

Evaluation of Technology-Based Service Scenarios for Supporting Independent Living

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Abstract— To develop technology-based service solutions for supporting the independent living of elderly citizens, we conducted a user assessment study. Six different service scenarios were created and analyzed in six focus groups by young adults, elderly, and health-care professionals (n=29). Results show that safety was viewed as the most significant aspect. The study also showed that independent of age, most individuals take interest in health related issues only when a clear threat is posed, even though health in general is considered an important issue in life.

I. INTRODUCTION

INCREASED life expectancy and decreasing birth rates form common trends of demographic change in most of the developed countries. Simultaneously, chronic diseases have become the leading cause of death and often result in decline in health especially in later years of life. The ability to live independently requires good enough health which consists of physical, mental and social aspects. All of these have to be considered in order to translate the longevity gains in life years to as many years in good health as possible.

However, the occurrence of most chronic diseases is strongly influenced by years of unhealthy lifestyle and lack of awareness in health behavior. Therefore, not only the seniors of today are of interest but also the opinions of younger adults. The younger adults have already a history of using many different devices and are likely to spend money on their wellbeing when aging. These issues suggest a possible change in demand of various health-care services is about to surface.

Existing technologies for supporting independent living consist mainly of surveillance systems targeted for care institutions, alarm systems for indoor use and various devices for independent or telemonitoring of vital sign parameters [4]. Often, the current systems actually do not address the issue of supporting independent daily living, but rather initiate a reaction or a chain of reactions once something has already happened.

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Effectiveness evaluations of home health-care interventions show contradictory results [3] and assessments of socio-economic benefits associated to existing systems are not generalizable [5].

This study aims to use scenario-based approach to find out how elderly, young people and health-care professionals view possible services to support independent living. It is also of interest to find out what is important in receiving health-care services, which ideas receive support from the participants and if there are any differences between these groups. The results support decision making in designing technology-based system for supporting independent living of seniors.

II. SCENARIOS

We created six service scenarios based on the current solutions on the market, the research on the field, and expert interviews.

A. Foundation for Creating the Scenarios

At present, teleconsultation and virtual visits are in frequent practical use in certain locations, but telemonitoring is still more of a research area. Some larger field trials have been carried out in the telemonitoring branch [7], but they mostly assess only the clinical effectiveness of telemonitoring compared to usual care. Even cost-effectiveness is still debatable [8].

Our study addresses users' interests and expectations about home telehealth. Few publications were available on this field. Moreover, more results of user assessments and user acceptance evaluations are needed about technologies that support independent living [6]. Such research is needed in order to prove the usefulness of and justify the investments in technology in healthcare. However, not only the direct economic impact must be taken into account but also topics such as ethical issues, quality of life, and the patients' preference.

To gain better overall understanding about the current home care services and support for independent living in Finland and to identify bottlenecks in the service flow and seamlessness, expert interviews were carried out.

The interviews consisted of three open interviews: the first with a services manager responsible of home care at a local health center, the second with a home-care employee and the third with a hospital-at-home nurse. Moreover, more information was received through five visits to care facilities,

TABLE I
DESCRIPTION OF THE SIX SERVICE SCENARIOS THAT WERE EVALUATED BY YOUNG ADULTS, SENIORS AND HEALTH CARE PROFESSIONALS

Person	Scenario description	Technology in scenario
A A heart failure patient	Vital sign measurement in the case of an illness. Personal measurement devices to monitor vital signs relevant to the illness and contact nurse who is informed about abnormal measurements.	Mobile phone with health diary, measurement devices (scale, blood pressure meter)
B Well-being couple near retirement age	Personal measurement devices (as in A) of own choice. No connection to health care services, but a personal trainer is used instead.	Mobile phone with health diary, measurement devices (scale)
C A lonesome aging person	Online peer support group for changing health behavior and lifestyle.	Computer, internet access, (any) telephone
D Aging couple, no relatives live close	Video call system at home via mobile phone or TV. Health care professional has a mobile device for accessing patient data anywhere.	Mobile phone with video camera, TV with video call possibilities, portable personal device
E A retired couple	Safety and security system for both indoors and outdoors, includes an outdoor positioning service. Senses abnormal behavior indoors (falling etc.) and alarms help.	Alarm wrist watch with positioning, environment sensors in the house, regular burglar alarm system
F A healthy retired widow living in senior housing	Memory board (a display) to present happenings, calendar events, messages and even TV. Activity measurement via a wrist worn device that acts also as a key and card for local traffic and other services.	Display for bulleting board (a flat screen on the wall), wrist-wear device including activity measurement sensors

hospital-at-home offices, and home care locations including discussions with the health-care professionals and customers at each location.

According to the interviewees, the primary problem in providing home care within public healthcare is lack of resources, mainly time and personnel. This impression was further enhanced by the visits to various care facilities. Moreover, the interviewees find some existing technology solutions helpful, but new technology also seems to be a burden and employees are not keen in adopting it into use.

The aging are a heterogenic group that includes very healthy and independent individuals but also very dependent people. This study focused more on people whose memory functions still work well, which affected the creation of the personas used in the scenarios.

B. Scenario Creation and Descriptions

We identified vital sign monitoring as one of the key ideas for the scenarios because it is in a widespread use within healthcare. It is essential in both rehabilitation and prevention of diseases.

Self-care was identified as a rising trend especially among decision makers, who hope that people start taking more responsibility of their own health since the public health-care resources are limited [2]. There is also a growing number of health monitoring devices on the market, which suggests that more people consider monitoring their health important than before.

Peer support has been utilized in situations concerning changes in life, such as disease-specific support groups [9]. It has also been successfully used in behavior change programs as weight management or smoking cessation.

Communication with family, friends and health-care professionals was also seen important and it was often mentioned in the interviews with health-care experts.

We decided to compare the health-care scenarios to scenarios focusing in safety and in entertainment. In addition, we decided to use various different technologies which are available on the market or feasible in near future to keep the scenarios realistic.

Based on the identification of key issues, we created six service scenarios that are described in Table I. These scenarios portray the most prevalent ideas, some of the recognized bottlenecks in current services, and desirable improvements for the future.

III. SCENARIO EVALUATION

Scenarios were evaluated by seven groups of 4-5 participants (n=29) in focus group discussions [1] and by filling out short questionnaires. Thus, we could gather both quantitative and qualitative data.

A. Focus Groups

The scenarios were evaluated in seven focus groups of 1) four technology experts, 2) seven young adults aged between 23 and 33 years, 3) eight older adults aged between 61 and 80, and 4) ten health-care professionals.

A pilot session with technology experts was arranged first, followed by two groups of young adults, two groups of seniors and two groups of health-care professionals.

The focus group participants discussed five to six aspects which have been used in prior studies [10], [11]. All users evaluated credibility, usefulness, ethicality, ease of use, and desirability for each of the six scenarios. In addition, the health-care professionals assessed the impact on their work.

All aspects were assessed with a short questionnaire using five-point Likert scale answer possibilities: strongly disagree, disagree, undecided, agree, and strongly agree.

Furthermore, the participants evaluated the importance

and priority of the scenarios both prior and after the focus group session.

B. Numerical Analysis

All 29 participants evaluated all six scenarios. To find out which scenario was generally considered the most interesting, we used a Goodness Grade value to compare the scenarios.

A Goodness Grade value was developed and found useful for supporting the interpretation of both the quantitative and the qualitative data in concept evaluations involving user participation. [10], [11]

A value for each scenario was obtained by first translating the Likert scale results into a numerical form, where 1 represents the most negative, 3 undecided, and 5 the most positive answer. Second, the ordinal scale was transformed from a 1 to 5 scale to a -2 to 2 scale. Third, the indifferent values were eliminated by using the answer frequencies multiplied with the values of the new scale. Then, the ratio between the sum over each aspect's new values and the maximum was calculated. Finally, a mean over all five or six aspects was produced.

The results are presented on a percentage scale which shows a scale of [-50, 50] instead of the traditional [0, 100] scale. The results on this modified scale show clearly, whether the scenario is seen more as positive or as negative.

IV. RESULTS

The composition and the number of participants affect the interpretation of the Goodness Grade values. Through the qualitative analysis performed in the focus group discussions some light can be shed to the reasons and meanings of the results.

The results of the numerical analysis are presented in Fig. 1. The difference between the most and the least interesting scenarios (16.9 percentage units) is clearly visible in the figure.

Scenario E performed best in the evaluation. The participants often viewed this scenario as an excellent solution, but would still consider using it only when they clearly felt they were at risk of injury. In such a situation, the benefits of a mobile alarm system were unquestioned.

Scenario C performed almost as well as scenario E. Successful change in lifestyle and possibility to communicate with others were seen in a very positive light. Other reasons for this scenario's success include the voluntary use of the system and lack of surveillance.

Scenarios F and D received both some evaluations in favor and some against. F was considered a desirable service especially by participants who use technology frequently or have positive attitude towards it – regardless of age. People familiar with video call liked D but others found it to have strong touch of monitoring to it. Most participants liked the idea of seeing someone else on the screen, but not being seen

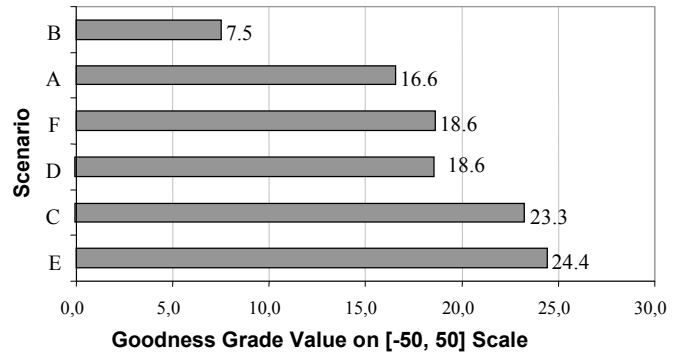


Fig. 1. The overall results of numerical analysis. All 29 participants evaluated five or six aspects of all scenarios and a numerical grade was created to provide a tool for comparing.

themselves. Health-care workers appreciated the mobile device and estimated that it would ease their work.

The monitoring of chronic disease in scenario A was seen important mostly by people with personal experiences related to heart problems. It was mostly seen as “useful if it helps”, but did not invoke any strong feelings of for or against.

Clearly the least desirable scenario B portrayed the self-care aspect but did not include a change in lifestyle. Mostly the participants found this scenario to involve too much self-monitoring and data recordings without a (medical) reason. Due to multiple recordings, it was also considered troublesome to use. However, there were also people strongly in favor of such a personal system.

When observing the results by group, some differences in preference become visible. Table II shows that the group of all young adults (including both technology experts and young adults) did not consider the safety scenario the most important. Instead, entertainment received best evaluation among the young. The young were the most worried about data security and privacy, especially concerning the video call scenario. In addition, five out of the seven young adults were willing to use an every day device embedded with safety features (such as a heart rate monitor with an alarm button).

Table II also shows that the seniors and health-care professionals preferred scenarios that issued safety features or emphasized communication possibilities (scenarios C and D). Both of these groups disliked scenario B. Seniors found the concept of self-monitoring useless unless they had a reason for it. The health-care professionals thought that logging data often may cause stress to the patients. Thus, they would not recommend it to their customers.

V. DISCUSSION

Even though the young adults of today will learn to use several equipment in the course of their lives, they will also have similar disabilities in the later years as the elderly today (e.g. decline in fine motor coordination, loss of eyesight),

TABLE II
DIFFERENCES BETWEEN INTEREST GROUPS IN THE ASSESSMENT
OUTCOME FOR MOST AND LEAST DESIRED SCENARIOS

Interest group	Most popular scenario	Least popular scenario
All Young Adults	F	D
Seniors	C, E	B
Health-Care Professionals	D, E	B

Letters in the table refer to the scenarios described in table I. Scenario B features self-care, C online peer support, D video call, E security and F entertainment.

hindering the use some devices. Thus, the technologies for supporting independent living must meet the user requirements of elderly in general, even though the skills and attitudes towards using the services are likely to change already within the next decade.

Compared to the seniors, the young adults are much more interested in self-care and choosing the parameters personally, as well as entertainment or other additional value created by the service or technology. Thus, the next generations of aging may appreciate motivation and support for healthy lifestyles and behavioral change delivered in a personal manner already in earlier years. Motivation for self-care can be found in higher social activity, feeling of security and successful improvement in lifestyle.

Security systems and increase in communication receive support from the evaluators. Especially the seniors and health-care professionals considered safety an important topic, which suggests that it is an issue in the life of seniors that needs addressing. Security includes both physical and psychological aspects.

Video call scenario received criticism, yet the technology and services are already available and actively used in private communication and as virtual visits in health-care domain.

In the future, a larger survey to verify the validity of these results should be carried out. The number of evaluators (n=29) in this study is too small to present any conclusive theories. However, some hints for technology development can be found.

VI. CONCLUSION

In general, all scenarios acquired favorable Goodness Grade values, which shows that people are interested in issues related to health. However, the most prevalent fact that this material presents is the unwillingness to proact for better health.

Monitoring health parameters was seen useful if there was a need for it. The participants defined the need to begin when a clear threat or even an accident had already happened. However, prevention requires an earlier action and therefore motivation and interest toward self-care should be reinforced during earlier years of life.

The evaluation participants found the entertainment scenario to be more of interest than self-monitoring of health related parameters, even in the case the user was able to choose the parameters independently.

Future systems that aim to support independent living in a preventive manner should address the physical needs of the aging. The aging process will affect the physical capacity of people similarly in the future as it does now. However, future seniors are likely to have more technical skills. They may also be more interested in participating in the health-care process through self-care and may appreciate the possibility for personal systems.

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