Sensor monitoring to measure and support activities of daily living for independently living older persons

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Older people's perspectives regarding the use of sensor monitoring in their home

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Abstract

Purpose: The early detection of a decline in daily functioning of independently living older people can aid healthcare professionals in providing preventive interventions. To monitor daily activity patterns and, thereby detect a decline in daily functioning, new technologies, such as sensors can be placed in the home environment. The purpose of this qualitative study was to determine the perspectives of older people regarding the use of sensor monitoring in their daily lives.

Design and Methods: We conducted in-depth, semi-structured interviews with 11 persons between 68 and 93 years who had a sensor monitoring system installed in their home. The data were analyzed using Interpretative Phenomenological Analysis.

Results: The interviewed older persons positively valued sensor monitoring and indicated that the technology served as a strategy to enable independent living. The participants perceived that the system contributed to their sense of safety as an important premise for independent living. Some of the participants stated that it helped them to remain active. The potential privacy violation was not an issue for the participants. The participants considered that healthcare professionals' continuous access to their sensor data and use of the data for their safety outweighed the privacy concerns.

Implications: These results provide new evidence that older persons experience sensor monitoring as an opportunity or strategy that contributes to independent living and that does not disturb their natural way of living. Based on the present study, the development of new strategies to provide older people with access to their sensor data must be further explored.

Introduction

In the Netherlands, two- thirds of people between 65 and 75 years have two or more chronic diseases. Among the people who are older than 85 years, at least 85% have more than two chronic diseases.[1] Multiple chronic diseases can limit daily functioning and hinder independent daily living.[2-4] For older persons, the further loss of function can be prevented or delayed if a decline in daily functioning is identified at an early stage. Such identification can enable health care professionals to provide preventive interventions that postpone functional decline. Sensor monitoring in the home environment offers the possibility of early detection. However, the degree to which older people value senor monitoring and what they expect from sensor monitoring remain unknown.

Previous research has shown that healthcare technology such as the use of sensor monitoring can be used to objectively measure and observe the daily functioning of older people who live independently.[5-10] Sensor monitoring is based on sensor network technologies that consist of different simple sensors that are installed in fixed locations and register in-home activities.[11] The use of sensor monitoring facilitates the early detection of changes in functional status through the observation of a daily activity pattern. This provides detailed information about the daily functioning that is performed during a regular day and the sequences and variations of activities. The sensor data are analyzed using data mining and machine-learning techniques to build activity models and further enable the recognition of daily functioning or uncommon patterns of daily functioning in the home. This information might enable health care professionals to provide early interventions to prevent the decline that is caused, for example, by falls or immobility.[5]

Although the literature has shown positive results of the use of sensor monitoring, most studies have largely focused on the technical aspects of sensor monitoring rather than its application in everyday life and clinical practice.[5] To further improve and implement sensor monitoring in daily practice, researchers must address the needs and expectations of the end users and health care professionals to customize the sensor system to their specific needs.[5,12,13] To this end, Kanis, Robben and Kröse (2012) presented an elderly-centered design method.

Only a few articles have been published on older people's perceptions and perspectives on the use of sensor technologies in their home.[14-17] Most of these studies have focused on smart home technologies, volunteers' use of technology in experimental situations, or people living in long-term retirement homes.[12,18] Studies on the perspectives of community-dwelling older people who use sensor monitoring in their home remain scarce.

To the best of our knowledge, only one study evaluated the perspectives of older adults with 'high demand care', using the Unattended Autonomous Surveillance (UAS) system. This system is based on a different type of sensor and healthcare technology, is placed in the home and aims to support aging-in-place.[15] The study of this system revealed that participants experienced a greater sense of safety and security with this system in their homes, although there was little understanding of the interoperability of the system and the healthcare that the participants received.

Consequently, knowledge remains limited about community-dwelling older people's experiences and opinions regarding the use of sensor monitoring, the impact it may have on their daily life and how the sensor data could be used to initiate interventions by attending healthcare professionals. Therefore, this research question was as follows: To what degree do older people value sensor monitoring and what do they expect from sensor monitoring in their daily lives?

Methods

Design

To provide a rich understanding of participants' experiences and opinions regarding the use of sensor monitoring, we used a qualitative interpretative phenomenological study design (IPA).[19] The IPA is useful to explore in detail how participants perceive a particular situation and the main currency for an IPA study is the meaning, which the participant gives to these experiences. Therefore, interpretation is needed to understand the experiences of the participants.[19]

Participants

IPA studies benefit from a small participant sample to allow detailed analyzes of each individual and to enable connections within participants' experiences and perceptions and to investigate the differences and similarities between these experiences.[19] We purposefully sampled eleven participants from a pilot study (n=23), in which the sensor monitoring method was tested during one and a half year. From the 23 participants, 10 were living alone in the community and 13 were living alone in a senior residence. For this study, we sought participants who were living alone in the community because in the future we are moving to the use of healthcare technology at home. Therefore, we contacted them by telephone, informing them of this research and asking them to participate. Seven participants were willing to participate. The three other persons were not able to participate due to aphasia or other personal circumstances. We contacted four more persons from our list living in a senior residence to participate. From this group, there were no refusals.

Before participating in the pilot study, a miniature model of a sensor-equipped house was used to explain how the sensor monitoring works to the participants.[20] The interviewed participants had a sensor monitoring system (see further explanation sensor monitoring system) installed in their home for a few months. Table 1 presents the characteristics of the interviewed participants, seven women and four men. The age of the participants ranged from 68 to 94 years, and the participants were all living alone in the community or a senior residence. Preceding the interviews, the participants provided informed consent and permission to record the interviews. The Medical Ethics Committee of the AMC approved the present study.

Sensor monitoring system

The activity behavior of daily functioning performed by an elderly person is monitored using a wireless sensor monitoring system installed in the home. The sensor monitoring system used, consisted of 16 simple binary sensors, including passive infrared motion sensors (to detect motion in a specific area),

Table 1. Characteristics of the interviewed participants

Participant	Gender	Age in years at time of interview	Living arrange-ment	Comorbi-dity	ADL functi-oning Katz ADL index (1-15 points)	Cognition MMSE (0-30 points)
A	M	84	S	2	3	30
B	F	79	S	5	1	29
C	F	68	S	2	7	29
D	F	85	S	1	1	30
E	F	77	C	4	4	30
F	M	83	C	3	1	29
G	F	91	C	7	4	27
H	F	88	C	4	2	28
I	M	93	C	2	3	29
J	V	78	C	7	6	28
K	M	79	C	2	5	29

M, Male; F=Female; C, living alone in the community; S, senior residence
Katz ADL, range 1-15; a higher score indicates more ADL dependence
MMSE, range 0-30; a higher score indicates better cognitive functioning
Functional Comorbidity Index (FCI); sum of 18 self-reported comorbid conditions with a score of 0 to 18. A higher FCI score indicates greater comorbidity and is associated with impairment in physical function 1 year later.

magnetic contact sensors on doors and cabinets (to measure whether doors are opened or closed) and a flush sensor in the toilet (to measure the toilet being flushed). The sensors register only in-home activities without a camera or sound recording of the participants. These sensor data are analyzed by an intelligent software program using machine learning techniques, that searches for activities of daily functioning and patterns of daily functioning (e.g. toileting, bathing or bed rest could be recognized but also more complex activities of daily living such as preparing kitchen activities could be recognized by the sensor system). The results can automatically generate a report. The report can be given to health care professionals, who can use them to make better –informed decisions or to design interventions to support the older person.[5,21] The sensor monitoring system does not detect emergencies.

During the pilot study, a web-interface for the reporting of the analyzed sensor data was developed for the use of health care professionals. During the interviews, also some examples of the sensor data reports, developed for the healthcare professionals, were presented.

Procedure

Semi-structured interviews were conducted between April and June 2013 at the participants' home for approximately one hour. An interview guide with a list of four topics provided a structure to the interviews. The topics were as follows: (i) motives for exploring the use of sensor monitoring; (ii) perspectives

on the sensor monitoring system and the sensor data; (iii) perspectives and experiences with the monitoring of daily functioning; and (iv) sensor monitoring to support daily functioning. No fixed structure was followed and the topics were broad to enable participants to freely reflect on their experiences and share their opinions.[19] The interviews began with general questions, followed by probes to elicit more detailed responses.[19] Some examples of the questions were: "could you tell me in what way do you experience having sensors in your house?" "How do the sensors affect your daily life?" "How do you experience being monitored 24 hours a day?" "What do you think of the privacy aspect?" "What do you think of who should have access to your personal sensor data?" "What do you think how the sensor data could support you in optimizing daily functioning?" Towards the end of each interview a summary was provided to give the participant the opportunity to further clarify or add more information.

Data Analysis

Interpretative Phenomenological Analysis (IPA) was used as a guiding framework.[19] Using IPA, we interpreted how sensor monitoring was perceived in the participants' daily life. Our main goal for this study was to study experiences of older persons regarding the use of sensor monitoring in their daily lives as well as their meanings of these experiences; how they value it, their points of view and their perceptions. We need all of this information to further develop sensor monitoring and how this can be implemented in cooperation with the users and healthcare professionals. Therefore, we especially have chosen to use IPA in our analysis. And because of this each transcript was read and re-read and analyzed for initial codes relevant for the research question. In each transcript, reflective notes were made to develop interpretations. These notes include personal thoughts, comments, observations and reflections that occur while reading the text. In each transcript, initial themes were identified. Connections between themes were noted.[22] Atlas.ti computer software was used to assist in organizing the data (www.atlas.ti.com). From the individual themes of all of the transcripts four main overarching themes were identified. This selection process of forming themes required the interpretation of the researcher. Capturing the meaning of the perceptions (to the participant) was central, but necessarily involved interpretative engagement with the text.[19] This enables the researcher to explore how persons ascribe meaning to their experiences in their interactions with their environment.[19,22] and is therefore suited for this study, which aims to study the experiences and meanings regarding the use of sensor monitoring in their daily lives. The interpretative element, which is the essence of the analysis in IPA studies, may give rise to discussion. However, according to Smith et al[19], audit is there to 'ensure that the account produced is a credible one, not the only credible one'.[22] Discussions and reflections with the research team helped to achieve validity. The four themes were described with using quotations that best captures the essence of the participants' experiences and thoughts.

The titles that were selected for the themes were reflective of the language that was used by the participants. To avoid the loss of meaning in the translation process from the Dutch interview fragments into English during the analysis, we employed the original language (Dutch) as long as possible. We performed the translation of the most important quotations and titles of the themes side-by-side

with a professional translator.[23]

Results

Sense of safety and living independently at home

Overall the participants' motives for exploring the use of sensor monitoring in their daily lives were based on the desired results, as sensor monitoring might allow older people to live independently at home as long as possible. All of the participants expressed a strong preference to remain in their own home, in their own neighborhood and responsible for to their self-maintenance. For example, Mrs. C stated: *"it may be useful for the future, I think. People can stay at home longer with the help of sensors because there is more supervision. And this is not so much for me as for all of us in the future. It is always nice to stay in your own neighborhood, especial for elderly people who have neighbors and friends in their neighborhood."*

All of the participants indicated that sensor monitoring was beneficial for their sense of safety at home, especially because they all lived alone and thus experienced a lack of safety. As Mr. A expressed: *"Look there are my sensors, they are my watchdogs and they look after me."* The participants experienced this sense of safety in two ways. Most participants stated that sensor monitoring is important for detecting emergencies such as a fall. Mrs. D explained this as follows: *"Well, you are on your own, so something can happen, like when you fall down and can't get up, and this has quite often happened before, that you can't get up one way or the other. Yes, then I had the idea that this should be watched by someone somewhere."* The second type of sense of safety was the possibility of detecting a decline in daily functioning. The sensors were able to capture things that the participants did not notice. Mr. A expressed this as follows: *"if there should be a slow change in my daily pattern I certainly wouldn't report it. I wouldn't notice, and therefore, I find it important that the nurse's station gets a signal like: keep an eye on that."*

The sensors keep an eye on me and that comforts me

Sensor monitoring contributes to the sense of safety as a premise for living independently alone at home as outlined above. This sense of safety contributes to the easy acceptance of the sensor monitoring system at home. As Mrs. B stated: *"I feel safe with this because without noticing it, somebody is keeping an eye on me"'* According to the participants, the visibility of the sensors in the home did not seem to impact their daily functioning. Most of them indicated that they did not notice the sensors after a period of time. They did not experience the presence of the sensors in their home as a disturbing element. Furthermore, the sensors were not considered to be visually unpleasant as expressed by Mrs. C: *"These sensors are hanging up, and yes you can see them, but they aren't that bad."* Most of the participants forget about the sensors after a period of time and experienced the presence of the sensors as natural in their home. Mr. F expressed this view as follows: *"Well, I don't see them anymore. At first, I did, but later on you just go pass them and that is it. No, it is like when go and live near a train uh, railway line, the first days you hear it and then you don't anymore, but they are still there."*

The social environment's reaction to the sensor monitoring seemed to support the quick acceptance of a sensor system in the home. Most of the participants reported that their visitors or family did not notice the sensors unless the participant called attention to them. One participant, Mr. A stated: *"No these sensors don't attract attention at all. Most think it is a fire alarm, others think it is a spotlight. So, the design is perfect, it doesn't particularly stand out""*

An added benefit of sensor monitoring in the home is the user- friendliness of the technique. Most of the participants explained that they did not have any technical knowledge and expressed their relief that the sensors did not require any action of them.

The majority of the participants seemed to easily accept the sensors as natural in their daily life. However, at times, one of the participants was reminded of the sensors in her home. She indicated that the sensor base -unit reminded her of having sensors in the home because of a burning LED-light on this unit. This made her feeling uncomfortable. However, when the sensor base unit was placed out of her sight, this problem was solved.

Sense of safety is more important than privacy

The participants did not experience the use of sensor monitoring as an invasion of their privacy. Their privacy matters regarding the data collection and sharing of these data differed. Some of the participants reacted indifferent towards the topic of privacy. Mr. R expressed: *"No, really I have nothing to hide, I have no secrets so it doesn't bother me."* Furthermore Mrs. R stated: *"No, it's of no concern to me, I don't even think of it. I don't mind if they are seeing what I'm doing here in my house."*

Other participants stated that the sensors only registered their in-home movements without cameras or sound recording and, therefore, they did not consider them to be an invasion of their privacy. Mrs. D expressed: *"Well, talking about privacy, they make such a fuss about it. You can only see that I am moving but not what I'm doing."* Mrs. D's quote captured many of the participants' experiences, emphasizing the difference between an individual who can see that one is moving and an individual who can see all of one's actions.

The participants indicated that the safety benefits of the sensor monitoring were far more important than their privacy. The system supported their ability to live independently at home. Therefore, they were willing to make some concessions concerning their privacy. The loss of some of their privacy was balanced with the advantage of having the system. For example, Mr. I expressed: *"yes, this is a guarantee for me, that's how I experience this. I like to live independently as long as possible. This really suits me; I'm in my own environment."*

The participants generally expressed that they did not feel watched or observed by the sensors. However, two participants experienced the monitoring of specific personal daily activities to be difficult to share with others, but they did not reject the monitoring of these activities. Mrs. C explained: *"No, I don't mind, it might be different for me if I had a partner. Then I wouldn't like to have a sensor in my bedroom. I know that it doesn't monitor life pictures but I certainly wouldn't feel happy when everything was recorded. Well it doesn't really matter for me in the kitchen and that kind of activities and how often I go outside, that doesn't bother me at all. No I don't find it an invasion of my privacy."* This was also expressed by

Mrs. E: *"Yes, actually I don't mind but when I think of getting out of my bed to go to the toilet I think: Oh God they see that I'm again going out of my bed and at that moment I find it annoying. Otherwise it doesn't matter to me."*

Although privacy in relation to sensor monitoring was not an issue for the participants, it was an issue for some of their relatives. Two participants mentioned that their children had a problem with the monitoring. These children were afraid that others would know more than necessary about their father or mother. Again, this was not a reason for the participants to reject the sensor monitoring. Both of the above examples illustrate the participants' perceptions of the strong benefits of sensor monitoring for their sense of safety, which they considered to be more important than their privacy concerns.

Sensor monitoring: a support for or a limitation of independence

The participants reported that it was most important that healthcare professionals had continuous access to their sensor data so that the professionals could react in cases of decline or emergencies. Mrs. J reported: *"I would really feel at ease if my community care nurse could see how I'm going on. She is only visiting me three times per week. Lots of things go wrong but they don't see that when they are not here. In this way they might be able to see that there is something different from normal."* One participant indicated that the sensor monitoring could replace unnecessary control visits by healthcare professionals. Specifically, Mr. E stated: *"Yes, that's very useful. The community care nurse doesn't have to come in every time. They can just do the follow up in this way."* Both examples illustrate the use of sensor monitoring as an acceptable system to care for the participant at a distance.

In this study, the web interface with sensor data was designed for healthcare professionals' use. Therefore, all of the participants needed the interviewer to explain the interpretation of their sensor data. Some of the participants did not express the desire to view or have control over their personal sensor data of daily functioning. Several reasons were given for this lack of desire. Some participants stated that they did not have sufficient technological knowledge to understand the sensor data from the computer. As Mrs. C reported: *"such a pattern is, of course very complicated for an outsider. Yes, for me, it is an abstract piece of art. I definitely can't understand it."* Other participants stated that they did not want not see their sensor data because they did not want to think about their health problems. Mrs. E expressed: *"You know yourself how well you are doing during the day. In this way you are going to be so confronted with it and now I try not to pay attention to it."* These participants experienced the sensor system as a readily applicable system, giving them the confidence of accessible help. On the other hand, this system contributes for them to a certain dependency, which can be considered as an unattended side effect of sensor monitoring.

However, other participants were curious about their sensor data and considered this information as helpful to them. For these participants sensor monitoring positively influenced on their movement or performance of exercises. For example, as expressed by Mr. K: "*Well, If I have to move more often and it reveals that you aren't doing this, you can take advantage of it."* Similarly, Mr. I stated: *"there is a sensor hanging above the sideboard. So, when I come downstairs I'm doing my exercises in front of it and I start swinging my legs for*

20 minutes." Both of these examples illustrate the control function of sensor monitoring as a stimulating factor for performing exercises or moving in the home. Mr. K expressed that the sensor data might contribute to a feeling of personal responsibility, as follows: *"it is a good development you get information how you are doing and you can take advantage of this. You don't have to go to your physiotherapist so often."*

When participants were asked whether their children could have access to their personal daily functioning data, the participants had varied reactions. Most of the participants stated that their children were allowed to view the data, but they did not want their children to worry about them. As Mrs. C reported: *"my children are allowed to look into it but I never would ask them to come and help me. No never, both my children are working during the day from morning till evening; they have a busy job, their own company. I just wouldn't want that the children… that your children have to look after you."*

Discussion

This study showed that the interviewed older people with sensor monitoring in their homes placed a positive value on sensor monitoring. Specifically, the participants indicated that the technology helped them to remain independently at home, contributed to their sense of safety and helped them to remain active. The increased sense of safety outweighed the privacy issues, mainly because the sensors only register the movement within the home, rather than all of the participants' actions, as done with camera or sound recording.

In accordance with previous research, this study highlights the participants' strong desire to remain in their familiar home environment for as long as possible.[24-28] This desire to remain in their home can be understood as older people's personal strategy to have continuity in their routines of daily life.[27,29] This study provides new evidence that older persons experience sensor monitoring as an opportunity or strategy that contributes to independent living and that does not disturb their natural way of living.

The use of sensor monitoring as a strategy that contributes to independent living is clearly explained by Wahl et al.[30] As shown in this study, the role of the environment, including housing, the neighborhood and technology, strongly influences older people's abilities to perform daily activities at home.[30] Wahl developed a conceptual framework for healthy aging that describes, how older people interact with their environment.[30] Within this model, new technologies could become a different resource for older people to enhance independent functioning at home.[30] In line with this model, sensor monitoring is a resource. In addition, the older adults do not need to closely interact with this resource.

This study's participants valued sense of safety as the most important aspect to remain independently at home, and the majority of the participants indicated that sensor monitoring contributed to this sense of safety. This finding is in line with previous research.[12,15,31-33] This increase in sense of safety can be understood in relation to the participants' old age and living situation. The participants all lived alone and experienced some functional health limitations. The participants were quite aware that this health decline could influence their ability to perform

their daily functioning and associated this decline with a decrease in sense of safety.

In this research, the older persons associated sensor monitoring with utilities such as detecting early decline and emergencies such as falls. Many participants reported stories of people in their environment who had an emergency such as a fall and experienced a long wait for help. Furthermore, many of the participants feared a slow decrease in decline that they would not notice. Although the participants were informed that the sensor monitoring in this research was used to detect decline in daily functioning and not to detect emergencies, they experienced the sensor monitoring as a contribution to their sense of safety for both aspects. The participants indicated that the sensor monitoring would be more useful, if it monitored both decline in daily functioning and emergencies.

According to older persons living independently at home, the following factors are influential to their sense of safety: having secure relations (relationships in which the person feels respected), sense of control (the knowledge about what is required to cope and manage situations) and perceived health.[34] In this study, the participants perceived a sense of safety due to the sensor system because it was controlled 24 hours per day. This comforted the participants and ensured their sense of safety. For example, Mr. A experienced the sensors as his 'watch dogs'. Due to the participants' strong wishes to age in their own home and the benefits of sensor monitoring for their sense of safety, they readily accepted and adapted to the technique as natural in their home. Furthermore, they considered this technique to be in balance with their privacy.

Privacy is often considered to be an issue in research on monitoring technologies.[12,15,18,30,35] Although privacy issues should not be ignored, this research showed that other aspects such as sense of safety were more important to the study participants. In most studies, the participants reported that privacy was balanced on the level of need and intrusion into privacy at home.[18] However, some formal caregivers and researchers reported that privacy was a serious issue ranged from positive to negative.

Privacy issues have a contradiction. They can be viewed as an invasion into older persons' privacy or as a protecting older people from unnecessary harm and support for independent living.[35,36] Some studies have discussed whether older people have sufficient technical knowledge to fully understand the danger of sharing personal data and the importance of protecting their privacy.[37] Therefore, older persons must be provided with information to reach a good understanding of the sensor monitoring systems.[20] In this study, the participants reported that the safety benefits of sensor monitoring outweighed their privacy concerns. The monitoring supported their ability to live independently at home and therefore they were willing to make some privacy concessions.

The present results also indicated a contradiction concerning whether sensor monitoring supported or limited the older adults' independence. Some of the participants did not express the desire to view or have control over their own personal sensor data of daily functioning. They stated the importance of healthcare professionals keeping an eye on them to detect changes or decline in their daily functioning and thus, care for them at a distance via the sensor system. This provided them with a sense of comfort and safety. Furthermore, these older persons experienced the system as user-friendly merely because it

required not any action of them. Although this contributes to a sense of safety and independent living, the system also introduced a certain participant dependency on the sensor system and indirectly on the health care professionals. One important reason for this dependency is the lack of a direct web-interface for the participants. Therefore, these findings indicate the importance that a special interface for older people must be developed, which is in line with Alexander et al.[38]

Future research must attempt to fully understand the degree to which older people wish to have access to their sensor data. This attempt should be made without influencing the user- friendliness of the sensor monitoring system, as older people consider this to be an important outcome that they appreciate. This also contributes to older adults' increased independence.

This study has strengths and limitations. First, strength is that this study provides in-depth insights into the perspectives of eleven single, independently living older people concerning their value of sensor monitoring after experiencing the devices for a few months and their expectations. As with other qualitative research, a limitation is that the generalization to other contexts is limited because the results were obtained from a selected small group of participants. However, these in-depth personal insights provide, both healthcare professionals and researchers with information to further develop and implement sensor monitoring in interventions to support older people to live independently at home. Future research should also involve the expectations of health care professionals regarding the use of sensor monitoring in caring for their patients and for advising caregivers. In line with this, Bruce[39] provided recommendations and practical tools to support health care professionals in their dialogue with the older persons and their family to make informed decisions for the use of monitoring technologies.

Second, we performed only one interview at one time point after the participants had a sensor system installed in their homes for a few months. Therefore, we did not explore changes in their perspectives over time. Third the participants were all old aged and experienced some age- and health-related limitations in their daily functioning. They were aware of their vulnerability and expressed a need for strategies to maintain independent living. Therefore, they easily accepted sensor monitoring in their home. Future research must investigate whether sensor monitoring can be used with older people who do not express their own vulnerability. In this way, the sensor monitoring can be used in a preventive manner to detect changes in daily functioning.

Implication for practice

The findings in this study encourage older people, who experience some age- and health-related limitations in their daily functioning and who are living alone in the community, to the use of sensor monitoring. All of the participants in this study experienced the use of sensor monitoring as contributing to their sense of safety and an early identification of functional decline. Both are important for continuing living independently at home in the community. The findings also encourage technicians and health care professionals to further develop sensor monitoring to meets the requirements mentioned by the end-users, such as the user friendliness of the system and the focus on sense of safety.

Conclusion

Older people with sensor monitoring in their homes believe that monitoring helps to maintain their daily functioning and safety and that their healthcare professionals should have access to their data to detect a decline in daily functioning at an early stage. Future research must be conducted to develop new strategies to provide older people with access to their sensor data. This strategy development should be done in cooperation with the older people. Another important aspect is to integrate an alarm system into the monitoring system, as this is important for older people's sense of safety.

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