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A High Road to Dutch Healthcare Reform

A. C. M. Dumaij, R. Mooij and J. L. T. Blank

Abstract This study aims to assess the adoption potential of healthcare innovations in their infancy. Such an assessment is useful, since the context of the innovations change rapidly as a result of the health care reform process. Successful innovations comply to a complex system of social, technical, and financial attributes. First we narrow down the vast amount of innovations in healthcare into a review set of innovations and select attributes of successful innovations from literature. Next the compliance of the review set with the attributes is assessed by an expert panel. There exists no metric to objectively measure compliance and empirical data analysis cannot be performed because there are no data. Six innovations with high expectations were assessed: smart homes, eHealth, electronic health records, self-management, robotic assisted devices and online health companion contacts. None complied convincingly to all attributes. Innovation in healthcare appears as a multi-level, multi-sector, multi-disciplinary transition and needs both successes and failures to make progress.

Keywords Healthcare · Innovation · Adoption · Reform

1 Introduction

“The flying Dutchman reigns European healthcare as the inequity gap grows”. The most remarkable outcome of the Euro Health Consumer Index 2009 report [1] is no
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technical infrastructure, suitability of the care processes, training and communication of the provider [12]. Also, the inspectorate reports that implementations are rarely evaluated so effects and user experiences cannot be reported.

3.2 eHealth

eHealth is defined as the services that empower the patient to take responsibility in his or her prevention, cure and care of disease or disability by means of information and communication technology. Types of interventions include remote monitoring of chronic heart failure and diabetes, secondary prevention of coronary heart disease, home monitoring of respiratory conditions and online psychological interventions (e.g., drugs and smoking cessation, anxiety disorders). Recent studies of eHealth for the chronic diseases diabetes management (DBM), chronic heart failure (CHF), and chronic obstructive pulmonary disease (COPD) conclude that healthcare expenditure decreases and quality of life improves when used in combination with (electronic) coaching and self management [13–15]. Adoption of eHealth services will be improved when delivered in combination with other online services, like banking, in a public–private business model. The financial structure of healthcare complicates or even obstructs reimbursement of healthcare services. Also, the myriad of technological standards seriously hamper system-to-system interoperability while progress in harmonization of standards is slow [16].

There are a huge number of studies more or less addressing the effects of eHealth. However, there are only a limited number of studies that systematically analyze cost-benefits from empirical studies and also find positive effects on productivity. A systematic review yields that home telemonitoring of respiratory disease results in an early identification of determinants in patient conditions and control of symptoms, positive attitude of patients and receptiveness [17]. Robust study designs are missing and evidence of effects remain preliminary. Remote monitoring of community dwelling patients with CHF has a positive effect on clinical outcomes and secondary prevention [18–20]. Economic data are missing.

3.3 Electronic Healthcare Record

Electronic healthcare record (EHR) is an innovation in the centre of the political arena for over 20 years. The government views the EHR as an instrument to improve efficiency, quality and safety. The healthcare professionals consider it as administrative burden that potentially makes patients more independent of them. The patients are surprised and confused about the slow rate of implementation. Recent pilot implementations at a national scale reveal imperfections that can be fixed from a technical point of view [21]. The Dutch legislator rejected a law for implementing the EHR nationwide, based on potential violation of privacy rights in April 2011.
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health device sector, which in general shows great potential. Last but not least, avoid pitfalls in the road from idea to certified product while innovating medical devices [40].

3.6 Online Health Companion Networks

A comprehensive analysis describes the factors that influence online health companion contact use among people with DBM, CHF, asthma/COPD, rheumatic diseases, renal failure or chronic muscle disorders [41]. Respondents of their study are characterized as follows: they are likely to be a woman; aged around 44; married; Dutch; internet users; diagnosed with rheumatic disorders, asthma or COPD and they tend to have lower incomes compared to the general Dutch population. Respondents report privacy concerns and negative stories as barriers for adoption and disadvantages of using online health companion contact. Additionally, concerns regarding the quality of information are perceived as annoying. Benefits mainly concern the possibility to meet people in a similar situation, recognition for their health problems and obtaining information and sharing experiences. The combination with other healthcare services is a determinant for online health companion contact use as well. If decided to use online health companion contact, the selection of a specific website is among others based on technological preferences. Important characteristics of a website include closed access; discussed topics; easy use; type of users and a clear structure. In general, respondents prefer websites facilitated by a forum and organized by patient organizations. Online health companion contact can increase quality of life and self-management according to experiences of the respondents. They perceive to be better informed, better able to accept their disease, better capable to ask questions to medical doctors, better deal with their situation and to receive an increased amount of social support.

4 Results and Discussion

The values given to the attributes of the innovations by the expert panel are shown in Table 2.

Successful innovations should comply to attribute factors, i.e., high relative advantage, trialability, observability, compatibility, supporting view of opinion leaders, observability, homogeneity of groups, building on standards, supporting roles and social networks, technical fit, adjustability, financial fit, competition, strong support organization and co-operation. Although there are no metrics to measure and compare attribute factors, the compliance should be as complete as possible. Critical conditions for successful implementation of innovations are: maintain innovation instruments, active management involvement and commitment, work by method,
Table 2 Expert rating of attributes of innovations in the Netherlands on a 3-point scale (green: positive; yellow: undetermined; red: negative)

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include the project manager in the management of the organization, be proactive and creative, measure progress in a simple way, encourage informal ambassadors, communicate with images, seek interaction and reflection, consider the project in the context of the organization, keep the materials and appliances in mind, and negotiate.

Many evaluation studies fail due to poor data collection, missing data and poor methodology [42]. This is not surprising, since innovation as a process comes with a rambling and excessive set of objectives, implementation methods, structures, timelines and finance, often claiming the same resources (personnel, clients, technology, finance). Sometimes objectives are even opposing each other. Objectives are rarely framed in a set of institutional instruments. Especially technical and social innovations are seldom thoroughly evaluated on efficiency effects. Implementation methods are usually practical rather than evidence-based. Transitions are rarely managed processes following the “new rules of the game” rather than pushing forward the “old rules of the game”. Innovation implementation programmes usually start with smart objectives and end with enthusiasm but poor results [43]. The actors involved in diffusion of innovation are knowledge institutes and experts, branch organizations, occupational groups, patients and clients, administrators, government policy makers. They come in a variety of combinations and levels of commitment to the innovations. It takes great coordination effort to define and create win–win objectives and to derive new infrastructure when policies change [44].
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initially no or limited effect on care from both the caregiver and client point of view due to slow start and lack of inclusion of regional co-operations. A rudimentary cost effectiveness analysis yielded an increase of effort by the caregivers for which there is no reimbursement. All innovation projects on mental diseases failed to commit primary healthcare providers, except for the case of anxiety disorders. This is attributed to the fact that there is little co-operation among caregivers and little integration of care processes [46]. Further causes reported to fail implementation are personnel switch, weak competence mix, poor understanding of output and outcome, lack of communication skills and implementation methods, unrealistic assumption that the 20/80 rule (tipping point) applies, and weak security of results.

5 Conclusion

Evaluation of innovations in their infancy is useful since the context of innovation is under reform. Successful innovations comply to a complex system of social, technical, and financial attributes. There exist no metric to objectively measure compliance and empirical data analysis cannot be performed because there are no data. Six innovations with high expectations were assessed: smart homes, eHealth, electronic health records, self management, robotic assisted devices and online health companion contacts. None complied convincingly to all attributes. Innovation in healthcare appears as a multi-level, multi-sector, multi-disciplinary transition and needs both successes and failures to make progress.

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Richard’s use of the epilepsy sensor illustrates a major benefit to the life of his mother through the ‘simple’ fact that she can sleep peacefully, knowing that she will be alerted if he has a seizure.

Brendan, aged 29
Brendan has had epilepsy for over 10 years and has frequent, usually nocturnal, tonic-clonic seizures. He lives with his mother. He feels ‘safe and secure’ with the carephone and pendant, bed epilepsy sensor and fall detector, these enabling him to maintain a record of his seizures that help when he sees his neurologist.

Brendan’s concern is the sensitivity of the bed sensor. This was adjusted, but then it was not going off when a seizure was occurring. He would like the technologies to be developed to be less sensitive but still effective for seizures.

Brendan’s use of the epilepsy sensor illustrates the potential for recording his seizures and using the information in reviews of his medication and in understanding his condition.

The user aspects indicated and illustrated in part by the cameos, point to a minimal need on the part of many users (and carers) for education or training regarding the bed epilepsy sensors and their role. In any case, the users and carers mostly have expert knowledge of epilepsy and the characteristics of the seizures experienced. The evaluation pointed, furthermore, to their being ready to take on new knowledge that related to their participation in the Project.

7 General Aspects

The Project examined in this chapter is important by virtue of it being the only one known to examine the efficacy of bed epilepsy sensors as a contributor to supporting independent living for a particular range of potential beneficiaries. A relatively wide range of potential users (adults, children, people with learning disabilities) was embraced, but it must be recognised that people aged over 65 were not included.

What was striking from the evaluation of the Project was the extent to which, unlike other telecare applications, the benefits of the bed epilepsy sensors are both to the users and the carers. In the case of the former a clear and major benefit was expressed regarding the fact that help could be obtained and even people’s lives can be saved. The ability of bed epilepsy sensors to alert people of a seizure occurring appears, therefore have been the primary benefit. Arising from this, however, is the reassurance to the user and his/her carers—with, in most cases, an added bonus for both arising in their quality of life.

If I suffered status epilepticus again it would probably save my life
If I’m on my own I feel more safe because of the alarm

As an aspect of digital homecare, therefore, an interesting application of a new technology has been demonstrated by the Project. It is one, furthermore, where the extent of need has been indicated as being substantial and one where further
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in a responsible and safe manner. A longitudinal study was conducted with 124 frail elderly clients of the home care organization. A regionally based communication infrastructure was organized to handle alerts and incoming messages from the elderly. A questionnaire was used to measure the clients’ feelings of loneliness and feelings of safety at baseline level and after 1 year (April 2010). Protocols for implementation and educational material have been developed to support organizations in the implementation of videocommunication. Applied research has been done at development level as well as implementation level of new applications and communication infrastructure supported by videocommunication. This paper, will shown how the introduction of videocommunication was carried out by the home-care organization. Information will be given on the development of services like a “Good morning, Good evening” service. The aim of this services is to provide daily structure, support of compliance with medication intake and prevention of social isolation by means of screen-to-screen videocommunication. Developments of consultation by means of videocommunication with a general practitioner and an application to facilitate memory training are currently under development and will be discussed. In the study almost all clients indicate that their feeling of loneliness has increased by the system. They feel that there is always someone who takes care for them which has a real positive impact on the clients. However, technical problems with the system still occur and finding a sustainable financial structure is a challenge.

Keywords Videocommunication • Care • Evaluation of use

1 Description of the Project

The participating organization is a home-care organization active in the province of Limburg. It delivers home care support to persons living in their own environment. As in all western countries, in this region the organization is confronted with a double demographic shift: a graying of the population causes an increase in care demand. Also, in the mid-term perspective, a reduction in workforce is to be expected. These two developments are accompanied by budgetary restrictions. Together, this indicates that within foreseeable time it will not be possible to continue service delivery in the situation as it stands. This consideration stimulated the management of the care organization to look for the development of alternatives. It is noted that in many research projects technological developments are identified as potential solution, yet technical organizational and ethical issues need to be addressed [1]. In home care delivery an essential part of the service delivery process is supported by communication between clients and care providers. Modern communication technology techniques enable the simultaneous use of video and voice communication which can even be distributed throughout a regular TV. Videocommunication may also become supportive to
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beginning of the project. Also the process of spontaneous marketing (clients acting as advocates of the videocommunication to their relatives) started slowly. The project started off by the special department of tele-services. In regular communication to care workers and clients only occasional communication on the progress of the videocommunication could be made.

During the project several initiatives were started to develop new applications. Examples are contact with general physician using the videocommunication and a memory support application. In addition, initiatives were taken to attract clients of other care organizations to participate in the project. Clients indicate that they are interested in the use of these newly developed applications.

The monitor activities delivered useful insight in the development of the project. The data gathered were used to guide the implementation activities. At the end of the monitoring period the data were also analyzed with respect to user satisfaction and effects at the user level. In part a comparison could be made between data gathered at the start of their participation and at the end of the project. A total of 85 clients completed both questionnaires. The tests showed that clients were very satisfied with the applications of the videocommunication. They showed a limited potential to actually pay for this kind of service. Over 65% of participants indicated that they are willing to pay less than 15 Euro a month, and only 5% indicated that they are willing to pay about 20–25 Euro. These amounts are insufficient to cover all the direct costs of this service. In judging this result it was noted that on the one hand it was highly unusual to pay for care services in The Netherlands and that this service was experimentally introduced as an extra service.

The perception of (personal) safety was monitored as well. The results showed a stabilization of the situation in most clients whereas in approximately one third an increase in unsafety was noted. These results were measured with a questionnaire in which items were included towards feelings of safety to live in their own apartment, the need of support to continue independent living. On the other hand the measurements of loneliness expressed at the individual level indicated that approximately 50% indicated a reduction of the sense of loneliness both at the social and at the emotional level (Fig. 6).

Measurements performed at the group level indicated that both at the social level and the emotional level of loneliness a significant reduction was noted. This result was obtained over a total period of 2 years with 85 clients. It gives a clear insight in the potential effects of the application of the videocommunication.

At the end of the project the care organization has taken the initiative to continue and expand the service.

4 Internal Influences on Development and Outcome

The project started as an initiative of the care organization department of “Telezorg” in close cooperation with the “technology in care” research department of Zuyd University. In cooperation with different companies the technical infrastructure was
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As can be seen from these data the development of the use of the video communication, in communication with the general physician, is most wanted by these users. Yet also a need for the use of this communication infrastructure in a non-care domain can be noted.

Being asked to their willingness to pay for these services most of the clients responded in a reserved way.

7 General Aspects

7.1 Outcome

As indicated with the data presented in Fig. 6 the use of the video communication renders an effect on the experienced loneliness by the user. Both the social and the emotional loneliness was affected in a positive way. At the level of safety no significant improvement could be noted in the comparison between before and after the use of the video communication. As a consequence of the experimental setup no comparison could be made with clients that are non-users of the video communication.

At the level of quality of labor the project has rendered only marginal effects up to now. The limited number of personnel involved and the limited number of applications are the primary cause. However, at the moment new applications are introduced and the use of the video communication is not only directed towards users but will become a regular tool of the care worker, it will also generate effects at the level of quality of labor. In this way care workers may become able to be connected to their clients in a more efficient way since they do not have to travel to the clients house.

7.2 Dissemination Strategy

The project has been started as an initiative of the care organization. Its main emphasis was directed towards both the identification of new services and towards the development of an innovative way of the delivery of services to the clients. The dissemination strategy chosen is a reflection of this. All existing clients will be contacted to stimulate them to use the video communication. Once the applications are well defined it will become possible to use them on other technical platforms enabling video communication as well. By that time it may very well be possible to join other service suppliers and combine efforts. The care organization is willing to use that strategy as well. To enable it, contacts are made with other care organizations active in the region as well as the health insurance board, service organizations in the living and welfare domain and local municipalities. Following these lines it must become possible to set up an arrangement in which the
videocommunication becomes part of a social information and communication infrastructure. In the mean time the care organization will have to continue with the development of new applications as part of the telecare services.

8 Conclusion

In conclusion, the development of the videocommunication as a tool for communication between care organization and the client has been brought forward by this project. First effects at the client level are positive. Attempts to identify and organize new services are promising but require a good cooperation with several organizations in the region. Implementation of the applications into regular practice can now be undertaken.

References

Establishing an Infrastructure for Telecare: Combining the Socio-Technical and the Clinical

Giovanni Rinaldi, Mike Martin and Antonio Gaddi

Abstract ICTs offer great opportunities for delivering telemedicine and social care in a number of domains including services for the elderly. This area of application, however, presents many challenges at many different levels. The purpose of this chapter is to describe an approach followed, and explore some lessons learned in Bologna (Italy). The stated objective of these developments was to maintain independent living, in their own homes, by elderly people for as long as possible and as cost effectively as possible. Thus the approach was an attempt to address the challenges both of the quality and the economics of care. Part of the background to the project was that, over the previous 10 years, more than three hundred elderly people had been involved in different home care projects in the Municipality. These initiatives started with traditional approaches to the integration of home care applications (telemedicine devices or software applications) using proprietary and ad hoc mechanisms and culminated in the development of the concept of a technical and organizational platform with the potential to overcome many of the problems of traditional e-Care applications and to exploit some of the new potentialities offered by network technologies such as eHealth and web 2.0 in health.

Keywords eHealth · Home care · Social care informatics · eCare · Socio-technical systems

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1 Introduction and Description of the Project

This chapter presents a multi-perspective view of what turned out to be a complex and emergent project. The attempt to discuss the work in terms of its clinical, political and technical backgrounds, its objectives and aspirations, the complex unfolding of events that took place and the learning and insights that were achieved, inevitably produces a narrative which spans a number of disciplinary perspectives. This underlines the multi-faceted nature of the task of introducing new forms of care through new channels and infrastructure.

The most inclusive expression of the requirement that the OLDES project addressed was “to promote and sustain the wellbeing of older people, at home and in the community, by providing an infrastructure and services capable of supporting the operation and governance of a dynamic and participative economy of care services”. This chapter describes the reference architecture which creates a framework for the application of current ICT components to the challenging area of telecare of the elderly. The concept of telecare combines both telemedicine, in the form of monitoring and supervising clinical processes and “tele-accompany” which is concerned with the development and maintenance of social capital through contact and interaction. The concept of wellbeing that was being pursued did not allow these two aspects of care to be separated and treated independently. A consequence of this commitment was that the environment had to accommodate the operations of, and relationships between, different agencies in health, social care and the voluntary and private sectors facilitating their partnership and brokering their co-production, with their clients, of safe and satisfactory outcomes and life experiences. We had also to consider the high number of co-morbidities experienced by the elderly which demands caution and flexibility in the choice and delivery of health and social services. At a technological level, the project provided set-top boxes with broadband internet connection in the homes of the participants. In the clinical part of the experiments, data from monitoring devices such as blood pressure, heart rate and weight was connected wirelessly to the local home hub and transmitted from there to a clinical applications server for access by doctors. On the tele-accompany side, various content and communications resources were offered to the users including voice over IP call and conference services.

A technologically advanced home care environment implies a highly distributed technical and organisational network, composed of heterogeneous and autonomous nodes involved in supporting the elderly through the delivery or orchestration service. The service platform is designed to support the dynamic introduction of new services and new configurations, in response to evolving need, technical opportunities and financial conditions. The elderly are themselves actors in the network not only as recipients but as the providers of elements of care and mutual support. This approach implies a concept of federation rather than the more usual one of vertically oriented integration. An essential aspect of a care relationship is that the subject of care is known, appreciated, understood
and respected by the providers of care. In network environments, the means of knowing and understanding “users” are embodied in technologies such as user profiling which detects, observes and analyses activities in the system. One of the significant issues to be addressed in the deployment of technologies for telecare is how mechanisms of governance can be incorporated into the environment to ensure that technologies such as these remain ethical and acceptable under the consent of the user and are not interpreted simply as observation or even surveillance. These issues of governability have not been considered as particularly significant in the general development of web services and technologies and this represents a major issue in their deployment in the caring and developmental public service arena.

1.1 The Previous e-Care Projects

The project implemented in Bologna co-funded by the EU under the Ambient Assisted Living theme called OLDES [1] had the main scope to overcome the shortcomings of previous homecare projects [2]. They had the followings goals [3].

- To connect the stakeholders in social and health care processes: citizens and their families, General Practitioners, specialists, nurses, social assistants, and Health Trusts (public, private and non-profit);
- To integrate the information needed during the treatment, to provide more complete and better co-ordinated care using ICT solutions;
- To obtain a real co-ordination of health and social services through an effective and integrated network of information, transaction communication services;
- To collect citizens’ health information through the network;
- To connect citizens to information on their own health by giving them an easy way to access the network and its content services.

The predominant target subjects for home care projects are older people living alone with or without chronic diseases. Other projects have been directed at people with disabilities or families with children having chronic health or social problems. The home care service for the elderly in Bologna started in 2006 at first as a tele-accompany service delivered from a contact centre. Its aim was to provide social and health services for elderly people living alone. Building on this foundation different targeted projects were implemented using monitoring devices for, for example, cardiopathic disease with over 300 elderly people with different degrees of disease being connected to the services. Funding from the EC VII Framework Programme provided an opportunity to build on and improve these interventions by developing and deploying an electronic service platform and the organisational structures and relationships needed to manage it.
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These objects are simply an abstract way of describing what is now considered the conventional functionality of middleware, i.e., of talking about the functionality which is currently implemented in the offers of the systems integrators.

The Hub object has connections to two classes of external functionality, User domain objects and Service objects:

The Hub object has connections to two classes of external functionality, User domain objects and Service objects:

A User Domain Object is connected to the hub by a standard network service such as WiFi or xDSL. The user domain object is composed of all the functions that are associated with the domestic equipment in the house of the elderly user but it should be noted that there could be several versions of this including fully functional PCs and client systems. The initial work of the project was based on the following sub-components of the User Domain Object.

- Set top box.
- Television with a remote control, microphone and SAP to the network.
- A set of clinical devices, fixed and portable sensors networked to the Set top box.

The connection of the User Object to the Hub is also shared by the Data Filter Object which is capable of monitoring all traffic and classifying it into three categories:

1. *Service signalling data* which is used to control the service process. This is recorded in the service network monitoring log where it may be accessed and used by management functions.
2. *Service meta* data which is descriptor data about the type of message/transmission which is taking place. It provides information about the type of content and the roles and contexts which the service session involves. This is also logged and provides an important input into the governance of practice and, through aggregation, to the planning and commissioning processes.
3. *Service content data* which is only logged or relayed to functions other than the addressed service end-points if there is a specific consent tag identifying the additional access rights and policies.

The Hub also has service objects connected to it. There are three sub-classes of service object and all of these inherit the basic capabilities of a service object in that their functions appear in the catalogues which define which other systems objects (service or user) that can access them and the uses that they can make of their data. There are several sub-types of Service Management Object. A Hub management object connects to a hub itself and also to the data filter object and controls its configuration and operation. Other services, accessing and using logged/monitored data do so through the access service provided by the Hub Management (service) Object. Service Management objects can also be associated with a service object where they are concerned with the configuration and the maintenance of the service. Each service management object also has a Management Access Point to provide the external interface to its functions.
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comparable with the results from another setting (laboratory population of Massa Lombarda near Bologna) [5, 6]. In this context we met 84 elderly people (mean age: 78 ± 6 years old, M:W = 1:1.2), grouped in ten associations or parishes. The interview was composed of 70 items and took approximately 15 min to complete. This process was conducted through interview in some cases and by the respondent alone in others. It consisted of four parts.

The first part, besides registry data, included a number of questions which explored the social network of the respondent including familial composition, frequency of contacts with relatives, capability of walking autonomously, means of transport usually used, cultural activities and level of education. The state of health of the subject was also investigated through questions about recent admissions to hospital, consultations with a general practitioner or specialist and eyesight, hearing and dental problems. A self-evaluation of health was also requested expressed in a scale from 1 to 5 (corresponding to "poor" and "excellent" respectively).

The second part was specifically dedicated to the use of technology enquiring about which tools were used in everyday life from a list of ten items including whether the subject could use a cell phone or a computer, whether they listen to the radio and/or watch TV and whether someone else in their family was capable of using technology.

The third part was about psycho–physical state including questions about what the respondents did when they felt lonely, whether they were ever depressed while at home and what they did in such cases, whether they regularly measure their blood pressure and whether or not they are able to do so on their own.

The fourth part was about ICT in medicine. The questionnaire included four questions about interest in ICT tools: (1) interest in an instrument to put people in contact with medical staff (2) interest in an instrument to measure some vital signs (3) interest in an instrument to communicate vital signs to medical staff (4) interest in having such an instrument with remote control.

The major aims of our analysis were: (1) to determine the level of knowledge elderly people have of ICT medical tools (2) to assess the interest in ICT (3) to look for factors which could influence attitude towards ICT.

Analysis of data must be cautious, due to the limited number of cases and the large number of factors which can influence results. However, this preliminary evaluation gave useful indications about further investigation. First of all, our data suggests that knowledge of ICT tools was quite poor among our group. This is not surprising, considering that systematic literature review shows that only very few sources of information "deal with presenting and customising health information for elderly and disabled people" [7]. However, results are in some way more encouraging regarding interest in ICT, even if considerable differences were present in our group. In order to suggest possible explanations for this variation, we looked for factors which could possibly influence their attitude towards ICT. We considered the impact that their state of health could have on an interest in ICT, because most users of telemedicine tools are suffering from complex, long
term conditions. In our analysis, however, no significant correlation was found between health and interest in ICT.

It is not easy to evaluate the state of health of a person and the questionnaire contained several questions which investigated this area. In our analysis we used self evaluation of the state of health to perform a correlation with interest in ICT. Results of our analysis show that our group was composed of elderly people who are generally in good health. Due to the fact that the interviews were conducted in public places like clubs and parishes, this was not surprising and our data probably did not represent the general elderly population. An obvious reason which could influence the attitude of elderly people towards ICT is their capability of using technological tools in general. People who are not used to them could find it difficult to use ICT tools, and this could prevent them from even trying. That is why we dedicated an entire part of the questionnaire, consisting of seven items, to the use of technology. In general, the surveyed people had fairly good technological skills, and there is a significant correlation between these skills and interest in ICT. This seemed to corroborate our initial hypothesis that familiarity with technology is the key factor in attitude towards ICT tools. An interesting and possibly counter—intuitive result of our analysis was that people who tend to go out more are also more interested in ICT, while people who find it difficult to move are often considered a primary target of ICT. Possible explanations of this data could be: (1) the fact that people who have more outside activities are more familiar with technological tools (2) people who have an outgoing personality tend to be more open towards new means of communication.

The preliminary study indicated that our selected cohort of quasi-healthy elderly people in Bologna had relatively little knowledge about ICT, but they were quite interested in ICT tools and their potential applications for health. Analysis of interest in ICT and several other variables (age, gender, level of education, state of health and isolation) do not show any significant correlation. These data seem to suggest that interest in ICT could be linked to a number of factors, including behavioural, cognitive and psychological ones, sometimes difficult to evaluate and not intuitive. Even if at the moment there is only a limited number of studies about this subject in the literature, our results were consistent with those of Williams et al. [8]. Further investigation is required to determine people's interest in ICT tools and therefore their impact on everyday medical practice and how this is changing with succeeding cohorts. The definition of a standard questionnaire would be very useful in order to make the results of different centres comparable and to gather large amounts of data. It seems necessary, for every kind of ICT tool, to consider the expectations and needs of the primary target this technology is aimed at. An effort should be made to analyse and empirically evaluate its acceptability and desirability among patients in different environments, with regard to several aspects (not only physical and cognitive, but also social, psychological, and so on, in order to have a global evaluation of potential users of ICT). This effort would contribute to giving e-health and telemedicine practice some solid and evidence-based support. The use of ICT in corpore vili, in other words, uses in which patients, especially elderly ones, are treated as passive actors
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Delivering this type of care implies a mix of technological and ethical factors with organizational and legislative possesses. In general, the physicians have expressed concern about the complexity of this situation and the difficulty of integrating available resources and opportunities in the primary care setting.

The relationship of clinical care between the GP and the patient is the most persistent and continuous one. The concept of continuous complex care we are developing here implies a new and even stronger connection between them and with the other roles involved in the primary care processes and relationships. These include nurses, who perform home activities, specialists in the hospital setting who address specific health problems and social workers. All of these actors need to co-ordinate with the GP to manage the health and wellbeing of the patient as part of a continual process [15].

This model contrasts with the fragmentation of the care process in the traditional view which emphasises the concept of episodes of care. It also cuts across political issues governing the traditional differentiation of responsibility between care agencies which fails to provide a co-ordinated response to the patients complex and changing needs.

### 3.1 The Attempt to Improvement the Home Care for Elderly

In this section we will present a critical commentary on the unfolding story of the project in which we will attempt to highlight the key learning points which influenced the course of the project and the activities that it was undertaking and to underline its many faceted nature. There were two processes which were largely responsible for the detailed course of events in the project. Firstly, there were unforeseen disruptions which forced responses which were not fully foreseen in the original plan and, secondly, there were occasions where information was introduced from the outside or came to light within the project processes which provoked a reassessment and response.

We are focussing on these changes as the indicators of learning processes rather than as responses to breakdown in, or inadequacy of, the previous plan and the term “critical” here implies interpretive and evaluative rather than judgmental.

In order to re-establish the starting assumptions and priorities of the project, we will present an analysis of the Project Summary in which were summarised the main technical objectives to reach, for improving e-Care services in Bologna.

“The OLDES project will offer new technological solutions to improve the quality of life of older people. It aims at developing a very low cost and easy to use entertainment and health care platform designed to ease the lives of older people in their homes. In order to achieve this, new concepts developed in Information Technologies will be integrated and adapted. The platform will be based on a PC corresponding to Negroponte’s paradigm of a €100 device, giving the guarantee of an affordable system” [16].
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**Municipality perspective:** In their role as the provisioners and managers of service, the view of e-Care is business as usual. The collective representatives of the users will be informed about the system and their support in managing the rollout and use of the system will be won. There seems to have been an assumption that service content did not present a challenge and that it could be acquired or created without much difficulty.

We can summarize the technical outcome of the project through four phases. The main achievements of the first stage of work were:

1. The concept of a service architecture based on a (potential network of) brokerage hub(s) which connects user systems to a distributed set of local and remote service systems.
2. A layered service architecture making use of some traditional communications service systems concepts.
3. An approach to the issues of service management and governance to addresses the issues of consent and confidentiality which included the concept of provisioning and permissioning services to access and share data with each other as well as controlling the access of users and service providers to services.
4. An initial representation of and engagement of the main sections of the OLDES Network in the clinical, social care and public service commissioning domains.

The new conception of the home care environment represented a long term view. The next phase of the project was characterised by the growing awareness of the stability problems associated with the domestic platform. During this period, the idea of developing some user generated data on needs and preferences was introduced and the first round of focus group work involved real potential users. This directly achieved two things: firstly it maintained contact and engagement and secondly it did provide some insight for the priorities of the design of the system. It also had the indirect effect of establishing the three cornered approach and relationship between project members, the Voluntary organisations and the end users rather than the assumed previous configuration in which the project spoke to the Voluntary sector representatives and they spoke to their members.

These interactions were developed further into the concept of the “OLDES Lab”. These are occasions at which e-Care users or potential users are brought together around some issue of interest or value for discussions, presentations and exercises. These activities generate content and relationships which can be further deployed and developed through network interactions.

The last phase of deployment involved the installation of systems in the home environments and the delivery of network nurturing activities in which animators promote activity by calling users and new content is introduced and promoted on the network. The importance of a smooth and simple installation process has been underlined in this process and it is clear that it cannot be treated as simply a technical task but must include an introduction and facilitation process which is sensitive to the needs of the user.
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In particular the domain of the care of the elderly generates a strong requirement for partnership and co-ordination between clinical and social care and within social care, the demarcation between formal services and the support at the informal, familial and community levels becomes blurred. An important aspect of these relationships is that they span significant boundaries between the apparatus of the State as the provider of public service, the Civil Society of the Voluntary Sector and Charities, and the market. Practical, working relationships which are effective in spanning these sectors tend to be based on trust rather than on formal structures and nurturing and promoting such trust is one of the most important aspects of the emergence of infrastructure.

5.2 Political Relationships: Municipality and Region

OLDES was initiated with very strong political sponsorship. The political significance of the ageing population as a constituency and the opportunity for Framework funding generated extremely strong political sponsorship. From this perspective, in the Emilia Romagna Region of Italy, many of the service resources for the care of the elderly are seen as aspects of the apparatus of the state in a context in which Welfare and Public Service are seen as significant responsibilities of public administration. Collective representation and action is also a significant aspect of this political milieu and, in the context of the ageing population this is reflected in the membership and active participation of voluntary associations and other organisations. In the early stages of the OLDES project, the concept of participation and user centeredness was seen from the standpoint of the Municipality, as a matter of official, collective rather than individual engagement. The broadening and deepening of this conception of engagement has been a significant feature of the learning processes of the project.

6 User Aspects

As we have indicated, there was a strong commitment to direct user engagement in participative design [19] and co-production in the OLDES project among what can appropriately be called the “social science” oriented members of the OLDES consortium who saw it as their responsibility to help and encourage partners to adopt what was for them a new and sometimes challenging approach [20].

In the early phase of the project, interactions with the voluntary organisations had proceeded as planned but reached a point where the perceived need was to “show them a real system”. This, however, was problematic because of the hardware delays and it was in this period that the idea of developing some user generated data on needs and preferences was introduced. A first round of questionnaire and focus group work was undertaken under the aegis of the selected
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is the case, the technical, organisational and political questions of governance we have discussed at some length here, remain.

- At what point in the emergence of a telecare infrastructure can telemedicine services be introduced? Where can the clinical trial model be applied and when?
- What initiation and diffusion models are useful and appropriate?
- Where are the clinical entrepreneurs? Usually in specialism and not in service management/commissioning. Implications?
- How and when will a market for, and integration of, telecare devices, with accreditations and standards and how can it be encouraged when current conditions promote stand alone products?
- How are the concepts of harm and freedom, welfare and community, changing in a world of ambient information and communication and, in the face of this, what are the limitations/boundaries of systems of care?

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Application of Teleophthalmology in Screening and Monitoring of Elderly Population in Rural Areas in Lithuania


Abstract A small regional telenetwork has been established in Lithuania and used for piloting homecare and remote care health care service delivery models on the grounds of the work of the Telemedicine Centre of the Lithuanian University of Health Sciences (formerly Kaunas University of Medicine) and private initiative of clinicians and researchers with the aim to promote bottom-up, self-sustainable telemedicine development and to increase accessibility to, and quality of, healthcare especially in rural or underserved areas. Stratetus, a small medical company, together with several family clinics in the rural areas of Lithuania and with support of the Family Medicine Centre of the Kaunas University of Medicine

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using the teledermatology model in delivering services to patients in rural communities.

Telehomecare is a developing area of healthcare services that will provide significant benefits to the care providers their patients. Telehomecare is defined as “the use of communications and information technology to deliver health services and exchange health information to and from the home (or community) when distance separates the participants”. Telehomecare in ophthalmology brings some real challenges, because in order to make correct ophthalmological diagnosis, a physician needs to evaluate relevant images which requires availability of a high quality equipment which up until recently was rather expensive [11–14]. Digital handheld equipment for ophthalmology was recently introduced to the market which helps to overcome some of these challenges. It can be used not only in general practitioner’s office, but can be used for patients’ homecare as well.

In countries like Lithuania where large hospitals dominate the health services providers market seeing large centrally initiated projects is the norm. However, as primary care provision is continuously moving toward smaller physician offices and family clinics, smaller projects coming from local initiative are becoming increasingly important and they may have large impact for local communities. However, they need access to technologies, cooperation of various stakeholders local, primary care and tertiary level physicians, and some support and encouragement to stay motivated. To try address these issues and bring services closer to the patients, a small telenetwork has been established in Lithuania on the grounds of the work of the Telemedicine Centre of the of Lithuanian University of Health Sciences and private initiative of clinicians and researchers with the aim to promote bottom-up, self-sustainable telemedicine development and to increasing accessibility to, and quality of, healthcare especially in rural or underserved areas. Stratelus, a small company which is also the coordinator of the EU-supported Eurostars project, together with several family clinics in the rural areas of Lithuania and with support of the Family Medicine Centre of the of Lithuanian University of Health Sciences started screening and monitoring of elderly population for diabetic retinopathy, aging macular degeneration, and optic nerve head evaluation in remote family clinics and their homes, in a mobile telenetwork mode, bringing the access point to the patient’s home. This is important for elderly population with limited mobility in rural areas.

Telehomecare has proven to be a good model for our project. In rural communities, the demand for tertiary level health care services is high, while patient and physician contact is still very personal and home visits are still often a form of health care services delivery. Telehomecare extended the existing primary care services to a higher specialist level. In terms of the end-user, the project was a combination of homecare and “near-homecare” i.e., provision of care within the community, at a primary care clinic at a proximity so close to home (within 10 min travel time) as compared with the tertiary healthcare centre, that it could virtually be considered homecare.
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3.2 Project Participants

Stratelus, a small enterprise, a telenetwork coordinator, and service provider (competence center) has partnered with the Telemedicine Center, the Family Clinic, and the Department of Ophthalmology of Institute for Biomedical Research of the Lithuanian University of Health Sciences; Optomed OY, Oulu, Finland; and Remote Analysis OY, Helsinki, Finland in development of the telenetwork and service offering. The participants in remote areas whose patients were served were the Primary Health Care Center of Klasco (Klaipeda stevedoring company—Klaipeda Stevedoring Company), Family Health Care Center of Vilkaviskis; Primary Health Care Center of Kaltinenai; Primary Health Care Center of JSC Elnita (Karmelava).

There were no specific requirements for the project participants—general requirements being interested and committed in participating in the project and telenetwork and willingness to learn using new technologies such as digital fundus camera and on-line data transmission.

3.3 Population Groups and Beneficiaries

The telenetwork was established in 4 remote areas with different distances from the Stratelus competence center which is based in Kaunas: Karmelava (20 km from Kaunas), Vilkaviskis (70 km), Kaltinenai (123 km), Klaipeda (205 km) (Fig. 1). Selection of the patients was done by family doctors and paramedics. Part of the selected patients was served at their home, part—in family clinic near their home (within local community).

Population groups have been selected in a number of rural areas in Lithuania. Among them, there were 2 groups—healthy people, who were subjected to
screening, or preventive health check-up, and patients—people with clinical symptoms, who were subjected to monitoring. Focus was on 3 clinical conditions at this stage—diabetic retinopathy and age-related macula degeneration and glaucoma.

The project had not received any public funding. Some donations and in-kind contribution was received from several healthcare/pharmaceutical companies. The reasons of participants’ interest in this project were ability to expand their services to their patients (their access to high competence diagnostics); by providing their patients with better and more timely diagnostics, decrease possibility of acute diseases or complications when treatment can be more complicated and more costly; develop their competence in ophthalmology. The ultimate beneficiary is the patient—it can be noted that accessibility of patients in remote locations to high competence diagnostics is constrained by such factors as distance to competence centre; wait time; travel time and resources; patient mobility; determination. Bringing service and experts to patients’ home or to a distance minimal to their home (most of patients that were served in family clinics live within 10 min) from their home or work place.

3.4 Methodology and Implementation

The methodology of screening was based on the need for collecting the data and information needed for patient evaluation.

Screening was performed by tertiary level specialists. They made the choice on which tertiary level tests that are not available at primary level are necessary. This choice could not be made by a primary level physician. Thus, there was a selection of patients made at the screening—those who need to travel to a competence centre for more complex tests and evaluation and/or for surgery, and those who can be diagnosed locally. In addition, tertiary level specialists-ophthalmologists trained primary care/family physicians on working with the digital diagnostic handheld equipment suitable for telemedicine, acquisition and transmission of data to the competence centre for consultation and evaluation. With active involvement and relevant training of primary care physicians, remote diagnostics will enable diagnosis be made remotely for a large proportion of patient population.

3.5 Technological Innovative Elements

The most recent version of a Smartscope digital handheld eye fundus camera was used (Fig. 3), and a specialized software was used for online data transmission which was enabled by availability of fast data networks.
3.6 Patient Recruitment, Dissemination, and Screening Process

Patients for screening at remote locations were identified, selected, and recruited by participating primary care/family physicians or paramedics. The information dissemination about the project to the patients was based on direct contacts between the local medical staff and patients. Most of the primary care physicians, nurses have lived in the area for a long time and know their location and people very well. This also helped to maintain trust between patients and physicians in offering new service. Based on multiple factors including patient condition, some of the patients were assigned consultation at home, some—in the near proximity to home, or at their workplace.

Though physically screening was performed at primary level facility, methodology, and technology used included tertiary level such as ultrasound which was performed by tertiary level ophthalmologists. Our findings were that in homecare environment, a combination of trained primary care/family physicians or nurses and innovative telemedicine diagnostic technologies, such as handheld ophthalmoscopes, and transmitting the data for evaluation to competence centre, it is possible to provide sufficiently precise diagnosis without having a patient to travel to a tertiary level medical facility. Thus, homecare can effectively bring high quality healthcare closer to a patient and decrease the time to diagnosis.

There were 2 groups of patients:

- Patients who arrived for evaluation to a clinic near their home (within 10 min travel) or at their workplace.
- Patients located beyond 10 min from a clinic, or patients with impaired mobility were evaluated at home.

Evaluation at a primary care clinic was performed by physicians-ophthalmologists who arrived from a competence centre. Their aim was to perform the first screenings and train local medical personnel, including the use of handheld equipment for ophthalmology. The investigation included basic ophthalmological examination, measurement of intraocular pressure, biomicroscopy by a slit lamp and eye fundus photography by handheld digital fundus camera. Some of the tests were performed by a family doctor or nurse with participation and observation of an ophthalmologist from the competence centre.

Evaluation at the patient’s home was performed by a family doctor or nurse with participation and observation of an ophthalmologist from the competence centre using the handheld camera Smartscope with add-ons for fundus photography and anterior eye segment investigation. Investigation included measurement of visual acuity, tonometry, slit lamp examination, Schirmer’s test, dilation of the pupil, and eye fundus examination with Volk 90D lens, eye fundus photography (digital handheld eye fundus camera Smartscope, Figs. 2 (right picture) and 3) and data transmitting. Cup disk ratio of the optic nerve head was also evaluated. The data obtained—visual materials i.e., pictures and patient data—were transmitted to the Stratelus competence centre for processing and evaluation by highly skilled
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Fig. 6 Screen (display) of transmission from patients’ end to competence center via remote analysis software. The second picture of four pictures sent is enlarged

Fig. 7 Screen (display) at the competence center prepared for expert decision to send. Patient data field is visible on the left side; field for expert’s response/evaluation is visible in the middle of the screen

degeneration. This, in turn, further decreases patients’ mobility which makes accessibility to health care even more constrained. High patient turnout at the locations involved demonstrated that homecare or near-homecare is in high demand and can significantly increase patients’ accessibility to health services. Patients’ distribution by age and gender are shown in Table 1. There was no
significant differentiation by gender and the patient population generally corresponded with the general population trends.

Table 2 shows patient distribution by disease. We could not compare frequency of diseases with the statistical average frequency of diseases of Lithuania because patients were chosen selectively and reflect the spectrum of diseases that telehomecare could potentially address. Furthermore, some patients had 2 or 3 diseases such as Cataract, Glaucoma, and dacryocystitis. This was in line with our aim to pilot and utilize telehomecare opportunities. There was a significant number of patients with refractive errors (Myopia, Hyperopia, Astigmatism) which we did not address within the scope of telehomecare.

### 3.9 Clinical Conditions Investigated

Glaucoma is one of the main ophthalmological problems in the elderly population in Lithuania. There are about 10–12% of all patients suffering from glaucoma and many people with suspected glaucoma. Most important diagnostic sign of glaucoma is evaluation of optic nerve head cupping and its dynamics. Traditionally, it is a complicated test, which needs to be performed correctly in an ophthalmologists office, at least equipped with slit lamp and 90D fundus lens, and dilated pupil, what sometimes is contraindicated for glaucoma patients. For the evaluation of the optic nerve head cupping as a homecare procedure, we used non-mydriatic (narrow pupil) digital eye fundus camera, operated by nurse together with rutin tonometry at patients home, and transmitted the image to teleophthalmology competence center for processing and evaluation.

Diabetic retinopathy was the second focal clinical condition. On average, out of 10 patients with diabetic retinopathy, 2 were seen at home, eye fundus images of 2 patients were sent to the competence centre for consultation regarding laser treatment. Diabetic retinopathy is another disease that poses considerable challenges to ophthalmologists and general practitioners. It is the second most prevalent cause of blindness in Lithuania. Its diagnostics and treatment is
inexpensive compared with laser methods (HRT and OCT). For diagnosis and evaluation of glaucoma changes the ONH digital pictures still stay as golden standard [15–17].

Screenings usually result in a high quantity of eye fundus images and their evaluation sometimes becomes complex purely because of the volume, when healthy images have to be distinguished from unhealthy—which have to be evaluated by an experienced expert-physician.

In order to increase efficiency and enable processing of high volume of clinical information, together with the Vilnius Mathematics and Informatics Institute, we started development of automatic eye fundus parametrisation methods. The first one we chose for parametrisation was optic nerve head and its cupping [18–21].

The main advantage of the proposed automatic optical nerve disk localization and approximation method is that the location of the optical nerve head is found automatically without involvement of the physician. Below is a brief scheme of the elliptical automatic optical nerve head localization and approximation. The method consists of the following steps:

- Step 1. Initial image processing.
- Step 2. Localisation of the optical nerve head. Identification of margins.
- Step 3. Elliptical automatic optical nerve head approximation.
- Step 4. Optic nerve head cupping approximation.

Samples of elliptical automatic optical nerve head approximation are shown in Fig. 8, cupping approximation—Fig. 9.

Although the image quality of the handheld camera is lower than taken with professional stationary camera (gold standard), it was sufficient to recognize optic nerve cupping in glaucoma (Fig. 8), hard exudates and hemorrhages in non-proliferative diabetic retinopathy. A shortcoming of the version of the camera used was in recognition of early stages of age related degeneration when only small macular edema can persist. The comparison of the output by the handheld camera and gold standard (stationary camera) resulted in giving the handheld camera a score of 7 as compared to score of 10 for the gold standard (Fig. 10). As in the methodology that was used, this camera was used especially to help general practitioners in screening and selecting patients for ophthalmologist’s consultation, the quality of image was found to be sufficient for this purpose. The overall clinical advantages in providing patients with better and faster access to services were significant.
4 Internal Influences on Development and Outcome

As we noted, factors of project success were active involvement of the project participants, including primary care physicians at service locations, patient demand in services, technology that enabled delivery of services at acceptable quality, and good clinical methodology. Active participants of the project were local/primary care physicians, tertiary level physicians, project leader and coordinator, and patients. Motivation of all the participants was maintained by expected outcome of the project, successful offering of health care services delivery in a home environment. In terms of the number of project participants, the project was small (in the range of 15–20 physicians and in the range of 200 patients) which made project management and coordination and interaction between the physicians simple and effective. Project participants were required to
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### Table 4 Kaiser Permanente study (1997) [22, 23]

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</tr>
<tr>
<td>Time of visit (min)</td>
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<td>18</td>
</tr>
<tr>
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</tr>
<tr>
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<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Time from triage to when patient is seen</td>
<td>24–48 h</td>
<td>Few minutes</td>
</tr>
</tbody>
</table>

Savings of 33–50% were noted
* Researchers noted that with telehealth the patient could be seen many times in 1 day if needed

Economic benefit for a participating local primary care clinic comes in the form of extended services to their patients and, by potentially decreasing occurrence of late or complicated diagnosis (although we haven’t had sufficient statistical data to prove it), costs of care may be saved as well. In our screenings, we saw trends generally similar to the ones shown in other sources [22–24] (Table 4).

### 5.2 The Impact of Project Outcome on Project Partners

The positive impact of the project and its viability provided all project participants with motivation to continue the project. Although there was a role of economic benefits in this, interest to continue was driven by clinical and learning reasons—the project helped to meet patient demand in services at rural and remote locations and it provided the participating physicians with opportunities to learn, clinically and use of new method and technologies.

### 6 User Aspects

(a) Synergies and efficiency: Several synergies evolved in the course of the project: local/primary care physicians—tertiary level physicians; local physicians—patients; local physicians—residents practicing in family clinics—the university residents belong to. All these synergies have positive impact on the idea, structure, and outcome of the project. Likewise, motivation and involvement of all these parties is important to keep such a project going. From an organizational point of view, the project demonstrated improvement of efficiency as there was considerable preparation for the screening visits at remote locations, good sharing of functions between the medical staff participating in patient visits, which resulted into a higher number of patients seen per hour than in a normal office visit setting. Synergies that developed via close cooperation between the team of the tertiary level physicians and local primary care physicians also contributed to increased
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7 General Aspects

Implementation of the project and its continuation will contribute to the quality of life of communities in rural and remote areas. Mobility of patients in those locations are often limited by physical and sometimes behavioral, psychological reasons and providing them with better access to healthcare is a step ahead not only making those areas more livable to elderly population but also more attractive for younger generation. As telehomecare is not a mandated service and has not yet become a prevailing or even significant mode of health care services delivery yet, initiative and willingness cooperate is crucial for the model to work. Resolution of legal (including the aspects of physicians’ liability), quality of services, and financial aspects is important if we want this model to be sustainable. Local communities will be interested in receiving better services closer to patients, but it is important to assure quality and maintain trust in this model. Patient/community outreach was mainly based on direct contacts by local physicians who usually know their community very well, and to some extent, local press.

8 Conclusion

The aim of our project was to test and pilot the ways and methods of improving accessibility of population in rural and remote locations to high quality and timely healthcare in a real clinical setting. Population in those locations (in terms of accessibility of their population to high quality health care services) is often underserved by modern diagnostic services, largely due to the travel time, cost and wait time constraints. Bringing the service closer to the patients, their home or near home serves as an equivalent of virtually providing tertiary level service at a primary level physical location. This project has improved accessibility to advanced diagnostics and timely healthcare for a number of rural population who otherwise would often choose not, or could not to, travel to tertiary level healthcare providers for advanced diagnostics until late stage of symptoms. By using telehomecare, we did not completely replace the need for some patients to visit the tertiary clinic in person—it complemented each other, allowed to eliminate some unnecessary visits to the tertiary level clinic, and in some cases, encouraged patients to visit the tertiary level clinic and address their health condition sooner.

The available technology represents the strength of this type of service, and in the light of general technology trends, further improvements in deliverables (e.g., image quality) and cost should be expected in near term. The opportunity is represented by demand in access to health care services at acceptable costs which would improve the quality of life in rural or remote communities not only for the prevailing elderly population but to younger generation as well. The challenges and threats that we identified were—conservative approach to new modes in physician–patient interaction such as telemedicine from physicians and from
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You have either reached a page that is unavailable for viewing or reached your viewing limit for this book.
1 Introduction

Population ageing is a global phenomenon affecting most regions of the world. Among OECD member countries, over 40% of total health spending is already being used to manage patients 65 years of age and older [19]. As we age, the incidence and prevalence of chronic diseases increase. This increased burden of chronic disease on health care resources and the resulting costs are a powerful incentive for finding effective ways to care for these patients. Further, in light of the increasing shortage of health care providers, especially outside large urban areas, the challenge has become even more complex in many developed countries. In response, many governments acknowledge the importance of providing homecare services. In fact, expanding the range of health care services provided in the home—one of the recommendations recently made by the World Health Organization [32]—is part of a fundamental trend observed in many health systems, including those in Canada, the United States, and many European countries [33].

Information technology applied to clinical information systems (CIS) is perceived as a key enabler for the implementation of these changes [17, 34]. New delivery mechanisms, such as telehomecare—defined as the application of information and communication technologies to bring health care to the home environment—are emphasizing care in the patient’s home as an alternative to acute care and as a complement to primary care. We identified two generic forms of digital homecare. Under the first model, called home telemonitoring, patients utilize condition-specific devices to monitor their clinical condition [23, 24]. Various technological devices such as personal digital assistants (PDAs), cellular phones, or PCs are then used to transmit information to a central telehealth management system which collects, stores, and displays clinical data and assessment documentation. Clinicians then utilize provider-focused devices to access the data associated with a cohort of patients and to provide timely interventions.

A second form of digital homecare model, called mobile computing, targets providers, not patients, as its main users and allows, on site or elsewhere, clinical data management visit scheduling, care planning and data sharing [4, 22]. The variety of mobile devices used by clinicians includes personal digital assistants (PDAs), laptops, tablet computers, GPS, and smartphones, to name but a few [11, 28]. These devices can access clinical information from a distance or update in real time the patient record or care plan. This also facilitates continuity and coordination of care among the care team. While home telemonitoring enables clinical interventions at a distance, this second form of mobile computing allows clinicians to integrate the care process on site at the patient’s home.

The present study concerns the second form of digital homecare. It examines the deployment and success of a large mobile computing project which took place in nine homecare units located in Québec, Canada. As digital homecare is a fairly new phenomenon and our understanding of the challenges and barriers associated with digital homecare implementation projects is still in its infancy, we used a CIS
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Table 1  Profile of the homecare sites

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<thead>
<tr>
<th></th>
<th>Site 1</th>
<th>Site 2</th>
<th>Site 3</th>
<th>Site 4</th>
<th>Site 5</th>
<th>Site 6</th>
<th>Site 7</th>
<th>Site 8</th>
<th>Site 9</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Territory and population covered</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Territory covered (km²)</td>
<td>1,491</td>
<td>66</td>
<td>1,500</td>
<td>1,400</td>
<td>n/d</td>
<td>852</td>
<td>2,279</td>
<td>1,267</td>
<td>830</td>
</tr>
<tr>
<td>Total number of residents</td>
<td>57,796</td>
<td>77,355</td>
<td>60,000</td>
<td>21,744</td>
<td>55,000</td>
<td>125,000</td>
<td>19,425</td>
<td>33,947</td>
<td>83,947</td>
</tr>
<tr>
<td>Number of residents/km²</td>
<td>38.8</td>
<td>1,172.0</td>
<td>40.0</td>
<td>15.5</td>
<td>n/d</td>
<td>146.7</td>
<td>8.5</td>
<td>26.8</td>
<td>101.1</td>
</tr>
<tr>
<td><strong>Nursing staff</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of nurses involved in the project</td>
<td>11</td>
<td>7</td>
<td>16</td>
<td>7</td>
<td>25</td>
<td>19</td>
<td>11</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>Total number of active patients</td>
<td>615</td>
<td>n/d</td>
<td>449</td>
<td>165</td>
<td>1,224</td>
<td>941</td>
<td>298</td>
<td>407</td>
<td>906</td>
</tr>
<tr>
<td>Case-load (Average number of patients per nurse)</td>
<td>75–80</td>
<td>45</td>
<td>50</td>
<td>58</td>
<td>65</td>
<td>100</td>
<td>45–50</td>
<td>129</td>
<td>57</td>
</tr>
<tr>
<td><strong>Nurses’ resources from private agencies</strong></td>
<td>None</td>
<td>Yes</td>
<td>None</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>None</td>
<td>Yes</td>
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<tr>
<td><strong>Financial situation</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Establishment experiencing a budget deficit</td>
<td>Yes</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Yes</td>
<td>Yes</td>
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<td>None</td>
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not only had to act as a traditional steering committee but also had to ensure knowledge transfer and emulation between sites.

4.2 Mobile Technology

The SyMO™ mobile technology software was intended to optimize the process used to plan and organize nursing activities in patients’ homes. The mobile technology enabled patient clinical data management at multiple locations (patient’s home, on the road, homecare program office or even healthcare professional’s own home), both in terms of data visualization and entry. The application included a series of automated care plans, clinical assessment tools and order forms to support registered nurses in patient evaluation and treatment, visit scheduling, follow-up and case load care planning. Data sharing with other members of the care team was also possible.

The software, which was installed on a portable computer, consisted of a series of modules. It was first composed of a dictionary of nursing care plans that covered all the procedures registered nurses need to perform in response to patient health problems (e.g., assessing physical pain, weighing patients, teaching patients). For
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the external challenges that influenced the project, like economic aspects and legal issues, are being discussed. Furthermore, an outlook on the follow-up project OSAmI is given with regards to the experience learned from SAPHIRE (http://www.srde.com.tr/metu-srde/webpage/projects/saphire).

**Keywords** Homecare · Tele-rehabilitation · Cardiologic rehabilitation systems

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1 The SAPHIRE Project

SAPHIRE (Intelligent Healthcare Monitoring based on Semantic Interoperability Platform) was a project funded by the European Commission as part of the 6th Framework Programme. The project had a contract period of 2.5 years, from the 01.01.2006 to 30.06.2008 and the total cost of the project amounted to 2.9 MEUR. SAPHIRE was built upon the results of an earlier European Commission funded project, IST-1-002103 Artemis [1], which developed a semantic web service-based P2P infrastructure for the interoperability of medical information systems. The Artemis system enables healthcare institutes to exchange electronic healthcare records in an interoperable manner through semantically enriched web services and semantic mediation. As the subtitle of the project suggests, the aim of SAPHIRE [2, 3] was the development of a system that uses a platform for semantic interoperability in order to provide services for an intelligent monitoring of patient data. The overall SAPHIRE vision is presented in Fig. 1.

Patient monitoring at home or at a hospital was achieved by a set of mobile and wireless connected sensors assigned to a single patient. Agent technology was used to collect and combine or fuse sensor data. The “agent behaviour” was supported by intelligent decision support systems based on clinical practice guidelines (CDSS). The patient histories stored in medical information systems were accessed through semantically enriched Web services and medical standards (like CDA or XDS [4, 5]) to tackle the interoperability problem. In this way, not only the observations received as patient’s physiological signs data during a conventional diagnostic process but also the patient medical history (such as previous diagnoses, medication list, allergies and adverse drug reactions), clinical guidelines [6], physiological signs received (continuously) from wireless medical sensors and the patient care plan all affected the clinical path to be followed. Due to the complexity of clinical standards and practice guidelines, healthcare professionals have difficulties in understanding and applying these guidelines in the clinical care setting. This necessitates computerized decision support systems automating clinical guidelines to support the health professionals. One of the major challenges in developing computerized decision support systems was accessing the many disparate data sources needed to retrieve patient-specific information. This led to a distributed architecture with an information infrastructure that requires safeguards to maintain security and privacy of patient data. Patient identification and medical
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the domain of homecare sensor data are of a lesser quality because of motion artefacts and instable bluetooth connections. An autonomous alarm system is, therefore, very difficult to develop. Also the guidance of patients to deal with professional medical equipment at home (e.g. 12-lead ECG) was of prime importance.

The result of the project was clearly not a marketable product. The sensors were not reliable enough to be used by the patients, and the complete sensor suite and the ergometer in their current configuration would have been so expensive that a sustainable business model was out of reach at that point.

However, the results of the project were promising enough to exploit them in follow-up projects like OSAmI, which add additional use-cases for the setup and strive for a simplified configuration. Also the use of a service-oriented architecture together with broadly accepted, open standards helps to cope with the challenges that are described in this paper.

Acknowledgments: The research leading to the results described in this paper has been funded in part by the European Community’s Sixth Framework Programme under grant agreement IST 027074, SAPHIRE project, and in part by the German Federal Ministry of Education and Research (BMBF) under grant agreement 01IS08003, ITEA2 OSAmI project.

References


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The result of both projects was a custom configurable eCare platform that connects to the users television through the Internet, and allows for video-telephony with a professional care help-desk, other users of the eCare system and informal caregivers using an instant messaging client on their PC.

2 Development of the Project

2.1 Arguments to Start the Projects

The major arguments for these projects were the societal challenges that have to be faced in the near future due to the ageing society. Indeed, already today there is a global shortage of qualified care staff, hospital and nursing beds which cannot only be solved by building more infrastructure or training additional persons in healthcare domains. Based on population numbers and predictions towards the future, the ratio of active persons compared to the care needing persons will drastically shift in the next decades; a ratio which has practically remained constant over the past century as indicated in Fig. 1. This figure shows the numbers for Belgium as an example, but they are applicable to each country in the western world. If the present model of care would continue, about half to two-thirds of the active population needs to be active in the healthcare sector by the year 2025.

While it is clear that not all elderly persons will be able to find a place in a nursing home, another societal change is taking place: both the elderly and society are more and more aware of the fact that most persons like to continue living at home continuing their independent lifestyle with specific care support provided at their location by professional nurse and family caregivers. Although this general user trend can be considered as a clear answer to the shortage in nursing homes, it aggravates the shortage of nurses since a home nurse also spends a lot of time traveling from one patient to another in case of homecare.

It should be clear that a change in the caring process will be part of the near future in order to be able to provide sufficient care for society. Although changing
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2.2.2 The Technological Axis

The nurse and operator of the alarm central request a clear speak-listen connection, a good image quality, the possibility of the implementation of the patient file and the history of the calls. These items are needed to make a good estimation of the call which will be followed by the correct interventions.

Concerning our target group, we should be able to modify the program on request/demand since elderly users need specific, adapted offerings according to their needs in their specific condition which evolves over time.

Technologies should be based on open standards that the solution can make use of available networks such as internet connections and can integrate with existing systems in order to provide a smooth adoption path rather than requiring a big bang style conversion. In addition providing a system without explicitly creating a lock-in scenario is being preferred by most organizations (both profit and non-profit).

The projects aimed at implementing a data and information pull-technology based scenario from home care or hospital with specific access rights (social nurse, nurse, etc.) for all users. This had to be done by demonstrating actual electronic exchange of necessary data between hospital and home care in a secure and trustworthy style such that all users (both providers and consumers of information) will be inclined to use the systems.

2.2.3 The Business Axis

eHomeCare comprises a large number of actors, with not only different interests and motivations but also very different financial models (government, non-profit, commercial, personal relationship, etc.). Concerning the cost efficiency, video communication might serve as a filter at the alarm centres, thus providing a benefit for the care organization. However we can wonder if the telecom operators are ready concerning the financial part of lowering the costs of the connection fees and monthly rent.

Business modelling based on financial flows typically ends in very complex figures and dead end reasoning. Can a more simple framework be devised which will enable the introduction of ICT in home care environment.

2.3 What were the Innovative Elements?

The projects encompassed several innovative elements on the different axes of the multidisciplinary approach. They can be summarized as follows

2.3.1 Multidisciplinary Axis

As both projects encompassed a multidisciplinary team, the goals and expectations of each partner (stakeholder) were oriented in different directions. During the first project COPLINTHO, this proved to be a tedious process resulting in delays and
complications to realize the demonstrator; the project even had to be extended in order to have a minimal field testing period. During the execution of the TranseCare project a specific “white book” methodology [5] has been devised based on the lessons learned during the COPLINTHO project. This approach not only allowed the different stakeholders to express their goals but also proved to be an efficient method that facilitated the discussions between technical and non-technical participants. Furthermore, it enabled the projects to create a clear focus on the use cases, the user scenarios and the demonstrator from the early start of the project while allowing to adapt the specific conditions of the demonstrators according to the outcomes of the technological research tracks (which are by nature uncertain at the start of a research project). This “white book approach” consisted of first distilling specific user scenarios based on the goals and expectations of all partners, using the persona methodology [6–8]. Secondly, the approach added a technological mapping to each scenario, which encompassed the relevant technological components and communication channels between the devices. In doing so, it was possible to estimate the technological risks of each user scenario according with respect to actually building the demonstrator. Furthermore, this approach also allowed the non-technical partners to take an active role in the discussions as each technological setting was specifically linked to each user scenario. The result of this approach was that already in an early stage a clear consensus was created which classified the user scenarios and demonstrators to “field”, “lab” or “concept” categories, thus managing the expectations of all partners, lowering the implementation risks in the field, and increasing the chances towards success at the end of the project.

2.3.2 Technological Axis

The communication platform studied and developed in the projects was not just about bringing the video communication to the end user, but it was about creating a solution that is fit for care. This means that the solution had to match a set of challenging requirements with respect to quality, safety, security, possibility™ to install (by non-technical staff), usability (by non-tech-savvy elderly) and the legal framework (privacy and trust issues). During the sequential projects, the concept evolved from a healthcare terminal based design to the far less intrusive design of Xtramira™ [9], which connects to the television set of the end user. The multi-disciplinary research helped to create the innovative design of the user interface allowing for a practically manual free usage (by the elderly), while at the same time realizing a high trust factor concerning privacy issues (“can I be seen on the internet”).

The Virtual Private Ad-Hoc Network (VPAN) [10] concept aims to securely and automatically interconnect distributed groups of devices. It aims to create secure self-organizing virtual networks in which any service can be deployed, shielded from the outside world. Since the services we want to provide involve different players (elderly, caregivers, family...), the interconnection of their
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4 Internal Influences on Development and Outcome

4.1 What Requirements were Expected from Those Involved in the Project

During both projects there has been a constant attention and continuous evolution with respect to the requirements. The white-book approach proved to be an essential tool to facilitate this process without ending up with projects where development is blocked due to constantly evolving requirements. During this process a number of “rules-of-thumb” were used as guidance:

- Focus on realistic goals: better less ambitious but possible than blue sky and nothing realized
- Don’t forget the user requirements (compare to the technological); they need to be gathered for different elements within the communication network (alert system calls, multiplayer gaming, video chat application, …)
- Manage expectations across disciplines during the entire project cycle: what is expected from healthcare and what is healthcare expecting from its technological partners?

More concrete the expectations in the projects can be summarize as follows:

- Healthcare is actively searching for technology working as an assistant of the nurse and/or as a facilitator for the elderly. As already mentioned the number of elderly is increasing faster that the number of nurses (see Sect. 2). Also, the elderly are more isolated in their homes since their social network is smaller. Hence the expectation of assistive technology. Healthcare expects a technology adapted to the user profile with an ease to use. Is the support of the technology matching the requirements of the user groups?
- The industry expects from the healthcare an actively participation with testing the applications, a constructive commenting and forwarding feedback concerning user experience and future expectation.
- The healthcare organizations are expected to actively search for test persons fulfilling the inclusion criteria and personnel.

4.2 How and Due to Which Causes Did Those Requirements Change During the Process

The very nature of both the COPLINTHO and the TranseCare project implied a change in requirements during the process. Indeed, since both projects had the combined ambition to advance user centred design of ICT services for home care as well as advancing the actual ICT technology at the same time, a conflict
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For future cases, it might be useful to search for test patients by contacting the leading nurses of different departments instead of only contacting one as was the case in the projects. The holistic approach to care by the homecare nurse is often sufficient to get an estimate on the capabilities and/or interest of the patient.

We also noticed that it usually were the children of the contacted person that were enthusiastic about the technology and were trying to convince their family member.

Another, long term, educational change should be made to the training of the nurses. At present, most nurses are confronted with this type of technology for the first time during their actual working situation. It should be more efficient to inform them earlier, e.g. during their school education period. The sooner they realize what technology can bring to them, their patients and his/her environment, the easier it will be to convince them to try the technology themselves and to support their patients.

6.2 Were User Satisfaction and Usability Part of the Project’s Goal and How?

In eHomecare user satisfaction is an important means to gain the confidence of the users. As mentioned before, research has shown that the “upcoming” baby boomers are very interested in technology. However, the research also concluded that these potential users want to use technology if their freedom and privacy is guaranteed. The current elderly population (prior to the baby boomers, also called the pre-war generation) has grown up with little or no technology adherence and with a “natural” fear for this technology. Therefore this pre-war group needs especially the product satisfaction to gain confidence.

Hence, both user satisfaction and usability were part of the projects from the start, however the focus was more oriented toward user centric design and evaluation by user rather than big statistical user satisfaction studies. For each demonstrator that was build, specific attention was given during the design and development process to realize a solution that could meet the user expectations and could also be used by the non-tech-savvy end users. Already early in the development process user feedback was achieved based on low fidelity prototypes (mock ups, paper printouts of the screens, etc.). The usability of the first operational high fidelity prototypes was evaluated during a lab test under controlled conditions with test users in observation rooms. During the field trials, a similar user evaluation was executed; however extensive observations are less obvious in the field. Hence the feedback was triggered using in depth interviewing techniques in order to get insight in the user motivation.

The result of this approach was a successful evaluation of an easy to use central desk application as well as the easy to use interface of the Xtramira™ device. Actual observation tests with different test persons with ages ranging from 57 to 75 clearly showed that 90% of the test persons could execute the test sequences based on the embedded instructions, without any additional training.
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