Smart Health Tools: Turning Images and Information Into Decision Support Tools

Alice P. Pentland, MD
Medical Director,
Center for Future Health
Health and Healthcare Challenges

Economic Reality

- More than 14% of U.S. GDP is devoted to health care.
- Ratio of wage earners to seniors
  - 4/1 (now)
  - 2/1 (~2025)
- Average cost of assistive care
  - $60,000 / year / senior adult
- Seniors visit the doctor 6 x more often than younger people

Demographic Trends

- The ratio of caregivers for at-home disabled will decrease from more than 20:1 down to less than 6:1 in 2030.
The Health Care System Must Change

Primary

Community Information Networks

Smart Home

Telehealth

Doctor’s Office

Secondary

Health Centers or Outpatient Clinics

Tertiary

Rural and Regional Hospitals

Referral Hospitals
<table>
<thead>
<tr>
<th>Prevention</th>
<th>Early Detection</th>
<th>Disease Management</th>
</tr>
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- Predicts and rapidly responds to health emergencies
- Helps manage chronic conditions
- Detects the onset of emerging health problems well before symptoms are visible
- Promotes preventive measures and healthy lifestyle behaviors

“Stay Healthy & Stay Home!”
Personal Health System (PHS)

Your Home is your own Medical Advisor

Health Status Interpreter
- General Health
- Diabetes
- Depression
- Cancer, Cardiovascular Disease, Others

Mobile Health Assistant

Personal Health & Wellness Informatics
Consumer-Physician Decision Support
Information to and from health care system or family, by owner's choice

Vital Sign Technologies

Smart Sensors and Effectors

Gait Module
Medication Advisor Module

Behavior Pattern Modules
Sleep Measures

Pathogen Detection Modules

Traditional Measures
New Technologies as They Become Available in the Future
The CFH Smart Medical Home Research Laboratory

Personal Health System
WHAT DO CONSUMERS NEED?

Personal Health Status Information & Decision Support Tools

- Images
- Information

For
- Making informed choices
- Communicating with Providers
January 7, 2003 Rash that Ms. S/Dr. H. observed. Dr H. inspected and checked for scabies. No evidence with microscope scrapings test. Prescribed 5% permethrin cream applied on 1/7 and again on 1/14 for both my wife and I. Prescribed Dermatop for the very bad spots. 60mg Allegra 2x per day. Come back in two weeks.

Project PI: A. Pentland & D. Krusch
The Medication Advisor

QuickTime™ and a decompressor are needed to see this picture.

Project PI: James Allen, George Ferguson
Gait Monitor- Video Motion Analysis

Project PI: M. Tekalp & M. Berg
PHS--The Consumer’s View

“We have better data and we own it!”

Communication System

Personal Health & Wellness Record

Central System

Middleware Wireless Technology

Modules such as Gait Sensors & Gait Analysis
WHAT DO PROVIDERS NEED?

Window into Behaviors & Vital Signs Between Visits & New Decision Support Tools

• Images
• Information

For
• Longitudinal Medical Record
• Improved Consumer Involvement
Personal Health & Wellness Information System

KEY
1. Personal Health System
2. Decision Support System
3. Personal Image Repository
4. Clinical Image Repository

* PHWR
1. In the home
2. Portable-Memory Stick
3. Internet
4. Other
What We Measure Determines What We Can Detect

<table>
<thead>
<tr>
<th>Vital Signs</th>
<th>Arthritis</th>
<th>Heart Disease/Stroke</th>
<th>Cancer</th>
<th>Diabetes</th>
<th>Depression</th>
<th>Dementia</th>
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<tbody>
<tr>
<td>Blood Pressure</td>
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<td>Temperature</td>
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<td>Weight</td>
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<td>Respiration</td>
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<td>Urine Output</td>
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<td>% Affected</td>
<td>57%</td>
<td>31%</td>
<td>20%</td>
<td>13%</td>
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(Over 70)
### What We Measure Determines What We Can Detect

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<td>Exercise</td>
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<td>Nutrition</td>
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<td>Activity Patterns</td>
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<td>Gait</td>
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<td>Sleep</td>
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**Center researchers will:**

1. Create tools to measure these key concepts
2. Standardize Their Interpretation In Medical Practice
3. Define Best Practice For Their Effective Use
New Vital Sign Team Expertise

Cardiology

Psychiatry

Sleep Disorders

Engineering

Computer Science

Biostatistics
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