Impact of a Broadband Interactive Televisit/ teleconsultation Service for Residential and Working Environments

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ABSTRACT
The availability of health care attention at the point of need is one of the key benefits of telemedicine. Home environment and working place are the two scenarios selected in this article to evaluate the impact of a televisit and teleconsultation service. 31 users from four different medical and patient groups participated in this study supported by European Commission ATTRACT project. The experiences, carried out in Madrid and Valencia Spanish sites, benefited from interactive broadband access networks to provide cost-effective telecare services. Key areas analyzed encompass systems usability, clinical outcomes, patients quality of care and infoedic issues. Services advantages were verified and compared both from patients and medical staff points of view. Main benefits pointed out refer to displacement reduction, better communication doctor/patient, provision of comfort or friendliness, more precise therapy follow-up and increases in patients' sense of well being.

INTRODUCTION
Telecommunication industry in the last years has mainly propelled the extensive deployment¹ of new infrastructures to support the provision of affordable interactive multimedia end user services for all. European context clearly reflects this situation and the forecast of big investments to make operative broadband access networks led to initiate ATTRACT² (Applications in Telemedicine Taking Rapid Advantage of Cable Television Network Evolution) telemedicine project. The goal was to exploit high speed communication technologies to provide citizens with affordable health telecare services both at home and their working place. The project, supported by European Commission IV Framework of Telematic Applications, allowed to set up multiple trials running in parallel. The work done permitted to verify and evaluate services feasibility as well as to identify implementation barriers and bottle-necks. The results aimed to get ready the launch and provision of telemedicine services as soon as suitable devices and broadband infrastructures such as HFC cable, xDSL, B-ISDN or LMDS may become affordable and available for all.

Main drivers and bottle-necks extracted can be separated in four groups: patients benefits, clinical outcomes, technological features and economical parameters. Patients advantages usually identified in literature³ relate to displacement avoidance, isolation reduction, improved communication with medical staff and higher sense of security. In terms of clinical outcomes⁴ issues studied include better therapy follow-up, improvements in care protocols, agility for congested services and other clinical parameters (infections reduction, treatment completion, quick symptom detection) that depend on each clinical specialty. Technology aspects to be solved refer to available infrastructures, networks capacity for multiple users, guaranteed bi-directional bandwidth, systems connectivity, security levels, perceived quality of videoconference and data processing. Finally, economic dimension is focused on cost-effectiveness⁵ compared with traditional health care attention, financing models and business plans.

ATTRACT allowed the development of multiple telemedicine services with different users groups located at seven sites: Madrid, Valencia, Belfast, Frankfurt, Milano, Crete and Thessaloniki. By this way, a wide range of applications, patient profiles, clinical specialties and technologies were covered providing a big sample for telemedicine services analysis. This paper details the results obtained in the Spanish sites, that is to say, three home televist services in Madrid and a tele-consultation service provided in Valencia at work environment.

MATERIALS AND METHODS
Homebound environment and workplace are the two locations selected to validate the services developed. The first one was evaluated in Madrid with the collaboration of 18 patients who received at home scheduled medical televists from three medical specialists at INSALUD Severo Ochoa Hospital (coverage 425,000 population). The three user groups
who participated are six patients treated at the Coronary Care Unit who had suffered from Acute Myocardial Infarc, six other on Continuous Ambulatory Peritoneal Dialysis attended at the Nephrology unit and six elderly people belonging to the Anesthesiology, Reanimation and Clinical Pain Unit.

The service is supported by a customizable electronic televist protocol that covers general check of patient’s Health State, therapy monitoring, prescription indications and sessions arrangement. Medical staff at the hospital access through the computer screen to collected patients information and start the televist session by connecting at scheduled time with a patient at home. Once the patient has received the call and checked the camera and television set, the doctor or nurse starts the audiovisual communication and provides the teleservice assisted by the mentioned protocol. Secure data stored can be consulted out of the televist time what eases work and ensures continuity between sessions. At the end of the session, patient may watch on the television explanatory notes with prescriptions written by the health carer. Patients usage of the service ranged from daily (Cardiac Care Unit) to twice or three times a week counting over 75 televist sessions after two months.

The tele-assistance service implemented and deployed in the campus of the Technical University of Valencia was validated and represents the working place scenario. A teleconsultation room was set up in the main building at the Telecommunication School and the medical terminal was installed in the health care center. The service offered provides: medical tele-assistance (for teaching institution, students and administrative staff), high quality videoconference, electronic clinical history, biomedical signals monitoring (EKG, blood pressure, hearth sounds and temperature), remote prescriptions, appointments through web and health info through a portal. The service aims to provide better medical assistance for the university population and to avoid displacements and waste of time. Medical staff providing the service were always doctors with average technology skills who had tele-consultation appointments with patients. The doctor was notified of a patient’s internet consultation request with a sound signal and then he gave priority to attend it between any ongoing appointments (with patients physically present) and the internet consultation request. This happened several times a week expecting higher frequency of use in the future due to the installation of additional tele-consultation room. The regular consultation procedure in most cases consisted on a clinical interview plus (sometimes) rescheduling for the next tele-session.

Acceptance and reliability of developed telemedicine services has been evaluated getting key conclusions for future experiences. Special attention was paid to clinical, social, technical and economical issues which directly impact on health care quality received by patients at home or at work. The evaluation study was designed to analyze collected data both at implementation and provision stages of the televist and teleconsultation services. Results also describe how the telecare services influenced on health and patients lifestyle, medical staff practice and nature of care services provided. The inquiry process was supported by literature questionnaires easing a standardized survey for the two services. The evaluation paid attention to the following influence areas: systems usability, perceived communication quality, satisfaction related to remote monitoring, continued use of the system, quality of patients’ life (social impact and progress in therapy), privacy issues, implementation into workspace and clinical outcomes. The questionnaire has been quantitatively analyzed through multiple-choice items and results were complemented by qualitative analysis of open-ended issues. Authenticity, variety and high value of information contained in these responses were shown by classifying data into key categories.

RESULTS

Information obtained in the study is presented and grouped according to the two group of participants involved in the telemedicine services: medical staff and patients. Five point Likert scales have been used to associate positive responses with score 1 and low agreement with value 5.

Evaluation of Medical Staff Acceptance Service

a) Satisfaction related to the usability

ATTRACT services ease of use was measured attending to users satisfaction on system usability. This dimension covers usefulness of the medical platforms, quality of information obtained and interface quality. Health care participants are satisfied with usefulness (mean=1.4) (scale 1= strongly agree, 5= strongly disagree) as they appreciate much the system for remote telecare provision. The interface functionality scored 1.76 and overall system usability was considered high (mean 1.7) what does facilitate service acceptance. Organization of information on the screen (mean = 2.00) was highly scored although users were not entirely satisfied with easiness of configuration to the medical needs (2.3). This fact is being enhanced by facilitating clinical protocols customization according to each clinical specialty.
b) Perception of the quality of communication
As shown in Table 1 exchange of information thanks to audio and video communication quality was judged very good by all participants (mean=1.86). Health carers do believe that the overall communication with the patient is quite satisfactory (mean =1.88) and do not see barriers in relationship process.

<table>
<thead>
<tr>
<th></th>
<th>Medical staff - Easy exchange of information</th>
<th>Medical staff - Overall communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>105</td>
<td>105</td>
</tr>
<tr>
<td>Mean</td>
<td>1.86</td>
<td>1.88</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.38</td>
<td>0.47</td>
</tr>
</tbody>
</table>

Table 1. Quality of communication: medical rating

c) Satisfaction related to remote monitoring
This question studied the confidence of medical doctors on the assessment made through the service in comparison with the standard physical face to face exam /meeting. Professionals do generally trust the assessment they can make using ATTRACT services (mean=1.77) and the most controversial question deals with the need of additional physical exams (mean = 2.56). Answers mainly depend on the specific case and health state presented by the patients. Madrid Pain Unit did not estimate the need of additional physical contact unless infusion pump needs to be reviewed. Dialysis service required face to face visit whenever potential infection is appreciated by using the service. All medical staff members could understand the patients’ condition when they provided the services (mean<=1.82) and also would like to continue using the system, particularly in addition to personal visits (mean=1.23). None of them would like to use the ATTRACT service as a full substitution of personal face to face traditional visits (mean=2.82). Figure 1 outlines the satisfaction indicators; lower columns represent more positive results.

d) Perceived changes in patients' progress in therapy
At Madrid Dialysis service, medical staff referred three cases (50%) of better health control because of the advantages (ease and frequency) of remote follow-up. For one of those three cases (and also for another, fourth patient) an additional reason was the time saving advantages of tele-visit. One case was outlined since avoiding mobility problems to the patient actually improved therapy outcome. Other mentioned that a better communication with the doctor is established by the tele-sessions. In total, tele-visit is reported as beneficial for 5 of the 6 patients at this trial site. In Madrid Coronary unit, one patient is reported as showing an overall health improvement thanks to the medical protocol control and other showed symptom improvement.

e) Perceived protection of the patients' privacy
The medical staff valued patients’ privacy protection very positively (mean=1.6). No reluctance was shown in Madrid site providing with patients data access is guaranteed by the system. The use in Valencia of the secure zone of University’s intranet provided a high degree of protection and privacy to patients data.

f) Organizational changes for the medical staff
Although in Madrid Coronary unit, no supportive changes were reported, the Madrid Pain Unit site preserved one medical doctor as assigned to the role of establishing the videoconference at a particular pre-arranged time. The Dialysis service pointed out the future possibility of assignment of one nurse / carer (in parallel to other duties) for using the computer in case a medical televisit session might be needed. In Valencia teleconsultation service, a new medical doctor specifically responsible for tele-care sessions was hired. In addition, the possibility of arranging appointments both for teleconsultation and normal visits via Web was introduced to improve care attendance management process.

g) Main advantages of ATTRACT telecare service
Medical staff stressed in all the sites the possibility to reduce patient’s transportation to hospital and augmenting accessibility towards patient. Madrid Pain unit valued quality and personalization of doctor-patient communication because of one-to-one conversation and personal attention. In addition, comfort provision (physical as well as psychological reassurance and feeling of security) and overall friendliness of process was pointed out in Valencia site. Madrid Coronary and Dialysis unit also remarked quality of image and possibility to visually contact the patient. Finally, other issues were valued like the possibility of using the system to optimize material and medical staff resources and to improve health care education for patients on topics such as medical complications and biomedical devices.
h) Main disadvantages of ATTRACT service
Some initial audio noise (Madrid site) as well as the additional need for technical support (Valencia site) were detected. Potential dependency on new technologies or technical support was mentioned as a disadvantage that reduces systems autonomy.

i) Perception on the efficiency of the work
The medical staff members are quite satisfied in how far the service supports them to complete their work. Not all perceive a reduction in the time dedicated to each patient and an increase in the number of patients attended per day. On the other hand they agree that they could examine patients more regularly.

Evaluation of the patient's perception
As mentioned in the introduction of this study, multiple patients profiles were involved in the telemedicine experience not only in medical or social requirements but also in terms of age distribution, cultural level or technology skills. Gender distribution was balanced and age ranged from 18 to 82 years old as outlined in Table 2.

<table>
<thead>
<tr>
<th>Site</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Madrid – Coronary</td>
<td>6</td>
<td>46</td>
<td>75</td>
<td>62.7</td>
<td>12.8</td>
</tr>
<tr>
<td>Madrid – Diálisis</td>
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<td>30</td>
<td>67</td>
<td>53.3</td>
<td>14.9</td>
</tr>
<tr>
<td>Madrid – Pain</td>
<td>6</td>
<td>32</td>
<td>82</td>
<td>68.3</td>
<td>10.1</td>
</tr>
<tr>
<td>Valencia</td>
<td>9</td>
<td>18</td>
<td>30</td>
<td>23.3</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Table 2. Patients distribution age

a) Context of use
At Madrid sites, system supported a televisit session at patient's home to contact his/her doctor and discuss health status and treatment progress. Medication or therapy may be updated and next telemedicine contact is arranged. Valencia patients (9) used the tele-care for medical consultation, by using a computer from a public tele-consulting room. As normal procedure they had to do their own scheduling first, through internet. To enter in the room they have to use a ID card through an automatic card-reader.

b) Usability and communication efficiency
Independently of medical service, patients reported similar good results and no significant differences were observed compared with medical staff.

c) Satisfaction related to remote monitoring
Madrid sites patients are very satisfied with remote monitoring (all means < 1.6 ranging on a scale from 1="highly satisfied" to 5="not satisfied"). Valencia users rate satisfaction with remote monitoring lower than medical staff (mean=2.3). Improvements of monitorisation devices usability were recommended.

d) Continued use of the system
Focus was put on the issue whether patients like the service enough to continue using it beyond the scope of ATTRACT, or whether they prefer traditional approaches (face-to-face communication). In all sites patients had reservations on replacing all personal visits with the service, preferring to continue using the service in addition to personal visits.

e) Perceptions of progress in therapy
This issue is rather satisfying across all the sites (mean<=2.38; ranging from 1=very good progress in therapy to 5=no progress). Users in Madrid Dialysis site rated highest progress in therapy (mean=1.75) thanks to the possibility to easily consult doubts with the doctor. Both at Madrid Coronary and Pain Unit sites, participants strongly accepted that the service has positive impact on their life (mean<=1.67) and that they felt safer in terms of health monitoring (mean<=1.5). However they did not feel much that they improved their ability to take care of themselves (mean>=2.83) or that they can better perform usual activities (mean>=2.83). Patients from Madrid Pain Unit totally agreed with the statement about feeling safer due to health monitoring (mean=1.00).

f) Patients' perceived privacy
All participants strongly appreciated that data confidentiality and privacy was guaranteed during the trials during the telecare services. They perceived no risk in using the services (mean = 1.2). No invasion on home privacy was declared since televisit sessions are scheduled ones, patients may accept or refuse the call and they do highly trust on care assistance provided by their doctors or nurses.

g) Advantages and disadvantages using the services
Time saving and facility of face-to-face consultation with doctors at any time were the main advantages perceived. Madrid sites reported increase in patients' sense of well being by giving both physical comfort in one's own home, psychological support and security/ reassurance through friendly and timely service at the point of need. Patients estimate that on demand teleconsultation service may be also very helpful to support their care information needs.

Considering that nearest hospital is 20' driving from Valencia campus and the likely long waiting queue, displacement reduction is also considered a big advantage. Main disadvantages included occasional connection problems and judgment of doctor-patient interaction little personal. This does not refer to the "climate of interaction" but to situations requiring direct physical interaction like having to touch the patient during the examination to make good diagnosis. One patient mentioned distrust in the system/interaction during the first few sessions.

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Cost-effectiveness dimension

A first approach to cost-effectiveness analysis has been done by studying televisit session cost variation as the total cost of providing the service divided by number of sessions. The telemedicine service provision cost includes personal cost—health carers involvement and technical support—as well as equipment costs such as devices price, communication fee, systems installation and maintenance\(^6\). Personal workload from televisit time dedication has been also computed in sessions cost calculation. The final figures obtained vary with the number of patients treated as well as the sessions frequency, duration or health carer dedication in comparison with face to face consultation. As shown in Figure 2, break even point is achieved after six weeks of service provision when the unit cost of a televisit services is lower than a face to face consultation. Service demand—number of patients entering the service—televisit dedication has been changed in the three cases comparison getting to different cost analysis. In the three cases, cost-effectiveness is achieved depending on the number of telemedicine sessions and service provision period.

The results obtained in ATTRACT were judged very positive in Valencia site and a report was presented to University's authorities. As a consequence, it was decided to extend the services in Valencia site to 9 technical schools and centers in the campus and in two distant centers located at 60 and 80 Km far from the Medical Center. Deployment is under progress.

ACKNOWLEDGEMENTS

Authors would specially thank to all patients and health staff participating in the telemedicine service. Support provided by ATTRACT Consortium including FORTH Institute survey support definitely contributed to the success of the service.

REFERENCES


CONCLUSIONS

INSALUD health managers at Madrid Severo Ochoa hospital highly valued the telemedicine service and are giving priority to enlarge the service provision for a year. The goal is to increase evaluation of clinical outcomes in deeper comparison with a controlled randomized study for the whole medical unit. Positive support is being received by biomedical device manufacturers to complement the televisit system with available data monitoring devices. Not only the number of potential patients but also their care demand results critical to analyze and achieve expected cost-effectiveness of the service considering also quality of care and accessibility issues.