# Accountability in a Sub-Saharan Hospital: Impact of Use of ICT Tools at the Gabriel Touré Hospital of Bamako

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## Introduction

The University Hospital Gabriel Touré is a third level Hospital of the health pyramid of Mali. As such it is one of the largest hospitals in terms of offering tertiary care in the national health system. Added to this is its central location and proximity to the people of the Malian capital Bamako. These factors make this hospital the most frequented and most solicited by citizens of the Republic of Mali.

As part of an efficient operation and providing quality service to the public, senior management of the hospital wanted to achieve concrete improvements of the working environment for the benefit of its employees and users actions. But it was quickly confronted with problems of availability of quality information necessary for the proper control of the institution.

The most pressing problems were the lack of reliable information on the situation of income and also the exact number of operational human resources at the hospital. Added to this was a crisis of confidence between the hospital staff and management on one hand and on the other hand between the users of public hospital and healthcare professionals of the institution. It is in this context that the senior management of the institution initiated the process of computerization of the entry-office and biometric census of hospital staff by using the expertise of the National Agency for Telehealth and Medical Informatics (ANTIM) because of the mission entrusted to this structure by the Ministry of Health.

## Methodology

The project was realized by ANTIM, focusing on discussion and including involvement of various stakeholders in the hospital. The most senior leaders of the hospital accompanied the process of performing an audit of existing information systems to determine the needs of all stakeholders and finally propose a technological solution taking into account all these factors. This allowed the implementation of a hospital information system software package called OpenClinic for fund and human resources management.

## Results

OpenClinic became operational on 29 January 2013. Financially it was noted that from its implementation, it improved significantly the revenue of the hospital.

In terms of direct revenue (payment by patients, cash directly perceived at checkout) without insurance and cesarean reimbursement, the hospital recorded after ten months of operation 446054837 XOF. This equates to a monthly average of 44605483 XOF against 35090725 XOF before.

It should be noted that the hospital had previously recorded 18,497,590 FCFA in December 2012 and 35,490,000,665 CFA francs in the month of January 2013.

Table 1

| Feb 2013 | Mar 2013 | Apr 2013 | May 2013 | Jun 2013 |
|---|---|---|---|---|
| 50,540,965 | 68,485,395 | 64,204,959 | 62,402,837 | 61,804,855 |
| Jul 2013 | Aug 2013 | Sept 2013 | Oct 2013 | Nov 2013 |
| 44,014,080 | 47,777,350 | 59,670,480 | 64,792,390 | 63,293,825 |

The table above shows the evolution of direct revenue (perceived directly at the patients checkout) without insurance reimbursement and cesarean per month at the beginning of the implementation of the software.

Table 2

| Feb 2013 | Mar 2013 | Apr 2013 | May 2013 | Jun 2013 |
|---|---|---|---|---|
| 56,105,550 | 75,494,950 | 67,981,500 | 60,911,550 | 67,377,900 |
| Jul 2013 | Aug 2013 | Sept 2013 | Oct 2013 | Nov 2013 |
| 57,623,450 | 63,580,350 | 74,266,750 | 74,761,450 | 74,583,500 |

The table above shows the evolution of total revenues of the hospital including all insurance (AMO, Mutual, Hospital's Halfprice, Free of charge

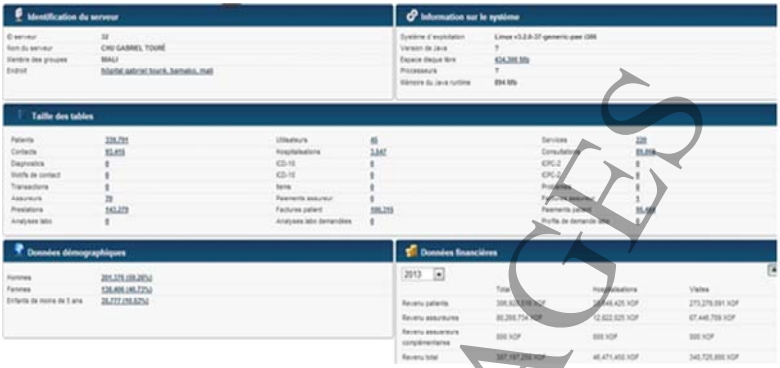
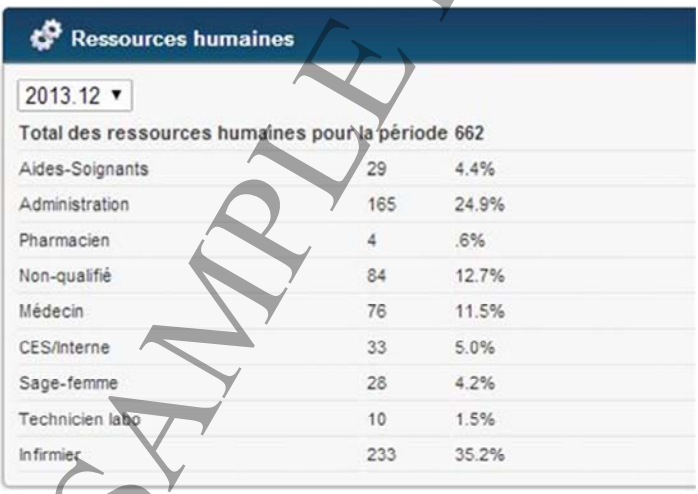



Figure 1 : Technical and Financial data dashboard

care for hospital staff) since the implementation of the software with the



Ressources humaines

2013.12

| Total des ressources humaines pour la période | 662 | |
|---|---|---|
| Aides-Soignants | 29 | 4.4% |
| Administration | 165 | 24.9% |
| Pharmacien | 4 | .6% |
| Non-qualifié | 84 | 12.7% |
| Médecin | 76 | 11.5% |
| CES/Interne | 33 | 5.0% |
| Sage-femme | 28 | 4.2% |
| Technicien labo | 10 | 1.5% |
| Infirmier | 233 | 35.2% |

Figure 2 Hospital human resources Dashboard

possibility for the hospital management and health authorities to monitor financial results in real time thanks to the interface of the national health data repository (Global Health Barometer of Mali).

In terms of human resources, it was noted that the services responsible for staff at the hospital had too divergent information; the census has resolved definitively this issue and has allowed producing secured badges for staff.

The biometric census of the entire hospital staff in OpenClinic software showed that the hospital has only 648 employees instead of 811 provided on the list of discounts. The operation allowed removing 163 fictitious

Objet The Global Health Barometer - TEST AMO extract CHU GT
De <chugt@globalhealthbarometer.net>
À <canam@globalhealthbarometer.net>
Date 2013-02-19 01:00

Ministère Santé webmail

- exportAMO.csv (14 ko)

Message de test avec extraction de données de facturation pour CHU GT en annexe.
- Période de facturation couverte: du 18/02/2013 06:58:03 au 19/02/2013 01:00:02
- Nombre de prestations facturées: 90
- Montant total des prestations: 330800 XOF
- Montant total à charge de l'AMO: 231560 XOF

Colonnes de la table en annexe:
- PREST_ID: numéro unique de la prestation facturée
- PREST_DATE: date de la prestation
- CONTACT_TYPE: C=Consultation, H=Hospitalisation
- CONTACT_ID: numéro unique de la consultation ou de l'hospitalisation
- CHUGT_ID: numéro d'identification interne du bénéficiaire au CHU Gabriel Touré
- AMO_ID: numéro AMO du bénéficiaire
- AMO_STATUS: affiliate=Adhérent, child=Enfant, partner=Conjoint, parent=Parent
- AMO_SOURCE: INPS ou CMSS
- PAT_LASTNAME: nom du patient
- PAT_FIRSTNAME: prénom du patient

Fig. 3Example of automatically generated message with the CSV file

employees from the list of discounts.

In addition, the installed system manages Compulsory Health Insurance (AMO) patients, this through authorization mechanisms managed directly by agents of the National Health Insurance Fund (CANAM) in the space dedicated to this purpose. This allows editing invoices that integrate CANAM's logo for any insured AMO patient; reducing significantly fraud attempts to health insurance. Data on services provided by the AMO patients are sent every night at midnight by e -mail to CANAM and to the direction of the Hospital Gabriel Touré.

This reduced significantly the misunderstanding between CANAM and hospital's management, concerning invoices. It was also highly appreciated by doctor’s controllers of CANAM, who saw their work greatly simplified by data availability online and in CSV format, ready to be analyzed in software like Excel.

All these data can be queried at any time by leaders with a security code that gives them access to a dashboard containing different modules appropriate to their responsibilities. The dashboard in addition to provide the opportunity to obtain statistics or generate graphics, also automates a large number of operations as centralized printing of identification cards or transfer data coverage and disease billing between providers and insurers.

## Outlook

The outlook is to quickly activate and configure modules on medical patient record, pharmacies and laboratories within the UHC-GT. In other words it is to make available the system to the physicians and other professionals (nurses, midwives, laboratory assistants, technicians ...) in the box of consultation and hospitalization services with electronic publishing orders (sheet of electronic care). This will significantly reduce fraud to care sheets which tend to become widespread in health institutions.

## Conclusion

The implementation of the modular hospital information system OpenClinic at the University Hospital Gabriel Touré has improved substantially the revenue of this institution.

In addition to this improvement, the dashboard was the most appropriate to implement. Because it allowed the decision-makers to better manage the hospital based on verifiable and proven data.

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Tidiani TOGOLA is active in several sector of ICT and is now one of the key actor in the development of Telehealth in Mali.

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# Clinical Quality Control of a Large Brazilian Teleconsultation Service: The Telehealth Network of Minas Gerais

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***Abstract:*** **The objective of this study is to assess the quality of the teleconsultations performed by the Telehealth Network of Minas Gerais (TNMG) and the impact of focused interventions to improve the quality. The first phase consisted of the analysis of the teleconsultations performed from 12/12/2012 to 12/01/2013 (n=440). Questions and answers were classified as "appropriate" or "inappropriate". Subsequently, an intervention was applied towards the most common reasons for inappropriate questions and answers, and then a second analysis was performed from 01/07/2013 to 31/07/2013 (n=434). In the first phase, 15.0% of the questions and 14.7% of the answers were considered "inappropriate". The most frequent reasons were "unfriendliness" (use of only uppercase letters) and "not enough information provided" for the questions, and "unfriendliness" for the answers. There was an improvement of the system to promote more structured questions, and staff and users were re-trained. In the second phase, 12.9% of the questions and 3.4% of the answers were considered "inappropriate". In conclusion, this study highlighted the importance of performing regular analyses of a teleconsultation service and implementing focused corrective measures, in order to improve the quality of the service provided.**

## Introduction

Minas Gerais is a Brazilian state with 853 municipalities and has a population of more than 20,000,000 habitants distributed in an area equivalent to France [1]. The remote areas of the state suffer from lack of quality of basic services, such as healthcare. Telemedicine is an import tool

to assist primary care professionals in these areas, in order to improve the medical attention for the population [2].

The Telehealth Network of Minas Gerais (TNMG) is a public telehealth service which assists 660 municipalities in the state, performing teleconsultations (second opinion) for a large variety of specialties and electrocardiogram analysis [2]. It is a regular health service, therefore it demands frequent improvement. The evaluation of the quality of the activities performed by TNMG is an important instrument to promote the excellence of the service. For the purpose of this study, the quality of teleconsultations was assessed, as well as the impact of focused interventions adopted to improve their quality.

## Methods

The study was divided in 2 phases. In the first phase, teleconsultations performed from 12/12/2012 to 12/01/2013 were assessed. Questions made by the healthcare practitioners from the municipalities and answers given by the specialists from the TNMG were classified as “appropriate” and “inappropriate”. If inappropriate, the possible reasons were evaluated.

Subsequently, focused interventions were applied: there was an improvement of the system to promote more structured questions; specialists from the TNMG and healthcare professionals from the municipalities were re-trained; and a manual was elaborated for the specialists. In the second phase, teleconsultations performed from 01/07/2013 to 31/07/2013 were analyzed by the same researcher.

Categorical variables from phases 1 and 2 were compared using the Chi-Square test.

## Results

In the first phase, 440 valid teleconsultations were assessed; 66 (15%) questions and 65 (14.7%) answers were considered “inappropriate”. In the second phase, 434 teleconsultations were assessed; 56 (12.9%) questions and 15 (3.4%) answers were considered “inappropriate”. There was a significant reduction in the number of inappropriate answers ($p<0.001$) when comparing phase 1 to phase 2.

The reasons for classifying questions and answers as “inappropriate” are shown in tables 1 and 2, respectively.

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Table 1 – Reasons for classifying questions as “inappropriate”

| Reasons | Phase 1 N(%)* n=440 | Phase 2 N(%)* n=434 | P-value** |
|---|---|---|---|
| Not enough information provided | 47 (10.7) | 35 (10.2) | 0.20 |
| Unfriendliness | 14 (3.2) | 10 (2.3) | 0.53 |
| Request for hospitalization or presential consultation | 6 (1.4) | 2 (0.5) | - |
| No possible answer | 3 (0.7) | 0 | - |
| Teleconsult (self or familiar consultation) | 2 (0.4) | 5 (1.1) | - |
| Unethical | 2 (0.4) | 2 (0.5) | - |

* As the same question can be classified in more than one category, the sum is higher than the absolute number of inappropriate questions.

** p-value was not calculated for variables with values lower than 5, due to imprecision

Table 2 – Reasons for classifying answers as “inappropriate”

| Reasons | Phase 1 N(%) n=440 | Phase 2 N(%) n=434 | p-value** |
|---|---|---|---|
| Unfriendliness | 43 (9.8) | 7 (1.6) | <0.001 |
| Not enough information provided | 18 (4.1) | 5 (1.1) | 0.001 |
| Long and not objective | 2 (0.4) | 2 (13.3) | - |
| Poorly written (bad spelling) | 2 (0.4) | 1 (6.6) | - |

* As the same answer can be classified in more than one category, the sum is higher than the absolute number of inappropriate answers.

** p-value was not calculated for variables with values lower than 5, due to imprecision

## Discussion

This study highlighted the importance of a quality control to improve the quality of a teleconsultation service. The “inappropriate” questions and answers detected on phase 1 triggered focused actions that reduced

significantly the number of “inappropriate” answers on phase 2, reducing drastically the number of teleconsultations classified as unfriendly due to the use of only capital letters on the answer, which may be interpreted as aggressive, and also significantly reducing the number of teleconsultations which did not provide enough information. Although the count was already low, the goal for every teleconsultation service is to keep this number as close as possible to zero. It was reduced with easy measures: developing a manual to the staff and re-training them.

It was observed that it is more difficult to make changes to impact the users from the cities. Although they were also re-trained and a new system was developed with more structured fields to make it easier for them to perform clearer questions regarding the clinical cases, the proportion of teleconsultations without enough information provided remained stable, as well as the proportion of the ones classified as unfriendly.

As there were a reduced number of questions and answers classified as “inappropriate”, the assessment of the interventions on each cause is limited due to the small sample size. Despite this, the study had an important role in alerting that it is essential that this activity is ongoing, in order to guarantee a constant improvement in the quality of the service.

In conclusion, this study highlighted the importance of a quality control in a teleconsultation service. The analysis of teleconsultations motivated focused corrective measures that promoted, mainly, a reduction in the absolute number of answers classified as “inappropriate”. Therefore, the TNMG can better assist primary care in municipalities in the state. To improve results, subsequent studies should include a bigger sample of teleconsultations, in order to increase the power to assess the different causes for classifying questions and answers as “inappropriate”.

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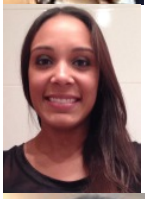

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# Confirmation of Proper Endotracheal Tube Placement Using Telemedical Technology: a Technique to Improve Far Forward Airway Management

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## Introduction

For the critically injured patient, establishing the airway is a priority. In battlefield situations, airway management including intubation is often performed by non-physician healthcare providers. These providers require initial training as well as skills maintenance, but these learning opportunities are limited by availability of instructors and location of learners at distant and sometimes front line sites. Several studies have demonstrated the feasibility of telemedicine as a training tool for these situations [1-3]. This investigation demonstrates the use of telemedicine technology to train distant site medical personnel in video laryngoscopy and to confirm proper endotracheal tube placement by tele-bronchoscopy.

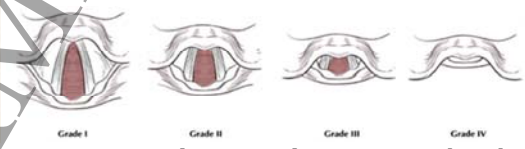


Fig. 1. Video laryngoscope connected to a Karl Storz C- Hub, which transmits images using an Internet based adobe connect videoconferencing program.

Fig. 2. Cormack, Lehane views of the glottic opening as seen during laryngoscopy

## Methods

After IRB approval, advanced practice nursing students at the University of Nebraska Medical Center Simulation Center, Omaha, NE were instructed in how to perform an intubation by an anesthesiologist at Walter Reed National Medical Center using an Adobe Connect video conferencing program. After receiving intubation instruction, each student performed two intubations using a Karl Storz video laryngoscope with a #3 Macintosh blade. During one intubation, the video-viewing monitor was turned away from the student's view so that the instrument functioned as a standard direct laryngoscope. A second video laryngoscopic intubation was performed with the student viewing the monitor. Visualization of each intubation was transmitted to the distant tele-mentoring site by linking the video laryngoscope to a Karl Storz C-HUB which transmitted the images through a standard internet connection using adobe connect (Fig. 1). During intubation, students reported the Cormack, Lehane (C/L) view they observed [4] (Fig. 2). After intubation, a bronchoscope connected to a C-CAM, which linked the video images through the C-HUB allowing transmission to the distant site was passed through the endotracheal lumen by the student under tele-mentoring from the distant site anesthesiologist (Fig. 3). Using visualization of the carina, the distant site anesthesiologist confirmed proper endotracheal tube placement. This was also observed and confirmed by the proximal site instructor.

## Results

Fifteen advanced practice nursing students learning intubation participated in this study. During direct line of vision intubation the average C/L score was 2.5 compared to 1.4 when using video laryngoscopy (Fig. 4). Students were successful in direct intubation 67% of the time compared to 100% successful intubations when using video laryngoscopy (Fig. 5). Students reported a confidence level of performing successful intubation 5.7 compared to

Fig. 3. This picture shows a bronchoscope connected to the C- HUB with a C-CAM. This device transmits the image from the bronchoscope over the Internet using Adobe Connect

8.0 when using video laryngoscopy as reported on a scale of 0 (no confidence) to 10 (high confidence) (Fig. 6).

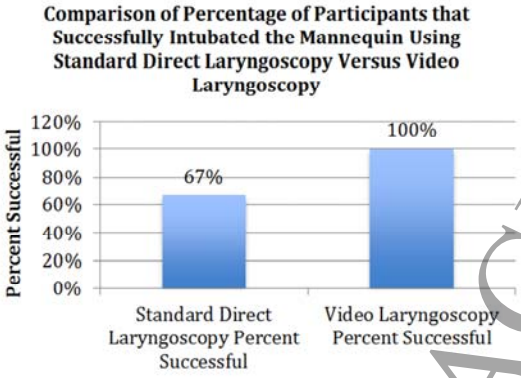


Fig. 4. Comparison of C/L Grade Using Standard Direct Laryngoscopy versus Video Laryngoscopy

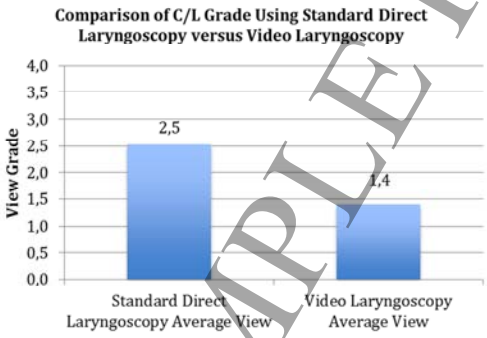


Fig. 5. Comparison of Percentage of Participants that Successfully Intubated the Mannequin Using Standard Direct Laryngoscopy versus Video Laryngoscopy

## Discussion

This study demonstrated that students could be successfully taught to intubate from a distant site via tele-mentoring. Video laryngoscopy was shown to provide an improved view of the glottic opening during intubation. Success of intubation was improved when using video laryngoscopy. This could be significant when a far forward provider is intubating a difficult airway or when the provider does not routinely intubate patients.

Tele bronchoscopy was demonstrated to allow a distant site anesthesia provider to confirm proper endotracheal tube placement. This procedure has significant potential to confirm proper endotracheal tube placement when intubations are performed in an out of operating room or field situation. This technique can be used to confirm proper endotracheal tube placements prior to transport of a patient, as when confirming proper placement at an air head before a long transport flight. Tele-bronchoscopy as demonstrated here, could be used to

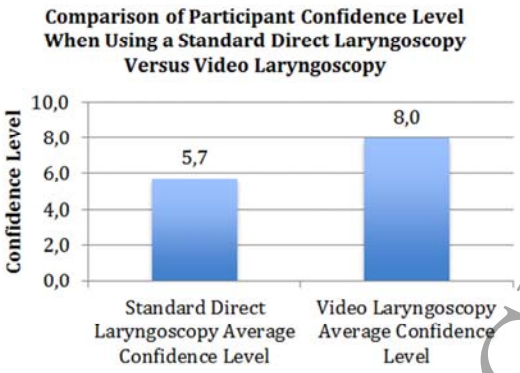


Fig. 6. Comparison of Participant Confidence Level When Using a Standard Direct Laryngoscopy versus Video Laryngoscopy

verify or adjust endotracheal tube placement during a transport, such as a flight, when auscultation is not reliable due to aircraft noise. It could also allow an airway management expert to confirm the proper placement.

In summary, the telemedicine methods used in this study can be used to improve far forward airway management. Tele-mentoring using a video conferencing program such as Adobe Connect can allow an instructor to train medical personnel in a remote area to learn new airway management skills or provide maintenance training. Tele-bronchoscopy can be used to confirm proper endotracheal tube placement in situations such as confirmation at an air head before transport out of a military theatre of operations.

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# Cost-Benefit Analysis of the e-Ambulance Project in Depopulated Areas in Japan

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## Introduction

Telemedicine or e-Health in some countries has already passed the experimental stage, and is entering the diffusion stage. In order for e-Health to be diffused further, there are still lots of obstacles such as the legal framework, economic foundations of implementations, and other regulations. In order to overcome these obstacles, one important requirement is to demonstrate its effectiveness, that is, e-Health contributes to efficiency of medical services and enhances wellness of people. One measure is to prove its cost-effectiveness by comparing its benefits and costs, but measuring concrete benefits in monetary terms is analytically difficult. CVM (Contingent valuation method) which has been recently widely adopted in the fields of health economics and environmental economics is one of methods to evaluate benefits in terms of WTP (Willingness to pay), which is the monetary amount that users want to pay for receiving the service [1-3].

This paper applies the Cost-benefit Analysis of the e-ambulance project in two cities in Japan: Aki City and Muroto City, Kochi Prefecture. Ambulances are equipped with ICT devices which transmit images of patient to remote hospitals. Two cities began the e-ambulance project in 2012. From there, it takes about approximately one hour to reach emergency hospitals located in Kouchi City, the prefectural capital. One of the merits of e-ambulance with the image transmitting system is that doctors in the accepting hospital can monitor the real time situation of a patient and prepare for necessary treatment when patient arrives. They thus save time and effort [4].

## Estimation of WTP

### *Surveys to Residents*

The surveys were conducted to residents in Ino Town on November 5, Aki City on November 18 and Muroto City on November 19, 2013. 55 residents were asked to answer questionnaire in Ino Town, 61 Aki City, and 48 Muroto City, totaling 164, and questions were pertaining to the following: (a) WTP; (b) effectiveness; (c) frequency of usage; and (d) user properties such as age, gender, income, education, and health condition. These are factors to affect WTP of residents.

### *Questionnaire*

The questionnaire related to WTP is based on the three-stage dichotomous method. We begin by asking whether they would be willing to pay monthly charges of 1,500 yen (US$15). This initial value in the CVM method is important, since WTP tends to depend on the initial value. If their answer is "yes," we then ask whether they would be willing to pay 2,500 yen (US$25). If they reply "yes" again to 2,500 yen, their WTP is 2,500 yen. If "no," then we lower the amount to 2,000 yen (US$20). If they reply "yes" to 2,000 yen, then that is their WTP. If again their answer is "no," we lower the amount further to 1,500 yen. In the first question of 1,500, if the reply is "no" to 1,500 yen, then we lower the amount to 500 yen, and so on. These series of questions are standard in the evaluation of public services, environments, and so on.

The distribution of WTP responded is as follows: more than 3,000 yen (5 answers), 2,500-2,999 yen (5), 2,000-2,499 yen (5), 1,500-1,999 yen (10), 1,000-1,499 yen (18), 500-999 yen (30), 250-499 yen (36), and 1-249 yen (11).

### *Estimation of Demand Function and WTP*

Based on the above WTP of each respondent, the probability of acceptance to amounts questioned is estimated and the number of residents who will agree to pay. The functional form of demand to be estimated is assumed to be logistic, namely the average WTP is calculated as the area under this demand function, which results in being 1,747 yen (US$175) per resident per year.

## Cost-Benefit Analysis

### *Total Benefits*

WTP obtained above is for per resident per year, and it is multiplied by total number of residents, since all residents have a chance to use an ambulance. The population of each city is 18,657 in Aki City and 17,490 in Muroto City as of January 1, 2014, and thus total population is 36,147. Multiplying WTP 1,747 yen by total population 36,147 yields benefits per year 63,148,089 yen. The period of the project is three years. To obtain three years' worth of benefits, the present values of three years' benefits are calculated with a 4% discount rate, resulting in 175,243,694 yen.

*Total Costs*

The total cost of the system consists of initial fixed and annual operating costs. The former is the items which have to pay at the first year of the project and covers that (i) ICT hardware equipment of the systems of transmitting and receiving images and related equipment, (ii) ambulance, (iii) costs related to software development and the purchase of software, (iv) installment, and (v) initial training cost. The initial costs amount to 231,459,775 yen. The latter is required annually and contains the followings: (vi) salaries of ambulance crew; (vii) maintenance fees which consist of those related to hardware and software; (viii) gasoline for ambulances; and (ix) communications charges. The annual operational costs amount to 9,990,328 yen and total operating costs over the period three years are 150,332,453 yen. Therefore total cost is 381,792,228 yen.

*B/C Ratio*

The B/C ratio over the period of three years is 0.459, that is, benefits are about half of costs for the three year project. It can be concluded that benefits are far smaller than costs. However, from the view of local governments which implementing the project, that is, Aki and Muroto City, they only bear the costs of operating costs, since initial costs are borne by subsidies from the central government, and they can bear only operating costs. The B/C ratio calculated in this way is 1.166 over the period of three years indicating that for two local governments, benefits exceed its costs. Thus from the view of city, this project is favorable and worthy to implement.

Thus the B/C ratios obtain for e-ambulance are similar to those of telecare, which were operated by local governments and received subsides for initial equipment from the central government. As a project, they are less than 1, that is, benefits are smaller than costs, while for local governments it is worthy to implement since benefits to the users are larger than costs which were borne by local governments.

## Conclusions

In this paper, WTP in Aki, Kuroto and Ino Town is estimated by CVM and WTP obtained is 1,747 yen and the B/C ratio is 0.459. According to our rigorous analysis, we found that this value is similar to the ex-post WTPs estimated in our previous research [3, 5]. The effects of the e-ambulance in Aki and Muroto Cities are also similar to realized ones in the other regions. These results indicate that WTP can be an indicator of potential effectiveness of regional health policy.

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# Economic Aspect of Medication Adherence Using a Wireless Medication Reminder in French Health System

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*Abstract:* **Orange and Isipharm (Astera group) have developed and tested with pharmacists a new application of wireless medication reminder using 2D barcodes. This application flashes the information of the prescription and automatically places medication reminders in the calendar of the smartphone.**
**The purpose of this paper is to analyze the potential economic aspect of medication adherence using a wireless medication reminder in French health system. Analysis is made in terms of cost and benefits for the health system.**

## *Introduction to Non-Adherence Consequences*

Non-adherence is generally considered as the failure to take medications on time, in the prescribed dose, and by the correct patient.

The incidence of non-adherence has been widely studied at countries level and a common observation is that about 50% of all the millions of annual prescriptions are not taken as prescribed.

In the world, the overall cost of non-adherence is estimated to $390 to $500 Billion (€375 Billion) each year [1].

In Europe, the consequences are approximately 200,000 premature deaths and an overall cost estimated to €125 Billion each year [2]. In USA, the consequences are approximately 125,000 premature deaths and an overall cost estimated to €158 Billion each year [3]. In France, the consequences are approximately 8,000 premature deaths and overall cost estimated to €19 Billion each year [4].

## *What Are The Benefits of Medication Adherence?*

The benefits of medication adherence, and in particular avoidable costs, have been widely reported through the literature. Indeed, studies report many ways to get a better use of drugs like medication compliance, prevention of iatrogenic effects, efficient and timely medicine use,

prevention of misuse and overuse (especially of antibiotics), prevention of medication errors, optimized use of generic drugs, management of polypharmacy (particularly among the elderly, chronic…) and others (professional advice, training ...).

In Figure 1 below, an international study has identified critical levers to improve medicine use and estimated avoidable costs due to unnecessary annual healthcare spending in 186 countries [5].

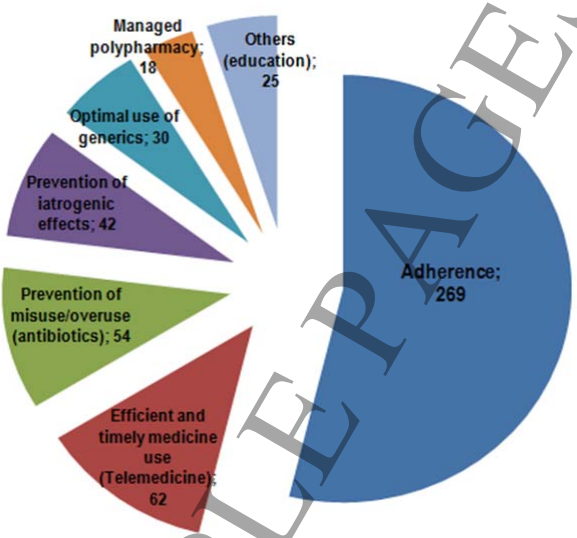


Fig.1 – Pie chart of global avoidable annual healthcare costs ($Billion)

Moreover, literature also describes many solutions in the areas of Telemedicine and Electronic Health Records, and many tools like medication devices (smart pill containers, alert watches, blister packs, wireless medication reminders)...[6].

However, since a given tool can be linked in part to one or more levers of improvement and since a given lever can contribute in part to several adherence benefits, it seems today difficult to evaluate which solution brings what part of the overall benefits and profits of medication adherence.

For this reason, we developed below a methodology of calculating the economic potential of an adherence tool.

*Measuring the Efficiency Rate of the Pill Tag Solution through a Pilot Test*

Pill Tag is a new wireless medication reminder using 2D barcodes. It is composed of a Flashcode and Calendar patented Application by ORANGE and the barcode printing is a part of the Pharmacy Management Software by ISIPHARM. The Pill Tag application flashes the information of the prescription and automatically places a medication reminder in the calendar of the smartphone.

The solution was implemented through a pilot test in a real situation with 40 pharmacists. We measured an Utilization rate of 65% and a Follow-up rate of prescription of 80% by the patients.

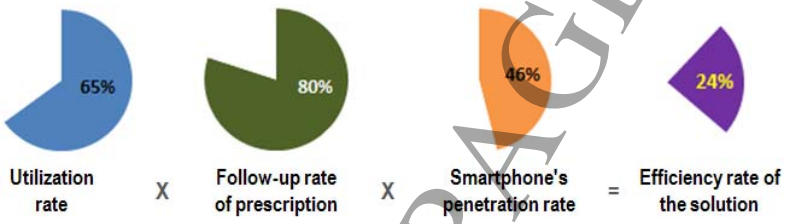


Fig.2 – Calculation of the efficiency rate of Pill Tag solution

Then, the Efficiency Rate can be calculated as the product of the Utilization rate by the Follow-up rate of prescription and by the Smartphone's Penetration rate (46%) in France. As a result, the Efficiency Rate of the Pill Tag solution is calculated to be 24% such as in Figure 2.

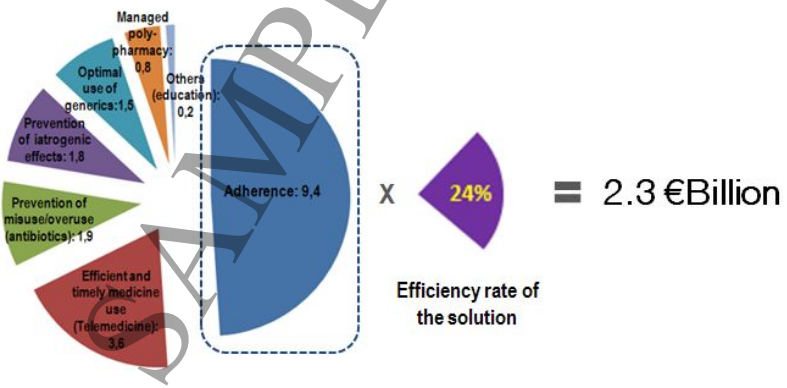


Fig.3 – Calculation of the maximum economic potential of the solution in terms of reducing costs to the French health system

*Calculating the Economic Potential of an Adherence Solution*

The methodology of calculating the economic potential of an adherence solution in terms of reducing costs for the Health System is the following:

(1) Using data from the literature, a rate of Potential Cost Reduction is assigned to each lever of avoidable health costs in the Health System;
(2) The levers actually operated by the solution are identified and rated;
(3) In parallel, the Efficiency Rate of the solution is measured by a test driver on Population;
(4) Then, the economic potential of the solution is calculated in terms of reducing costs to the health system such as in Figure 3.

Using this methodology, we calculated a theoretical maximum Economic Potential of €2.3 Billion. It should be noted that such an economic potential corresponds to a theoretical enrolment rate of 100% of patients and pharmacists.

In addition, we have elaborated a potential business model for the French health system. For this, we assumed an incentive model to pharmacists such as the successful French Pharmaceutical Record model where pharmacists receive 35% commission for dispensing generic and also lump incentives for remote electronic transmission, updating electronic health insurance cards. In 2012, this incentive model has achieved €400 Million of cost reduction for the health system.

Therefore, assuming an individual remuneration to pharmacists for supporting medication adherence and assuming a 50% enrolment rate of patients after 4 years, we calculated a potential €1150 Million of avoidable annual healthcare costs with an annual investment of €44 Million for the French Health System.

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# Consumer Perception and Needs of Home Telehealth Services among Dwelling Adults in Taipei

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## Introduction

As medical services and scientific technologies advance, people's average life expectancy has been greatly increased, and population aging has become a global phenomenon. Corresponding with the population ages, prevalences of chronic diseases and disabilities will also increase. In most developed countries, approximately 80% of adults over age 65 years have at least one chronic disease. Of these, 30% have three or more chronic conditions [1-2]. In Taiwan, the elderly population reached 11.2% in 2014 and is expected to rise to 20% by 2025 [3]. Approximately 65% of older adults have at least one chronic disease [4]. The cost of health care will soar because of this trend. Medical expenditures of the National Health Insurance for the elderly population reached 43.6%, which was seven times the cost of all other age groups combined [5]. These changes suggest a need for new care-delivery mechanisms [6-7]. Home telehealth care, using advanced information and communication technologies, has become a mainstream trend in health care for this situation [8-9].

Home telehealth care is defined as remote care delivery or monitoring between a healthcare provider and a patient outside of a clinical health facility, most often in their place of residence [10]. By supporting home telehealth care, it is possible to effectively manage the endemic numbers of people living with chronic diseases, improve access to care, increase work efficiency, and handle clinician shortages, especially of underserved populations [11]. However, some researchers think that telehealth care still has organizational, ethical, design, cost-effectiveness and usability problems, as well as other matters that need to be resolved and innovated [12-14]. Hence, it is not completely accepted in most societies. In case of Taiwan, the Department of Health commissioned a Telecare project in 2007 to manage long-term care needs by utilizing information technologies. Unlike health care systems of western countries, the single-payer, compulsory National Health Insurance system enabled the Taiwanese nearly equal financial access to comprehensive health services and provides all citizens

with financial risk protection from large medical expenses. At the same time, it gives patients the right to freely choose their providers and doctor shopping with minor conditions and multiple physician visits have been resulted. Since telehealth care system with the potential to improve patients' disease management and decrease health care cost, Taiwan's government has therefore initiated the pilot project to enhance citizens' health. The project has been launched in Taipei since 2009. Since the implementation of home telehealth care is still in the pilot testing stage, before it can become a fully implemented effective and efficient alternative care model, consumers' perspectives should be explored. The purpose of this study was to investigate the general public's perception and needs for home telehealth services.

## Methods

A cross-sectional telephone interview was used for research design. The stratified random sampling method using the district's proportion of population over the age of 20 was applied (table 1). Random Digit Dialing was used to select 5,944 households listed in the Taipei telephone directory. A total of 545 adults completed the survey (successful reaching rate=9.20%).

The self-developed survey questionnaire contained four parts with acceptable reliability ($\alpha$ = 0.70~-0.90) and content validity (CVI $\geq$ 0.86). The "Need for home telehealth service" contains 6 items. Each item of the instrument was scored on a 5-point Likert type scale. The mean scores were calculated; a higher score indicates higher perceived needs. The Acceptance of home telehealth service contains five of nominal type items. Finally eleven 3Cs facility items were developed to evaluate subjects' information literacy and age, gender and educational level were used as demographic variables.

Table 1: Sampling distribution structure: District representatives (N=545)

| District | Population (%) | Stratified sample size (%) | Sample collected (%) |
|---|---|---|---|
| SongShan | 161666 (7.5%) | 33 (6.6%) | 40 (7.3%) |
| XinYi | 190509 (8.9%) | 42 (8.4%) | 42 (7.7%) |
| DaAn | 214604 (10.0%) | 47 (9.4%) | 47 (8.6%) |
| ZhongShan | 178475 (8.3%) | 36 (7.2%) | 40 (7.3%) |
| ZhongZheng | 112554 (5.3%) | 29 (5.8%) | 40 (7.3%) |
| DaTong | 105502 (4.9%) | 30 (6.0%) | 40 (7.3%) |
| WanHua | 168682 (7.9%) | 41 (8.2%) | 41 (7.5%) |
| WenShan | 205505 (9.6%) | 54 (10.8%) | 54 (9.9%) |

| | | | |
|---|---|---|---|
| NanGang | 104366 (4.9%) | 27 (5.4%) | 40 (7.3%) |
| NeiHu | 233062 (10.9%) | 54 (10.8%) | 54 (9.9%) |
| ShiLiu | 250393 (11.7%) | 57 (11.4%) | 57 (10.5%) |
| BeiTou | 216482 (10.1%) | 50 (10.0%) | 50 (9.2%) |
| Total | 2141800 (100%) | 500 (100%) | 545 (100%) |

## Results

Subjects in this study were 20-85 years old with a higher representation of female (60.7%). 282 subjects (51.7%) had a college or higher educational preparation, and 138 (25.3%) had received a high school level of education. In surveying subjects' acceptance of home telehealth service, 182 (33.4%) indicated that they had heard of such a service before and 340 (62.4%) represented that this service would make them feel more secure in health. Even though 353 (64.8%) felt the service would be convenient to access and 374 (68.6%) said it will enhance their self-management behavior; on the other hand, 328 (60.2%) indicated they would have concerns in private data protection (table 2).

Table 2 Consumers' Acceptance for Home Telehealth services

| Variables | n | % |
|---|---|---|
| Do you ever hear of such a service before? | | |
| Yes | 182 | 33.4 |
| No | 363 | 66.6 |
| Do you think this service might make your health more secure? | | |
| Yes | 340 | 62.4 |
| No | 107 | 19.6 |
| It depends | 53 | 9.7 |
| Don't know | 44 | 8.1 |
| Do you think this service can allow you to more easily get care? | | |
| Yes | 353 | 64.8 |
| No | 106 | 19.4 |
| It depends | 54 | 9.9 |
| Don't know | 30 | 5.5 |
| Do you think the service will let your private data not be protected? | | |
| Yes | 328 | 60.2 |
| No | 147 | 27.0 |
| It depends | 46 | 8.4 |
| Don't know | 22 | 4.0 |
| Do you think this service can increase your opportunities for physicians or other health professionals contact you? | | |

| | | |
|---|---|---|
| Yes | 374 | 68.6 |
| No | 99 | 18.2 |
| It depends | 39 | 7.2 |
| Don't know | 30 | 5.5 |

Regarding computer and information literacy, subjects in Taipei have certain standard in the informational equipment and capability. In "Will you feel any difficulty in calling out or receiving call using mobile phone?"473 (86.79%) expressed no difficulty at all. 512 (93.9%) owned computer equipment at home; 390 (71.6%) said that they can operate the computer by themselves. Up to 279 (51.2%) said that they used 3Cs products daily and 115 (21.1%) was "occasionally used". Those said that they used it for more than 1 hour daily had reached 55.6%. 318 (58.3%) said that they sometimes use internet search for health and medical information. 397 (72.8%) felt it was important to know how to search for the information. 237 (43.5%) known how to search for useful health information through internet and up to 368 (67.5%) had ever used the internet to register and access to the health service.

Table 3 illustrated majority of subjects agreed with the services provided, with the highest need in daily biomesuarements and feedback and health education. Most people (91%) stated that they would not feel the need to use this service currently, but 65% said that they might use it in the future. In terms of willingness to pay, only 192 (35.2%) agreed to pay for 101-500 NTD and 176 (32.3%) agreed to pay less than 100 NTD.

Table 3 Consumers' Needs for Home Telehealth services

| Variables | n | % | Mean | SD |
|---|---|---|---|---|
| Home telehealth service needs to allow you upload blood pressure and blood sugar result as needed? | 545 | | 3.72 | .97 |
| Strongly agree | 85 | 15.6 | | |
| Agree | 330 | 60.6 | | |
| Neutral point | 32 | 5.9 | | |
| Disagree | 89 | 16.3 | | |
| Strongly disagree | 9 | 1.7 | | |
| Home telehealth service needs to remind you any abnormal findings in biomeasurements results? | 545 | | 3.95 | .90 |
| Strongly agree | 131 | 24.0 | | |
| Agree | 325 | 59.6 | | |
| Neutral point | 30 | 5.5 | | |
| Disagree | | | | |

| | | | | |
|---|---|---|---|---|
| Strongly disagree | 51<br>8 | 9.4<br>1.5 | | |
| Home telehealth service needs to provide you with health education? | 545 | | 3.86 | .90 |
| Strongly agree | 99 | 18.2 | | |
| Agree | 348 | 63.9 | | |
| Neutral point | 27 | 5.0 | | |
| Disagree | 63 | 11.6 | | |
| Strongly disagree | 8 | 1.5 | | |
| Home telehealth service needs to make health records easily to be downloaded? | 545 | | 3.70 | 1.01 |
| Strongly agree | 86 | 15.8 | | |
| Agree | 328 | 60.2 | | |
| Neutral point | 26 | 4.8 | | |
| Disagree | 90 | 16.5 | | |
| Strongly disagree | 15 | 2.8 | | |
| Home telehealth service needs to provide consumer health consultation? | 545 | | 3.85 | .94 |
| Strongly agree | 114 | 20.9 | | |
| Agree | 323 | 59.3 | | |
| Neutral point | 27 | 5.0 | | |
| Disagree | 73 | 13.4 | | |
| Strongly disagree | 7 | 1.3 | | |
| Home telehealth service needs to notify you community activities? | 545 | | 3.76 | .93 |
| Strongly agree | 82 | 15.0 | | |
| Agree | 343 | 62.9 | | |
| Neutral point | 32 | 5.9 | | |
| Disagree | 81 | 14.9 | | |
| Strongly disagree | 7 | 1.3 | | |
| Home telehealth service needs to provide you distanced visit? | 545 | | 3.76 | .99 |
| Strongly agree | 106 | 19.4 | | |
| Agree | 309 | 56.7 | | |
| Neutral point | 29 | 5.3 | | |
| Disagree | 95 | 17.4 | | |
| Strongly disagree | 6 | 1.1 | | |



## Conclusion

The success of home telehealth services implementation depend upon consumers' acceptance of the program. The results of this analysis offer further insights into dwelling adults in Taipei. This survey demonstrated that general publics agree with the conept and potential benefits of home telehealth services when they have information about them. However, few

people are willing to pay out of their own pocket unless the service is very inexpensive. With the high capability of computer literacy, result of this study shows that the largest barrier to the development of home telehealth services is cost. Policy makers and product development of industries should consider results of this study for future implication.

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# Will a 6-week Telephone-based Physiotherapy Intervention Improve Quality of Life in Patients with Knee Osteoarthritis?

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## Introduction

Knee osteoarthritis (OA) results in poor quality of life (QoL).

It has been documented that the concept of tele-medicine which refers to the use of communications and information technology for the delivery of clinical care may be done simply over a telephone or may be as complex as using satellite technology and videoconferencing to do a real-time consultation [1]. Thus, the practicability and usability of tele-physiotherapy in developing nations like Nigeria needs to be ascertained using the available, affordable and relevant telecommunication. Tele-physiotherapy, which involves the use of telecommunications technology as a medium for therapeutic care appears not to have been explored among patients with knee OA.

## Aim

This study was carried out to investigate the effect of a 6-week telephone-based physiotherapy programme on QoL of patients with knee OA.

## Materials and Method

Fifty randomly selected patients with knee OA were assigned equally into two treatment groups; Clinic Group (CG) and Tele-physiotherapy Group (TG). The CG received thrice-weekly physiotherapist administered osteoarthritis-specific exercises in the clinic for six weeks, while the TG received structured telephone calls thrice-weekly at home, to monitor self-administered osteoarthritis-specific exercises.

Participants' QoL was assessed using World Health Organisation Quality of Life-Bref Scale (WHOQoL-Bref). Assessment was done at baseline,

second, fourth and sixth week of intervention. Data were analyzed using ANOVA and Independent t-test.

## Results and Discussion

The mean ages of CG (54.96±7.81years) and TG (56.04±7.40years) were not significantly different.

Within group comparison showed significant improvements in TG and CG's physical health domain of WHOQoL between weeks 0-4, 0-6, 2-4 and 2-6.

The TG's psychological domain of WHOQoL showed significant differences between 0-4 and 0-6 weeks, while the CG's psychological domain of WHOQoL showed significant differences between weeks 0-2, 0-4 and 0-6.

There were no significant differences in TG and CG's social relationships domain and environment domain of WHOQoL across baseline, 2nd, 4th and 6th week of intervention.

Between-group comparison of CG and TG's showed that there were no significant differences between CG and TG's physical health, psychological and social relationships domains of WHOQoL across baseline, 2nd, 4th and 6th week of intervention. However, there was significant difference in the environment domain.

## Conclusion

Six-week tele-physiotherapy improved QoL in patients with knee OA, comparable to clinic based treatment. Thus, tele-physiotherapy should be incorporated into the rehabilitation programme of patients with knee OA.

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An extensive version of this study has been accepted for publication in the International Journal of Telemedicine and Applications.

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# A Fast, Android Based Dietary Logging Application to Support the Life Style Change of Cardio-Metabolic Patients

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## Introduction

The increased burden of chronic diseases in the health care of modern societies is well known. It is clear that old methods to cover the health supply demand of the society are insufficient, so services utilising modern info-communication technologies are taking over a part of classic workflows of the chronic disease management [1, 2]. The majority of these chronic diseases root, however, in a life style deviation, so systems supporting only the remote measurement of physiological are insufficient, because they miss the very important intervention possibilities of life style modification. The correction of life style deviations is one of the most human effort intensive procedures in the health care. However, it can also be supported by modern info-communication technologies. The use of a dietary log application to support later dietary counselling is a typical function where apps of mobile devices can be very effective.

The basis of most computerized services available for dietary logging is a Food Composition Database (FCDB) containing the nutrient content for a wide range of common foods. Nutrients are the basic carbohydrates, proteins, minerals, vitamins etc. and foods are either ingredients of dishes (like white flour or olive oil) or they are consumed alone like apple or red wine. Some FCDB's, like the USDA SR FCDB are free for download [3]. In order to compute the nutrient content of the user's meals, the dietary database must also contain a highly culture-specific set of recipes as well. There are several web-based or mobile applications that provide an interface for the logging of the user's meal and various services related to the analysis of the log like daily/weekly overview charts, support for losing or gaining weight etc. The Calorie Counter android application boasts with the biggest recipe database of more than half a million [4], a large part of which was contributed by the users. Similar applications, with a smaller database, are the My Diet Diary and Tracker 2 Go [5, 6]. Our research group at the

University of Pannonia, Hungary, earlier developed an android based dietary logging application called “Lavinia”. In a previous study we have already tested the ability of this system to cover the diet of an inpatient cardiac rehabilitation facility working with five parallel arrays of menu for a three week rehabilitation treatment [7].

## Objective

The purpose of the current study is to test the time demand that the users need for dietary logging with the “Lavinia lifestyle mirror” application.

## Short Depiction of the Lavinia Logging Application

The Lavinia dietary logging application was developed at the Medical Informatics R&D Centre at the University of Pannonia, Veszprem, Hungary, to support dietary logging on mobile interfaces, dietary log analysis, and also personalized menu generation using a dietary database specialized for the Hungarian culture. Its data base currently stores 9500 food items along with their nutrient contents and 1373 dishes composed from the foods, but on the android user interface we show only the most important 299 dishes and 360 foods, organized in 195 sets, to simplify the search and thus preserve user motivation. The system supports a hierarchical set-based search (see Fig. 1) as well as the usual keyword based search. We also allow to log generalized dish sets (like ‘pasta’) when the user does not find an exact match. If such a set is logged, we use the averaged nutrient contents of the set members in the analysis.

## Methods

This study was performed using the dietary data of a medical institution, the Cardiac Rehabilitation Center of the Military Hospital, Balatonfüred, Hungary. In the current, preclinical phase only staff members were included to perform a final test before the planned clinical test of the system, in which typical patients treated in the institution will take part. The test period was 22 days long, for 5 different, manually compiled regular hospital menus, so in total we processed the meals for 110 days, with 3 meals per day, with Lavinia. The full list contained 1179 logged items with 156 different dishes and 38 foods (total 194). Some items occurred quite frequently, but there were also dishes specifically designed for a certain diet.

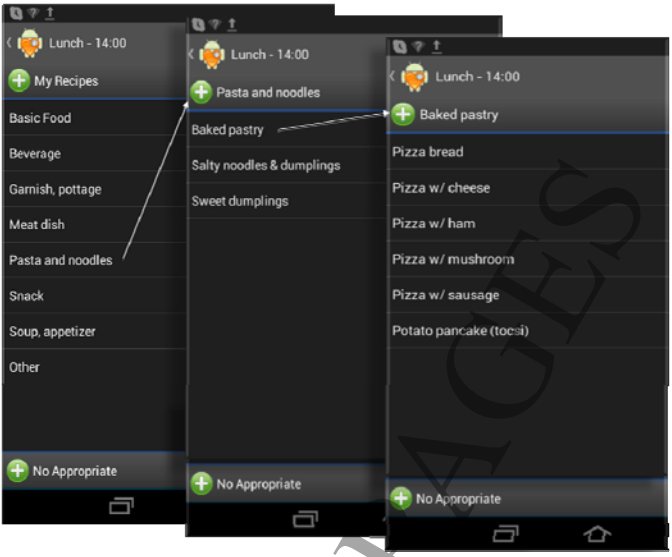


Figure 1. Screen shots of a “set-based” search procedure in the Lavinia mobile application

The time expenditure of the mobile phone based logging procedure was measured using these 1179 items. Five persons, familiar with mobile phone usage, but new to our set based dietary logging user interface received a short (3 to 5 minutes) introduction to the operations in the Lavinia system. Then they entered the list in the Lavinia system. The activity of the test subjects was logged and time stamped by the application from the start of any new item entry to the completion of the process. The switch from the set based search to the free text based search was allowed at any point for the subjects. We measured the average time spent for an item at the beginning and end of the process. The application start up time was not considered, assuming continuous stand by position for the investigated application in the background on the android system.

## Results

The five persons recorded the institutional menus in Lavinia for the investigated 22 days with an average of 12.0 items per day. The average net time consumption for entering a single item decreased considerably from 25.60 sec on the first day to 12.45 sec on the last, with a typical logarithmical learning curve (time=-4,06*ln(days)+26,95, R2=0.60). This decrease was dominated by the acceleration of the set based recording from

24.89 sec to 12.00 sec (time=-3,52*ln(days)+22,71, R2=0.75), while neither the frequency nor the time consumption of keyword based search was changed during this short period (13,4%, extra 22.15 sec.). The overall result is that the average total daily time consumption of dietary logging decreased from 6.80 min to 2.61 min (time=-0,86*ln(days)+5,49, R2=0.65).

## Conclusion

The set based dietary logging application is a viable system to generate a nutrition mirror for the users. The daily total time consumption of dietary logging is highly acceptable. Users possibly need longer practice to reduce the extra efforts connected with keyword based search

## Acknowledgment

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# Utilization of a Web-Based Electronic Medical File to Improve Case Management and Continuity of Care in the Remote Areas of Mongolia

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## Background

Mongolia, located in the heart of central Asia, occupies a vast territory of 1.6 million km$^2$. One third of its 3 million inhabitants reside in the capital city, leaving the rest of the country's area scarcely populated. Under the country harsh climate, the temperature varies from -30°C to +40°C.

Cardiovascular diseases, largely caused by the traditional fatty diet, have been a major health concern and the leading cause of mortality for the past 20 years, with a constant increase every year. The semi-nomadic way of life of people moving from one place to another makes it difficult to ensure proper follow-up of patients with chronic heart disease. The huge gap in terms of equipment, medical education and human resources between the provincial and the central hospitals makes the physicians feel isolated and helpless, and results in high patients flow, referred or not, from the remote areas to the center.

Under these conditions, telemedicine was a means to bridge the distances. It was initially meant to create a communication network between doctors disseminated throughout the country and to make the central specialized expertise available to the distant provinces. First steps began in 2001 through regular telephone lines. Despite limited bandwidth and desperately slow transmissions a strong team spirit emerged among the physicians from 8 provinces out of 21 who pioneered telemedicine in Mongolia. Advising and exchange of experience between the provinces and the center, as well as between provinces, were soon facilitated by a specialized website. The visible result of this phase was a substantial drop of unnecessary referrals to the central hospital.

As telecommunication means developed in Mongolia, high speed Internet connection became available throughout the country. It was then possible to build, for every patient, a personal medical file accessible from any place where the patient would show up for medical care.

## Objective

The next phase of the project began with the objective to build an individual electronic medical file serving multiple purposes and meeting the needs of various concerned parties: the patients, the health professionals, the hospital managers and the health authorities. The potential benefits include proper follow up of treatment, surveillance of symptoms, avoidance of repeated investigations [4], easy tele-advising, limited and appropriate referrals, activity based management of hospitals and clinics, sound statistics and HIS/MIS systems [5].

Meeting this objective implies that the medical file become a routine tool for the physicians, hence that it meet their needs and facilitate their work.

## Material and Method

After the first phase that used emails with attached documents, and the first half of the second phase during which several formats were tested, the choice was to develop a simple structured electronic medical file with the following characteristics:

- Free software components
- Web-based
- Robust
- Flexible and modular
- Ensuring interoperability, security and confidentiality.

A French IT company was selected to develop a specific product based on a platform meeting these requirements. Although the product is tailored for cardiovascular diseases, and consequently named “MnCardio”, the aim was to come up with an architecture allowing the interface to be configured to suit any specialty, while maintaining the common architecture and structure.

The developed software has three major functions:

- It collects simple clinical information from the patients and constitutes an individual medical file;
- It provides the doctors with a space to discuss difficult cases and seek advice from peers and from the reference center. Cases are easily illustrated and documented with data extracted from the patient’s file;
- It contributes to the building of a clinical database and produces activity and morbidity statistics.

The individual medical file primarily allows patient care and continuity of care. The doctors retrieve the patient’s file from the central dedicated servers and update it with today findings and results. Part of these data is stored anonymously in a database for activity, management, or epidemiology statistics.

The personal medical files are protected and accessible only to authorized health professionals. An authorized physician can read and update the file from any location where the patient shows up, be it during a nomadic move or due to prescribed referral.

When a case requires advice from colleagues or from more specialized levels, the doctors can flag that patient file for later use without disrupting his/her activity. Later s/he can prepare a "ticket" with all necessary information (clinical, lab test, imaging investigations with attached images and video files) and post it in the forum section where it becomes visible to the authorized doctors of the network. It is the physician who initiated the discussion who closes it when s/he considers all necessary information is obtained.

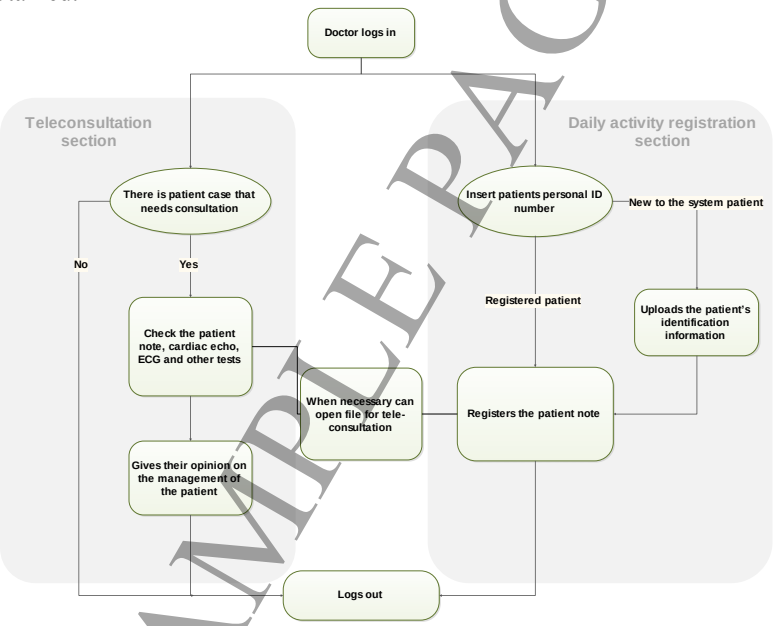


Figure 1. The general functioning of the system

During its early stage of utilization, the system was installed at the Shastin central hospital and in the 8 provincial hospitals where the project was initiated. The server was temporarily hosted at the developers' headquarters in Paris. Since 2012, as the third phase of the project began, new servers were installed in Mongolia, at the MoH and at the Centre for Health Development, and the system was progressively extended to the 13 remaining provinces and to the 9 urban districts of Ulaanbaatar.

## Results

Between 2009 and 2011, only the outpatients clinics of the initial 8 provinces were connected. Since the beginning of the project's third phase the coverage was extended to be completed by the end of 2013. Currently 83 doctors are using the software. The database now contains 54,528 registered patients totaling 65,134 visits. 7,224 patients (13.2%) account for the 10,606 excess visits (16.3%) with an average of 2.4 visits per patients for those who came repeatedly.

| Item\Year | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|
| Number of registered patients | 248 | 104 | 1409 | 8973 | 43794 |
| Number of follow-up visits | 0 | 0 | 23 | 1454 | 9129 |

Table 1. Distribution of patients' registration per year

Tele-consultation was requested in 355 cases that generated from 1 up to 17 answers per question, with an average of 3 answers per request.

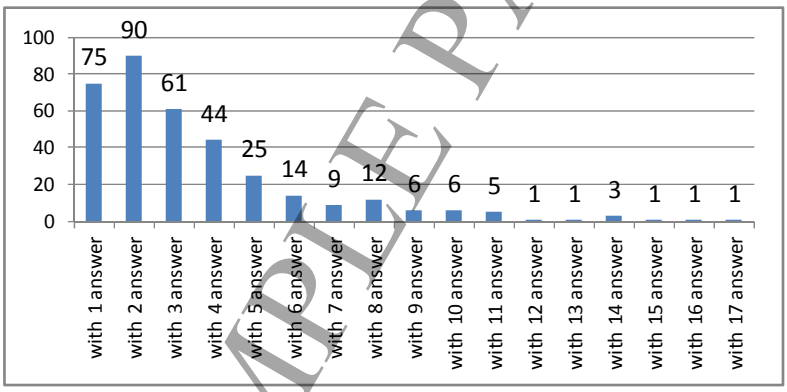


Figure 2. Distribution of answers per request of tele-consultation

Only 27 (32.5%) of the participating doctors regularly use the system, meanwhile 56 (67.5%) do not. A survey among the inactive doctors indicates that the time they can spend per visit is limited, due to the great number of patients. Excessive workload is the first reason put forward for not using the system, except when they are in need of advice. The second reason is a slow or occasional loss of the Internet connection. Interrupted connection may be due to the late payment of the subscription. Requests are frequently submitted to the local health authority for higher speed connection or for uninterrupted subscription, but not all of them make it a priority.

| | Number of project doctors | Number of doctors using MnCardio | % of active doctors | Average number of visits/ doctors |
|---|---|---|---|---|
| 8 provinces | 15 | 8 | 53% | 1822 / 8 = 228 |
| 9 urban districts | 26 | 12 | 46% | 5209 / 12 = 434 |

Comparing the activity of the physicians from the provinces and from the urban districts shows that the number of patients seen probably does not explain the utilization or the non-utilization of MnCardio.

## Discussion

Developing a network based on the patient's medical file represents a major step forward from the initial development of the "medico-social" network that resulted from the first phases of the project. Meanwhile it continues to link the physicians together through its central tele-consultation/ tele-advising feature, it constitutes an individual medical file that benefits to every recipient and actor of the health system.

First beneficiary, the patient, may be treated appropriately from any place in the country. This is of utmost importance for those who will benefit from cardiac surgery, as strict follow-up and fine-tuning of their treatment will be required.

The doctors, whatever they may feel at first, will ultimately save a lot of time as a number of tasks may be automated, such as the printing of the patient's health booklet, or the activity statistics that are required by the MoH's services and departments.

The managers of health institutions, as well as the politicians/decision makers, need activity-based information and sound figures to prepare meaningful aggregated statistics, to make appropriate strategic choices, and to fairly distribute the resources.

More generally, this project is following its baseline principle that is, from the very first days, to rely on the physicians activity. The aim is now to provide them with a routine tool that facilitates their task and improves the quality of service. Unnecessary referrals to the central hospitals should continue to decrease, and the doctor's follow-ups of the patients should be simplified as well, since previous e-medical record of any patient attending any clinic will be instantly accessible.

The results obtained after only a few months of full deployment clearly show that there is a problem of acceptance. Two major causes may be considered:

- Either the proposed system does not meet the needs of the physicians and is a real additional burden;
- Or the whereabouts and the benefits that can be derived from its utilization are not understood.

Objective measurements of the time actually spent to fill an individual file show that it may save time for the physician, provided that there is no duplication of tasks. Eliminating redundancies may require some reorganization and may involve the managers of the clinics. Meeting the needs means that the user interface be kept simple and convenient, and that innovative components and solutions be imagined and worked out.

Introducing an electronic medical file requires first that the concept of individual file be understood. It is not yet the case for all physicians. Then, it is a matter of education that must be shared between the health authorities and supported by the project. The fact that the MoH requested that the servers be installed within its premises, and that the system be extended, indicates that there is a will to pursue the experience.

Those issues must therefore be addressed with the health authorities, keeping in mind that there are plans to establish a national health and management information system, and that it opens an opportunity to build on real-time activity of the health delivery institutions. Developing the system as a web application permits to reach its users directly when modifications and updates are necessary. Properly trained IT engineers will ensure local sustainability to further develop the system in other fields of telemedicine within a common architecture.

## Conclusion

The telemedicine model developed in Mongolia is designed to build an individual medical file allowing the doctors to care for a nomadic population, and to allow peer to peer as well as province to center tele-advising. Simultaneously, it can feed a national HIS/MIS with real time activity and morbidity data.

Although provincial and central hospitals have Internet connection and despite a simple, user friendly interface, less than one third of the doctors routinely use the software as a medical record. Nevertheless, preliminary results show the benefits that can be derived from wider utilization: the patients can access specialized consultation without undertaking difficult and costly travel throughout the country; unnecessary and costly referrals decrease, allowing more effective referrals; appropriate follow up contributes to better case management; routine data collection generates sound reporting for decision making.

Wider utilization calls for the training of IT engineers who will further develop the product and for clear support from the health institutions to modify the attitudes and help incorporate new concepts in practices.

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