Impact of a Televideo Application on Health Care in a Nursing Facility

A component of
Indianapolis Network for
NGI Applications to Telemedicine
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Potential Benefits of Telemedicine

- Bring health services to patients
- Improve quality of care
  - Decrease time for diagnosis and decision-making
  - Improve continuity of care
  - May improve adherence to treatment
- Continuing medical education
- Reduce costs of some care
Outline for Today

• Clinical setting
• Goals of project
• Assembling equipment in the laboratory
• Deployment in the clinical setting
• Clinical trial
• Conclusions
Clinical Setting
Clinical Setting

• Nursing homes: 2 million high-risk disabled patients with a high prevalence of multiple, chronic illnesses.

• Lockefield Village Health and Rehabilitation Center
  – 240-beds
  – Multiple levels of care
  – Nurse practitioners and 7-10 physicians share call schedule
Goals of Project
Goals of Project

• Implement video-based teleconferencing between health providers at home and patients in a nursing facility
• Measure impact on health outcomes

Secure transmission
Peripheral Physicians and Central Patients

Red dots indicate physicians’ homes
Assembling Equipment in the Laboratory
Needs

- Tolerance to standard Internet conditions (varying bandwidth; T1 too expensive)
- Available in all rooms in nursing home
- Secure (encrypted) transmissions
- “Simultaneous” live videoconferencing and recording of videos (i.e., file storage)
Tolerance to Standard Internet Conditions

- **MPEG**
  - Very high quality, especially motion
  - Requires constant high (1.5 Mbps) bandwidth
  - Expensive and less available
  - Chosen for recording (file storage)

- **H.323 / H.261**
  - Smaller frame size and lower frame rate
  - Requires less constant bandwidth (64 Kbps and up)
  - Less expensive and greater industry support
  - Chosen for live videoconferencing
Available in All 200+ Rooms in Nursing Home

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
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<tbody>
<tr>
<td>Compaq DeskPro P3 500 128 Mbyte RAM</td>
<td>1,000</td>
</tr>
<tr>
<td>NEC 1525X LCD TFT monitor</td>
<td>670</td>
</tr>
<tr>
<td>Cisco Wireless PCI card</td>
<td>200</td>
</tr>
<tr>
<td>Polycom Soundpoint speakerphone</td>
<td>100</td>
</tr>
<tr>
<td>Cannon VC-C3 camera</td>
<td>1,244</td>
</tr>
<tr>
<td>Tilt/pan camera base</td>
<td>52</td>
</tr>
<tr>
<td>VCON Escort 25</td>
<td>600</td>
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<tr>
<td>Array MPEG recorder</td>
<td>1,000</td>
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<tr>
<td>Lowel Pro light</td>
<td>234</td>
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<tr>
<td>Pole for light</td>
<td>65</td>
</tr>
<tr>
<td>Retractable power cord</td>
<td>80</td>
</tr>
<tr>
<td>APC 650 UPS</td>
<td>260</td>
</tr>
<tr>
<td>CompuCaddy table</td>
<td>508</td>
</tr>
<tr>
<td>Metal shelf</td>
<td>12</td>
</tr>
<tr>
<td>Security alarm</td>
<td>60</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$6,085</strong></td>
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</table>

*Alternative:* hard-wire all rooms
Power Options
Wide Area Network Context

• Cable links from home physician to Internet to nursing home (many hops)
Major Problem #1

- Had to encrypt live video for privacy
- Internet Service Provider’s standard contract prohibits router-based encryption on physician’s side
- We had to produce our own solutions
$230 Unix Router for Encryption

- Soekris net4501 router
- Open-source FreeBSD UNIX router
- IPsec with strong 256-bit encryption
- Wireless Encryption protocol
- 133 MHz AMD elan sc 520
- 64 Mb RAM
- 4.85” x 5.7”
- $230
- 3 ports
  - Internet
  - Video PC: secure
  - Personal PC: pass-through
Simultaneous Live Videoconferencing and Recording

Physician Home conferencing

Video streaming (RMRS)

Regenstrief Medical Record System

Nursing Home conferencing with simultaneous record

FTP transfer (Gopher)

Video Server
End to End Picture
Videoconferencing Example
Deployment in the Clinical Setting
System Requires Training

• **Problem**
  – High turnover of nurses
  – 3-person scheduling problem of telemedicine
    • Patient
    • Facilitator
    • Provider

• **Solution**
  – Dedicated research assistants
Spontaneous Videoconferencing
Who initiates? Who confirms

Usual Data Flow from Nursing Home to Physician
Augmented Data Flow to Intercept Calls to Physicians

1. LPN → Answering Service
2. Answering Service → Research assistant
3. Research assistant → Gopher
4. Gopher → Physician
5. Physician → Live conferencing
6. Live conferencing → LPN
Revised Data Flow to Intercept Calls to Physicians

LPN → Answering Service → Research assistant → Gopher → Physician → Live conferencing
Wireless System Caused Low Apparent Bandwidth

Problem
Directional performance
AP350 base station cannot filter traffic

Solution
Better antenna
Router-based traffic filter to create private network
Audio dropout required alternative means for audio communications

- Numerous Internet hops
- Internet service provider limits bandwidth
Audio dropout required alternative means for audio communications

- Numerous Internet hops
- Internet service provider limits bandwidth
Clinical Trial
Objectives

• Assess feasibility of using the laboratory-derived equipment in a real clinical setting
• Assess outcomes attributable to spontaneous, night-time videoconferencing for acute medical problems
• Assess whether videoconferencing could substitute for some bedside evaluations
Hypotheses

• Secure videoconferencing through Internet is feasible
• Satisfaction will be greater
  – Physicians/NP
  – Patients
• Fewer radiology/laboratory test
• Less referral to emergency department
• No difference in mortality
• Physicians will feel confident assessing medical conditions remotely
Components
Accessible to Providers

• All participants
  – Lab and radiology data
  – Previous orders, visit notes and discharge summaries

• Intervention participants
  – Live videoconferencing
  – Previously recorded videos
    • Baseline videos
    • Live videos
Electronic Medical Record’s Integration of Link to Video
Enrollment and Admissions

- Consent
- Proxy information
- Assessment of cognitive status
- Level and acuity of care
Nighttime Conferencing

- Acute nighttime problems
- Randomized study changed to observational
- Research assistant facilitate examination
Daytime Conferencing to Compare Remote to Bedside Evaluations

• Situations
  – Acute daytime problems
  – Wound care
  – Routine daily visits
• Video exam followed by in-person exam
• Assessment of new or changed orders
Sources of Data

- Enrollment and admissions
- Patient, nurse, and physician satisfaction
- Reports of technical difficulties
- Information about calls (pager messages)
- Video files
- Cost and other measures of utilization
# Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All participants</th>
<th>Participants with videos</th>
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</thead>
<tbody>
<tr>
<td>Age, years (mean)</td>
<td>61</td>
<td>76</td>
</tr>
<tr>
<td>Race, African-American</td>
<td>58</td>
<td>79</td>
</tr>
<tr>
<td>Gender, female</td>
<td>55</td>
<td>70</td>
</tr>
<tr>
<td>Number of calls, per resident who generated &gt;0 calls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-10 calls</td>
<td>97</td>
<td></td>
</tr>
<tr>
<td>&gt;10 calls</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Number of videos, per resident with &gt;0 videos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 videos</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>&gt;2 videos</td>
<td>4</td>
<td></td>
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</tbody>
</table>

Cells contain percentages
Results Will Be Made Available Through Publications
Conclusions about Spontaneous Videoconferencing through Internet

- **Feasibility**: spontaneous, Internet videoconferencing is feasible
  - Special planning needed in current setting
  - Need ease of use, minimal training
  - Videoconferencing via cable modem works

- **Usefulness**: limited in urban academic setting
  - Not useful for many medical conditions
  - Need permanent, low-cost, ubiquitous videoconferencing equipment
  - Reverse configuration (peripheral patients) might not work, due to slow uplink

- **Quality**: QoS needed for voice but not visual data

- **Routing**: needed for security and traffic filtering
  - Expansion of integrated security mechanisms will facilitate applications
NLM
NGI Telemedicine Study

• Greg Abernathy
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