Telemedicine and Telehealth: The IDEATel Perspective

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Acknowledgements

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*Deceased.  **Current address: E. Tennessee State University (Johnson City, TN).
WHAT IS TELE MEDICINE?

TELECOMMUNICATIONS

MEDICINE

BIOMEDICAL INFORMATICS

Biomedical Informatics Issues

- Data Capture and Display
- Databases
- Coded Vocabulary
- Artificial Intelligence
- Data Security
- Outpatient Clinical Systems
- Disease Management/Case Management
Telemedicine, Telehealth
Or Telematics?

- Patient → Teleconsultation → Provider, usually a doctor
- Patient → Communication → Practitioner, information source, or expert system
- Any healthcare participant → Communication → Any healthcare resource or participant

Health Information at a Distance is not New

- Leper bells, plague flag
1876

- Watson come here I need you

1879 Lancet

VERS TO CORRESPONDENTS. [Nov. 29, 1879. 819]

Practice by Telephone.

The Yankees are rapidly finding out the benefits of the telephone. A newly made grandson, we are told, was recently awakened by the bell at midnight, and told by her inexperienced daughter, "Baby has the cough." What shall I do with it?" Grandmama replied she would call the down doctor, and would be there in a minute. Grandmama woke the doctor, and told him the terrible news. He in turn asked to be put in telephonic communication with the anxious mamma. "Lift the child to the telephone, and let me hear it cough," he commanded. The child is lifted, and it coughs. "That's not the cough," he declares, and declines to leave his house on such small matters. He advises grandmama also to stay in bed; and, all anxiety quieted, the trio settle down happy for the night.

1920 Norway

- Haukeland hospital established a service for Health care support of ships by radiolinks
1928 Royal Flying Doctor Service

1948 - 1960
- 1948 First Teleradiology
- 1959 Nebraska Psych, single campus
- 1964 Remote Consultation
- 1965 First Telesurgery (broadcast)

1967 Logan Airport
### 1980’s
- Little advance in US
- Norway establishes national network

### 1991 Desert Storm
Teleradiology

### 1992 - East Carolina
Correctional Telehealth
1993 - Bosnia Military Video
Telehealth

1999 Medem

2001 First Transatlantic Surgery
Telehealth Categories

- Information Resources
- Messaging
- Telephone
- Remote monitoring
- Remote interpretation
- Electronic Referral / Teleconsultation
- Video consultation
- Haptics, Telepresence

Information Resources

- 73 million use Web for health or medical information (Dec. 2002)
  - Up 59% since 2000
  - Is it Telehealth?
- Chat groups benefit patients
- Is EMR Telehealth?
Messaging

- Patients send doctors email
  - 90% of Pts want it – Harris 2002
- Medem
  - 45 Medical Societies
  - 90,000 Physicians
  - 500,000 Patients/mo.
- Some reimbursement

Web-based Messaging

- 150 - 300 Calls / wk.
- One sixth of ambulatory visits
- “No” reimbursement
- Virtually no training
- Protocol books
- Largest Telemedicine group is telephone-based
Remote Monitoring

- Pacemakers
- Glucose Meters
- Spirometry
- Coagulation - INR
- Thermometers
- Blood Pressure
- Often POTS-based

Monitoring Devices

Remote Monitoring Issues

- Who watches the data?
- Economics
  - Who pays?
  - How much?
- Device maintenance
- Hawthorne effect
Remote Interpretation
- Mostly static images
- "Store-and-forward"
- Teleradiology
- Telepathology
- Teledermatology

Remote Reading Questions
- When does radiology become "tele"?
- Economically or Quality driven?
  - Studies of "Off shore" reading

Electronic Referral or Consultation
- Store-and-Forward
- Multimedia capabilities vary
- Partners Telemedicine
- 2nd Opinion Software
- Economics improving, but still problematic
One Store and Forward Company

Video Consultation
- "Store-and-Forward"
  - Technician captures images and data
  - Later reviewed by Expert
- Synchronous Video
- Replaces patient transportation
  - Rural
  - Military
  - Prison
  - Home nursing

Store-and-Forward Video
- Not widely reimbursed
- Is it messaging?
- Widely used in Military
Synchronous Video

- "Traditional" Telehealth
- Most early Telehealth was synchronous
  - Kansas
  - Georgia
  - Bassett
- Typically high bandwidth
  - Dedicated networks
  - ISDN H.320
  - Satellite

“Traditional” Telemedicine

Rural

- Remote locations
- Low physician density
- Synchronous video reimbursed by HCFA
  - Low utilization
  - Many pilots closed
### Military
- Funded largest US telemedicine projects
- Ship-board and battlefield
- Lack of physicians
- Much store-and-forward
  - Corpsmen collect data
- Transportation extremely expensive

### Prison
- Large proportion of commercially viable telemedicine programs
- 30% of all teleconsultations (1998)
- Transportation is expensive
  - $250 - $2000
- Security concerns
  - Patients, not data

### TeleHome Nursing
- Monitoring, not diagnostics
- Early discharge
- Small, low-bandwidth units
- Integrated with devices
  - BP, glucose, Stethoscope, etc.
- Prospective Payment
- Nurse clinicians
Telehome Nursing

Telepresence, Haptics

- Virtual Reality
- Force feedback
- Remote surgery
  - Minimally Invasive Surgery
  - Latency issues

TeleRobotics
Uses of Telemedicine

- Patient care
- Education
  - Patient and Professional
- Research
- Public health
  - Preventive care
  - Disease Management
- Health care administration

Telemedicine Benefits

- Improved care
  - Access to best care
  - Faster response
  - Reduced barriers to use
  - More frequent monitoring
- Reaching remote and under-served areas
- Cost savings
  - Transportation costs
  - Reduced complications

Telemedicine Barriers

- Acceptance
- Funding
- Convenience
- Legal
- Technology
- Security
- Standards
Evaluating Telemedicine

- Process of care
- Health outcomes
- Access to care
- Cost
  - Patients, providers, payers
- Perceptions

*Telemedicine: A Guide to Assessing Telecommunications in Health Care, IOM*

IDEATel

- Informatics for Diabetes Education And Telemedicine
- Large-scale home-based telemedicine project for medically-underserved diabetic patients
- Randomized controlled clinical trial (N=1665+)
- Multi-site consortium
  - Columbia and New York Presbyterian Hospitals (Downstate)
  - SUNY Upstate Medical University-Syracuse

Phases

- Ramp-up
- Install
- Run 1
- Upgrade
- Run 2
- Wrap-up
- Analysis

<table>
<thead>
<tr>
<th>Year</th>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>Gen 1</td>
<td>Gen 2</td>
</tr>
<tr>
<td>2004</td>
<td>Gen 3</td>
<td></td>
</tr>
</tbody>
</table>
317 Upstate Collaborating Practices

IDEATel Home Telemedicine Unit

Video Conference Cam
Glucose Monitor
Blood Pressure Monitor

Video over POTS
Bridging the Digital Divide

<table>
<thead>
<tr>
<th></th>
<th>Upstate(%)</th>
<th>NYC(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt; 65</td>
<td>87</td>
<td>89</td>
</tr>
<tr>
<td>US Born</td>
<td>96</td>
<td>22</td>
</tr>
<tr>
<td>English-speaking</td>
<td>96</td>
<td>26</td>
</tr>
<tr>
<td>White, NH</td>
<td>92</td>
<td>1</td>
</tr>
<tr>
<td>Income &lt;$20K</td>
<td>50</td>
<td>93</td>
</tr>
<tr>
<td>Use Computer</td>
<td>33</td>
<td>5</td>
</tr>
</tbody>
</table>

IDEATel Launchpad

IDEATel Communication

From Mathematica Interim Report 2003
Evaluation Study

- Annual Evaluation Visit
- Service Utilization Interview
  - Telephone, Q 3 months
- Provider Satisfaction Survey
- Patient Satisfaction Survey
- Qualitative Study of Patient Perspective
- Cost Analysis
- Independent Evaluation
  - Mathematica
Utilization

<table>
<thead>
<tr>
<th></th>
<th>COMPLETED HOME TELEVISITS</th>
<th>GLUCOSE UPLOADS</th>
<th>BP UPLOADS</th>
<th>WEBSITE VISITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOWNSTATE</td>
<td>4,405</td>
<td>155,688</td>
<td>139,618</td>
<td>10,033</td>
</tr>
<tr>
<td>UPSTATE</td>
<td>9,872</td>
<td>330,020</td>
<td>213,811</td>
<td>35,412</td>
</tr>
<tr>
<td>TOTAL</td>
<td>14,277</td>
<td>485,708</td>
<td>353,429</td>
<td>45,445</td>
</tr>
</tbody>
</table>

*As of 4/23/04*

Patient Satisfaction

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am satisfied with the telemedicine system</td>
<td>4.51</td>
<td>.686</td>
</tr>
<tr>
<td>The telemedicine system helps me monitor my health</td>
<td>4.43</td>
<td>.727</td>
</tr>
<tr>
<td>Video visits save me time</td>
<td>4.38</td>
<td>.802</td>
</tr>
<tr>
<td>It was easy to learn to use the equipment</td>
<td>4.18</td>
<td>.861</td>
</tr>
</tbody>
</table>

N=351, Scale 1-5

Impact on Patient Knowledge

- Very Negative
- Slightly Negative
- Neutral
- Slightly Positive
- Very Positive
Impact on Ability to Manage Diabetes

1 YEAR RESULTS
(N = 1,406)

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Interven</th>
<th>Adj. Δ</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glyc Hgb (%)</td>
<td>7.17</td>
<td>6.97</td>
<td>-.18</td>
<td>0.006</td>
</tr>
<tr>
<td>*Glyc Hgb (%)</td>
<td>7.78</td>
<td>7.42</td>
<td>-.32</td>
<td>0.002</td>
</tr>
<tr>
<td>Systolic BP (mmHg)</td>
<td>140.7</td>
<td>137.4</td>
<td>-.4</td>
<td>0.001</td>
</tr>
<tr>
<td>Diastolic BP (mmHg)</td>
<td>70.1</td>
<td>68.4</td>
<td>-.9</td>
<td>0.0001</td>
</tr>
<tr>
<td>Total cholesterol (mg/dl)</td>
<td>182.4</td>
<td>170.4</td>
<td>-.11</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>TG (mg/dl)</td>
<td>171.8</td>
<td>154.7</td>
<td>-.16</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>LDL cholesterol (mg/dl)</td>
<td>105.9</td>
<td>95.7</td>
<td>-.9</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>HDL cholesterol (mg/dl)</td>
<td>48.6</td>
<td>47.9</td>
<td>-.6</td>
<td>0.22</td>
</tr>
</tbody>
</table>

* N = 705 with baseline glyc hgb > 7.0%
Δ adjusted for differences in baseline values.
As of 10/31/2003
What does the future hold?

What is coming?

- Reimbursement for Electronic Messaging
- Section 728
- Continued Congressional Activity

Open Problems

- Changing Telecom Environment
  - VOIP
  - Cellular
  - Broadband
- Inter-organizational System Integration
- Data overload
Telehealth Evolution

Remote Monitoring Load

<table>
<thead>
<tr>
<th>Condition</th>
<th>Prev.</th>
<th>Pts./MD</th>
<th>Freq.</th>
<th>Tests/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>6%</td>
<td>120</td>
<td>1</td>
<td>120</td>
</tr>
<tr>
<td>HTN</td>
<td>18%</td>
<td>360</td>
<td>0.2</td>
<td>72</td>
</tr>
<tr>
<td>Asthma/COPD</td>
<td>8%</td>
<td>160</td>
<td>1.2</td>
<td>192</td>
</tr>
<tr>
<td>CHF</td>
<td>1%</td>
<td>20</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Anticoag.</td>
<td>1%</td>
<td>20</td>
<td>0.2</td>
<td>4</td>
</tr>
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Pseudo-random Multi-parametric Data Stream

- It is not humanly possible for caregivers to monitor this data flow.
- Computerized information management tools are required.
### 20 Patients

<table>
<thead>
<tr>
<th>MRN</th>
<th>Name</th>
<th>DOB</th>
<th>Sex</th>
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<tbody>
<tr>
<td>3386531</td>
<td>GAGE, LINDA</td>
<td>1947-04-19</td>
<td>M</td>
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<td>4141414</td>
<td>JOYCE, JAMES</td>
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<td>F</td>
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<td>MOON, DOGGIE</td>
<td>1901-01-01</td>
<td>M</td>
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<td>3937549</td>
<td>STRANGE, BOB</td>
<td>2000-02-02</td>
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### 200 Patients

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Icons to the Rescue?

Computerized alerts?

- Limit Detectors
  - High FP and FN rates
- Statistical Process Control
  - Acute changes
- Outcome Models
  - Statistical, not prescriptive
- Physiologic Models
  - Promising
The Remote Monitoring Challenge

And now...?

- Intelligent filtering
- Human Computer Interaction
  - Patients
  - Clinicians
- Standards
- Seamless communication
  - Message-based workflow

It flies. Now what?
For more Information

- www.ideatel.org
  - Publications
  - Videos
  - Telemedicine Syllabus
  - Contact Information
- tie.telemed.org
  - Telemedicine Information Exchange