Telemedicine in Developing Countries

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Director
Ecuador

- Population: 13,547,510
- Area: 283,560 sq km
  - note: includes Galapagos Islands
    - slightly smaller than Nevada
- GDP per capita: $4,300
- Population below poverty line: 41%
- Cotopaxi in Andes is highest active volcano in world.
Remote Environments

- Fixed Telemedicine Units
- Mobile Telemedicine
- Networking
- Low Bandwidth
- Digital Health Record
- Validation
- Utility, Utilization, Cost

Ecuador
Challenges

- Geographical Isolation
  - Absence of serviceable roads
  - Limited air travel

- Communications Isolation
  - Absence of telephone service in cases
  - Unreliable Internet connections
  - Communications provided by radio in some cases

- Disjointed healthcare delivery
Hub-and-Spoke
Clinica Luxemburgo

- Fixed Telemedicine Workstation

**Fixed Telemedicine Workstation**
- Intel Celeron 1.7 GHz CPU
- 512 Megabytes RAM
- 100 Gigabyte 7200rpm Hard Drive
- 64 K ISDN Modem
- 56 K Analog Modem
- CD R/W Drive
- 4 USB 2.0 Ports
- 4 IEEE1394 Firewire Ports

**Any Audio Input**
- Digital Stethoscope

**Ultrasound Machine**
- SonoSite
- PAL / NTSC Video

**Any Video Input**
- Camcorder
- Still Camera
- Microscope Camera
- Colposcope Camera
- Video Conferencing Camera

**Inmarsat Satellite Phone**
- Or KU-band uplink ISDN 64K

**56 Kbps Telephone**
- Modem to Dialup ISP

**TCP/IP Wireless network**
- to onsite computers, Lab, etc.
  - Radio modem
- Distant Hosp. & Aero

**30-Aug-06**
# Project Description

- **Fixed Unit**

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients seen in Clinic</td>
<td>6343</td>
</tr>
<tr>
<td>Patients entered into EMR</td>
<td>1447</td>
</tr>
<tr>
<td>Patient records sent to other facilities</td>
<td>1076</td>
</tr>
<tr>
<td>Ultrasound exams performed</td>
<td>2460</td>
</tr>
<tr>
<td>Ultrasound images stored in EMR</td>
<td>1037</td>
</tr>
<tr>
<td>Ultrasound images forwarded as part of consult</td>
<td>854</td>
</tr>
<tr>
<td>Patients impacted by telemedicine</td>
<td>862</td>
</tr>
<tr>
<td>Patient records sent as consultations</td>
<td>738</td>
</tr>
<tr>
<td>Patients sent from other facilities</td>
<td>1021</td>
</tr>
<tr>
<td>Patient records received by telemedicine</td>
<td>703</td>
</tr>
</tbody>
</table>
Mobile Surgery Network Members

- Mobile Surgical Practice based in Cuenca, Ecuador
- Primary care telemedicine sites in:
  - Sucúa
  - Macas
  - Manglaralto

Area: 283,520 sq km (175,780 sq mi)
Population: 11,700,000
People: Mestizo (40%)
  Indian (40%)
  Spanish descent (15%)
  African descent (5%)
Project Historical Background

- Mobile Surgery
Project Description

- Fixed Unit
Project Historical Background

- Mobile Surgical Truck
Hub represents mobile surgical unit
Spokes represent various primary care facilities with fixed telemedicine stations (base price shown)
Project Description
Mobile Surgery Network

- Trained personnel in three sites
- Networking with clinics in Sucúa & Manglaralto
Status – Mobile Surgery

- Surgical Truck in place and operated by Cinterandes Foundation
- Performing collaborative surgery
- Networking with clinics in Sucúa & Manglaralto

≥ 100 patient encounters (pre- and post-op)
Cinterandes Interaction with Primary Care Centers

Primary Care Sends Pt Information:

Cinterandes Receives & Responds (Schedules videoconference as needed)
EKG, Blood Pressure, Pulse, Oximetry, ETCO2, Respiration Rate, Audio & Video, and text messaging on a 64K satellite connection
Status – Mobile Surgery

- Seven surgeries captured
- Comparison of electronic record v. paper (17 questions, 4 reviewers)
Project Description
Teleanesthesia

Medical Informatics
And Technology Applications Consortium
30-Aug-06
Remote Anesthesiology Monitoring

- First successful test in December 2001
- Two additional trials June 2002 and December 2002
- Total of seven anesthetics delivered with remote monitoring
- Part of MITAC's ongoing research & support for telemedicine in Ecuador
Remote Anesthesiology Monitoring

InMarSat B Phone

Earth Station - FRANCE

ComSat

TeleVital Inc.
Milpitas CA

Internet Cloud

RDTU

Macas, Ecuador

Consultants
## Project Description

### Mobile Surgery

<table>
<thead>
<tr>
<th>Complications of 4545 cases, 1994-2003</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Serious</strong></td>
</tr>
<tr>
<td>Deaths</td>
</tr>
<tr>
<td>Cardiac arrest</td>
</tr>
<tr>
<td>PE</td>
</tr>
<tr>
<td>GI Injury, Hernia</td>
</tr>
<tr>
<td>Bleeding Req. Tx</td>
</tr>
<tr>
<td><strong>Other</strong></td>
</tr>
<tr>
<td>Wound Infection</td>
</tr>
<tr>
<td>Lap conversion</td>
</tr>
</tbody>
</table>
Figure 1.

Figure 2.

Most common operations:

- Cholecystectomy: 226
- Inguinal hernia: 699
- Ventral hernia: 557
- Circumcision: 767
- Orchidopexy: 362
Project Outcomes

- Publications (peer-reviewed)
  - A Networked telemedicine solution for Primary Care in the Ecuadorian Amazon. Intl J Fam Pract and Am Fam Physicians
  - Remote anesthetic monitoring using satellite telecommunications and the Internet. Anesth Analg
  - Telemedicine and Electronic Health Information for Clinical Continuity in a Mobile Surgery Program. World J Surg
  - Implementation and Evaluation of a low-cost Telemedicine Station in the Remote Ecuadorian Rainforest. J Telemed Telecare
  - Intermittent and Mobile Surgical Services: Logistics and Outcomes. World J Surg
Project Outcomes

- Publications (peer-reviewed)
  - Telemedicine to Integrate Intermittent Surgical Services into Primary Care; Telemed J E Health.
  - The role of low-bandwidth telemedicine in surgical prescreening. J of Ped Surg
  - A case report of remote anesthetic monitoring using satellite telecommunications and the Internet. Anesthesia and Analgesic
  - Low-bandwidth telemedicine for pre- and postoperative evaluation in mobile surgical services. J Telemed Telecare
  - Acquisition and evaluation of radiography images by digital camera. Telemed J E Health
Kenya

Information support for the ambulant healthcare worker. Telemed J E Health
Mobile technology for power, information and transmission
Pakistan
Pakistan