mHealth Applications in CVD
Prevention and Treatment

Theodore Feldman, MD, FACC, FACP
Medical Director, Center for Prevention and Wellness at Baptist Health South Florida
Medical Director, Miami Cardiac and Vascular Institute at South Miami Hospital
Clinical Associate Professor of Medicine, FIU Wertheim College of Medicine

Intersection of mHealth and CVD

- Physical Activity
- Smoking Cessation
- Diabetes Management
- Weight Loss
- Remote EKG Monitoring

Physical Activity

- Less than half of adults meet the 150 minutes a week of physical activity recommendation
- Despite well-evidenced dose-dependent reductions in CVD and all cause mortality
- Protection from common and costly chronic conditions (including non-CVD conditions)

"the technology has outstripped the research, and scientists are still struggling to understand whether the monitors work as promised, how to keep people motivated to use them, and exactly what the devices are supposed to accomplish, anyway."
The Digital Revolution in Physical Activity Monitoring

Pedometers Interventions

Cochrane Review: Physical Activity

- Evidence for pedometers in the workplace:

  **Authors' conclusions**
  
  There was limited low quality evidence to assess the effectiveness of pedometer interventions in the workplace for increasing physical activity and improving subsequent health outcomes.

  *Cochrane Database Syst Rev. 2014 Oct 15;CD009209*

- Evidence for mobile phone text messaging:

  **Authors’ conclusions**
  
  We found very limited evidence that in certain cases mobile phone messaging interventions may support preventive health care, to improve health status and health behavior outcomes. However, because of the few number of participants in some of the included studies, qualified with study limitations of risk of bias and lack of demonstrated control, the evidence for these effects is low in evidence quality. The evidence of high quality for interventions about smoking cessation. Furthermore, there are significant
mActive Trial

<table>
<thead>
<tr>
<th>Phase I</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unadjusted Mean (SD)</td>
<td>Adjusted Mean (SD)</td>
<td>Adjusted Mean (SD)</td>
</tr>
<tr>
<td>Age</td>
<td>48.2 (7.5)</td>
<td>50.2 (7.6)</td>
<td>50.2 (7.6)</td>
</tr>
<tr>
<td>Activity Time</td>
<td>5.1 (0.8)</td>
<td>5.1 (0.8)</td>
<td>5.1 (0.8)</td>
</tr>
<tr>
<td>Phase II</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unadjusted Mean (SD)</td>
<td>Adjusted Mean (SD)</td>
<td>Adjusted Mean (SD)</td>
</tr>
<tr>
<td>Age</td>
<td>46.8 (7.8)</td>
<td>48.8 (7.9)</td>
<td>48.8 (7.9)</td>
</tr>
<tr>
<td>Activity Time</td>
<td>6.1 (1.0)</td>
<td>6.1 (1.0)</td>
<td>6.1 (1.0)</td>
</tr>
</tbody>
</table>

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Smoking Cessation

- Traditional smoking cessation tools:
  - Pharmacotherapy: Nicotine patches, Chantix
  - Counseling
  - Quit line service
  - E-cigarettes???

Unluckily, this is still the reality!!

- Smoking: leading cause of preventable death in the world
  - Accounts for 1 in 10 premature deaths in the world each year
  - Two-thirds of current smokers want to quit
  - Greater than one half have to quit during the last year
mHealth innovation aimed at smoking cessation

- Quitbit: lighter that tracks all your smoking
- Kosmo: e-cigarette that helps customize nicotine reduction program
  - Informs you when you smoke 1 cigarette equivalent
- Smokio: smart phone connected vaporizer

Applications for smoking cessation

<table>
<thead>
<tr>
<th>Application</th>
<th>iPhone application: QuitSmokingCounter.com</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoidance</td>
<td>Quitbit: lighter that tracks all your smoking</td>
</tr>
<tr>
<td>Commitment</td>
<td>Kosmo: e-cigarette that helps customize nicotine reduction program</td>
</tr>
<tr>
<td>-skipping</td>
<td>Informs you when you smoke 1 cigarette equivalent</td>
</tr>
<tr>
<td>Technology</td>
<td>Smokio: smart phone connected vaporizer</td>
</tr>
</tbody>
</table>

Cochrane Review: Smoking cessation

- Mobile-phone only interventions -> increase long term quit rates
  - Abstinence of no smoking at six months past quit date (excluding 3 lapses or up to 5 total cigarettes)

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Treatment</th>
<th>Control</th>
<th>Total</th>
<th>Risk Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bristol 2011</td>
<td>80</td>
<td>78</td>
<td>158</td>
<td>1.49 [1.25, 1.79]</td>
</tr>
<tr>
<td>France 2013</td>
<td>100</td>
<td>99</td>
<td>199</td>
<td>1.24 [1.04, 1.49]</td>
</tr>
<tr>
<td>UK 2006</td>
<td>100</td>
<td>100</td>
<td>200</td>
<td>1.19 [1.00, 1.44]</td>
</tr>
<tr>
<td>Whittaker et al.</td>
<td>110</td>
<td>107</td>
<td>217</td>
<td>1.19 [1.01, 1.42]</td>
</tr>
</tbody>
</table>

Total: 4798


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Diabetes
Are we avoiding new and treating existing cases of diabetes the best we can??

<table>
<thead>
<tr>
<th>Number of new diabetes cases</th>
<th>Rate of new diabetes cases per 1000 (crude)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>17 million</td>
</tr>
<tr>
<td>By age</td>
<td></td>
</tr>
<tr>
<td>26-44</td>
<td>371,000</td>
</tr>
<tr>
<td>45-64</td>
<td>862,000</td>
</tr>
<tr>
<td>65 or older</td>
<td>400,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of adults using diabetes medication*</th>
<th>Percentage using diabetes medication (unadjusted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin only</td>
<td>2.8</td>
</tr>
<tr>
<td>Oral and oral medication</td>
<td>5.1</td>
</tr>
<tr>
<td>Oral medication only</td>
<td>11.2</td>
</tr>
<tr>
<td>Neither insulin nor oral medication</td>
<td>5.5</td>
</tr>
</tbody>
</table>

Improvements in diabetes management: Enter mHealth?

mHealth Diabetes Control: Meta-analysis

<table>
<thead>
<tr>
<th>Study</th>
<th>Intervention</th>
<th>Outcome Measure</th>
<th>Effect Size</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roberts (2017)</td>
<td>Diabetes management using PDA versus no device</td>
<td>HbA1c Blood concentration</td>
<td>-0.06</td>
<td>-0.08 to 0.00</td>
</tr>
<tr>
<td>Jones (2017)</td>
<td>Diabetes management using PDA versus no device</td>
<td>HbA1c Blood concentration</td>
<td>-0.06</td>
<td>-0.08 to 0.00</td>
</tr>
<tr>
<td>Harbord (2016)</td>
<td>Diabetes management using PDA versus no device</td>
<td>Blood sugar control - glocemia</td>
<td>-0.08</td>
<td>-0.08 to 0.09</td>
</tr>
<tr>
<td>Harbord (2016)</td>
<td>Diabetes management using PDA versus no device</td>
<td>Blood sugar control - pre-prandial glucose</td>
<td>-0.08</td>
<td>-0.08 to 0.09</td>
</tr>
<tr>
<td>Harbord (2016)</td>
<td>Diabetes management using PDA versus no device</td>
<td>Blood glucose (mean)</td>
<td>-0.08</td>
<td>-0.08 to 0.09</td>
</tr>
<tr>
<td>Harbord (2016)</td>
<td>Diabetes management using PDA versus no device</td>
<td>Blood glucose in the morning</td>
<td>-0.08</td>
<td>-0.08 to 0.09</td>
</tr>
<tr>
<td>Harbord (2016)</td>
<td>Diabetes management using PDA versus no device</td>
<td>Blood glucose in the evening</td>
<td>-0.08</td>
<td>-0.08 to 0.09</td>
</tr>
<tr>
<td>Valiante (2015)</td>
<td>Diabetes management using PDA versus no device</td>
<td>Blood glucose in the morning</td>
<td>-0.08</td>
<td>-0.08 to 0.09</td>
</tr>
<tr>
<td>Valiante (2015)</td>
<td>Diabetes management using PDA versus no device</td>
<td>Blood glucose in the evening</td>
<td>-0.08</td>
<td>-0.08 to 0.09</td>
</tr>
<tr>
<td>Valiante (2015)</td>
<td>Diabetes management using PDA versus no device</td>
<td>Daily insulin requirements</td>
<td>-0.08</td>
<td>-0.08 to 0.09</td>
</tr>
<tr>
<td>Valiante (2015)</td>
<td>Diabetes management using PDA versus no device</td>
<td>Fasting plasma glucose</td>
<td>-0.08</td>
<td>-0.08 to 0.09</td>
</tr>
<tr>
<td>Valiante (2015)</td>
<td>Diabetes management using PDA versus no device</td>
<td>Fasting plasma cholesterol</td>
<td>-0.08</td>
<td>-0.08 to 0.09</td>
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</tbody>
</table>
Diabetes management via smart phone plug-ins & applications

- iBGStar: blood glucose monitoring device

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Obesity Epidemic: Is it a Diet or Physical Activity Problem?

- More than 1/3 of U.S. Adults are obese
  - Obesity-related conditions include heart disease, stroke, T2DM, and certain cancers, some of leading causes of preventable death
  - There are noticeable differences in how obesity affects certain populations based on their age, race, SES, and education
    - Obesity is higher among middle age adults: 40-59 years old (~40%)
    - Non-Hispanic blacks have the highest age-adjusted rates of obesity (~48%)
    - Higher income non-Hispanic blacks are more likely to have obesity than those with low income
    - Higher income women are less likely to have obesity than low-income women
    - NO significant relationship between obesity and education in men, but in women there is a trend that those with college degrees are less likely to have obesity compared to less educated
Weight Loss Innovation

- **Web-based interventions (WBI):**
  - Literature review concluded modest but statistically significant weight loss when compared to no intervention or minimal intervention (4 meta-analysis)
  - Concerns for WBI are high attrition rates
  - Life years gained and cost effectiveness were comparable and better to in person counseling, respectively

- **mHealth Interventions:**
  - 11/14 studies demonstrated statistically significant beneficial effects on weight and diet using mHealth SMS-only interventions
  - In 2012, 50% of smartphone apps downloaded were weight and exercise related.
  - Literature on mHealth weight loss apps is limited and at times inconsistent, but results do demonstrate high participant satisfaction and acceptance of mobile app intervention
  - Studies have shown up to 4.5 kg reductions in participants but most notably have reported excellent adherence, satisfaction, and acceptability – key factors in helping to maintain weight loss goals

- **Active Video Game Interventions (AVGI):**
  - In the U.S., over 1/3 of children and adolescents are considered overweight and obese
  - Only 29% of high school students achieve the daily recommended 60 minutes of PA
  - Traditional video games have been reported to cause a nearly 2-fold increase in obesity
  - AVGI increases light- to moderate-intensity PA acutely but does not significantly contribute to the recommended daily dosage of PA
  - In smaller studies, children using the AVGI vs. more sedentary gaming did notice a significant weight loss of almost 4 lbs

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**mHealth Innovation**

- As technological advancements expand, there has been a fast-growing public interest in innovative, interactive, user-centered, and low-cost weight loss and maintenance alternatives.
- Innovative weight loss interventions using web-based, mobile, social, and active video games have been shown to be effective, but current literature supports mainly their use as an adjunct to traditional face-to-face interventions.
- More studies are needed to facilitate health care provider knowledge and trust in order to achieve successful implementation of these innovative behavioral interventions in the clinical setting.

**Tailor-made Diets**

- Achieve Successful Weight Loss and Management Programs for Patients???
Exercise to Achieve Weight Loss: “Class 1B”

Exercise + Heart Healthy Diet to Achieve Weight Loss: “Class 1A!!”

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Atrial Fibrillation

• Most common sustained heart rhythm disorder and increases the risk for heart disease and stroke
  — Causes 15-20% of ischemic strokes
• Prevalence of AFib and Aflutter in the U.S. is projected to increase from 3.4 to 8-12 million over the next 30-40 years
• AFib/Aflutter are not life threatening if treated properly
• Signs and symptoms vary – AFib is diagnosed with ECG
  — Diagnosing AFib early allows for proper medical management, either via medications or procedures

ENTER ALIVECOR!

AliveCor

AliveCor – Provider Dashboard

• Say goodbye to the hassle of manual pulse monitoring and paper logs. You can easily and automatically share ECGs, AF episodes and symptoms you’re feeling with your doctor.
  — Easily identify the recordings you have not yet reviewed
  — Flag noteworthy recordings
  — View reports for a particular recording
  — View the symptoms your patients were feeling during the recording