS was considered as very helpful to enhance freedom for those who experience agitation in a closed environment. As a nurse practitioner quoted *'One person usually felt very restless and behaved aggressively towards healthcare professionals and other residents. Since the introduction of the GPS he makes long walks and drinks his coffee at the station. When he returns he seems contented and is physically tired'*. Similar to the use of GPS, using motion sensors (for fall detection), was valued by healthcare professionals for offering autonomy, in the sense that a person could live independently *'being watched over'*.

Despite the perceived opportunities of surveillance technology the interviews also revealed some dilemmas which interfered with certain values. For example, with respect to the use of GPS, a recurrent dilemma surfaced around conflicting interests between the value of autonomy on the one hand and the value of safety on the other hand. Although healthcare professionals indicated the use of GPS could enhance personal freedom, autonomy and dignity for the service users, our study also showed that healthcare professionals felt reluctant to actually facilitate the use of the GPS device. For example an advanced practice nurse confessed that she *'had witnessed a care professional blocking a door with a laundry basket to prevent a resident from going outside'*. The nurse had argued that she valued autonomy of the resident but she also felt responsible for his safety. The interviews also showed that the next of kin *'often like the idea of more freedom for their loved ones'* but at the same time they express their unwillingness to give consent for the use of the GPS system because of the perceived risks, e.g.: *'If she loses her day structure, we can start all over again. It is okay as it is right now, more freedom will make her head spinning'* (next of kin). As this quote illustrates there may not only be conflicting values between different stakeholders, but also tensions in practice between espoused and enacted values.



Another dilemma identified in the use of GPS related to roles, tasks and specifically the responsibilities of healthcare professionals and service users when using this technologies. Quotes such as *'What if he runs away? It would be my fault'* (next of kin) or *'If I give consent and something happens, who is to blame then?'* (next of kin) or *'I think there is too little attention to discuss the risks between care professionals and next of kin (nurse)'*, illustrate that responsibility is an issue that needs attention.

Another dilemma that was identified in using surveillance technology was about practicality. This was often an issue and showed the need for tailor-made solutions of health technology. It was found that although motion sensors were valued by healthcare professionals for guarding the patients' safety, in some cases, it seemed to compromise the service users' personal freedom or dignity. Especially when the health of service users deteriorated, it was found that the technology failed to offer practical solutions for the issues for which they were used. For example a resident became restless, every time she approached the door, because *'of an alarm that went off'* (nurse). Another example is about an elderly person, who had deteriorated lately, *'who confused the fall detection sensor with a cuddly toy and took it to bed'*.

### 3.6. Discussion

To conclude on the first research question as to how relationships change between healthcare professionals, service users and significant others by introducing technology, on the positive side, the results indicated an enhanced engagement when assistive technologies, such as telecare or telemonitoring are being used. Notably, professionals and service users who had experienced using these systems associated it with relational connectedness. This corresponds with literature about the positive relation between professionals' views on technology and their experience with this form of caregiving [19]. Nevertheless, although this result is hopeful, the fear that technology interferes with the relationship with the patient, has also been reported [29, 30]. According to Pols [31] relational connectedness by telecare only applies if there is already 'confidential', personal contact. One of her findings was that a strange and unknown person encountered through a webcam, became even stranger, maybe even scary or intrusive, whereas when as the webcam communication and support was added to an already good relationship this friend or trusted carer would become even closer, intensifying the relationship. She concluded that telecare magnifies the characteristics of the already existing relationship between users by imposing a relational distance that fits best with intimate contacts. 'Knowing the care recipient' is considered essential for signaling and decision making in the care relationship and missing non-verbal signals and the impossibility for 'physical touch' in telecare can make this contact more superficial.

Concerning the second and third question, as to what are the implications of technology on values, the findings showed the potential strength to respect the values and beliefs of individuals and to enhance autonomy and self-management of service users. However it also showed several dilemmas arising from conflicting interests. As has been reported in earlier studies [17], these conflicting interests act as a barrier to use technology in practice. After all, according to the Normalization Process Theory (NPT), coherence in values is one of the conditional factors for actual use. First of all the results showed dilemmas around responsibility. The findings showed that what is expected of technology, is not always realized. For example

the research on telemonitoring showed that not every person is able or willing to take responsibility for their own healthcare. Secondly, there are dilemmas related to autonomy, privacy and dignity, and safety and control. For example potential conflict was attributed to telecare: (service user) autonomy and (healthcare professional) control. Moreover, with regard to surveillance technology, competing values around safety versus autonomy were described. On the one hand use of surveillance technology with movement sensors (such as GPS) or video surveillance was seen as enhancing personal freedom and autonomy of persons living with dementia. On the other hand it confronted care professionals with issues around guarding the patients safety. Also, some technology was found to have a negative impact on the individuals' privacy and dignity or to hamper personal freedom. These examples show that whilst technology claims to increase the autonomy of service users, it may also compromise their feelings of dignity. Moreover, it challenges healthcare professionals, service users and their significant others to re-consider the weight given to valuing service users' physical safety above other (psychological, social and spiritual) values such as autonomy and freedom of movement [32, 33]. In other words it is important to acknowledge that technological innovations can cause the phenomenon of competing values within healthcare, not only between different stakeholders' groups, but also *within* groups and individuals. These results correspond with literature on surveillance technology for persons living with dementia in which intra-personal/professional conflicts were identified [33–36]. This highlights the need and the difficulty of realizing engagement and involvement of all relevant stakeholders in the implementation of technology in daily practice, which refers to the construct of cognitive participation in the NPT, and elaborates on this construct by including other stakeholders apart from healthcare professionals.

Finally the results showed dilemmas around practicality: improper use of surveillance technology and the need for tailor made solutions disclosed a paradox. In the pursuit of greater safety, this safety was rather impeded by the use of new technologies than improved. One could argue that the examples around practicality illustrate the importance of acknowledging human-centered design of assistive technology. It underlines the necessity to pay attention to the *inspiration phase*, to understand what service users feel, think and experience, the *ideation phase* in which prototypes are tested and refined after feedback is collected from users, and the *implementation phase* in which the final product or service is evaluated, to test the impact of the technology when it is used in care practices. Finally the examples showed that the condition of collective action of the NPT to actually facilitate the use of technology in practice, was not realized. This draws special attention to one of the facilitating conditions of the UTAUT model: the realization of supportive infrastructures (both organizational and technical).

The described dilemmas arising when using technology in healthcare, confront us with the need to explicate choices: what do we value most, and in what situation? When using technology, roles, tasks and responsibilities of healthcare professionals and service users should be made explicit and agreed upon between all stakeholders involved. Also there is a need to regularly/continuously evaluate changes to the care relationship and the perspectives of different stakeholders (cf. reflexive monitoring) during its introduction and thereafter [37].

## 4. Conclusion

The integration of assistive technology into healthcare practice is not only dependent on the intention to use a (technological) innovation but also relates to role and process changes. In health care, professional roles are based on values inspired by personal relations between healthcare professionals and patients or service users. Therefore, for technology to be applied in a successful manner the perspectives of different stakeholders during and after the introduction of technology should be identified and evaluated.

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## Conflict of interest

We declare no conflicts of interest with respect to the research, authorship, and/or publication of this paper.

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