Opportunities for Technology Infused Management of Chronic Diseases: Hypertension As An Example

Frank A. Treiber, Ph.D.
CoEE Endowed Chair of Technology Applications for Healthful Lifestyles
Medical University of South Carolina
Colleges of Nursing & Medicine

Overview

• New CoEE Technology Center to Enhance Healthful Lifestyles

• Rationale for Technology Center

• Advances in Telehealth Technologies
  – Example of BP control: state of science, primary & secondary prevention programs under development.
  – Opportunities for telehealth primary & secondary prevention research
CoEE Tech. Center to Enhance Healthful Lifestyles

- HSSC supported multi-institutional research center (MUSC & USC)
- Tasked with development, testing & licensing of software & hardware technologies to foster effective health promotion, disease prevention and health care management;
- Goals: Economic growth to S.C. & reductions in premature deaths, prevalence of chronic diseases & associated reductions in healthcare costs
CoEE Technology Center
Rationale:

• S.C. ranked 46th in premature mortality
• Many deaths due to stroke (40th in nation); cancer (36th); CVD (35th) & diabetes (46th);
• S.C. ranked 45th in obesity, which is linked to all of the above chronic diseases
CoEE Technology Center
Rationale:

• **Lifestyle programs have shown promise:**
  – Smoking
  – Diet
  – Physical activity
  – Alcohol and drug use
  – Ineffective stress management

• **However, dissemination is problematic:**
  – Expensive
  – >personalization needed (one size doesn’t fit all)
Development of efficacious cost effective personalized disease prevention & management programs will be partially addressed using new technologies:

- **mobile phones**
- personal digital assistants
- iPod/iPad technologies
- web based computer assisted programs, interactive call centers
Technology Communication Revolution

- **Cell Phone Utilization:**
  - 79% of Americans (2007)
  - 42% use Smart Phones (2009)
  - 5,805 health/med. & fitness apps (Apple App Store)
  - 15 Million Americans will be using wireless health devices by 2012


Telehealth Technology Advancements

**Holter monitor**

- Now

**Piix monitor**

- Underway
Intel® Health Guide PHS56000 (RCT Underway. N = 60 AA’s- Dr. Abbott, JHSON)
Intel® Health Guide

The Intel® Health Guide connects patients and their care teams for personalized care management at home.

- Vital sign measurement
- Reminders
- Patient education content

- Customizable care protocols
- Video conferencing

Patient → Intel® Health Care Management Suite → Technician Interface → Backend Services Tool Kit → Clinician
Nonin Medical Inc. N95 emulator and devices.
Technology & BP Control

- **Cell Phone Based**
  - Logan et al. (2007): 4 mths, n=33, Bluetooth enabled BP monitoring, voice mail/pop up feedback, fax backs to M.D.
    - 24 hr ABP: -11/-5 mmHg
  - Park et al. (2009): 2 mths, n=49, self monitoring of BP, weight & meds., nurse directed SMS feedback
    - resting BP: -9.1/-7.2 mmHg vs no change
A moment to breathe

Above, seventh-grade pupils perform breathing meditation in Jim Murrinowski’s science class at Tuft Middle School in Augusta. At top, Emily Welborn, 13 (front); Macy Goodwin, 12; and Alexis Cook, 13, take part in the exercise, part of a study of the technique by Medical College of Georgia researchers.
Change in Daytime Ambulatory SBP

N = 100 AAs
16.2 +/- 1.3 yrs

Improving BP Control Among Prehypertensives

BP Screening 75th – 95th percentile on 3 occasions

3-month RCT:
Primary Outcomes:
- Changes in 24hr ABP, resting BP
Secondary:
- Changes in SNS, HPA oxidative stress biomarkers, % adherence, well-being, satisfaction

Adherence

14-18 yrs
n=32

TBAM
n=16

19-40 yrs
n=32

TBAM
n=16

TCTL
n=16

TCTL
n=16
Technology Infused BP Control Trial With Uncontrolled Hypertension

Outcomes
- Primary:
  - Changes SBP/DBP, (24 hr ABP), % time ≤ threshold
- Secondary:
  - Med. adherence (refill rates), well-being, satisfaction, cost effectiveness

3 Month Trial

Churches
- Identification of Population
- Provider Networks

Health Screening (3X):
- SBP 140-199mmHg
- or
- DBP 90-109mmHg
- Glucose & Lipid Panel
- HbA1c
- Questionnaires

Usual Care (e.g., AHA materials)

Self Management Training
- A&D BP Monitor
- Smartphone
  - Bluetooth enabled auto transfer of BP (2 consec readings ≥ 3x/week)

Facilitator

HCP

Server

Alerts

- Weekly feedback/coaching for one mth until BP controlled
- APRN sends med changes to HCP

Smartphone
- Autofeedback
- Refill Requests & delivery via mail
- Smartphone
  - Autofeedback, etc. & facilitator (Coaching)
Opportunities to Utilize Technology in Life Science Research

Real Time Monitoring:
- Affective and physical states
- Physical activity
- Dietary intake
- Physiological functions (BP, ECG, O2, glucose, weight)
- Medication adherence
# Transformation of Healthcare Delivery Model

<table>
<thead>
<tr>
<th>20th Century</th>
<th>21st Century</th>
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<tbody>
<tr>
<td>Treat disease when symptoms appear and normal function is lost</td>
<td>Intervene before symptoms appear and preserve normal function for as long as possible</td>
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<tr>
<td>Did not understand the molecular and cellular events that lead to disease</td>
<td>Understanding preclinical molecular events and ability to detect patients at risk</td>
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<tr>
<td>Expensive in financial and disability costs</td>
<td>Orders of magnitude more effective</td>
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</table>
The Future Paradigm: Transform Medicine from Curative to Preemptive

Predictive ↔ Personalized ↔ Preemptive

Participatory
Differential Impact of Stress Reduction Programs Based on Expectancy, Environmental Stress, and ET-1 LYS 198 ASN Genotype

Figure 1. Breathing Awareness Meditation Training

Figure 2. Life Skills Training

Gregoski et al. (in preparation)
Changes in Ambulatory SBP: Influence of Discrimination, ET-1 LYS198ASN Carrier Status, & Treatment Group

Gregoski et al. (in preparation)
Technology & Behavioral Change

- **Cell Phone Based**
  - **Glucose control:**
    - 3 mths., n= 30, glucose monitoring, feedback to healthcare provider including suggested therapy changes; -2.03% vs +.68% HbA1c, 84% vs 23% patients received med. changes (Quinn et al. 2008)
    - 6 mths., n= 51, glucose monitoring, weekly nurse directed SMS feedback; -1.05 vs +.11 % HbA1c (Kim & Jeong 2007)
    - 3 mths., n= 69, internet entered vs cell phone/glucometer auto transfer; -.70% vs – 1.2% HbA1c (Cho et al. 2009)
Future Directions of Telehealth Research

- Theory based (e.g., social cog. learning, social marketing, health beliefs, self regulation ...)
- Attend to cultural sensitivity; greater involvement of intended users
- Include youth, families, African Americans, Hispanics & men
- Increase use of behavioral principles (e.g., structured lessons, skills training, self monitoring, homework, feedback, pos. reinforcement (including $), social support- synchronous chat rooms, email)
- Increased personalization of contact (interactive voice & SMS messages, self configuration of apps - reminders, alerts, etc.)
- Use of trained facilitators/coaches