mHealth Monitoring for Arrhythmia Outpatients in Georgia

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http://PfH.medportal.ge

COST 605

Econ@Tel
A Telecommunications Economics COST Network

cost

eHealth

eHealth has been defined as - **Technology-enabled health**, which offers a new route to better public health, a better quality of life and increased life expectancy.

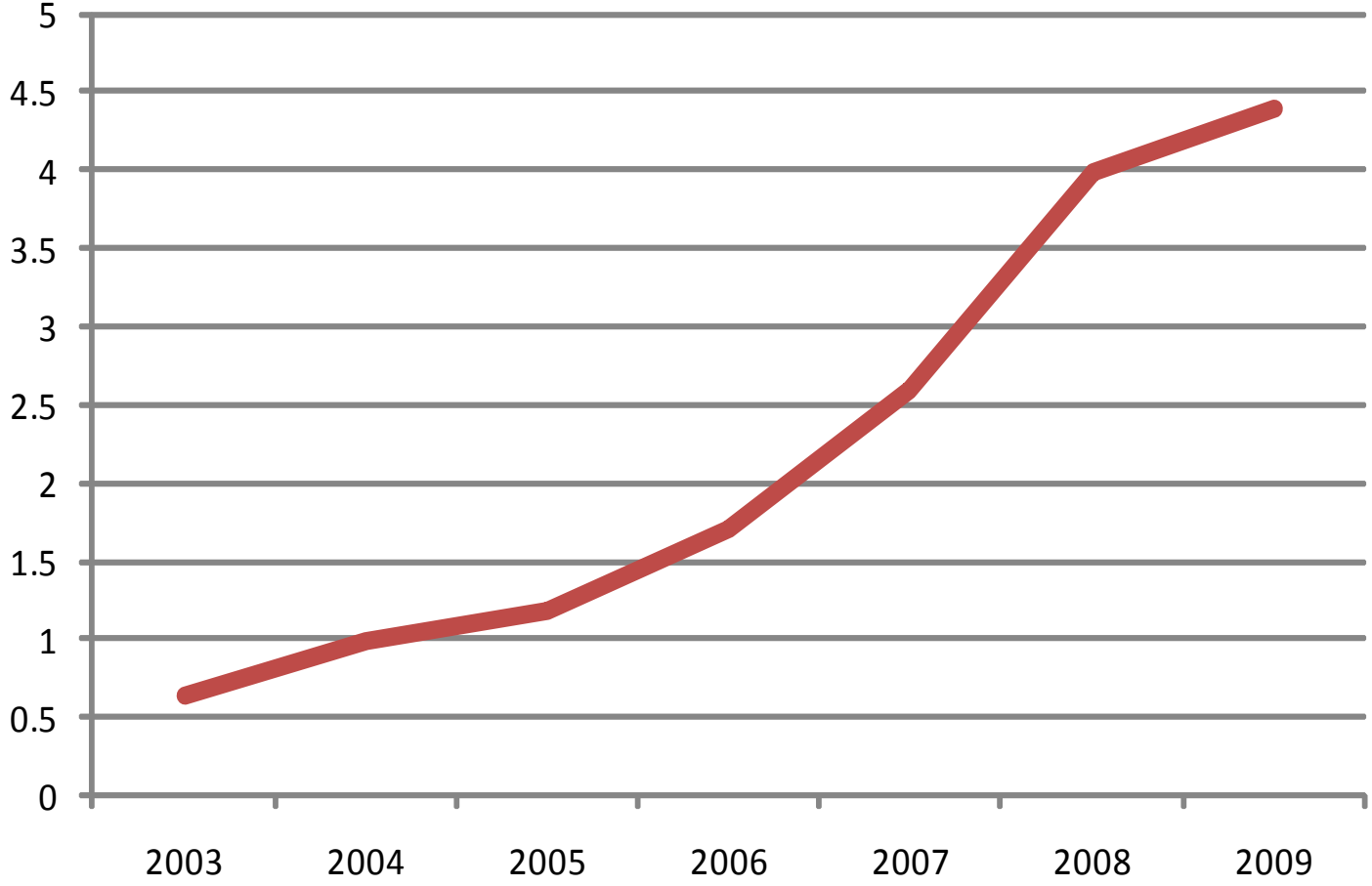
eHealth includes (but may not be limited to):

- **HIS / EMR**;
- **Telemedicine**;
- **eLearning** of Health Professionals;
- **Consumer health informatics**;
- Health knowledge management;
- **mHealth**;
- Virtual healthcare teams;
- Medical research using Grids.

mHealth

- **mHealth** (mobile health) represents a an important recent sub-segment of e-Health, which covers the practice of medical and public health, supported by mobile devices, such as mobile phones and PDAs, for health services and information.
- As in developing countries there is limitation to rapid growth of technology-rich and expensive infrastructure, whereas there are already existing mobile communication networks, **mHealth** seems advantageous mode of eHealth.

Mobile subscribers in Georgia (mln.)



mHealth benefits for developing economies

mHealth projects throughout the developing world are demonstrating concrete benefits, including:

- ✓ **Increased access to healthcare** and health-related information, particularly for **hard-to-reach populations**
- ✓ Improved ability to diagnose and track diseases
- ✓ Timelier, more actionable consumer health information
- ✓ Expanded access to ongoing medical education and training for health workers
- ✓ More chances for cost-efficient solutions.

Mobile Health for Cardiac patients

Problem:

- ✓ Patient hospital costs are heavy burden for them and Insurance companies
- ✓ Discharging patient earlier pose increased risk for first days

Solution:

- ✓ to monitor chronic patients at homes by means of Mobile Telemedicine (MT-Med) during post-hospital period or during change of their treatment regimen

Mobile Telemedicine (MTM – MTMed) pilot project for Georgia

- Business Partnership Project (BPG)
- funded by Georgian Research and Development Foundation (GRDF) – local branch of US CRDF and Georgian National Science Foundation (GNSF).
- Total Grant Funding - $22000
- Business partner - MagtiCom Ltd

Objectives

- To evaluate Cardiac Arrhythmia (of different types) diagnostic ability of the MT-Med Equipment
- To test different communication modes for Mobile Telemedicine in Georgia
- To assess cost-efficiency of the MT-Med scenario
- To extend to other cardiac telemonitoring , e.g. Hypertension
- To plan 2nd stage of the project – arrhythmia monitoring for remote areas

Technical Advantage

Vitaphone (www.vitaphone.de) (suggested by Jan van Ooteghem) equipment produced in Germany and tested, approved and widely used in EU and USA. Czech company MDT s.r.o. provides LMRA software for Nokia symbian phone and ensures better adjustment for mobile telemedicine

- ✓ **mobile remote monitoring: anytime, anywhere**
- ✓ **lightweight and secure**
- ✓ **reliable connection to doctor**
- ✓ **immediate, personalized feedback**
- ✓ **long-term operation**
- ✓ **remote supervision**
- ✓ **timely intervention**
- ✓ **adjustability to user-need/requirements**

Mobile Telemedicine MTM-Geo

http://mHealth.medportal.ge

Arrhythmia monitoring scheme

- Design: Arrhythmia 24-h monitoring by means of ECG loop recording (Holter), which records arrhythmia events automatically, recognizing R-R interval irregularities. Then loop recorder transfers event ECGs through Bluetooth to mobile phone.
- Special LRMA software (**MDT** s.r.o. Czech Republic) then allows phone to send by 3G communication data to server in Hemnitz (Germany). In less then 1 min the patient's ECG (.pdf file) is received by physician at corporate secured e-mail.
- All ECGs could be transferred and safely stored for patient data dynamics review.

Signals

- MT-Med equipment detects arrhythmia as R-R irregularity. With a low-level signal the ECG recorder interacts with phone, which with the same low-level beep confirms sending-receiving (at server's end) the recorded ECG.
- As it is done, the doctor's e-mail gets new mail with .pdf type ECG file.
- In case of electrode detachment or low battery the Loop recorder issues high level pitch signal (3 beeps). If the fault not recovered it switches the equipment off.

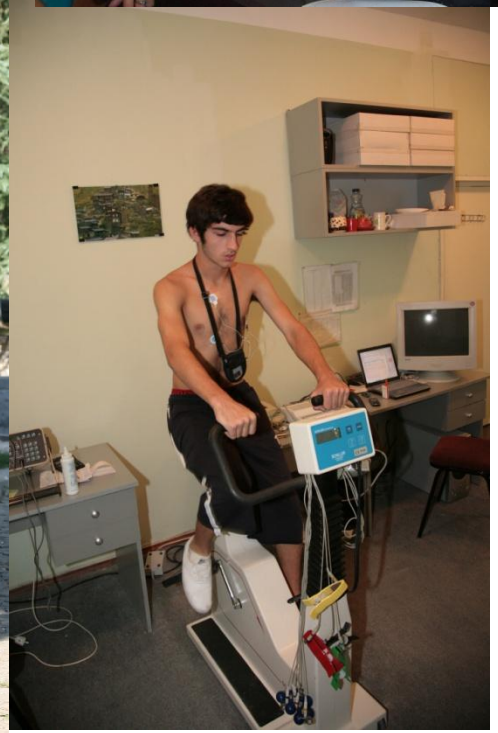
Patients and Control group

- 35 outpatients with different types of arrhythmia (M/F=16/19, age – 12-80 y)

among them

  - 5 patients with concomitant Epilepsy,
  - 2 patients after radiofrequency catheter ablation,
  - 1 patient after aorto-coronary bypass graft surgery and
  - 2 patient with unexplained syncope.
- Control group - 7 clinically healthy sportsmen – soccer players (all – men, 15-17 y), during 30 min veloergometer stress-test.

Patient and control group studies



Results

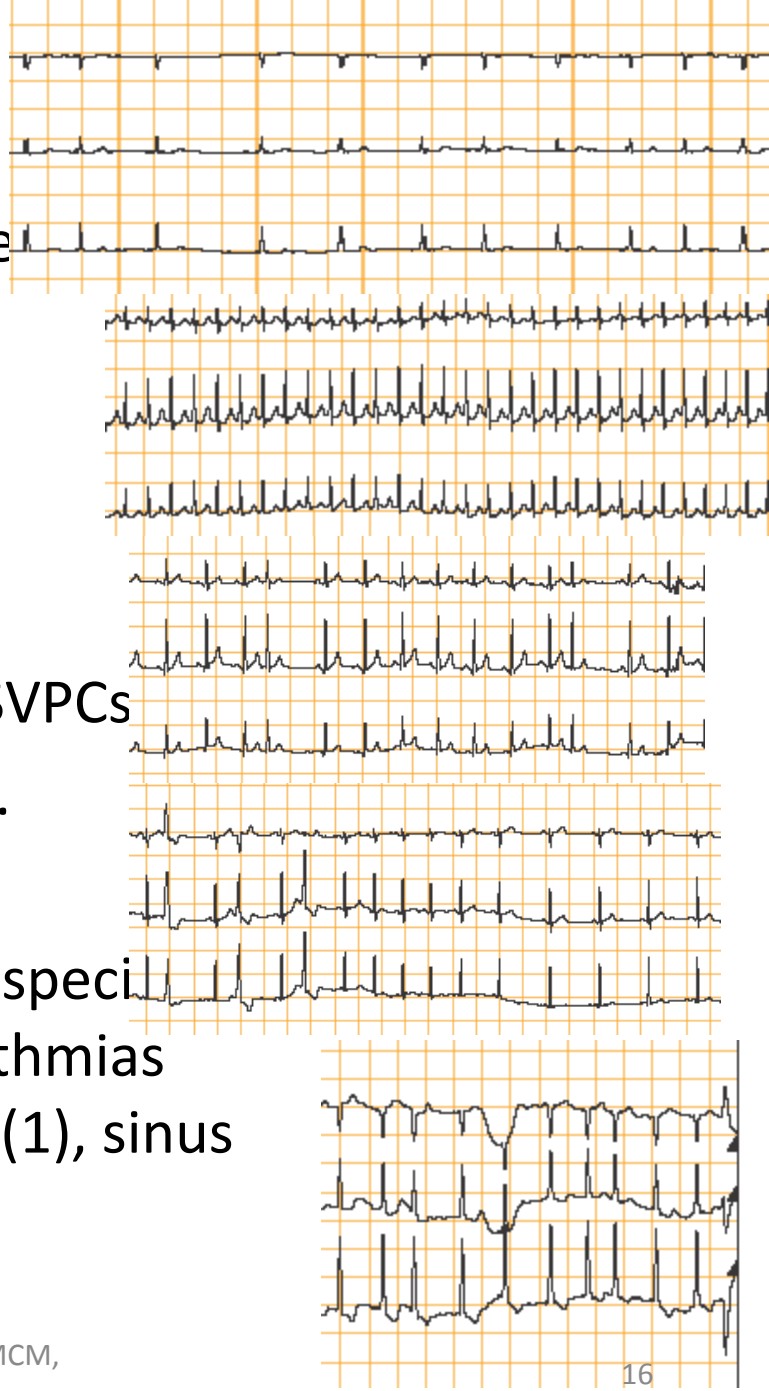
- Arrhythmias were registered/monitored during 7-68 hours of observation.
- Number of automatically recorded ECG events varied between 3 and 170 per observation,
  - or 0.4-10.7 events/hourly.

Results

The following arrhythmia have been detecte

- sinus brady- and tachyarrhythmia,
- sinus node weakness syndrome,
- atrial fibrillation,
- supraventricular tachycardia (SVT),
- supraventricular premature complexes (SVPCs
- ventricular premature complexes (VPCs) .

In 3 patients and 1 sportsman previously unspeci (despite of multiple investigations) arrhythmias were recorded – paroxysmal tachycardia (1), sinus node weakness syndrome (1), VPCs (2).



RFA patients

- Arrhythmia relapse was shown in both of 2 patients after radiofrequency catheter ablation (RFA), but mostly they were asymptomatic. The vast majority of true arrhythmia events were due to trivial arrhythmias - SVPCs/PVCs or sinus tachycardia. They had a total 12 episodes, 2 of which were symptomatic. We discovered 8 episodes of paroxysmal SVT in one of them during 48h, and 2 episodes of SVT & SVPCs in second of them during 72h of investigation. All these episodes of arrhythmia were asymptomatic.

Side Effects

- 30 patients have passed investigation without side effects, whilst in 3 cases (all – women) light insomnia and nervousness (expecting signal during night) were reported.
- In two patients with neurosis (both – elderly men, 1 – with epilepsy) we had to stop investigation due to anxiety/agitation.

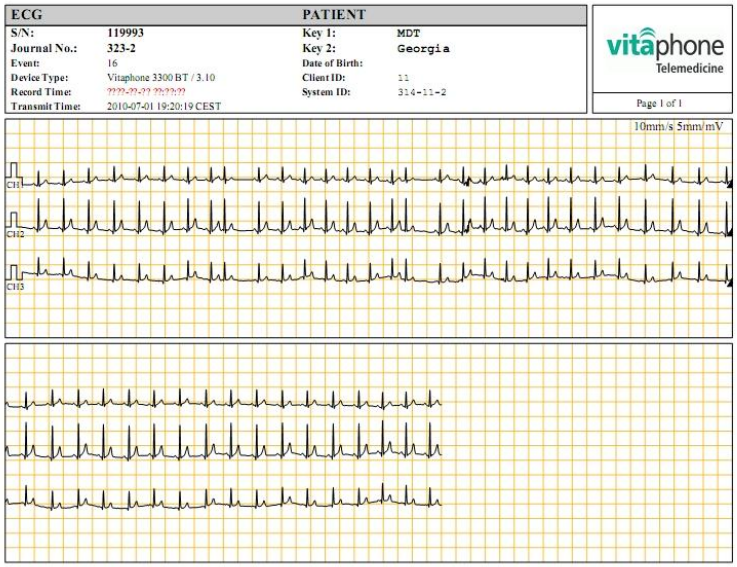
Technical Faults

- Stuck of communication between ECG Loop recorder and mobile phone
  - Only 5 such events out of over 2300 recorded (event) (0.2%)
- Minor artifacts have been recorded mainly at first minutes of recording (in <4%) or during vigorous physical exercise (around 12%, mainly - in sportsmen group).
- Low voltage in one of 3 recorded channels time to time (mainly during night time , in 3 patients - <10%) – presumably due to loose contact of electrode during sleep.

Technical Faults(cont-ed)

Not registering all cases as the existing model – as due to recording 25 sec before and 15 sec after the event the equipment is “deaf” for another 40 sec, therefore it can only register 30-40 events per hour theoretically but that is acceptable. But in addition to that we have noted that sometimes the software misses the event, which is then recorded in next “pre-event” period. We have noted that approximately in 10% of cases.

The event recognition rate is even lower in atrial fibrillation which is a situation when R-R interval is constantly changing and virtually all episodes could be regarded as “events”. But the software has problems to assess the “average” R-R interval due to that



Competition: Alternatives for m-telemonitoring for Arrhythmia patients

(Physicians survey results)

Monitoring	**Traditional**	**24h-Hoter-ECG**	**Home (Cable system) monitoring**	**M-Health**
Accuracy	**(6-10)**	**(9-10)**	**(6-10)**	**(9-10)**
Reliability	**(5-10)**	**(8-10)**	**(5-10)**	**(7-10)**
Frequency	weekly **(1)**	Constant **(10)**	Constant **(10)**	Constant **(10)**
Transmission	0,5-7 დღე **(1-5)**	0,5-2 დღე **(5-7)**	Instant **(10)**	Instant **(10)**
Cost	$10-$20 **(4-8)**	$6-10 **(5-8)**	$3-$35 **(1-9)**	$12-$23 **(3-7)**
Universality	Indoor **(4-5)**	In- & Outdoor **(10)**	Indoor **(4-5)**	In- & Outdoor **(10)**
Teleconsilliums	No **(0)**	Slightly Delayed **(5)**	Instant **(10)**	Instant **(10)**
Total	**21-39 (avg. 30)**	**52-60 (avg. 56)**	**46 – 64 (avg. 55)**	**59-67 (avg. 63)**

Cost-Efficiency of m-Health – average 280%

(preliminary calculations of daily cost)

Expenses	Minimum	Maximum
	GEL	GEL
Mobile communication cost	0.08	3.15
M-Health equipment (with 2 year depreciation acct-d)	5.91	11.82
Physician's fee	7	15
Other personnel fee	1	3
Overheads	3	5
M-Health daily cost	**17.0**	**38.0**
Inpatient daily cost	90	220
Inpatient daily cost (without medication cost)	***45***	***110***
MT-Med Cost Efficiency	**119%**	**647%**

mHealth as both Challenge and Help for HealthCare Business

- Market share
  - Among approximately 73,500 Arrhythmia cases at least 7,000-10,000 are hospital cases annually and of them at least 10% need post-hospital telemonitoring. Besides another 10-20% cases the treatment regiments are changed and that needs also careful telemonitoring if not inpatient omonitoring.

Target users:

- Health/Medical Insurance Companies
- Advanced multiprofile or Cardiology Hospitals
- Regional Hospitals

Project Presented

- ESF–COST High Level conference “Future Internet and Society - Complex Networks Prospective” (Acquafredda di Maratea, Italy, October 2-7, 2010)

- Mobile Health Expo (Las Vegas, NV, USA, Oct 19-21, 2010)

- mHealth Summit, Washington, DC, Nov 6-8, 2010

Patients and Doctors supporting mHealth

(**PWC Research Institute**, 2010)