e-Health and m-Health applications: Experience from Georgia

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Partners for Health experience

- founded in 2002 on the basis of Tbilisi-Atlanta Health Partnership
- **PfH** represents leading institution in Georgia in terms of **medical informatics and e-Health** with substantial project management experience: **over 40 projects from numerous international agencies**, likewise WHO, US AID, The World Bank, SIDA (Sweden), Council of Europe, CRDF-Global (US), OSI (US), The Global Fund
- **PfH** has an extensive experience in telemedicine/e-Health/m-Health research and practical applications, as well as in Advanced Distributed Learning (ADL), Health Information Management Systems (Electronic Medical Records - EMR, e-Registries) and public health portals development.
- In Georgia PfH has pioneered projects in
  - telecardiology (since 1999),
  - teleoncology (2001),
  - EMR (since 2002),
  - health Web-portals (since 2006),
  - mobile health (since 2010),
  - m-teledermatology (2014),
  as well as
  - e-Learning projects (since 2000) and
Participation in EU COST projects

- Economics of Telecommunications (Econ@Tel) 2007-2011.
  COST IS0605 Action

- Adapting European Health Systems to Diversity (ADAPT) 2011-16.
  COST IS1103 Action
MTM-1 Cardiac Arrhythmia Telemonitoring

m-Telemonitoring scheme (m-TM)

Patient's side

Physician's side

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Technical Advantage of MTM for Arrhythmia patients

Vitaphone (www.vitaphone.de) equipment produced in Germany and tested, approved and widely used in EU.
Czech company MDT s.r.o. provides LRMA software 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
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 then allows **phone to send by 3G communication data to server in Hemnitz (Germany) or currently Brno (Czech Republic)**.

• In less then 1 min **the patient’s ECG (.pdf file) is received by physician at corporate secured e-mail** and/or reflected of server [www.mdtekg.cz](http://www.mdtekg.cz).

• All ECGs could be transferred and safely stored for patient data dynamics review and for teaching purposes.
Results

• Arrhythmias (CArr) were registered/monitored during 7-68 hours of observation.
• Automatically recorded ECG events varied from 3 to 170 per observation or 0.4-10.7 hourly.
• Cases of sinus brady- and tachyarrhythmia, sick sinus syndrome, atrial fibrillation (AF), supraventricular tachycardia (SVT), supraventricular premature complexes (SVPCs) and ventricular premature complexes (VPCs) have been correctly recognized by automatic recognition software and recorded.
• Arrhythmia relapse (SVT or SVPCs) was detected in 43% (3/7) of patients who underwent RFA, mostly - asymptomatic. Asymptomatic VPCs were often (50%) detected after CABG surgery.
• 52% of arrhythmia episodes were asymptomatic.
• From n=10 patients with epilepsy 30% had SVT, 20% - sinus tachycardia (ST).
• Among n=10 patients with unexplained syncope, 20% revealed ST, 20% - SVT and 10% - sick-sinus syndrome.
• In 7 patients (13%) the diagnosis was modified/clarified based on MTM findings.
# QoE Survey results (patients)

<table>
<thead>
<tr>
<th>QoE Indicators</th>
<th>strongly disagree</th>
<th>disagree</th>
<th>hard to say</th>
<th>agree</th>
<th>strongly agree</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patients</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfied by MTM</td>
<td>0%</td>
<td>8%</td>
<td>8%</td>
<td>23%</td>
<td><strong>62%</strong></td>
<td>26</td>
</tr>
<tr>
<td>Easy to use</td>
<td>0%</td>
<td>4%</td>
<td>4%</td>
<td><strong>38%</strong></td>
<td><strong>54%</strong></td>
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<tr>
<td>Convenient to use</td>
<td>0%</td>
<td>8%</td>
<td>12%</td>
<td><strong>35%</strong></td>
<td><strong>46%</strong></td>
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<tr>
<td>Acceptable price</td>
<td>9%</td>
<td>18%</td>
<td>9%</td>
<td>27%</td>
<td><strong>36%</strong></td>
<td>11</td>
</tr>
<tr>
<td>Better than inpatient care</td>
<td>8%</td>
<td>8%</td>
<td>23%</td>
<td>23%</td>
<td><strong>38%</strong></td>
<td>26</td>
</tr>
<tr>
<td>Better than ECG monitoring</td>
<td>19%</td>
<td>15%</td>
<td>12%</td>
<td><strong>42%</strong></td>
<td>12%</td>
<td>26</td>
</tr>
<tr>
<td>Better than expected</td>
<td>12%</td>
<td>8%</td>
<td>19%</td>
<td>27%</td>
<td><strong>35%</strong></td>
<td>26</td>
</tr>
<tr>
<td>Experienced no problems</td>
<td>12%</td>
<td>15%</td>
<td>4%</td>
<td>31%</td>
<td><strong>38%</strong></td>
<td>26</td>
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</table>

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# QoE Survey results (doctors)

## QoE Indicators

<table>
<thead>
<tr>
<th>QoE Indicators</th>
<th>strongly disagree</th>
<th>disagree</th>
<th>hard to say</th>
<th>agree</th>
<th>strongly agree</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Doctors</strong></td>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Satisfied by MTM</td>
<td>0%</td>
<td>14%</td>
<td>14%</td>
<td>29%</td>
<td>43%</td>
<td>7</td>
</tr>
<tr>
<td>Easy to use</td>
<td>0%</td>
<td>0%</td>
<td>14%</td>
<td>57%</td>
<td>29%</td>
<td>7</td>
</tr>
<tr>
<td>Convenient to use</td>
<td>0%</td>
<td>0%</td>
<td>14%</td>
<td>43%</td>
<td>43%</td>
<td>7</td>
</tr>
<tr>
<td>Acceptable price</td>
<td>0%</td>
<td>0%</td>
<td>14%</td>
<td>29%</td>
<td>57%</td>
<td>7</td>
</tr>
<tr>
<td>Better than inpatient care</td>
<td>14%</td>
<td>14%</td>
<td>29%</td>
<td>14%</td>
<td>29%</td>
<td>7</td>
</tr>
<tr>
<td>Better than ECG</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>14%</td>
<td>86%</td>
<td>7</td>
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<tr>
<td>Better than expected</td>
<td>0%</td>
<td>0%</td>
<td>14%</td>
<td>14%</td>
<td>71%</td>
<td>7</td>
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</table>

INTERFASOL meeting - Dublin, 15.11.2016
Cost-Efficiency of Arrhythmia m-Telemonitoring –
in average on 270% cheaper
(daily cost calculations, 1 € = 2.2 GEL)

<table>
<thead>
<tr>
<th>Expenses</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile communication cost</td>
<td>0.1</td>
<td>0.95</td>
</tr>
<tr>
<td>m-Health equipment (2-year depreciation accounted)</td>
<td>5.9</td>
<td>11.8</td>
</tr>
<tr>
<td>Physician’s fee</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Other personnel fee</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Overheads</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>m-Telemonitoring daily cost</td>
<td>21</td>
<td>47.75</td>
</tr>
<tr>
<td>Inpatient daily cost (incl. medications)</td>
<td>90</td>
<td>220</td>
</tr>
<tr>
<td>Inpatient daily cost (without medication)</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>MT-Med Cost-efficiency</td>
<td>286%</td>
<td>251%</td>
</tr>
</tbody>
</table>
Patient and control group studies
Hypertension e-Health/m-Health Telemonitoring

http://mHealth.medportal.ge
BP monitoring equipment

**m-Telemonitoring** – IEM Stabil-O-graph
+ Huawei IDEOS (Android) - with MDT LRMA software

**e-Telemonitoring** – Microlife Watch BP03
BP m-telemonitoring data (MDT)
BP m-telemonitoring: Pros and Cons

• BP mobile-monitoring seems not cost-efficient for the moment due to high cost of the IEM equipment and easiness of BP interpretation, compared to arrhythmia m-telemonitoring;
• BP m-telemonitoring has advantage for elderly lonely patients;
• 76% of AH patients assessed BP m-telemonitoring positively, emphasizing better self-assurance, however rest 24% (mainly - younger ones) have doubted its added value.
• Cost-efficiency could be achieved in case of cheaper equipment. (currently – around 850 Euros).
• Main disadvantage – this equipment is only for office/home (indoor) usage, not – for mobile outdoor monitoring.
BP e-Health telemonitoring report
Night time circadian rhythms for AH patients
(systolic BP data)
BP - Circadian rhythms of Normal Controls

Chart Title
Conclusions

1) Our study confirmed that mHealth represents feasible methodology to monitor Cardiac Arrhythmia cases, improving patients’ comfort of life and increasing their mobility with enhanced safety.

2) m-Health telemonitoring oh Arterial Hypertension patients with home/office-based equipment represents limited advantage due to non-complexity of measurement and results readings, as well as – of relative high cost of equipment.

However, night-time automatic measurements provide useful information for hypertension treatment adjustment to individual circadian rhythms.
e-Health/m-Health Services for Dermatology Outpatients
Screening for Skin Cancer and Follow-up

Zviad Kirtava\(^1,2\), Teona Shulaia\(^3,4\), Natalia Kiladze\(^2-4\), Nato Korsantia\(^2,4\), Teimuraz Gogitidze\(^5\), David Jorjoliani\(^1\)

\(^1\) – *Partners for Health* NGO; \(^2\) – Tbilisi State Medical University; \(^3\) – “*Marjani*” Clinic; 
\(^4\) – Association of Dermatooncology, Dermoscopy and Skin Optical Diagnostics; 
\(^1-4\) – Tbilisi; \(^5\) – Breast & Oncology Dept, Maritime Hospital, Batumi, Adjara; 
Republic of Georgia
Incidence of Skin Cancer is increasing in Georgia. Better statistical reporting – since 2013, but still no functioning cancer registry. (data – NCDC Georgia)

Objectives of study: To evaluate efficiency of m-Health/e-Health methodologies (e-registry, still-image teleconsultation and teledermoscopy) for skin cancer screening of dermatological outpatients, especially - in remote regions with limited advance-level specialized/morphological services.
Material and Methods

Dermoscopy/teledermoscopy investigation was carried out by DermLite DL3 (in Tbilisi) or DL1 (in Batumi, Adjara) dermoscopes attached to Samsung Galaxy S4 Smartphone. Dermoscopy assessment was carried out according to Dr. Harald Kittler’s (Vienna) pattern analysis algorithm.

<table>
<thead>
<tr>
<th>Patient data</th>
<th>Marjani Clinic (MC), Tbilisi</th>
<th>Batumi Maritime Hospital (BMH)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>301</td>
<td>283</td>
<td>584</td>
</tr>
<tr>
<td>Control group (retrospective)</td>
<td>0</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>
Dermoscopy and TeleDermoscopy – sharing 2\textsuperscript{nd} opinion

Dermoscopy – non-invasive Epidermal microscopy, improving early diagnosis of skin cancer, especially of melanoma (almost on 50%) at earlier stages. For last decade handheld analogue dermoscopes were replaced by digital-desktop ones, and recently to – mobile (smartphone-connected) devices

Need of teledermoscopy: Lack of following at remote/rural sites:
- Experienced, highly skilled personnel
- Modern, high resolution equipment
- Theoretical knowledge, including recent updates
- Scarce financial resources for referral (patient’s or specialist’s travel cost)

Solution: Teledermoscopy enhances skills, provides 2\textsuperscript{nd} opinion and makes referral and remote diagnosis better and cost-efficient
Dermoscopy vs. clinical photo

Clinically: Melanoma?
Dermoscopy: Seborrheic keratosis

Recommendation: biopsy/reevaluation after 3 mo.

Clinically: Melanoma
Dermoscopy: Clark Nevus
Re-evaluation after 3 months

Clinically: Melanoma,
Dermoscopy and Pathology:
Melanoma
Teledermoscopy improving quality of skin cancer diagnostics in Adjara (4-year analysis)

### Diagnosis approval analysis from Adjara region

<table>
<thead>
<tr>
<th>Periods</th>
<th>Teleconsultations</th>
<th>Diagnosis confirmed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (%)</td>
<td>No (%)</td>
</tr>
<tr>
<td>2013 (Control group from Adjara, no Dermoscopy)</td>
<td>15</td>
<td>N/A</td>
</tr>
<tr>
<td>patients from BMH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>51 (70.8%)</td>
<td>21 (29.2%)</td>
</tr>
<tr>
<td>2015</td>
<td>98 (72.6%)</td>
<td>37 (27.4%)</td>
</tr>
<tr>
<td>2016 (4 mo, Jan-Apr)</td>
<td>34 (52.3%)</td>
<td>31 (47.7%)</td>
</tr>
</tbody>
</table>

Diagnosis approval growth along with teledermoscopy

![Diagram showing diagnosis approval growth over years](image-url)
TeleDerm process chart
TeleDerm e-Registry

Patient's CODE: B-05-M-0243
DATE: 07/05/2015
Physician: R1-01

Cursus Morbi

2 წლის მაისში მართვით ბრძოლა.

ICD-10: C44.41

PHOTO #: 4

DERMOSCOPY #: 9
## TeleDerm Cost-Efficiency analysis

<table>
<thead>
<tr>
<th>Expenses (in GEL, 1 Euro=2.5 GEL)</th>
<th>Traditional setting</th>
<th>TeleDerm (e-Health)</th>
<th>Cost-efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of consultation in Batumi</td>
<td>40</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Cost of consultation in Tbilisi</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel cost (Batumi-Tbilisi, train, R/T)</td>
<td>36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hotel Cost in Tbilisi (1 night)</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal - domestic service (project stage)</strong></td>
<td><strong>146</strong></td>
<td><strong>40</strong></td>
<td><strong>365%</strong></td>
</tr>
<tr>
<td>Travel cost (Tbilisi-Vienna, plane, R/T)</td>
<td>1125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hotel cost in Vienna (3 nights)</td>
<td>525</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visa cost</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign consultation (without insurance)</td>
<td>318</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal - international service (project stg.)</strong></td>
<td><strong>2199</strong></td>
<td><strong>40</strong></td>
<td><strong>5498%</strong></td>
</tr>
</tbody>
</table>

### POST-PROJECT STAGE

<table>
<thead>
<tr>
<th></th>
<th>Traditional setting</th>
<th>TeleDerm (e-Health)</th>
<th>Cost-efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teleconsultation (domestic)</td>
<td></td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Teleconsultation (international)</td>
<td></td>
<td>143</td>
<td></td>
</tr>
<tr>
<td><strong>Total - domestic service (postproject stage)</strong></td>
<td><strong>146</strong></td>
<td><strong>65</strong></td>
<td><strong>225%</strong></td>
</tr>
<tr>
<td><strong>Total - international service (postproject stg.)</strong></td>
<td><strong>2199</strong></td>
<td><strong>183</strong></td>
<td><strong>1202%</strong></td>
</tr>
</tbody>
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# QoE Survey in patients

## QoE Survey results (Tbilisi)

<table>
<thead>
<tr>
<th>QoE Survey results (Tbilisi)</th>
<th>strongly disagree</th>
<th>disagree</th>
<th>hard to say</th>
<th>agree</th>
<th>strongly agree</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>TeleDerm is beneficial</td>
<td>0.0%</td>
<td>5.0%</td>
<td>20.0%</td>
<td>35.0%</td>
<td>40.0%</td>
<td>40</td>
</tr>
<tr>
<td>TeleDerm provides assurance</td>
<td>2.5%</td>
<td>10.0%</td>
<td>25.0%</td>
<td>32.5%</td>
<td>30.0%</td>
<td>40</td>
</tr>
<tr>
<td>TeleDerm saves money</td>
<td>5.0%</td>
<td>12.5%</td>
<td>20.0%</td>
<td>32.5%</td>
<td>30.0%</td>
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<tr>
<td>TeleDerm Saves time</td>
<td>7.5%</td>
<td>12.5%</td>
<td>15.0%</td>
<td>35.0%</td>
<td>30.0%</td>
<td>40</td>
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</table>

## QoE Survey results (Adjara)

<table>
<thead>
<tr>
<th>QoE Survey results (Adjara)</th>
<th>strongly disagree</th>
<th>disagree</th>
<th>hard to say</th>
<th>agree</th>
<th>strongly agree</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>TeleDerm is beneficial</td>
<td>0.0%</td>
<td>4.5%</td>
<td>9.0%</td>
<td>41.0%</td>
<td>45.5%</td>
<td>22</td>
</tr>
<tr>
<td>TeleDerm provides assurance</td>
<td>4.5%</td>
<td>13.6%</td>
<td>13.6%</td>
<td>31.8%</td>
<td>36.4%</td>
<td>22</td>
</tr>
<tr>
<td>TeleDerm saves money</td>
<td>0.0%</td>
<td>0.0%</td>
<td>18.2%</td>
<td>13.6%</td>
<td>68.2%</td>
<td>22</td>
</tr>
<tr>
<td>TeleDerm saves time</td>
<td>0.0%</td>
<td>4.5%</td>
<td>18.2%</td>
<td>31.8%</td>
<td>45.5%</td>
<td>22</td>
</tr>
</tbody>
</table>
QoE survey in physicians
(6 from Tbilisi and 4 from Adjara)

<table>
<thead>
<tr>
<th>QoE Survey results (Doctors)</th>
<th>strongly disagree</th>
<th>disagree</th>
<th>hard to say</th>
<th>agree</th>
<th>strongly agree</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>+1</td>
<td>+2</td>
<td>10</td>
</tr>
<tr>
<td>TeleDerm is beneficial</td>
<td>0%</td>
<td>0%</td>
<td>10%</td>
<td>30%</td>
<td>60%</td>
<td>10</td>
</tr>
<tr>
<td>TeleDerm provides assurance</td>
<td>0%</td>
<td>0%</td>
<td>10%</td>
<td>20%</td>
<td>70%</td>
<td>10</td>
</tr>
<tr>
<td>TeleDerm saves money</td>
<td>0%</td>
<td>10%</td>
<td>20%</td>
<td>30%</td>
<td>40%</td>
<td>10</td>
</tr>
<tr>
<td>TeleDerm saves time</td>
<td>0%</td>
<td>10%</td>
<td>20%</td>
<td>20%</td>
<td>50%</td>
<td>10</td>
</tr>
</tbody>
</table>
Conclusions

• Teledermoscopy is a method of choice for skin cancer screening, dermatology patients full-scale e-Registry and follow-up.

• m-Teledermoscopy represents feasible and particularly cost-efficient methodology for regional/rural primary care and dermatology onco-vigilance with provision of qualified second opinion and further monitoring, improving patients’ safety due to early stage recognition of possible neoplastic transformation.

• Combination of both clinical and dermocopic image-repository for diagnostic and follow-up usage, as well as joint appliance of m-Health and e-Health methodology represents the best mix for yet-limited mobile broadband areas.
EU Migration: Pros and Cons

• EU is facing unprecedented demographic changes
  – an ageing population,
  – low birth rates,
  – changing family structures
  – migration
  – For the first decade of 21st century the proportion of migrants in the population of EU states rose to over 10%.
• EU (and at national level) tries:
  – to review and adapt existing policies, using positive impact of migration and trying to manage and balance the negative ones.
• More research and innovation is needed in clarifying how some trends, initially considered as negative ones, can be dealt with new tools and methodologies/applications and possible even converted to non-negative ones, keeping the positive factors, e.g.:
  – economic growth opportunities
  – counterbalancing ageing.
Georgia – migration problems

#4 highest rates of migration (IOM, WB and UN data) after Gaiana, Bulgaria and Ukraine

Georgia's population (1989-2014)
31% decline
Problems of UD-migrant population in EU

• Poor financial ground
• Poor social networking
• Poor professional skills
• Poor language skills
• Poor health status, including mental health
• Mainly illegal work if at all
• No health insurance
• No legal documents - Deportation risks
• Significant financial obligations (debts, families...)
• High chance of trafficking
• High risk of engagement in criminal activities
Health challenges

- High risk of mental health, chronic diseases, infections
- Limited medical check-ups/counseling
- Limited chance of networked/informal medical counseling

  (due to very large number of medical professionals in Georgia, it is a habit “to ask a relative doctor”, which is not a case in EU)

- Late stage chronic diseases, self-prescription, hiding a problem
- Fear of deportation limiting chance of application to GP
- Changes in health laws (due to financial crisis in EU) limiting access to health for UDM
- Lack of online-available medical resources at least on native languages
Strategy for better health among UDM

• Increase awareness
• Education - basic health needs
• Ease isolation
• Health Information resources/campaigns on native languages
• Communication to home countries medical systems/NGOs
• Advocacy for better health support programs
• Bilateral and EU grant applications
• Circular migration options with better health insurance
• E-Health engagement
MIG-e-Health

• Virtual electronic health record form for application
• Anonymous teleconsultations between Georgian migrants and Georgian medical professionals
• Skype consultations options for the ones – pre-screened
• Levels of health status – with Medical “check-up required” to be referred to EU-based partner Migrant center
Future Project – Intergenerational bridge for elderly house inhabitants

Participants:

• Partners for Health NGO – ICT partner
• Dept of Psychology of Tbilisi State University (Prof. T. Gagoshidze)
• Association “Mzrunveli” (“Carer”) – having experience of 3 elderly houses

Different IT technologies - skype videconferencing, social networking (Facebook) and photo and video databases will be used.