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Implementation of CareTV in care for the elderly: The effects on feelings of loneliness and safety and future challenges

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Abstract. *Background*: The number of lonely elderly is expected to increase due to demographic changes. CareTV is a technological solution, which allows users to interact with carers, family and friends from their home. In prior research users mentioned that CareTV expanded their social contacts, but it had not been measured if feelings of loneliness as a consequence have decreased.
Objective: Investigate whether CareTV is a valid instrument for elderly to engage in meaningful social contacts by a video connection to avoid loneliness. Evaluate the implementation process and identify the remaining future challenges.
Methods: From March 2008, elderly people receiving homecare from Proteion Thuis were informed about CareTV and asked to participate in the study. The CareTV duplex video/voice network allowed clients to communicate 24 hours, 7 days a week with a nurse practitioner. Applications of CareTV are (1) Alarm Service (2) Care Service (3) Good morning/good evening service (4) Welfare and housing and (5) Family Contact. During the one year trial period, feelings of loneliness and safety were measured using a questionnaire. In addition, clients' experiences were evaluated in open questions in the survey. The implementation was evaluated retrospectively with a framework developed by Broens.
Results: 180 clients of homecare organization Proteion Thuis were connected to CareTV. 130 clients with the average age of 73.2 years were included in the study. The results show that the average feeling of loneliness at group level significantly ($p < 0.001$) decreased from 5.97 (sd 2.77) to 4.02 (sd 3.91) between the start and end of the study on a scale from 0 till 11. Social loneliness (5-items) as well as emotional loneliness (6-items) showed significant decreases. To evaluate safety, no sum score could be calculated, but on item level: for 5 out of 9 items, most clients felt less safe after one year. For one item most clients had improved feelings of safety and for three items, most clients had an equal score. Evaluation of implementation shows what has been done and what needs to be done in future for the specific determinants.
Conclusion: Feelings of loneliness significantly decreased within one year. As loneliness is a problem in an estimated 30–40% of the elderly, CareTV seems to be a suitable instrument for elderly, to live longer at home with less feelings of loneliness. Feelings of safety on item level did not seem to improve, this might be due to the fact that no validated scale was used. On the other hand, individual clients indicated that they felt safe with careTV. In future, a study with a validated safety scale should be performed in order to clarify the effect of CareTV on feelings of safety. The analysis of the development and implementation process indicates that the business development approach may be strengthened and that the homecare organization itself may take the lead in that process.

Keywords: Tele-medicine, frail elderly, safety, loneliness

1. Introduction

Due to an increase in life expectancy and simultaneous growth of the elderly people population an increase in need for complex care is to be expected. At this mo-

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ment, in the Netherlands, 15.6% of the Dutch population is over 65 years, however, this number is predicted to rise to 25.3% in the year 2035 [1]. A higher incidence of frailty can be seen with ageing. It is estimated that approximately 7% of the persons above 65 years are frail, and that the occurrence of frailty increases with age and may exceed 45% after age 85. Frailty can be defined as a heterogeneous condition characterized by impaired strength, gait, balance, body composition and fatigue [2]. Risk of deterioration in functional status, complications, prolonged hospitalization and an increased risk of death are associated with frailty [3].

Moreover, 30 to 40% of the elderly people do experience feelings of loneliness, which can be the result of physical limitations and cognitive decline. Loneliness is defined as: "the unpleasant experience that occurs when a person's network of social relationships is deficient in some important way, either quantitatively or qualitatively" [4]. In general, loneliness is caused by both individual and societal factors. Individual factors, such as loss of a partner or relationship or long-term provision of informal care have a lot of influence on a persons' social network. This also applies to social factors such as, loss of employment, poor education or income decline. Lonely people often experience a reduced self-esteem, depression and anxiety disorders. Physically, lonely people have more disorders such as headaches, stomach pain, breathing and sleeping problems. Loneliness leads to psychological and physical symptoms and increase the demand of care [5,6].

Due to these expected demographic changes and the increase in the number of frail elderly people, a gap will arise between supply and demand in health care provision. Reorganization of the Dutch health care system into a more efficient way of care delivery can be a solution to decrease workload on health care professionals. In this process, innovative technologies could facilitate this and support health care workers.

Since care at home is preferable to most elderly and in most cases is less expensive than institutionalized care, systems using advanced technology to support people at home could benefit both client and care provider. Recent advances in supportive technologies are: electronic sensors, fall detectors, pressure mats and communication technologies. Communication technology enable simultaneous use of video and voice communication. There are indications that communication devices, and especially CareTV, improves feelings of loneliness in elderly. In one study clients reported that social contact was promoted by the use of video-voice communication; however, they did not measure feelings of loneliness [7]. Camarinha-Matos et al. [8], explored the opinions of formal carers about ICT and elderly. In their opinion, ICT can help to decrease feelings of loneliness [8]. In a pilot study it has been shown that with communication by image and sound, the demand for care can be answered quickly and efficiently.

In 2005, Proteion Thuis, a Dutch home care organization started to implement CareTV, a communication technology applied to a regular TV, which allows video voice contact 24 hours a day, 7 days a week with a nurse practitioner. It also provides support to health care professionals while they are visiting a client. There is an ability to contact colleagues or in future being able to access patient files.

As described above, elderly people are vulnerable to feelings of loneliness. CareTV has been developed to increase or maintain autonomy of the users, quality of life and to decrease loneliness, in order to let elderly people live at home as long as possible. Therefore, the aim of this project is to evaluate the effects of CareTV on the feelings of loneliness and safety. Moreover, the question needs to be answered how these elderly people appreciate CareTV. Finally, since the use of CareTV may become a routine service in homecare, several issues have to be organized to safeguard structural implementation. Therefore the implementation strategy has to be evaluated as well as to identify the remaining future challenges.

2. Methods

2.1. Participants

Participants of the study were elderly people receiving care from home care organization Proteion Thuis. From March 2008, all clients who received nursing care of this organization were informed about CareTV and were asked to participate in this study. Inclusion criteria were: clients have to receive home care, are able to watch television and have a telephone connection. Exclusion criteria were: severe visual problems, severe cognitive deficits and not living independently. The project started in March 2008 and data were collected until June 2010. The design of the study is a longitudinal design with baseline measurements at moment of inclusion and a follow-up measurement after 1 year of inclusion.

2.2. CareTV

The CareTV video network allows clients to communicate with a nurse 24 hours a day, 7 days a week,

Fig. 1. Remote control belonging to be the CareTV. (Colours are visible in the online version of the article; http://dx.doi.org/10.3233/TAD-120359)

by means of video and voice connection [9], which has to be operated by a remote control (Fig. 1). The current offer of CareTV of Proteion Thuis consists of the following applications: (1) Alarm Service: on a 24/7 basis, clients can send an alarm with the button on the remote control. They also receive a necklace with a transponder to send alarms. (2) Care Service: Clients can contact a central office of their home care organization for questions about health and care. (3) The Good Morning, Good Evening service (GMGA): Since this service was started in September 2008, nurses have been able to contact clients on a regular basis (daily, weekly etc.). This service is intended for social support, offering structure and medication support. (4) Welfare and housing: This service has been available from December 2008, during working hours, clients can contact a welfare organization with questions about housing, welfare and care. (5) Family Contact: CareTV can be used to contact friend and family with a video and voice connection.

2.3. Measurements

Data were collected through questionnaires at moment of inclusion and in March/April 2010. The survey consisted of the loneliness scale, questions about feelings of safety and open questions about the clients' experiences with the CareTV.

The loneliness questionnaire of de Jong-Gierveld [10] was used to measure the clients' feelings of loneliness at inclusion and after 1 year of inclusion. The 11-item questionnaire distinguishes between social loneliness and emotional loneliness. A higher score indicates a more severe level of loneliness. The loneliness scale has a reliability of 0,8–0,9 cronbach's alpha.

To measure clients' feelings of safety a questionnaire with nine statements regarding client's feelings of safety was developed in cooperation with experts of the homecare organization (Table 2). For each statement, clients were asked if they: totally agree, agree, more or less agree, not agree or not agree at all on nine statements. Each item is scored with 1–5 points. For the positively stated questions less points indicate feeling more safe and for the negatively stated questions less points indicate feeling less safe. The scale is not validated, so unfortunately no sum score can be calculated and analysis could only be performed at item-level. At baseline and after one year clients were asked for their experience in open questions. Questions were related to the following topics: reason for connection to the different applications, expectation of use, actual use of the applications, reasons for non-use and experience with the applications.

2.3.1. Statistical analysis

Means and standard deviations were calculated for continuous demographic variables. Categorical variables were calculated in percentages. Differences in the total, social and emotional scale of loneliness between baseline and follow-up were tested for significance using dependent t-tests. P-values smaller than 0.05 were considered significant. The statistical package SPSS, version 17 was used to analyze the data. Differences in feelings of safety between baseline and follow-up were described at item level. At each item, change scores were calculated by subtracting the item scores at the end of the study from the item scores at baseline. For positively stated questions, when the item change scores remained the same, it was stated that the client felt equally safe. Negative change scores refer to more feelings of safety and positive change scores to decreased feeling of safety during the study period. For the two negatively stated questions: a negative change score means decreased feelings of safety, a positive score indicates increased feelings of safety and when the item score remained the same, it was assumed that the client feels equally safe. The number of clients in each group was counted. The answers on the open questions of clients' experiences have been categorized.

2.4. Evaluation of implementation

Implementation of the arrangement CareTV started in 2007 in two pilot projects followed by this study to establish the effects of CareTV. The implementation of CareTV did not follow a strict pre-set plan. Therefore, the process of implementation will be evaluated retro-

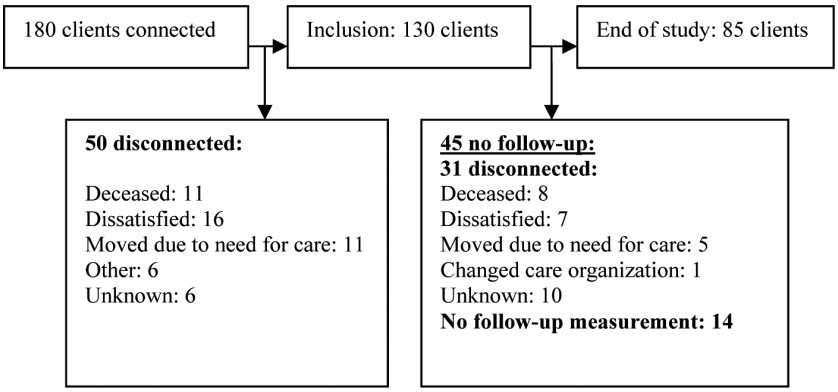

Fig. 2. Flow chart of client participation in the project.

spectively. Broens et al. [11] have, based on a literature review, presented a framework of determinants by which necessary conditions for effective telemedicine implementation can be evaluated. In this paper we use their framework to describe the procedures used to implement CareTV so far. The results will be listed by the determinants of the Broens Framework: technology, acceptance, finances, organization and policy, elaborating on what has been done for each determinant and what needs to be done.

3. Results

This results section is divided in two parts, part one focusses on the effects of the previously described study, whereas the second part describes the implementation of the technology, CareTV.

3.1. Effects of CareTV on loneliness, feelings of safety and user experiences

Between March 2008 and April 2010, 180 clients were connected to CareTV, 81 of them were disconnected in this period of time, because of the following reasons: client deceased (24%), moved (20%), dissatisfaction (28%) and some other reasons (9%), and unknown reasons (20%). Dissatisfaction was among other things related to technical problems and clients that were not capable of using the device. Technical problems occurred mainly when in clients' houses, the technology was outdated and connection to the system was not possible.

Fifty clients were disconnected before the baseline measurements took place, 130 clients participated in the baseline measurements. Eighty-five clients filled in the questionnaire at the end of the study, which means that 31 clients had been disconnected from the system between the baseline measurements and the measurements at the end of the study. The remaining 14 clients did not want to participate in the study any longer (Fig. 2).

The demographic characteristics were collected at moment of inclusion. Table 1 shows the demographics of the 130 participants that were included in this study and the 85 participants that completed the study. Information was retrieved on sex, indication for care, living situation and age (Table 1).

Average feelings of loneliness according to the loneliness scale of de Jong-Gierveld are 5.97 points at group level (on a scale from 0 to 11) at the moment of inclusion. Between the start and end of the study, average feelings of loneliness decreases from 5.97 (sd 2.77) to 4.02 (sd 3.91), which is a significant decrease with a p-value smaller than 0.001. Drawing a distinction between emotional and social loneliness gives significant changes ($p < 0.001$) between start and end of the study. The emotional loneliness score (on a scale from 0 to 6) decreases from 3.53 to 2.42 between start and end of the study. The social loneliness score (on a scale from 0 to 5) decreases significantly (p-value < 0.001) from 2.45 to 1.60 between start and end of the study (Fig. 3).

Individually, total loneliness decreases between start and end of the study in 54 out of the 85 clients (63%). Forty-six out of the 85 feel less socially lonely between start and end of the study (54%). Forty-nine out of 85 clients (85%) feel less emotionally lonely at the end of the study compared to moment of inclusion (Fig. 4).

Feelings of safety, have been analyzed at item-level. For only 1 out of 9 items: most clients (40%) indicate that they need less help at end of study in comparison to the start of the study. For 5 statements clients report

Table 1
Demographic characteristics caption

Variables		Inclusion ($N = 130$)	End of study ($N = 85$)
Sex	Male N(%)	26 (30.2)	25 (29.4)
	Female N(%)	60 (69.8)	60 (70.6)
	Missing values	44	0
Care Indication	Nursing (VP) – N (%) Yes	31 (30.4)	25 (30.1)
	personal care (PV) – N (%) Yes	78 (76.5)	67 (80.7)
	Social support act (WMO) – N (%) Yes	8 (7.8)	6 (7.2)
	supportive counseling (OB) – N (%) Yes	2 (2)	2 (2.4)
	Missing	28	2
Living situation	Alone	84 (83.2)	72 (86.7)
	Together	17 (16.1)	11 (13.3)
	Missing values	29	2
Age	Range	32–90	38–90
	Mean (sd)	73.2 (11.8)	73.1 (11.2)
	Missing values	37	3

Table 2
Feelings of safety, translated from Dutch ($N = 85$)

Statement	More safe number of clients (%)	Equal number of clients (%)	Less safe number of clients (%)
I feel safe in my own house	10 (11.8%)	53 (62.4%)	22 (25.9%)
In case of emergency, I can manage ($n = 84$)	30 (35.7%)	19 (22.6%)	35 (41.7%)
I can do everything myself, I don't need much help ($n = 84$)	27 (32.1%)	27 (32.1%)	30 (35.7%)
In case of emergency, I can contact family or acquaintances	16 (18.8%)	35 (41.2%)	34 (40%)
I know enough people, who can help me with the things I cannot do myself	23 (27.1%)	29 (34.1%)	33 (38.8%)
I need a lot of help	34 (40%)	20 (23.5%)	31 (36.5%)
I don't have a lot of contact with other people	26 (30.6%)	28 (32.9%)	31 (36.5%)
I have a lot of contact with my neighbours	25 (29.4%)	31 (36.5%)	29 (34.1%)
I have a lot of contact with family and acquaintances	23 (27.1%)	29 (34.1%)	33 (38.8%)

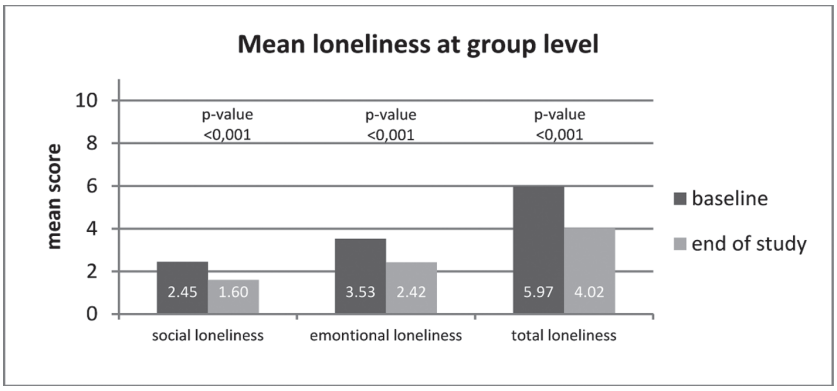

Fig. 3. Feelings of loneliness at group level ($N = 85$).

a decline in feelings of safety between start of the study and end of the study (Table 2).

Eighty-eight percent of the clients have good experience with the care services. But technical problems or familiarization are experienced by 12%. Only 18% of the clients have used the application welfare and housing in the past year. For those who used it, they mention that it is good or easy (37%), 32% say that they don't need it, 11% think that it is difficult to use and 21% say that although they have used it at least once, they don't use it much. Fifteen clients are connected to family contact at the end of the study (one did not answer the questions) and experiences vary from: nice (36%), difficult (14%), haven't used it yet (29%) and

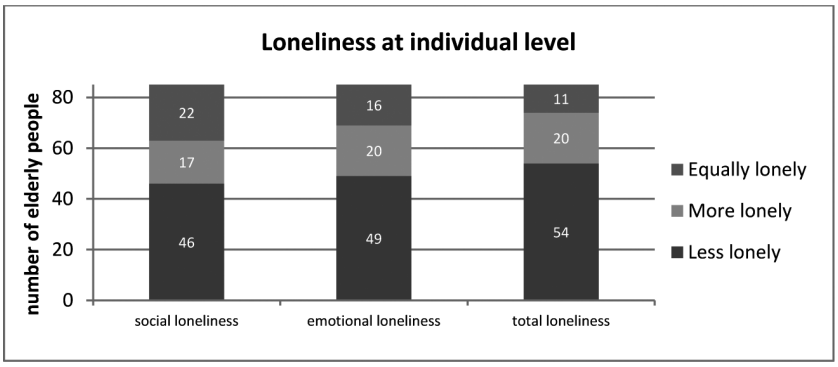

Fig. 4. Feelings of loneliness on individual level between startand end of the study ($N = 85$).

21% of the clients have technical problems with this application. As one user mentioned: "I was able to call with my son once, afterwards the application never functioned again". For the application alarm: 39% of the clients think that it is nice. It takes too long before help is sent (2%) is a comment, but on the other hand 22% of the clients think that help is sent quickly. More responses are: it is easy (6%), it makes me feel safe (19%) and "I haven't used it yet" (6%). Five percent of the clients experience technical problems. The answers on the good morning/good evening service are divided into good morning users and good evening users. Good morning users (17), one didn't answer the questions, mention that it is nice (81%). As one client mentioned: "a lot happens in one day, it is nice to have a talk at the end of the day". Other experiences are: difficult (6%), reassuring (6%), easy (6%). Thirty-nine clients use the good evening service (one didn't answer the questions) and 50% of them think it's a nice service and 32% think it's good. 18% gave different answers. One client's reason for having chosen the application assistance in medication intake is: "My short-term memory is partially lost due to brain infarctions, consequently I frequently forget to take my medicine". Experiences of users of assistance in medication intake (6 users) are good (83%) and easy (17%). Most mentioned preferences in new applications are contact with a General Practitioner, information on their own Care record mediated by CareTV and information services at the community level.

3.2. Implementation of CareTV

Implementation was evaluated considering the Broens framework [11]. Results of the analysis of different determinants are expressed in Table 3. Additionally, future challenges for specific determinants are expressed.

Fig. 5. CareTV being used.

Analysis of the necessary determinants for successful implementation involved in the implementation of telemedicine shows that at the technological level, development started from a technological perspective instead of a user perspective. Consequently, only limited number of care related applications are present until now. Homecare workers as well as their clients did not play a central role in the development. It has been shown that user related effectiveness of CareTV stimulates acceptance. Additionally, structural changes in the structure and organization of the Dutch elderly care system hinder the uptake of this CareTV as part of routine care provision. On the policy level, in the Netherlands a shift in the financial infrastructure is made from publically financed (individual) care towards community services, consequently, a new set of rules is being designed by which the delivery of care at a distance can be reimbursed. In Table 3 several items can be identified to show how the home care organization can improve the structural implementation of CareTV.

Creating and organizing the required technological infrastructure to deliver teleservice is a task beyond the control of one individual care organization. Installation,

Table 3
Analysis of the approach to develop and implement telecare services according to the framework presented by Broens et al. [11]. Actions to be taken by care organizations are printed in bold format

Determinant	Element	Done	Future challenges
Technology	*Support*	Protocols developed New application development	Downscale project organization **Start developments directly from users perspective**
	Training	Introduction training healthcare workers Protocols developed	Incorporate training as part of the company's infrastructure
	Usability	Feed-back from users to technology provider	Upgrade communication Using diversity of tools Initiate feed-back and co-creation with technology providers
	Quality	Part of routine service delivery Research on effectiveness as part of routine organization	**Develop new care applications for CareTV** Exchange experiences between organizations Expand effectiveness research Implementation strategy actively endorsed by organization
Acceptance	*Attitude*	Information to stakeholders Spread user experiences Inform informal caregivers and clients	**Information to end- users and coworkers about new applications and experiences of other organizations**
	Evidence	effectiveness research description of use case Identify quick successes	**Business research** Expand effectiveness research
	Diffusion	Communication tools used Exchange of information	**Structural communication to professionals, users and stakeholders**
Finances	*Provider*	Information given on performance Business case developed	Accommodate changes at organizational level to expand the service Clarify performance i.e. registration of time required
	Structure	Societal business case developed Information given	Involvement in the change of health policy Cost effectiveness research endorsed
Organization	*Work practice*	At the department level	**Implementation to other departments within service organization**
Policy	*Legislation*	Not touched	**Contact with Dutch Health Authority**
	Standardization	Advocate principle of standardization	Active participation to reach this strategic target by care organizations **Stimulate working together between organizations**
	Security	Apart from discussion with ethical research board not really touched	Identify risks by active FONA registration (Faults Or Near Accident) **Perform usability research**

use of the technological components, setting up a (tele-) communication infrastructure, training, and actual service delivery, informing end-users and relatives had to be organized. Setting up this kind of new business as part of a new organization would have the advantage of a straight forward process. The Dutch healthcare system however is a publically financed system having strict regulations on financed practices. Therefore, privately funding and introducing a new service would be a financial risk, which has been tried by others [12]. The principle by which a disruptive innovation is created gives the advantage that a new business is organized without initially interfering with routine business and without losing the expertise of care provision [13]. This has been done by creating a development department, telecare, within the Proteion care organization and by organizing the cooperation between this department and Zuyd University as a knowledge provider. The telecare department consists of experienced care workers, which allows for the creation of new services in close contact with clients without interference with regular service provision. Within a short period of time it will become clear whether or not the technology is suitable for large scale application. Critical factors in the successful implementation are the determinants listed above and more specific in the use of CareTV will be the transfer of knowledge and the newly developed service arrangements towards the regular service departments of the care organization. To be able to support the decision to implement the service at larger scale other aspects have to be addressed and most of them can be initiated by the homecare organization itself:

- Expand the number of applications in which CareTV can be used both by clients themselves and by care workers
- Design financial instruments to exploit this kind of service in a cost-effective way including direct payment by clients
- Applied research is needed to develop and apply a societal business cases
- Standardize the technology used to increase the potential use of this kind of services

– Develop a strategy in which different (care) organizations use the same infrastructure to communicate with their clients

4. Conclusion

Recent advances in technology with respect to electronic monitoring devices in combination with the problems of an ageing population raised the question whether use of CareTV can decrease feelings of loneliness and increase feelings of safety. On average, feelings of loneliness decrease significantly between the moment of inclusion and the follow-up measurement. Loneliness can be divided into an emotional component and social component. This research shows that both subscales show a significant decrease. This implies that CareTV can soften feelings of missing a good friend or partner and can partly enrich an essential part of the general social network (friends, family, colleagues etc.) of the client. Despite the decrease in loneliness, it should be noted that clients on average still feel moderately lonely at the end of the study, which also was the case at the moment of inclusion. CareTV has no effects on feelings of safety in this study, only for 1 out of 9 questions most clients feel safer at the end of the study. However, in the open questions, clients frequently reported: "it makes me feel safe". Moreover, main reason for using the GMGA service were safety and social talks. That most people feel less safe according to the scale with the service can partly be explained by the technical problems that still occur, so they cannot fully rely on CareTV. Many clients already were connected to other alarm systems, such as necklace alarms. This could have diminished the effects on the feelings of safety. Other explanations are aging of the population and the increase of severity of problems during the study. The fact that safety is measured with a non-validated questionnaire could also have influenced the results.

Loneliness is a severe problem in this population. In the future, it is expected that the time relatives provide informal care will decrease. Furthermore, formal care will also decrease due to the demographic changes. Technology, if used properly, can diminish loneliness problems at the moment and in the future. This study proved that CareTV has effects on feelings of loneliness.

Lack of a control group is a limitation of this study, as well as the fact that only 85 out of 130 clients completed the study. Completers could differ from non-completers in their satisfaction with the system. Twenty-three of the 81 clients who were disconnected from the system during the study were dissatisfied. Reasons for dissatisfaction were among others: occurring technical problems and clients not capable of using the device. These findings could imply that CareTV might not be useful for all elderly people. Unfortunately, due to the high amount of missing values in the demographic characteristics, it is not possible to tell whether the group at moment of inclusion differs from the group of clients at the end of the study. Additionally, it is unclear whether the clients not participating in the study at all, differ from the clients at moment of inclusion or end of the study.

Further research should focus on the inclusion of a control group, preferably a larger group of participants and frequency and intensity of technology use should be taken into account. But for this study, it can be concluded that CareTV is a supportive tool to depress feelings of loneliness. However, we were unable to tell whether the technology let elderly people live at home for a longer period of time, nor can we say whether care is delivered more efficiently, because there is no data on consumption of care. In order to investigate this, further study will focus on gaining detailed insight into the effects at informal caregiver level as well as formal caregiver level and into the cost-effectiveness of CareTV.

Assessing the implementation process shows clearly that several actions have to be performed by care organizations themselves. These steps demonstrate that the renewal of homecare by introducing telecare should be an initiative from the care organizations themselves; facilitated but not dominated by the technical means. The driving force should be the creation of an opportunity to improve the effectiveness and quality of the care provided to clients. As noted already by the analysis the Dutch "care at a distance program" [14], many barriers are present that hinder the development of new approaches in care. They are present at all the identified determinants (Table 3). The barriers have to be addressed in conjunction to each other. However, taken together they support the conclusion that the care system itself does not produce enough stimuli to innovate and to spread the innovation of care. The take up mechanisms by care management, professionals and, last but not least, clients are sometimes lacking. Once these are improved the use of CareTV will become a meaningful tool to provide homecare. As we have shown in previous projects the environment in Noord- and Midden-Limburg is open to innovation.

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