Northern Periphery Programme 2007–2013

COMPETITIVE HEALTH SERVICES IN SPARSELY POPULATED AREAS - eHealth Applications across the Urban-Rural Dimension

Subreport from Finland: the results on the remote wound therapy, remote speech therapy, remote monitoring health parameters for weight loss group, and for patients with cardiac arrythmia

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GENERAL INTRODUCTION

The aim of this project was to enhance the provision and accessibility of health services in the sparsely populated areas (SPAs) of Europe. We mapped and identified best practices and innovative eHealth solutions which could be transferred, further developed and integrated into a health care system elsewhere in the partner regions. There was the special focus on new eHealth service concepts and solutions for primary health care, chronic conditions and remote specialist services. We piloted new eHealth services in Finland, Sweden, Norway and Scotland using an implementation model which can replicated elsewhere in the Northern Periphery and other peripheral areas of Europe

Objectives of the project

The main objective of our project was to enhance the provision and accessibility of health services in the sparsely populated areas of Europe by developing and implementing innovative eHealth solutions and promoting transfer of the best eHealth practices across the NPP area.
Our main objective was achieved through the following specific aims:

1. Mapping of the existing eHealth practises and innovations in all partner countries. We assessed health service needs and gaps in the rural and remote areas. Special focus was placed on identifying eHealth services for primary care, chronic conditions and remote specialist services. The outcome of this mapping phase was published as a report entitled "*A Portfolio of eHealth Applications in European Sparsely Populated Areas*". The results are also be available in a web-based database, which includes information about the best practices, pilot sites that would benefit from eHealth applications and country-specific policies that may influence technology transfer. It may also be used as a reference guide when eHealth is being introduced and implemented in the remote regions of Europe.

2. Assessing the likelihood of adoption of eHealth innovations in health care sites across Northern Periphery using a whole system approach. Sites that were likely to accept and integrate new eHealth innovations were chosen as pilot sites for transnational development and transfer of eHealth services.
3. Utilizing transnational eHealth Triple-Helix Partnerships for piloting innovative eHealth services and best practices across the Northern Periphery. Our Triple-Helix Partnerships included both urban and rural partners. Transnational Triple-Helix partnerships maximized knowledge transfer, promote innovation capacity building and also provided an opportunity for efficient organizational learning.
4. Creation of "*A European Network of Rural eHealth Care*" for sustainable and on-going transfer of knowledge and technology across the Northern Periphery. This will ensure the viability and sustainability of rural health services. This network will include representatives from the peripheral maritime regions, ultra-peripheral regions and the mountainous territories of Europe.

Ultimately we aimed to create viable and sustainable eHealth services and businesses that will continue to benefit the residents of remote and rural European regions beyond the end of this project. In order to encourage and facilitate transfer of expertise and innovative practices across the

Northern Periphery, we will summarize our finding in a road map *"An Innovation System for eHealth Services in European Sparsely Populated Areas"*.

Project consortium:

Northern Ostrobothnia Hospital District and Oulu University Hospital, Finland
Centre for Rural Health and University of Aberdeen (Scotland, UK)
County council of Västerbotten and Umeå University, Sweden
Norwegian Centre for Telemedicine and the University Hospital of North Norway
Department of General Practice, National University of Ireland

Associated partners:

Lapland Hospital District
NHS Highland, Inverness, Scotland
SMEs: Finland, Sweden, Norway and United Kingdom

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We hope that this report is of use for the hospital district when planning and implementing further health services for its' sparsely populated areas.

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Last but not least we owe to thank the patients for their readiness and valuable opinions along with the surveys.

Local expert group of Finland

BACKGROUND

In Finland the Ministry of Health and Social Affairs has regularly followed up the implementation and usage of information and communication technology applications. Electronic health record systems are advanced, all hospital districts and health care centres use electronic patient records almost exclusively. Remote video consultations between primary and secondary health care centres are offered in 66% of hospitals and used by 17% of health care centres (Hämäläinen et al 2009).

Among them telepsychiatry is most advanced, especially in the northern part of the country (Ohinmaa et al 2008), but there are also services for dermatology, orthopaedics, ophthalmology, and diabetes care.
Direct eHealth services enabling citizens to consult professionals, schedule appointments, download own measurement data and see laboratory results, cover approximately 2 – 10% of service providers, but the coverage is rapidly increasing (Hämäläinen et al 2009).
The providers of health care services purchase network connections from commercial providers, which provide secure and high bandwidth connections. Even in the peripheral sites the bandwidth can be regarded to be wide enough for image transmission and centralized health archiving.

Among the existing eHealth practises and innovations of the partner countries the Finnish expert group selected 1) video conferencing consultations for remote wound treatment (from Norway), 2) video conferencing for speech therapy (from Sweden), 3) network based monitoring of a) cardiac patients by a special equipment with tailored devices CheckUp©Care /Explizit (from Sweden), and b) a weight loss group by the same special equipment with tailored devices CheckUp©Life/Explizit (from Sweden). Remote wound consultations and remote speech therapy fulfilled the criteria of the needs and gaps of services for chronic conditions at remote sites, as did network based monitoring of patients because it offered direct eHealth services for citizens in primary health care.

1. VIDEO CONFERENCING FOR CONSULTATIONS ON WOUND THERAPY

Dermatological problems are considered very suitable for managing by means of video conferencing (Wootton 2001). The acceptance of wound therapy by video conferencing has been found high among wound treatment experts and patients, and it has been cost-effective (Ablaza and Fisher 2006, Binder et al 2007, Chanussot-Deprez and Contreraz-Ruis 2008), at least over long distances (Wootton 2001). The accuracy of a telemedicine consultation in terms of sensitivity, specificity, and positive predictive value has been assessed to be close to “gold standard,” (Elmore 2000).

1.1. Study population

The expert group chose the health care centre of Pudasjärvi as the remote site for carrying on the services with Oulu University Hospital. Pudasjärvi is a sparsely populated northern municipality located at the distance of 90 km from the hospital. There was willingness to

implement new health services in the health care centre, and in addition, the personnel were experienced in using video conferencing.

Eight patients, two females and six males, mean age was 68 yrs (42 - 85), all of them with chronic cutaneous wound problems in need of specialist consultation were identified and they volunteered by signing the form of informed consent. Their mean of distances to the health care centre (HCC) was 16,4 km (0,2 – 65) and 90 km to the Oulu University Hospital (OUH). Their assessed travelling times to the HCC were 2,8 h (1- 9), and to OUH 4 h (2 – 9). Their means of transport were: one by a bus, four by a car, and one by taxi. Two of the patients were in need of escorts for their health care centre visit, and four would have needed escorting for the OUH visit.

1.2. Methods and setting

The patients and professionals of the health care centre and University Hospital filled in structured forms documenting their opinions (concerns in some cases).
The findings are presented descriptively as tables, graphics, and quantitative numbers as ranges, means, and medians.

Installation and testing of the equipment and the process was carried out in October 2009, pilot launch in December 2009 and data collection continued until the end of June 2010. The video conferencing set was Tandberg C20 Full HD with two 42" screens, and the mobile equipment for home nurse visits Tandberg Centric 1700 MXP. In the health care centre a nurse specially trained for cutaneous wound treatment presented the cases to a nurse with comparable specializing or a dermatologist at the outpatient department of OUH via the video conferencing set. In the consultation room of the OUH there were two monitors, one for showing the patient, and the other for the patient record display (Figure 1).

All specialist consultations took place with the outpatient department of dermatology, as there were no cases for surgical consultations during the data collection period. Additionally a home nurse could consult the wound nurse located in the health care centre by the portable video conferencing set.

Figure 1. The video conferencing set up for chronic wound treatment

1.3. Results

Videoconferencing assessed at the outpatient department of dermatology

The outpatient department of dermatology at the OUH gave consultations by televideo for eight patients. Five consultations were given by a team of a dermatologist and a nurse, and three by the nurse.

1.3.1. Staff's point of view

Assessments of the dermatologist and specially trained nurse

There were five patients aged 59 – 81 (mean 71,2) yrs, four men and one women. The reasons for the consultation were chronic skin problems, three of them got the diagnosis of chronic cutaneus ulcer, one neurodermatitis, and one was not defined.

The quality dimensions of the information transmitted by videoconferencing enabled a functional mode of action and the patient cases were found to be applicable for a videoconference consultation. Sufficient amount of information was received about all cases except one patient, who had a chronic wound of the head. In this particular case the details of the lesion remained unclear. There were no disturbances in the picture or voice in three of the cases, and minor disturbances in two cases (Figure 2).

The skills of using the equipment were assessed as very good or good at the both sites, and the collaboration with the patients and the of the health care centre team worked well. A consultation only by phone as a substitute for videoconferencing was seen as insufficient for all of the cases.

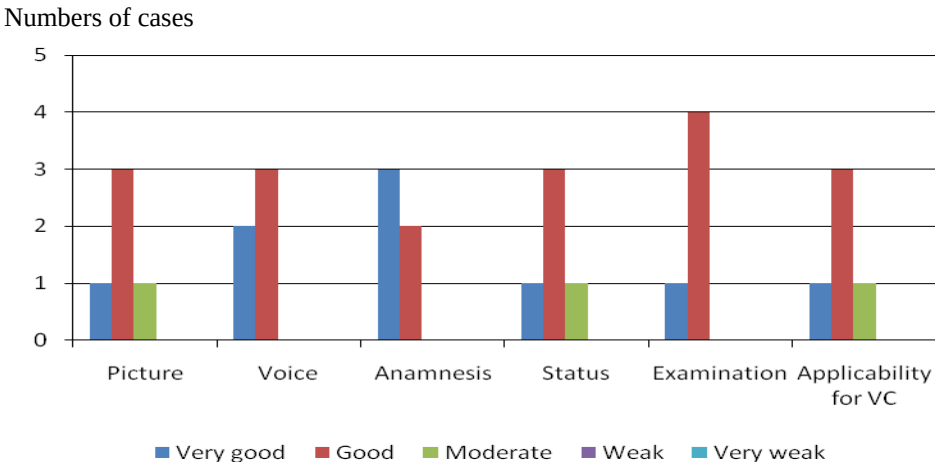

Figure 2. The quality of the information mediated by videoconferencing (VC)

Assessments of the specially trained nurse of OUH

The specially trained nurse gave consultations for three patients, aged 41 – 80 yrs, two of them women, one man. There were no disturbances with connections in terms of the picture or voice, and the quality of the information was assessed to be very good or good. The duration of the videoconferencing was from 15 to 33 (mean 22) minutes.

Assessments of the trained nurse of health care centre on consultations with OUH

The wound treatment nurse assessed seven televideo conferencing consultations with the department of dermatology of the OUH. All of them concerned men, aged 42 – 83 (mean 62,9) yrs.
In general, the quality of videoconferencing, and the collaboration with the patients and the team of the specialized health care were assessed as good (Figure 3).

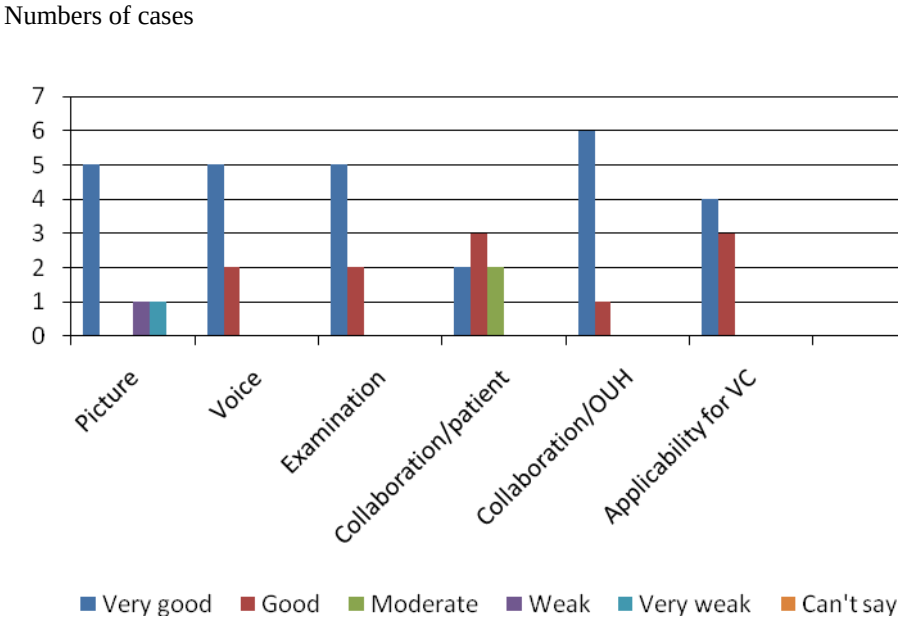

Figure 3. Assessments on videoconferencing of the trained nurse of the HCC on consultations with the OUH

The skills of using the equipment were assessed as good or very good. One patient with a wound at his back felt as an outsider because he had difficulties to see the screen.

The opinion of the professionals was that in none expect for one of the cases videoconferencing could be substituted by a phone consultation. The video conferencing sessions were educationally very good or good in five cases in terms of diagnostics as well as when assessing the degree of difficulty of the illness. The video conferencing sessions changed the treatment plan in five cases, and substituted a conventional visit to OUH for all of the six cases. The duration of the consultation was 15 min as assessed in two of the cases. Video conferencing was chosen as the mode of action in the future in all similar cases.

Assessments of the consultations between home nursing and the wound treatment nurse at the health care centre

The consultation included two patients, both women aged 78 and 84 yrs. The portable videoconferencing set was used at home visits. The quality of the picture and the voice was very good or good. The collaboration between the wound treatment nurse and the patients and between the wound treatment nurse and the home nurse worked very well. The sessions were beneficial in terms of diagnostics and assessment of the degree of difficulty of the illness, changed the treatment plan and substituted patient visits to the health care centre. The home nurse proposed that the portable unit should be lighter and smaller in size. The equipment was connected by a separate antenna for "@ 450"-lines and they worked very well, hence the antenna could fitted to the unit. The camera in the portable unit had a zooming function, which was found beneficial.

1.3.2. Patients point of view

A total of eight patients assessed the service of televideo conferencing for their chronic cutaneous wound problem. They were aged 41 – 85 (mean 68) yrs, and six were women, two men. Their distances from home to the health care centre were 0.2 – 65 (median 3.5) km, and travelling to there took 1 – 9 (median 2.3) hours. Two of them were employed, six pensioned. Four had traveled by a car, two by a taxi, one by a bus, and two had walked. One of them had an escort for the health care centre visit, but four of them would have needed somebody e.g. for driving a car. One person could have been also in need of a personal assistant for visiting the OUH, and one would have needed somebody to help at home in order to able to visit the OUH. The travelling time of the patients would have been in an average of 3.9 hours (median 1,5).

The patients were satisfied with the service. They found that they were able to express their problem and it was recognized in the OUH. They thought that they got information sufficiently, and were satisfied with the service (Figure 4).

Numbers of cases

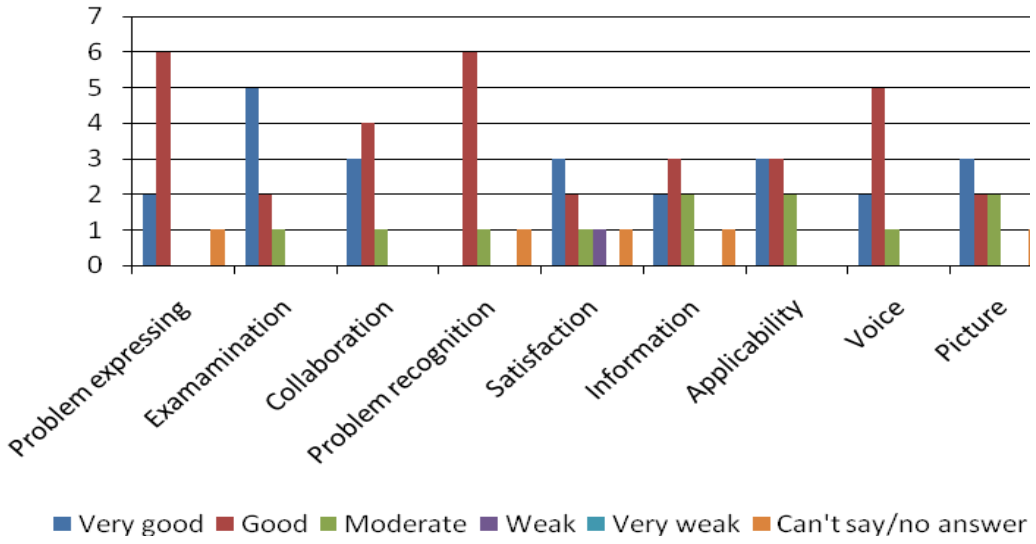

Figure 4. Patients' point of view on the video conferencing. (Problem expressing refers to patients' opinion on how they were able to tell about their problems)

All but one patient thought that they got answers to all of their questions. The assessments on the sessions in general were very good or good, and all were willing to use videoconferencing for the next time, and expressed that they would recommend the use of video conferencing consultation for health problems also to their friends.

1.3.3. Organisation's point of view

Results of the organization maturity measure, the eHIT

This chapter shortly the summaries the opinions and the summaries of the topic scores for eHIT (Figures 5, 6). Detailed data is shown in Appendix

Results of the team of the department of dermatology of the OUH

Context
The videoconferencing for remote wound treatment was quite well in line with the national and local national policy, because it supports service production at remote sites. The implementation was small in terms service production, and enough resources were allocated for the purpose. The influence focused mainly on the nurses. Technology can cause risks in diagnostics because the picture quality has to be to good enough in order to identify potential signs of malignancy.

The Intervention
The application facilitates professional –patient interaction. The security, confidentiality, and reliability realized quite well. The mode of action fits best for revisits, but for the first visit a conventional face to face meeting is important. Videoconferencing can be regarded as effective and cost-effective, reducing discomfort and costs of travelling. The preliminary preparations for the consultation session is done at the primary health care causing time savings in the OUH.

The workforce – people and work patterns

Training for using the equipment takes time at the beginning. There were no problems in terms of the division of labor in the unit. The patients and the team at the hospital and health care centre were present virtually at the same time.

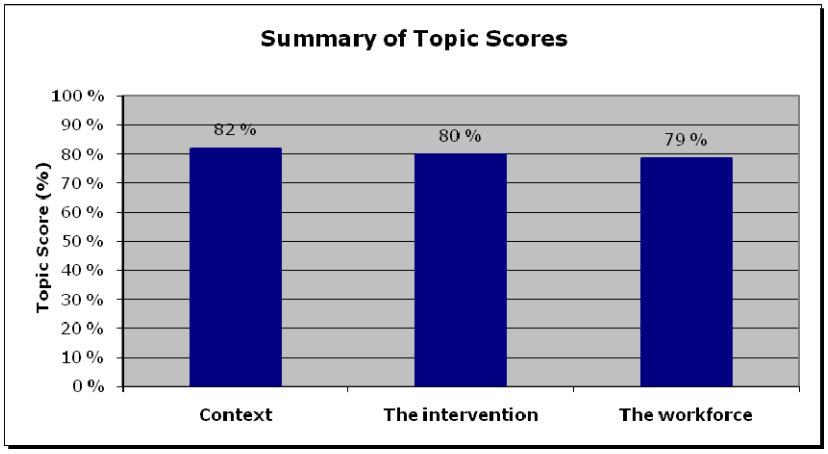

Figure 5. Summaries of the topic score of eHIT on televideo conferencing for wound/ulcer treatment in the point of view of the Dept. of Dermatology of the OUH

Results of the Pudasjärvi HCC team

Context

The videoconferencing for remote wound treatment was quite well in line with the national and local national policy, because it supports service production at the remote sites such as Pudasjärvi.

The attitudes of the health care centre were positive with this mode of action, and the collaboration worked very well. The new organization into which the health care centre now belongs to has perhaps not yet internalised the significance of this kind of a service.

The intervention

The application can be regarded as facilitating professional –patient interactions. Security, confidentiality, and reliability were comparable to conventional services. The influence on the efficiency was positive because of the rapid access to the specialist.

The workforce – people and work patterns

At first the work load of the wound treatment nurse increased because of preparations for the sessions. The mode of action was assessed not to have any significant influence on the mutual confidence among the personnel.

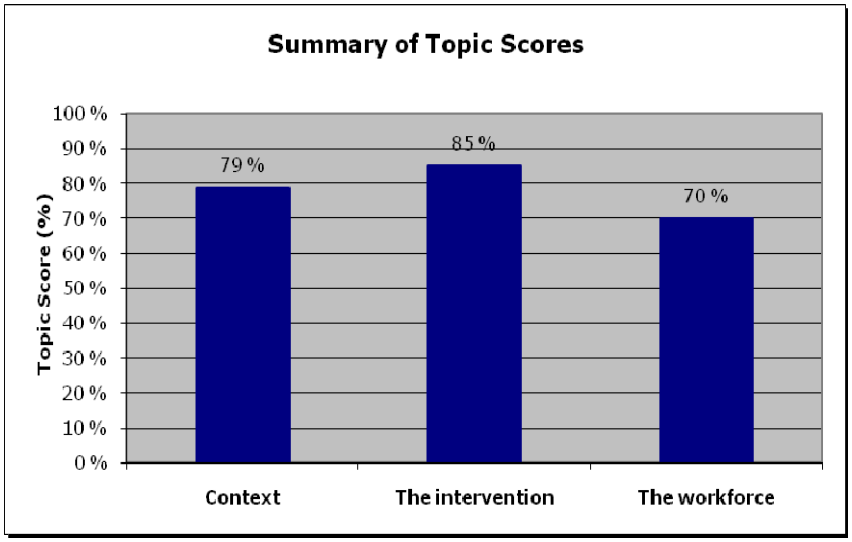

Figure 6. Summaries of the topic scores of eHIT on televideo conferencing for chronic wound treatment from the point of view of Pudasjärvi health care centre

An extra notation of the Pudasjärvi team on the eHIT: the eHIT questionnaire should also include questions about functioning and usability of equipment.

The organization changed during the survey. Pudasjärvi now belongs to a larger health centre unit, the Oulu Arc health care centre. The decisions on service delivery are no longer local and therefore continuing this remote service might be questionable.

A notation of the interviewer's on the eHIT as a tool: the test battery is the same in spite of the position of the responder in the organization. An employee who works on basic client services has difficulties with the two first and other administrational questions, but can easily address the questions concerning directly her/his every day work

1.3.4. Results of the SWOT analysis

SWOT analysis of the Department of the Dermatology of the OUH on the televideo conferencing for wound treatment at the end

Strengths
Saves travelling discomfort of patients. The quality of care and know how improves at the remote site. The clinical practices become uniform. The work of the nurse of the dept of dermatology became easier because for her there was any more no undressing and redressing of the bandages.

Opportunities
There is an option to expand the service for other skin diseases. Accelerates the patient turn-over, if the technology works well

Weaknesses

The quality of the technology to mediate reliable information is crucial. Meeting the patient remains superficial.

Threats
Remote diagnostics may be a risk. This easy way to access specialist may lower too much the threshold for contacts inducing costs.

SWOT analysis of the Pudasjärvi health care team centre on the televideo conferencing for wound treatment in the end

Strengths
The quality of the screen image was good, the staff of the University Hospital was very satisfied with that. In some cases there were problems with the angle of the view.
The patients were very satisfied with the remote service; they appreciated saving time and travelling, and the rapid and easy access to the hospital specialists.
A descriptive example of high patient satisfaction was the case of a patient participating from home sofa, so easy and comfortable!

Opportunities
This mode of action could expand as a service.

Weaknesses
The size of the portable equipment is big, there had to be two nurses in order to carry it for home visits

Threats
As far as the service itself is concerned, no threats worth of mentioning. However, the organizational change concerning the health care centre which happened during the surveys may influence the continuation of the service.

1.3.5. Assessments on cost-effectiveness

Taking the finding that the effectiveness of videoconferencing for wound treatment is comparable with ordinary visits to the outpatient department of dermatology of OUH, cost-minimization analysis can be applied. The Pudasjärvi HCC assessed that annual numbers of wound treatment consultations which could be substituted by videoconferencing is about 20. Based on our eight patient sample, we can extrapolate that five of the 20 annual cases would be employees who would lose work time when visiting OUH, and 15 would be pensioners. Ten patients would need extra help e.g. as a car driver, and three an additional personal assistant for the OUH visit.
A taxi invoice from Pudasjärvi to the OUH and back is 190 €, including two hours waiting time. Because the patient excess sum from that fee is 18 €, the costs for the social security are 172€ for a round trip by taxi. The compensation of travelling by own car is (20snt/km, for 2x80 km) is 32 €, and after the deduction of the excess, the costs of social security are per a visit 14 €. The price of a return trip by bus between Pudasjärvi and the OUH is in an average 25 €, and taking into consideration the patient's excess 18 €, the costs for social security are 7 €. (The calculations are based on the fares of the Social Insurance Institution, the union of taxi drivers, and the union of bus operators).

The invoicing of the OUH to a municipality of a demanding first outpatient visit to dermatologist and nurse is 230 €. The invoicing of a wound treatment consultation by videoconferencing was not set, but applying the invoicing a comparable consultation at the surgical department, it would be 155 €. The outpatient's fee for a hospital visit is 27,40 €.The costs of an extra assisting person are about 24 €/h calculated on the grounds of the mean monthly salaries (Statistic Finland) and social security costs in Finland.

The calculated usage costs of the two alternatives are presented: the conventional consultations, and televideo conferencing consultations.
Approximations of the costs of conventional outpatient visits to the OUH
The costs to the municipality for a patient visit to a trained nurse can be assessed to be 20 €, and for 20 visits 400 €. On the grounds of the calculations, we can approximate that the OUH invoicing for the 20 conventional consultations are to the municipality 20x230 € = 4600 € minus patients' fee 20x17,40 =548 € or *4012 €.* Adding the costs of the nurse or 400 €, we have a total of *4412€.*

The costs to 20 patients are the outpatient fees 548 €, and the lost four working hours per a person of the 13 assisting or 52 hours a 24 € = 1248 €. Additionally are the excesses of travelling or 20x18 € = 360 €. The total costs to 20 patients are *1608 €.*

The costs to the Social Insurance Institution for patients' travelling to the OUH. We can assume that a) 10 would have used a car, b) five a taxi, and c) five a bus. The cost of a) are 10x14 € = 140 €, of b) are 5x172 €=860 €, and of c) are 5x7 €=35 €. The total to social security *1035 €.*
Total annual costs of the 20 patients 7055 €

Approximations of the costs of the televideo conferencing visits to HCC
The costs to the municipality for a patient visit to a trained nurse can be assessed to be 20 €. On the grounds of the calculations, we can approximate that the OUH invoicing of the 20 conventional consultations are to the municipality 20x155 €= 3100 € minus patients' fee 548 € or 3552 €. In addition, the costs of the connections with maintenance per one videoconferencing are assessed to be 5 €, hence 20x5 €=100 €. Total costs *3652 €*

The costs for 20 patients are the outpatient fees 548 €.We can approximate additionally a total of two hours expenses of two assisting persons, or 2x24 €=48 €. The travelling costs to the 20 patients are about 100 €. Total costs 6*96 €.*

The costs to the Social Security Institute for patients' travelling to the HCC. The median of the length of patients' travelling was 3,5km. There remains no costs taking the patients' excesses into consideration
Total annual costs of the 20 patients 4348 €

The difference between all of the usage costs show, that for the 20 patients annually video conferencing sessions would we 2707 € cheaper than the conventional visits to the OUH. The biggest winner would be the Social Insurance Institution. The total of all of the costs per a patient would be about 135 € annually.

We must add to the costs of video conferencing the investment costs of the equipment. The total price of the two video conferencing equipment is 23000 €. Annual costs taking into

consideration amortization and maintenance costs are approximated to be 7000 €. The annual costs of the 20 video conferencing without the investment costs were 760 € lower for the municipality compared to the 20 conventional visits. We can conclude that the usage solely for remote wound treatment for the population size of Pudasjärvi is not cost-effective. However, if there were altogether about 200 annual outpatient consultations with the departments of the OUH, the mode of action would be cost-effective. On the other hand, if video conferencing equipment were used actively for education of personnel, administrational purposes, etc, considerably lower numbers of consultations with the OUH would be enough in terms of cost-effectiveness.

In the calculations the benefits to the health care centre as a result of the educational function of video conferencing, improving quality and know how and decreasing the need for consultations, have not been taken into consideration. In addition, video conferencing can reduce discomfort of travelling to the patients and their caregivers, which can be regarded as a quality dimension of delivering services.

There would be also 15 videoconferencing sessions between the wound treatment nurse and home nursing. They spare the travelling costs of patients and nurses, and somewhat the costs of social security, but total amounts are tiny. The biggest winner is the patient with reduced discomfort.

1.4. Conclusions

The patients and the health care professionals both in specialized and primary health care were satisfied with the content and quality of the video consultations for chronic wound treatment. Dermatology is known as the specialty that lends itself well to telemedicine. There are surveys for instance from Norway, New Zealand, and United Kingdom with evidence of cost-effectiveness (see Wootton 2001). From Finland there are positive results of teledermatology from the western part of the country (Vainio et al 2000), and from Lapland (Kirvesoja et al. 2000).

The modern video conferencing technology used here has potential to transfer high quality information across distances. In the case of wounds, patient history obtained initially by a wound treatment nurse is sufficient for a specialist with appropriate expertise to formulate a diagnosis and treatment plan (Marek et al 2006). In the study of Wootton et al (2000) no major differences were found in the reported clinical outcomes of teledermatology and conventional dermatology. However, as far as chronic skin wounds and ulcers are concerned, the possibility of a malignancy must be taken into consideration. It is an example of the cases in which video conferencing can’t substitute an ordinary visit to a dermatologist.

In terms of economy, the biggest winner of video conferencing is the Social Insurance Institution. This service delivery method reduces the costs and discomfort of travelling of patients.
The cost-effectiveness to the municipality is realized if there are enough video conferencing for consultations and education in addition to remote wound therapy.

Decision support over video links to nurse practitioners dealing with minor injuries has shown to be effective and safe (Wootton 2001), and the comparable setting of the present study refers to the same finding. The cost effectiveness of video conferencing is also dependent on distances saving travelling, and other cost saving elements as the fact that the education of general practitioners in joint consultations could reduce the number of referrals (Gilmour e al. 1998).

The organization on both of the sites was found to be mature enough to implement the video linked consultations for chronic dermatological problems into their assortment of services. The results of the SWOT analyses strengthened the idea that this mode of action suits well for remote areas.

2. REMOTE SPEECH THERAPY

Information technology (IT) has brought new ways to support health care delivery and patient education. New IT tools can enhance and supplement communication between patients and health care professionals (Demiris et al 2008). Benefits of telecommunications systems in treating communication disorders are increasingly recognized for the speech disorders of children (Hill et al 2002, White et al. 2006, Theodoros et al 2008). This mode of service delivery shows particular promise in giving patients access to specialist services for problems, which are difficult to manage and often require long-term follow-up support (Kully 2000).

The original plan included videoconferencing consultations for speech therapy between the OUH and health care centre, but these did not realize. In the following the results of speech therapy between the speech therapist and the patient in the municipality of Pudasjärvi are presented.

2.1. Study population and setting

There were three children aged seven, seven, and six years. Two of them had pronouncing problems, and one linguistic special difficulty. They volunteered, and the parents of all of them signed the informed consent form. Quite many parents of children otherwise suitable for the videoconferencing hesitated – 2/3 denied participation to the video sessions.

Speech therapy by a video conferencing device took place between the speech therapist in her office at the health care centre (Figure 7), and the child with her/his assistant person (a teacher) at a remote school (Figure 8). The video conferencing set was Tandberg C20 Full HD with two 42" screens, and mobile equipment for using at the school was Tandberg Centric 1700 MXP. Consultations with the University clinic were anticipated, but there were no cases as Oulu University Hospital is a consulting unit not in charge of actual therapy.

Figure 7. The speech therapist teleworking at her office

2.2. Methods

Structured interviewing forms with open questions were filled in by the therapist. The children had a teacher as an assisting person for the usage of the equipment. The findings are presented descriptively as tables, graphics, and quantitative numbers as ranges, means, and medians.

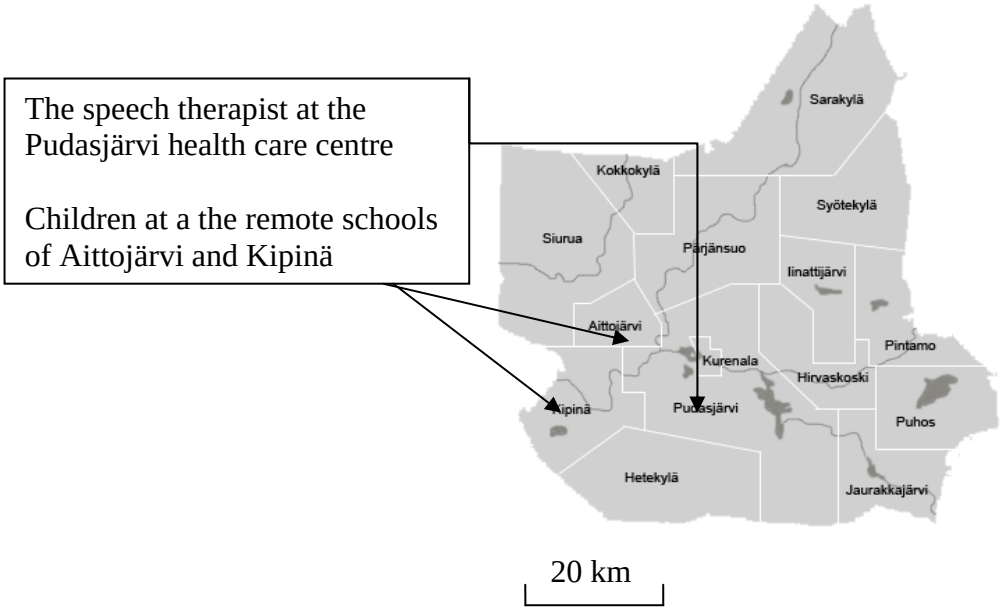

Figure 8. Geographical setting of the remote speech therapy

2.3. Results

The children had to travel a distance of 0, 25 and 32 km to the place of therapy. The father was escorting one and the mother the other one who had to travel long distances. During the survey, one of the children got nine therapy sessions, eight of them via videoconferencing and one conventionally, the other child had eight sessions (seven of them via videoconferencing), and the third child 16 sessions (11 of them via videoconferencing).

In general the videoconferencing sessions succeeded quite well. The speech therapist was able to assess the speech problem very well or well. The video conferencing equipment delivered a sharp image, zooming and selecting different view angles were important tools. Sometimes the child didn't realize that the therapist couldn't see her/him when the child had moved outside the view. The picture and the voice were mostly good enough for the therapy, and the mode of action was assessed to be moderately applicable for the therapy in the therapist point of view (Figure 9). There were, however, "freezing" or "pixelating" of the picture due to the problems with the local network. There were minor problems in the quality of voice, too. Sometimes the speech therapist had a difficulty to distinct if the child pronounced letters 'S' or 'R' correctly.

The remote speech therapy lessons were easier for children to concentrate on compared to conventional sessions (i.e. compared to a normal therapy rooms with distractions, surroundings). A possibility to communicate with the teacher after the session was seen as important to the speech therapist, which would be difficult in the course of a conventional therapy. The children seemed to like the process and the therapy was progressing nicely, and

thus the sessions were found to be effective. The parents were satisfied as they could avoid excess travelling up to tens of kilometers.

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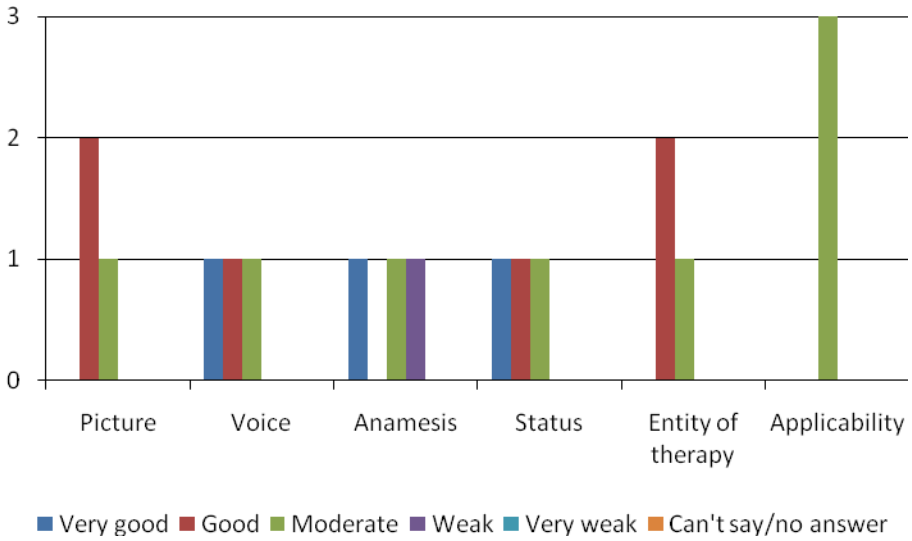


Figure 9. Assessments of the speech therapist on the quality of videoconferencing

It the beginning some of the children needed to get used to the equipment/distant learning, so the sessions were shorter. Moving the portable video unit was considered taking too much time from the teacher and therefore the school should have their own equipment. Otherwise there were no problems in using the equipment at the remote site. The room used for sessions at the remote school was the teachers' room, where existed disturbing activities. The speech therapists saw the difficulties in delivering material for home exercises as a drawback in videoconferencing.

2.3.1. Organizations' point of view

Results of the organization maturity measure, the eHIT

This chapter shows the summaries of the topic scores on the remote speech therapy according to the eHIT (Figure 10). Detailed data is shown in Appendix

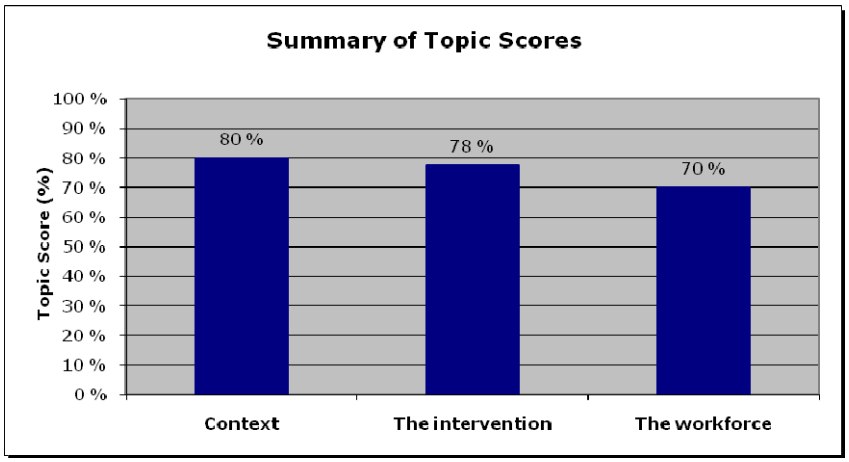


Figure 10. Summaries of the topic scores on the remote speech therapy in the Pudasjärvi health care centre point of view

Context
The use of videoconferencing is well in line with the national and local policies and targets. It improves access to care at remote sites. There were also negative attitudes among the speech therapists of other neighboring municipalities. The collaboration with the school teachers worked very well. The local opinion leaders supported the mode of action. The local organization is very interested in a sustainable implementation of the service

The intervention
The problem was the lack of a room dedicated for the purpose. The intervention substituted conventional services, and it was assessed to save travelling time and costs. The therapy sessions proceeded and results were achieved.

The workforce – people and work patterns
Planning the sessions took time, and in the beginning it was difficult to assess the time needed for each session. Contacts to the school teachers increased, and among them the awareness about speech therapy and its significance improved.

2.3.2. Results of the SWOT analysis

Strengths
The innovation was found to be efficient, positive results were achieved. The children, the special education teacher, and the therapist were present at the same virtual room. Planning of a play during the session was successful and drawing for expressive means and as an exercise worked very well with the children. The equipment showed even small pictures clearly, and the possibility to control the angle of view was very beneficial. Some children seemed to be even better motivated than in conventional sessions.
The parents of the children saved travelling costs and work time. This also applies to the therapist. Moreover, there was no need for the children to interrupt school day in order to travel elsewhere.

Opportunities
This mode of action could expand as a service.

Weaknesses
Problems with network lines appeared every now and then in therapy. There was only one equipment at the peripheral site and for this reason the special education teacher had to carry it from one place to another. Toys are essential for children's speech therapy, and the therapist could not utilize them during the sessions. One solution could be that the therapist and the child have same toys at both sites.
Sometimes children had difficulties to concentrate on the tasks. Some children seemed to have difficulties to comprehend which was the difference between real world and the picture on the screen.

Arrangements in the room at the remote school were not good, as there were too much environmental disturbances. Taping of the sessions for home exercises didn't work. Some parents had refused to allow their children to participate due to negative prejudices on therapies by video conferencing.

Threats
No threats worth of mentioning.

2.4. Conclusions

The video linked mode of speech therapy was found to be feasible for the children, and results were achieved. The children, the special education teacher, and the therapist were present at the same virtual room, which is an indisputable benefit of this video conferencing setting compared to a conventional session.

The remote service improved access to therapy by saving travelling time and costs of the parents, and thereby customers were satisfied with the service. In addition, there was no need for the children to interrupt their school day for travelling.

The quality of the transmitted information by videoconferencing seemed good enough for the purpose. The equipment was easy to use, and it had beneficial features, such as control of the zoom and the angle of view. The sessions included elements such as play, drawing as means of expression and other exercises and these worked very well. For the future, there arose the need to arrange a dedicated room for remote sessions in order to have a distraction free, peaceful space.

This pilot demonstrated that full assessment and treatment of children with communication disorders can be accomplished successfully via telemedicine. The finding is in line with the studies carried out elsewhere (Hill et al 2002, Sicotte et al 2003, White et al. 2006, Theodoros et al 2008).

The health care centre was found mature to implement video conferencing for speech therapy, as the results of eHIT pointed out. The results of the SWOT analyses were parallel: there were strengths as achieving the targets, satisfaction of the parents of the children, and the fact that the children seemed to be well motivated, although they had sometimes difficulties to concentrate.

TELEMONITORING OF HEALTH PARAMETERS

Information technology (IT) has brought new ways to support health care delivery and patient education. New IT tools can enhance and supplement communication between patients and health care professionals. Patient-centered applications presuppose secured data exchange for instance between the application and the patient record used by the clinician (Demiris et al 2008). One emerging system is home telemonitoring, which has been used for patients with heart failure (Scherr et al 2006, Clark 2007, Owais et at 2009), hypertension (Mirou et al 2007), to follow up physiological parameters as blood pressure, heart rate, blood glucose level, and pulse oximetry data (Field 2002), and electrocardiogram (ECG) (Barclay et al 2008).

One of the remote monitoring platform systems is CheckUp©Life and CheckUp©Care, "the Bags" from a Swedish company Explizit. The Bag includes several wireless medical devices and software for measuring and sending physiological parameters in real-time over the Internet. The measurement results can be viewed immediately by a doctor at the hospital or health care centre. The parameters include blood pressure, glucose, medication (to check if the patient has taken his medication or not), pulse rate, oximetry, ECG, haemoglobin, pulse, spirometry and weight. Because the service package is portable the patient can take it home and take the measurements him/herself or it can be located at a health care centre where patients can come in and take the measurements independently.

Each patient is given a personal identification card that uses RFID–technology; the card has a number that can be connected to the patient's social security number once the data gathered on the card reaches the secure hospital network. When the physiological parameters are measured the patient places the personal identification card in the portable health monitoring equipment.
The platform for remote monitoring: the system consists of PC software, computers, sensors and headphones (if needed).

For the present study the Bag was piloted for a weight loss group and for monitoring cardiac arrythymias. The Bag was customised with appropriate devices parameter measurements (Check©UpLife and CheckUp©Care, respectively).

3. MONITORING OF HEALTH PARAMETERS FOR A WEIGHT LOSS GROUP

Technical testing report on CheckUp©Care by Kimmo Kääriäinen

3.1. TECHNICAL TESTING

3.1.1. Introduction

The object in this testing process was a product called CheckUp©Life. It is a bag which includes several wireless medical devices. The bag sends measurements to the web server over bluetooth and GPRS connections. Content of the bag was chosen to be suitable for weight loss. The bag included blood pressure, glucose and PEF devices, but also a scale with body fat percentage calculator. In addition, there was an exercise bike integrated to the bag.

3.1.2. Targets

The object of the testing process was the CheckUp©Life bag and web page (oulu.explizit.se) which is used for monitoring measurement values. Explizit delivered CheckUp©Life and the Monark exercise bike to the Technology Healthcare Centre of Kaakkuri September 2009. At the same time system developer Fredrik Krekula from Explizit organized training sessions for the product test specialist Kimmo Kääriäinen and project engineer Tapani Viio from the product testing group of the technology health care centre Kaakkuri.

The objective of universal user testing was to give a possibility for five test users to acquaint themselves with and test the CheckUp©Life bag and web server. In addition, the purpose of testing was to collect first-time user experiences and opinions on whether applications like CheckUp©Life could be utilized for piloting the system as a health service for a weight loss group. In addition, two nurses of the Technology Healthcare Centre were given a change to get familiar with the web server.

Suggestions which would improve applications usability were formed from test users' comments. These suggestions could help using the application at least at the commissioning phase.

3.1.3. Executing and organizing the testing process

Universal user testing

Five test users where recruited to the testing process. The purpose of testing was to collect first-time user experiences and proposals on how to improve the application. Tests were executed during weeks 38/2009-41/2009. Besides test users, product test specialist Kääriäinen and project engineer Viio were present at test sessions.

The test users were given an assignment to use four devices of the CheckUp©Life bag. In addition, test users had to log in to a web server and find the measuring results of the devices. Also, users were asked to use the exercise bike. Before using the application, users filled in a primeval questionnaire. The questionnaire included questions on e.g. medical home measurements devices. During the tests, users were asked to express their thoughts and ideas aloud and after assignments they were interviewed. Kääriäinen made introductions in Finnish for using the bag. Web page was used in English.

All the test users had to give a written permission for testing and recording the use of the application.

Evaluation of the health care professionals' interface

Evaluation of health advisors user interface was executed by two nurses of the Technology Healthcare Centre. Test focused on the health advisor's view of web pages. Users were asked to express their thoughts aloud. In addition, user experiences were sorted out by a questionnaire.

Test users

Five patients from the healthcare centre were invited to use the application as test users. Test users were selected from different age groups. Two specially trained nurses were test users for health advisors' view of web page.

Test methods

Universal user test

Operational cases, recording, thinking aloud and questionnaires were used as test methods in the universal user test.

Test users were asked to think aloud and the whole test session was recorded.

Operational cases in test session were:

1. Open the CheckUp©Life bag and set the bag in working order.
2. Perform measurements with four (4) devices.
3. Log into the web page oulu.explizit.se.
4. Explore your measurement results.
5. Send a feedback/question for personnel.
6. Search your measurement history.
7. Search your measurement history as a graphic view.
8. Go back to front page.
9. Log out from the web page.
10. Put devices back to the CheckUp©Life bag.

In addition, test users had a possibility to measure maximal oxygen uptake with exercise bike which was integrated to the bag.
Following background information was found out from test users through questionnaires and interviews:

- Age
- Gender
- Have you searched for healthcare services via Internet?
- What kind of services would you like to find from Internet?
- What does word “home measurement device” tell you?
- Have you used home measurement devices before?
- What kind of home measurement devices would you be interested in?

After test sessions, users were interviewed. The interview included e.g. following topics:

- User experience. Troubled/easy aspects of application, terminology. (web page)
- Layout of service (web page)
- Did the service inform users while exploring/using devices?
- Expectations. Service’s suitability for purpose.
- Improvement ideas for service. What should be modified, what is good and should not be modified?
- Devices. Were some of the devices in the bag especially easy or difficult? Are there some devices that should be included in the bag?
- Would you recommend the application/service for your friends?
- Privacy protection. Did you feel that your information was safe?
- Utilization of service. Where this kind of service could be utilized?
- Opinions score for service.

Interviews were recorded and discovered experiences were collected to the final report.

Evaluation of the health advisors’ view

Evaluation of health advisors’ view utilized the same methods as universal user test. Nurses got administration codes for the service and used the web page at their own pace. They were given an assignment to read measurements and feedbacks from test users. Also, they were asked to evaluate the bags suitability for healthcare centre environment and where it could be utilized.

After test sessions nurses were interviewed on e.g. following topics.

- Information from service. Is there enough/too much information? Does the information give benefits for user?
- Functions. Are different functions of service easy/difficult?
- Are there some functions you would add to the service?
- Where this kind of service could be used? (healthcare centre vs. other places)
- Are there some devices you would add to the bag?
- Internet as communicating service in healthcare.
- Improvement ideas.

3.1.4. Results

Universal user test

Five test users took part in thetest sessions. Three of them were men and two women. Two test users were from age group of 20-29 years, one of the users was 40-years old, and the rest of the users were from age group 55-63 years. All users wanted to use the exercise bike and to take the Åstrand index test. They had used the Internet e.g. for searching e healthcare services. Three of them were familiar with the Oulu Selfcare web pages and the healthcare library.

In general, the users hoped to find more web pages were they could have beneficial health information, and information that could reduce unnecessary healthcare centre calls or visits was welcomed. Three users found important the services where people can book appointments to healthcare services via Internet.

All of the users were familiar with home measurement devices where users write results to piece of paper and hand it over to the healthcare centre or visiting nurse, but none of them had seen a device before which sends electronic messages to the healthcare centre or a web server. The test users thought that the ECG and blood sugar measurement devices would be interesting home measurement devices.

The following chapters include material from recorded test sessions and interviews. While examining the results, it should be remembered that the test users used the application for the first time, so upcoming opinions are their first-time experiences.

Physical features

Weight of the bag (5 – 10 kg) was a surprise for the test users. They thought that the size of the bag is suitable, but the weight should be lower. On the other hand, the users saw important that the bag is substantial and enables transportation without damage to the devices. The draw-handle was seen as convenient. The devices inside the bag have been inserted firmly and user-friendly. Also, the test users thought that the producer has clearly used time for planning the transportation characteristics of the bag.

Start-up

The test users had some problems to find the conductor rail. The conductor rail was shown in the Finnish guide written for the testing process, but still only two users found it immediately. The users hoped for some kind of a symbol to the bag which would help finding the rail. However, they thought that placing of the conductor rail is logical and easy to remember the next time.

Placing of personal data card was found functional, although everyone did not find it straight away. Some of the users wondered which way card should be inserted. As for the conductor rail, test users came up with an idea of putting symbol to point the place for the card.

Scale

The test users thought that the weight of the scale is too high. That would be a problem if the scale needs to frequently moved or transported. However, if the scale is located at a permanent location, test users did not regard it as too problematic.

The users succeeded in coupling of the power supply and the USB-transmitter very well. They found the right USB-transmitter from the bag and connected it correctly. Some of the users were wondering why the scale has its own power supply. They thought that the scale would be more practical if it had a rechargeable battery.

Sometimes when the scale was launched, the code “R5” stood on the screen for a long time. This confused the users and made them restart the scale. Furthermore, the users were confused about the scale’s starting values, which were made for a 40-year old male. In addition, some test users thought that “Step on” text and arrow are shown too small on the screen. The bag informs when the measurement has succeeded by a beep, which users found great. However, the users hoped that the results were shown on the screen after the measurement. That would also be useful information for a user to have a confirmation that the measurements has been done correctly.

Due to the preparations, the users found the scale to be the most difficult of device of the bag. If the scale is stored in the bag and has to be set up every time, it might be laborious. Users hoped that the USB-transmitter could be installed inside the scale in near future. Also they thought that existing transmitter could be attached to the scale if there were a fitted opening in the bag for it.

Measuring peak flow of breathing out (PEF)

The users thought that the PEF meter was really easy to use. The only problem occurred when a user installed a mouth piece after launching the device. In that case operating time was exceeded and the device had to be launched again. The users praised the wireless characteristics. Also, users liked the small size and weight of the devices. Even though the device is quite small, text on the screen is big enough to see.

The users found great that the device gave lots of information during the use. The device gave clear instructions for starting up measurements. Also, the results remained on the screen after the measurements. The device gave feedback on successful measurements and informed the user of sending them to the bag. Generally, the users found the PEF meter pleasant to use and easy to learn.

Measuring blood pressure

The users found measuring blood pressure simple and easy to use. Like the PEF meter, the blood pressure measurement is a wireless device which does not need any power source or USB-transmitter. Results remain on the screen after measurement, which was found great. The users did not find any particular weaknesses. They especially appreciated the simplicity of the device, since it can be operated with only one button.

Some of the users notified that previous results are shown on the screen when device is launched. They reminded that if the device is used in a group session, all the participants might not want to show their results to the others. Therefore it could be better if the screen is empty when the device is launched.

Measuring blood glucose

Using the glucose meter was found easy to use. The USB-transmitter is already installed to the device which speeds up implementation. Results are shown on the screen after measurement. The users thought that the device is easy to use because there are no additional functions.
The users hoped that the bag would include a better sting for taking blood sample. Taking a blood sample from hands was hard for some of the users, so they hoped for an automatic sting. Also, users thought that device would be better if it had a rechargeable battery in it.

Exercise bike

The user experiences regarding the exercise bike were divided. Some of the users found preparations troublesome, while others found them logical and simple. Most of the users wondered why the USB-transmitter needed a separate power supply. When the bag is included, the use of the bike requires three different power supplies, which was seen as problematic.

The users criticized the bike not giving enough information during the exercise. It did not inform when the exercise was started or when it ended. However, the bag informed users with strong beeps, but the users found beeping confusing. In order to get convinced that the test had started, user had to exercise 2-3 minutes to see if resistance had risen. If the test had not started, the bike did not give any information or provide feedback on what should be done next.

Two users misused the device and therefore had to restart the test from the beginning. The other one forgot to press the bike power switch, and the other one did not turn on the power switch from the USB-transmitter.

A large technical problem was found during the test and this was communicated to Explizit. When bike's horns were adjusted, wires inside the meter moved and came off from the joints. There is not enough room for wires at the junction of bike's meter and horns.

The users hoped that the bike's screen would be better. They suggested that the screen could show the "start" and "end" commands, but also information that the test of Åstrand index is functioning as planned. The users also hoped that the heart rate and elapsed time were shown on the screen.

The www-pages of Explizit

The users did not see problematic that the web pages were in English. They found English terminology simple and easy to learn, and thought that users with poor English will learn it fast. They did not have any problems to log in. They thought that results on the front page are compact and simple. However, the users proposed that there could be an info box linked to the results, which could give information on what the results of different measurements e.g. PEF mean. This information has been collected to its own page, but the users thought that an info

box could be more convenient. Some of the users were startled about the warning sign, but still they found it convenient.

Sending messages to the health advisors was found easy and simple. The users found communicating with advisors important. Graphical data was found very useful. They thought that graphical data is the most interesting way to follow history data of measurements. Historical text data was also found functional. However, some users proposed that the best ("healthiest") results could be on green font, and "unhealthiest" ones on red font. In that case users could find fast when e.g. blood pressure or weight has been at its highest.

Opinions on the web pages appearance were divided. All the users found the web pages clear and adequate. Some of them thought that the pages are grayish and boring and wanted more color to the pages, while other part found pages great. Some of the users noticed that there are no annoying commercials and hoped that pages will stay that way.

Generally, the users found the web pages successful and did not find any such functions which should be fixed. However, they suggested some new functions to the pages: a food diary and a simple exercise diary would be a great addition to the pages.

Answers to the questionnaires

Expectations varied between the test users. Some of them believed that wireless devices are technical but also difficult to understand without a manual. The bag was found a bit heavy and large. There again, a firm bag is better for transportation. The users would place the bag under a bed if it were at home. Therefore they hoped that bag would be a bit smaller. The web pages were found clear and logical. Current measurements and historical data were well-informed and exploring was simply and fast.

The users thought that CheckUp©Life gives sufficient information of succeeded measurements. The beep, which occurs when the bag is launched and measurements have succeeded, is functional. Monark bike was the only device which did not give enough information for the users.

Generally, the users had very positive image of the bag and web-pages. They did not find any particularly difficult or challenging characteristics that might impede operating the device. All of the users thought that they could use the CheckUp©Life again and would recommend it for their friends. They thought that the application would be a good addition to a weight loss group. Also, the CheckUp©Life could be utilized e.g. at the gyms with special groups or at work places for employees health follow-up. The users thought that the bag is a great motivator for weight reduction and the effect can be strengthened when the bag is used in a group. Three users saw important that the health care personnel are able to comment on their personal results. Two users used the bag independently and fluently without communications with professionals.

The users did not see a problem with web pages data protection and felt that their results are safe. They found username-password verification adequate for a web page such as this. The server was located in Sweden which was not seen as problematic.

The users proposed that a waistline measurement be added to bag. Users hoped for more health information to the web pages e.g. a trustworthy collection of Internet links on weight loss, exercise, and diets.

The web pages for the health care professionals

Health care professionals' web pages were evaluated by two nurses of the Technology Healthcare Centre. They used the pages in their own pace partially in conjunction with the weight loss group. They used the web pages for five times each.

The nurses found the web pages interesting and thought that the information was useful from a professional point of view. Measurements were shown in a clear and adequate form. History and graphic data were found fast and easily and were seen as very useful when following users' development.

Some of the participators of the weight loss group forgot their password. Therefore the professionals tried to find a place from the web pages where they could send it to users. However, when they noticed that the password can be requested from the login page, they thought that it's definitely easier and better way that users can get password themselves.

Creating a personal user card was easy for both users. The only thing that made waves was setting ones' birthday. In Finland birthdays are usually written in form of dd.mm.yyyy, whereas in Sweden correct shape is yyyy.mm.dd. The users suggested that the correct form could be put in brackets next to the birthday field. This could be useful if the application is used outside Sweden in the future.

The message function was seen as smooth and users did not see any needs to change it. For reminders, users hoped for a text a message what the reminder is about. As an alternative, the users proposed a calendar where health care professionals could mark e.g. group meetings and reminders of upcoming measurements.

The users had troubles to find where a new sample method can be added. They thought it was now in an illogical place and suggested that the interleaf "Limits" could be named as "Sample methods".

The health care professionals would also like to add a food diary to the web pages, as did the test users. They could then comment on users' eating habits and make suggestions on how to improve one's diet. They thought that the CheckUp©Life could also be utilized e.g. at home visits. For this purpose the bag should be lighter. If the bag were utilized at gyms, the web page could also include separate exercise sections, where advisors could follow users' exercising habits and give advice on how to improve their physical condition.

The professionals would also like to add waistline measurements to the bag as did the test users. The measurements do not have to be sent directly to the web pages even though it could be convenient. They have experienced Internet as a good communication tool between patients when there is no need for acute care or reply. Internet is a very good channel for giving tips and advice on health matters. For example in the Healthcare Centre environment Internet releases more time to answer patient feedback and questions compared to the distinct telephone hours.

The professionals found using the CheckUp©Life as a positive experience and they could imagine using the application as part of their own work e.g. in a weight management group.

OCCURRED PROBLEMS
Usability

The were problems that can be classified as note worthy and cosmetic usability problems. Both types of problems are related to information given by the application. Table 1 shows the identified problems and their criticalness as well as possible solutions to these problems.

Table1. The problems, their criticalness and possible solutions of the CheckUp©Life setting

Problem	*Criticalness*	*Solution*
Exercise bike does not give enough information on test progress and errors.	3	Screen on the bike should be utilized better for showing information during the exercise.
Scale does not show results after measurements.	4	Results should stay on the screen for a few seconds.

Criticalness of different problems is classified in table 2.

Table 2. Criticalness of usability problems of the CheckUp©Life setting

Degree of criticalness	*Criteria of the criticalness of problem*
1	*Critical usability problem* Complicates substantially using of the application and/or may cause misunderstandings. Problem which cannot be avoided in a system. May prevent user to utilize system or suggest utilizing it incorrectly. Recommended to be fixed.
2	*Severe usability problem* Prevents effective performance. Problem can be bypassed and thus avoided. Makes utilizing the system difficult. Recommended to be fixed so that system would become easier and faster to use.
3	*Notable usability problem* Does not prevent operating but complicates it. Problem can be bypassed. Causes disorientation or irritation. Recommended to be fixed so that user experience would become positive.
4	*Cosmetic problem or error* Minor inconsistencies and esthetic matters. Causes frustration when user draws attention to nonessential matters in system

Technical problems

Two technical problems occurred during the test sessions and were informed to Explizit immediately. One of the three bags did not forward results from the bag to the server. Explizit suggested that the SIM-card needs to be taken out of the telephone inside the bag and then restarting the device. This method worked and so results could be sent to the server. Problem was most likely related to the GPRS-connection between Finland and Sweden because the device utilized Swedish SIM-cards.
The second problem was the breaking of a wire inside the Monark exercise bike's meter. The problem was solved by reconnecting wires with tape. The problem was informed to Explizit who will attempt to make a better cover for wires inside the meter.

3.1.5. Summary

Testing was executed in two separated parts. In the first part five volunteers used the application in the Technology Healthcare Centre of Oulu. In the second part two nurses of the healthcare centre tested the health care professionals' section of the web pages. The aim was to get first-time-experiences when using the CheckUp©Life. These experiences yield few propositions how to make application more easy to use and how to improve it.

The results indicated that the application appeared to be useful and promising for the use of a weight loss group. The users found operating the application easy and the devices were easy to learn. None of the devices in the bags were especially difficult. The users were most disappointed with the information during the bike exercise test. The exercise bike did not give feedback on progress or if the test process succeeded or not. The users hoped that the scale and glucose meter would be wireless like the PEF and blood pressure meters. If the application is utilized for weight management purpose, a waistline measurement would be a good addition.

The internet pages were experienced as clear and functional. English language did not cause any troubles for the test users. The participants thought that the application would be a good addition to a weight loss group. Also, CheckUp©Life could be utilized e.g. at the gyms for special groups or at work places for occupational health care. The test users suggested food and exercise diaries as additions to the web pages. The professionals also proposed a calendar to be added to the web pages. This could help using the application in groups. The calendar could include e.g. meetings and reminders.

In general, the testing process was a positive experience for the users and professionals. They found the service very interesting and could imagine using the application in the future, but also recommend it to their friends.

3.2. USER TESTING

3.2.1. Study population and setting

Study population comprised of six women and one man. All of them volunteered to participate in the study and signed the informed consent form. Their mean of age was 58 yrs (38 -70). One of them suffered from back disease, one of hypothyreosis, one had hypertonia, hypercholesterolemia and back disease, one had hypertonia and arthrosis, one diabetes,

hypertonia and arthrosis, and one hypertonia, hypercholesterolemia, and hypothyreosis. Three expressed their motives for participation only slimming, two wanted to decrease strain on joints, and one thought that the Bag could motivate them for weight reduction. A doctor or nurse had recommended participation in a weight loss group for three patients, a family member or a friend for two of them, and two participated spontaneously. Only one of the seven had participated in a weight reduction group earlier, and six were first-timers. One of the participants had avoided exercise, two used to be random walkers, one used to exercise 10 – 60 min weekly, and the rest were more active walkers, one of them had more than three hours per week of strenuous exercise.
The volunteers participated in a weight loss group for 14 weeks with regular common sessions in the health care centre supervised by a specially trained nurse. Laboratory tests were measured by the CheckUp©Care bag in the health care centre (five patients) or at home (two patients).

3.2.2. Methods

Patients' height, weight, waistline, blood pressure, serum cholesterol and plasma glucose were measured in the beginning and in the end of weight loss group sessions. In addition, their eating and moving habits were registered.

3.2.3. Results

3.2.3.1. Test parameters

The patients participated in weight loss sessions 3 -5 times. The number of the sessions was reduced from the planned because of a simultaneous swine flu epidemic.
The mean of weight of the study population at the beginning was 90,1 kg (76 – 113,3), and at the end 89,7 (74,9 – 111,50), BMI 34,3 (30.1 – 41.6), and 34,2 (30,2 – 41,0), fat percentage 50,0 (28,8 – 73,5) and 45,0 (28,6 – 53,5), waistline 110,7 cm (97,8 – 128,0) and 107,7cm (97,9 – 124.4), respectively. Four patients achieved weight loss of 0.4 – 1,8 kg, but the weight increased for three by 0,3 – 0,9 kg. The situation was comparable for BMI, the waist line, and the fat percentage.

3.2.3.2. Participants' point of view

The opinions of the participants on the service are shown in Figure 11. The expressed satisfaction didn't seem to correlate with the results of weight loss. Three of the participants regarded the equipment as easy to use, none of them regarded it as difficult.

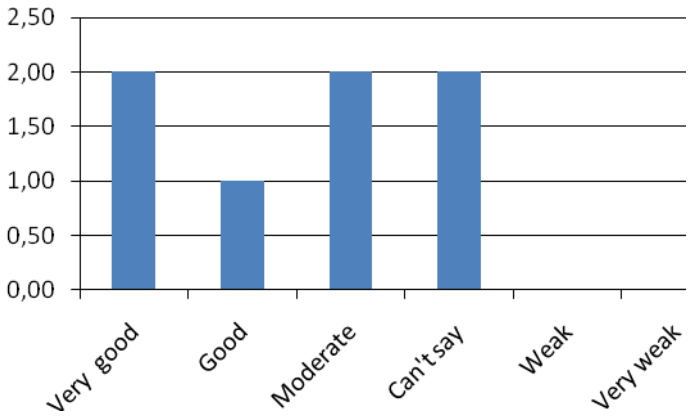


Figure 11. Opinions of the weight loss group on the CheckUp©Life setting

3.2.3.3. Organizations' point of view

Results by organization maturity measure, the eHIT

This chapter shows the summaries of the topic scores on the CheckUp©Life for the weight loss group (Figure 12) and briefly the background data. Detailed data is shown in Appendix

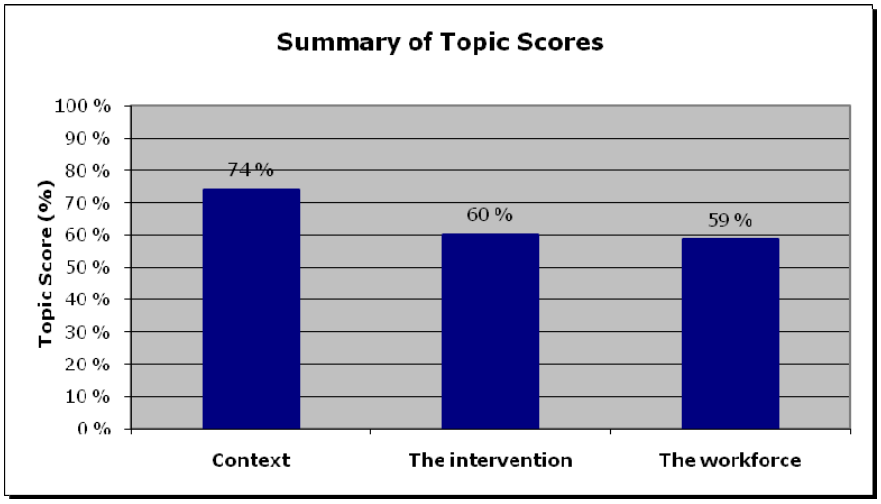


Figure 12. Summaries of the topic score of eHIT on CheckUp©Life in the Technology Health Care Centre

Context
The compatibility with the national and local policy and the potential to help to achieve the targets for providing remote sites with health services were scored high. The organization welcomes eHealth applications which are in line with the policy of the Technology Health Care Centre.
In the health care centre there is a good working relationship between staff members, as well as support of the opinion leaders. The application has a minimal impact on resource allocation. In

general, however, the resources are scant, which causes implementation of new applications to be done along with conventional, routine tasks.

The intervention
The application was found as easy to use and it facilitated interactions between professionals and professionals and patients. The measurement of fat percentage showed different values in the test-retest setting. The team was not aware of any evidence based reports on this topic.

The work force- people and work patterns
The compatibility with the existing power relationships within the organization was scored high. The application was assessed not to change the division of labor. It increases workload because of initial user training of both personnel and patients. The rules on usage have to be agreed upon together.

3.2.3.4. Results of SWOT analysis

SWOT analysis of the team of the Kaakkuri health care centre on the CheckUp©Life for the weight loss group at the end.

Strenghts
Motivates the clients.

Opportunities
Fits for individual usage for health promotion, for instance for diabetics.
The bag was simpler to use by the Swedish SIM-card and the server was located in Sweden, which proved to be a reasonable solution

Weaknesses
The size of the scale is large which makes its clumsy. There are lots of wires for different devices.

Threats
The conventional Id number and password for access is not enough in terms of data security.

4. TELEMONITORING HEALTH PARAMETERS FOR CARDIAC ARRHYTHMIA DIAGNOSTICS

Testing report on Checkup©Care by Kimmo Kääriäinen

4.1. TECHNICAL TESTING

4.1.1. Introduction

CheckUp©Care is a bag which includes several wireless medical devices. Bag sends measurements to a web server over bluetooth and GPRS connections. Content of the bag was chosen to be suitable with cardiac patients. The Bag included blood pressure, ECG and blood sugar/cholesterol meters.

4.1.2. Targets

The object of the testing process was the CheckUp©Care bag and web pages (careoulu.explizit.se) which are used for monitoring measurement of physiological parameters. Explizit delivered CheckUp©Care and Monark exercise bike to the Technology Healthcare Centre in May 2010. At the same time system developer Fredrik Krekula from Explizit organized a training session for the product test specialist Kimmo Kääriäinen.

The object of the test was to give a possibility for two or more users to familiarize and test the CheckUp©Care bag. In addition, personnel members of the Technology Health Care Centre were asked to use the web server. Two nurses and one doctor were chosen as test users. The protocol was designed to test usability of the application, as well as to experiment with new kind of application in remote care of cardiac patients.

4.1.3. Executing and organizing the testing process

Two patients were recruited for the testing process. Test users were trained to use devices, and they were also given device manuals. Tests were executed during weeks 22/2010-25/2010. During the tests, the test users used the application at home and had the possibility to take measurements when they wanted. The Healthcare centre personnel could monitor the results and comment on them if needed. Before the testing begun it was agreed that personnel will respond to the measurements transferred to them within two hours during normal working hours (08.00-16.00).

Test users

The test users were 20-30 years of age. An experienced general practitioner and two specially trained nurses were named as health advisors and test users of the healthcare centre.

Test methods

Usability of the CheckUp©Care was tested with a questionnaire drafted by FinnTelemedicum. (See Appendix)

4.1.4. Results

Test users did not have any technical problems during the test session. The third bag which was located in the Oulu University Hospital did not work properly. The problem seemed to be in the blue tooth connection. When the bag was transferred to another location, the bag worked correctly. Possibly something disturbed the blue tooth connection and caused the difficulties.

Health care personnel did not like the graphical layout for the ECG-curves. They thought that the view could be sharper for making acute diagnoses. They also wanted a communication channel with patients, as it would allow patients to express their feelings during the measurements, e.g. when feeling dizzy. This would provide the doctors with more information and they would be able to comment on measurements through this channel. A similar kind of communication channel is included in the Explizit's CheckUp©Life application.

The personnel considered important that the system gave some kind of information e.g. text message or e-mail when patient has completed a measurement. Now they had to go to the web server repeatedly in order to see if there would be new measurements. The personnel thought that with little improvements this kind of application would be useful in the near future for treatments like this.

The test users saw this application useful, interesting and easy to use. None of them had problems with the devices. They took two blood sugar, blood pressure and cholesterol measurements during the tests. ECG was measured numerous times a day. They did not have problems with the size of the bag. The Bag was unpacked and installed once and placed in a closet so it did not take much space. Test users also thought it could be great to have a communication channel on Internet as did the personnel.

4.2. USER TESTING

4.2.1. Population and setting

The target of the study was to recruit patients with suspected cardiac arrhythmias from the Department of Cardiology of the Oulu University Hospital. Recruiting patients from the waiting list realized only for one (male), and therefore two female patients were recruited directly according to the proposal of a health care centre physician. All of them volunteered and signed the informed consent form.

The patients received instructions for the use of the CareBag, and performed lab and ECG measurements at home. They had been informed that feedback from the health care centre physician is available at office hours within two hours. In acute or emergency cases the patients were instructed to use conventional out-of –hours services.

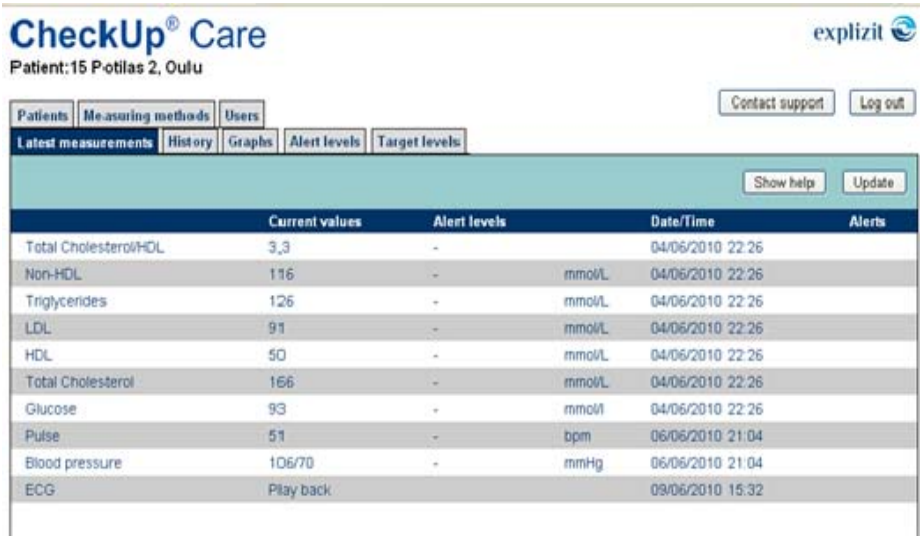
4.2.2. Methods

The selected patients volunteered to fill in study forms and to take ECG and lab measurements using the CheckUp Care Bag.

4.2.3. Results

Two females aged 23 and 28 yrs, and a man aged 50 yrs volunteered and participated. The preliminary diagnosis for one of them was extrasystolia, for the other a subjective sense of cardiac arrhythmia, and for the third extrasystolia, trigeminia, and bigeminia

Two of them measured the lab tests (Figure 13) and ECG (Figure 14) at home and transferred them to the server with no technical problems. Neither of these patients made additional contacts with the health care centre. For the third case there were, however, technical problems possibly due to blue tooth connections in the measuring environment, and therefore data collection failed.



	Current values	Alert levels		Date/Time	Alerts
Total Cholesterol/HDL	3,3	-		04/06/2010 22:26	
Non-HDL	116	-	mmol/L	04/06/2010 22:26	
Triglycerides	126	-	mmol/L	04/06/2010 22:26	
LDL	91	-	mmol/L	04/06/2010 22:26	
HDL	50	-	mmol/L	04/06/2010 22:26	
Total Cholesterol	166	-	mmol/L	04/06/2010 22:26	
Glucose	93	-	mmol/l	04/06/2010 22:26	
Pulse	51	-	bpm	06/06/2010 21:04	
Blood pressure	106/70	-	mmHg	06/06/2010 21:04	
ECG	Play back			09/06/2010 15:32	

Figure 13. The CheckUp©Care showing lab results

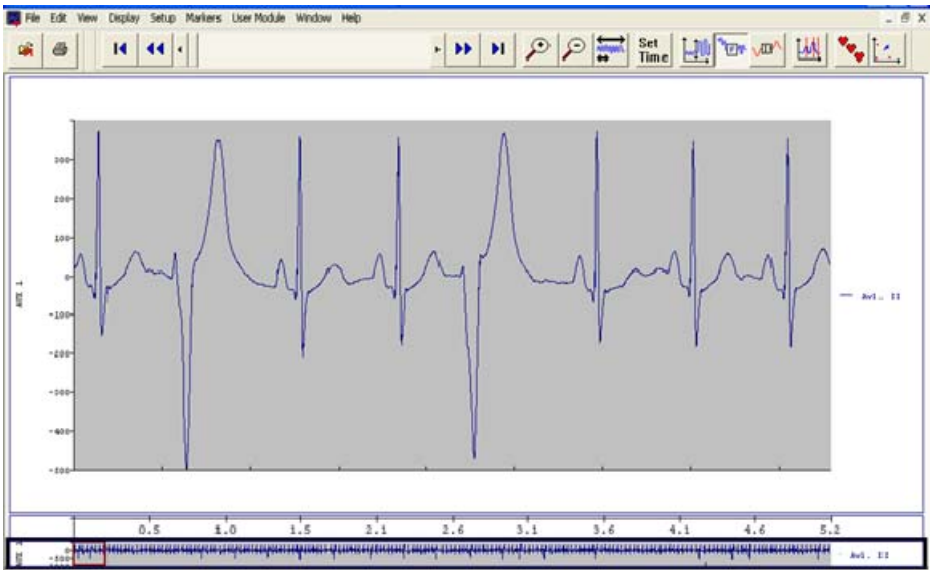


Figure 14.The CheckUp©Care showing ECG

4.2.3.1. Professionals' point of view

The collaboration with the patients and giving feedback from the system worked very well. In general the system worked very well for one of the patients and weakly for another. The Bag was regarded as a suitable tool for diagnostic of cardiac arrhythmia. However, the quality of the ECG was weak, and when a new ECG was captured, it deleted the older one.

The laboratory setting of the Bag was not necessary in this case, as the patients lived close to the Technology Health Care Centre and had an easy access to laboratory tests. Also the units used to describe the results of the lab tests were not commonly used in Finland and this further diminished their usability.

The information achieved by this system changed the treatment plan for one of the patients. She got medication for her problem.

One of the patients assessed the device usage as easy, while another patient considered it difficult.

4.2.3.2. Patients' point of view

The patients were very satisfied with the service and considered it suitable for this kind of examination. One of them complained that the glue for the electrodes caused a strong irritation on her skin.

4.2.3.3. Organizations' point of view

Results by the organization maturity measure, the eHIT

This chapter shows the summaries of the topic scores (Figure 15) of the CheckUpCare and briefly the background data concerned. Detailed data is shown in Appendix.

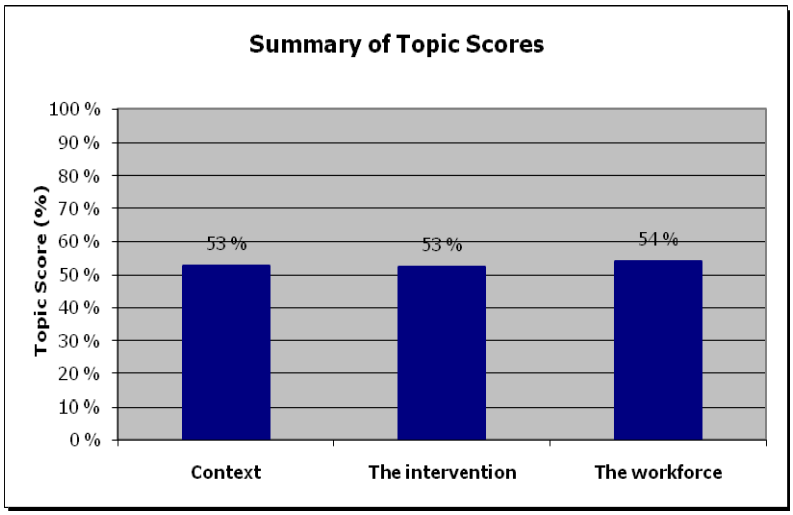


Figure 15. Summaries of the topic scores of eHIT on CheckUp©Care in the Technology Health Care Centre of Kaakkuri

Context
The current version was assessed to be suitable for a marginal user group of some cases of arrhythmia, but Holter systems are already available. The decisions for treatment can't be done on the grounds of the present type of low quality ECG. If the ECG would be better, the usage would be wider. The local culture welcomes new innovations, but there is a lack of resource allocation.

The intervention
The intervention can promote professional-patient interaction, because patients can communicate from home. Confidentiality was assessed as good, but reliability was scored low due to the quality of the ECG. The innovation was not assessed to be cost-effective because it did not substitute conventional visits.

The workforce – people and work patterns
The usage of the CheckUp©Care was not assessed to have any influence on the division of labor between heath care professionals or on the mutual confidence between them. The innovation increases workload because of training both the staff and the patients.

4.2.3.4. Results OF SWOT analysis

SWOT analysis of the Kaakkuri health care centre team on CheckUp©Care at the end

Strenghts
A new tool, and the technology better than for instance in the self care project of the city. The wireless connections make it very nice to use.

Opportunities
A better quality of the ECG would expand usage of the device

Weaknesses
Fits for a limited patient group only. The screen of the ECG was clumpy. The link from the web site to user's computer needs to be opened, at this stage did not work well

Threats
There exists a data security risk, because it is secured only by a user id and password.

4.3. Conclusions on telemonitoring health parameters

Two types of services were piloted using a telemonitoring platform of health parameters. These were the CheckUp©Life for the weight reduction group, and the CheckUp©Care for cardiac arrhythmia diagnostics. These types of applications have potential to enable a fundamental redesign of the health care processes based on the use and integration of electronic communication at all levels. It can empower patients and support them to have active and choice making role in their own health (Demiris et al 2008).

Technically the system can be regarded as advanced, because in terms of feasibility no significant problems existed with an exception of the one case in the cardiac arrythmia cases. The size of the bag was considered large and it was quite heavy which makes it space demanding and difficult to move. There was a need to further develop the view of the measured parameters with laboratory units, above all with the ECG which currently is shown without appropriate grid lines. In order to raise interest in the level of primary health care the quality of the ECG of the Bag should fulfil the quality criteria of ECG for clinical usage.

The patients of the weight loss group were rather satisfied with the service in spite of the fact that no significant weight loss was gained. The piloting period was, however, short and interrupted by the swine flu epidemic and the problems it caused in the service delivery of the health care centre. Obesity is associated with many serious problems such as hypertension, hyperlipidemia, and type 2 diabetes. Weight loss is known to be very beneficial, and reduce several risk factors. Traditionally principal strategies for weight loss have been a low-calorie diet and physical activity. Regular self-monitoring of weight has produced encouraging results, increasing awareness and offering means to quickly find and react to relapses (Boutelle 2006). The CheckUp©Life can be considered to be of value in a room dedicated for self-care as in the Kaakkuri Health Care Centre for self-monitoring the weight as an element of common guided sessions of weight loss groups. This setting could offer enough usage for the Bag.

It is worth considering what is the rationale for having blood sample tests in the Bag in a well equipped health care centre, where high quality lab test are easily available. The reasonable frequency of the blood tests for a patient with obesity or cardiac arrhythmia is sparse in the long

run. In addition, the quality of the fat percentage measurement of the Bag is questionable for clinical usage, because measuring fat percentage in a valid way presupposes presently dedicated and demanding test setting of a specialized laboratory.

Both of the settings of the bag raised pros and cons in the usage of public health care. They support, no doubt, patients' empowerment and self-care and they were found feasible to use. The most promising area of usage would seem to be remote areas, where there is need for the versatile medical devices. A center responsible for the health care services of the region is needed for coordinating the data transfer and communication.

5. SUMMARY

In the sparsely populated areas of the Northern Ostrobothnia Hospital District, in the northern part of Finland, three video conferencing services were piloted: a) remote wound treatment consultations between the Oulu University Hospital and the health care centre of Pudasjärvi, b) wound treatment consultations between a trained wound nurse at the health care centre and a home nurse at the patient's home and c) remote speech therapy between the speech therapist at the health care centre and a child at a remote school. The videoconferencing systems were adopted from Sweden, and the equipment were Tandberg C20 Full HD with two 42" screens, and a mobile Tandberg Centric 1700 MXP.

In the technology health care centre of Kaakkuri, Oulu, remote monitoring platform systems CheckUp©Life and CheckUp©Care of Explizit for weight loss and for cardiac arrhythmia diagnostics, respectively, were piloted.

The video conferencing systems worked very well and were easy to use, and the technical quality of the information was found good enough for both the wound treatment and speech therapy.

The patients were satisfied with the remote wound therapy, and the professionals thought it could substitute many conventional visits to the outpatient department of the hospital. In terms of usage costs it can be regarded as cost-effective, saving travelling time and costs. Both organizations were mature enough to implement the service model, and the SWOT analyses strengthened the conclusion that remote wound treatment by videoconferencing is a feasible and effective service for the population of remote areas.

In terms of economy, the biggest winner of the remote wound therapy seems to be the Social Insurance Institution due to reduced compensations of travelling costs. The patients benefited from reduced costs and discomforts of travelling. In terms of the usage costs remote wound therapy was also beneficial to the municipality. Taking the investment costs of the equipment also into consideration, remote wound therapy alone may not be cost-effective. However, the conclusion is opposite if there is enough additional usage for other consultations and education. In addition, video conferencing consultations with specialized hospitals was found to have an educational influence to the personnel of the primary health care, improving quality of care and reducing consultation needs.

The remote speech therapy by video conferencing satisfied the therapist and the parents of the children concerned. It obviously saved time and travelling costs of the child and their parents. In those instances when a teacher was present with the child at the remote site, the costs of the teacher's working time must be taken into consideration, and they weaken the cost-effectiveness of this service. For older children and adults, remote speech therapy can be regarded as a feasible and effective way to deliver services also in terms of costs-effectiveness in the remote areas

Participants of the weight loss group were satisfied with the remote monitoring platforms and found it easy to use. There were controversial opinions among the health care professionals. Both the Life and Care bags raised pros and cons in public health care usage. They support, no doubt, patients' empowerment and self-care and were considered feasible to use. The price of the bag is about 7000 €, and taking the amortizations and maintenance costs into the consideration, annually about 2000 €, which is not far from a nurse's two weeks total labour costs. The focus of the present short study was on the feasibility of the monitoring platform, not on the influence of weight loss.

For patients with cardiac arrhythmia, the equipment was easy to use, but the quality of the ECG raised criticism. The platform might be cost-effective if Bag usage would substitute several visits to a specialized hospital. However, presently the platform doesn't offer benefits compared with the prevailing Holter monitoring system. The most promising field of usage would seem to be remote areas, where versatile medical devices are needed. A center responsible for the health care services of the region is needed to provide a platform for data transfer and communication.

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