Using Technology To Understand and Promote Physical Activity Behavior

Presented by:
Siobhan Phillips, Ph.D., M.P.H.
Northwestern University Feinberg School of Medicine
Using Technology to Understand and Promote Physical Activity Behavior

Siobhan M. Phillips, PhD, MPH
Associate Professor, Department of Preventive Medicine
Director, Physical Activity Promotion, Robert H. Lurie Comprehensive Cancer Center
Northwestern University Feinberg School of Medicine

NIH Office of Disease Prevention Mind the Gap Webinar
February 20, 2020

No Conflicts of Interest to Disclose
Benefits of Physical Activity (PA)

- **↓ Risk of:**
  - all-cause mortality
  - Cardiovascular disease mortality
  - Cardiovascular disease
  - Hypertension
  - Type 2 diabetes
  - Adverse blood lipid profile
  - Cancers of bladder, breast, colon, endometrium, esophagus, kidney, lung, and stomach
  - Dementia (including Alzheimer’s disease)
  - Anxiety and depression
  - Falls (older adults)
  - Fall-related injuries (older adults)

- **Improved:**
  - Quality of life
  - Cognition
  - Sleep
  - Bone health
  - Physical function

- Slowed or reduced weight gain
- Weight loss, particularly when combined with reduced calorie intake
- Prevention of weight regain following initial weight loss

Slide adapted from the Physical Activity Guidelines for Americans, 2nd edition. Available at [health.gov/PAGuidelines](http://health.gov/PAGuidelines)
2018 PA Guidelines

How much activity do I need?

**Moderate-intensity aerobic activity**

Anything that gets your heart beating faster counts.

- At least 150 minutes a week

**Muscle-strengthening activity**

Do activities that make your muscles work harder than usual.

- At least 2 days a week

Tight on time this week? **Start with just 5 minutes.** It all adds up!

Why Does PA Matter?

Costs of Inadequate Physical Activity*

- $117 billion dollars in annual health care costs
- 10 percent of premature mortality

*Defined as not meeting the key guidelines for adults

Percentage of U.S. Adults Ages 18 Years or Older Who Met the Aerobic and Muscle-Strengthening Guidelines, 2008–2016

Slide courtesy of the Physical Activity Guidelines for Americans, 2nd edition. Available at healthy.gov/PAGuidelines
Technology May be a Useful Tool for Understanding and Promoting PA Behavior

96% of Americans own cellphone
81% Own a smartphone

~22% of Americans own wearables
How Could This Help Us Better Understand PA Behavior?

- Social Media
- Videos/Pictures
- Publically Available Data
- Surveys/Feedback
- Pairing with other sensors
- GIS/GPS
- Medical Records

How Could this Help Us Better Understand Physical Activity Behavior?
How Could Technology Help Us Promote PA?

- Greater reach
- More scalable
- Less burdensome
- Ability to remotely monitor patients
- Can integrate PA data with other data streams
- Facilitates tailoring of PA programs

Technology-based PA Interventions

- Meta-analyses demonstrate mixed findings:
  - Significant increase in:
    - Daily steps, MVPA and energy expenditure in interventions with **wearable PA trackers** (standardized mean different=0.24-0.28)
    - PA in **interventions using mobile devices** v. control conditions (Weighted mean effect size= 0.54)
    - PA in interventions using **text messaging** v. control (Median effects size= 0.50)
  - **Technology-based interventions** 12% more effective than similar or minimal control interventions in increasing PA
    - Interventions targeting patients 25% more effective
  - Non-significant increases in:
    - Overall steps in interventions with **smartphone app** (mean difference of 476.75 steps)
      - Short-term (3 month) interventions and those only targeting PA (without diet) were significant
    - Total PA and walking in **mhealth interventions** (standardized mean difference= 0.14 for both)

Brickwood KJ et al., 2019, JMIR Mhealth Uhealth, 7(4); Romeo A et al., 2019, JMIR, 21(3); Bucholz SW et al., 2013, Worldviews Evid Based Nurs, 10(3); Fanning J et al., 2012, JMIR. 14(6); Hakala S et al., 2017, Eur J Phys Rehabil Med, 53(6); Diretto A et al., 2017, Ann Behav Med, 51(2)
Using Technology To Understand PA Behavior Real World Example: IMPACT Study

Funded by the Lynn Sage Cancer Foundation
Methods

- "Burst" 1: Wear Actigraph 24/7, Daily EMA Assessments
- 5-7 weeks
- Complete Questionnaire Battery

- "Burst" 2: Wear Actigraph 24/7, Daily EMA Assessments
- Complete Questionnaire Battery

- "Burst" 3: Wear Actigraph 24/7, Daily EMA Assessments
- Complete Questionnaire Battery & Study Evaluation
- Obtain Medical Record Data

Treatment

IMPACT
My sleep quality last night was...

1 2 3 4 5 6 7 8 9 10

Very Poor Poor Fair Good Very Good

next
Results: Participants

- 75 women consented and were eligible
  - Cycle 1: 35.8%; Cycle 2: 64.2%
  - n=63 (84%) completed all 3 time points
    - n=8 withdrew prior to/during T1 because felt too burdensome
    - n=5 lost to follow-up
      - n=1 discontinued CT prior to T2
      - n=2 discontinued CT prior to T3; n=1 had health complication at T3

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Descriptives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age [M, (SD)]</td>
<td>48.6 [31-71]</td>
</tr>
<tr>
<td>Disease Stage</td>
<td></td>
</tr>
<tr>
<td>Stage 1: 26.2%</td>
<td></td>
</tr>
<tr>
<td>Stage 2: 53.8%</td>
<td></td>
</tr>
<tr>
<td>Stage 3: 20.0%</td>
<td></td>
</tr>
<tr>
<td>Neo-adjuvant Chemotherapy</td>
<td>34.3%</td>
</tr>
<tr>
<td>Very Good/Excellent Health Status</td>
<td>52.2%</td>
</tr>
<tr>
<td>BMI</td>
<td>27.6 (6.8)</td>
</tr>
<tr>
<td>Non-white</td>
<td>23.4%</td>
</tr>
<tr>
<td>Hispanic/Latina</td>
<td>12.9%</td>
</tr>
<tr>
<td>≥College Degree</td>
<td>78.1%</td>
</tr>
<tr>
<td>Working at least part-time</td>
<td>67.2%</td>
</tr>
<tr>
<td>Household Income ≥$100K</td>
<td>46.3%</td>
</tr>
</tbody>
</table>

Solk, P et al., Quality of Life Research (2019) 28:3333–3346
Individuals MVPA Varies
## Results: Daily Symptoms and MVPA

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Between Subjects</th>
<th>Within Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta$ [95% CI]</td>
<td>$\beta$ [95% CI]</td>
</tr>
<tr>
<td>Affect</td>
<td>2.06 [-0.71, 4.84]</td>
<td>1.95 [1.61, 2.30]</td>
</tr>
<tr>
<td>Anxiety</td>
<td>-2.76 [-7.10, 1.58]</td>
<td>-1.05 [-2.06, -0.4]</td>
</tr>
<tr>
<td>Fatigue</td>
<td>-6.89 [-14.36, 0.56]</td>
<td>-4.90 [-5.82, -3.98]</td>
</tr>
<tr>
<td>Depression</td>
<td>-0.17 [-7.30, 6.96]</td>
<td>-0.52 [-2.10, 1.06]</td>
</tr>
<tr>
<td>Pain</td>
<td>-0.72 [-3.30, 1.86]</td>
<td>-1.48 [-1.87, -1.08]</td>
</tr>
<tr>
<td>Activities of Daily Living Physical Function</td>
<td>-4.49 [-10.14, 1.16]</td>
<td>-4.22 [-5.01, -3.42]</td>
</tr>
<tr>
<td>Walk 15 minutes Physical Function</td>
<td>-6.47 [-12.53, -0.41]</td>
<td>-4.70 [-5.43, -3.98]</td>
</tr>
<tr>
<td>Cognitive Function</td>
<td>5.84 [0.55, 11.13]</td>
<td>3.93 [2.92, 4.94]</td>
</tr>
</tbody>
</table>

**Controls for**: time point, age, treatment status, disease stage, adjuvant v. neodjuvant, cumulative number of treatment cycles, BMI, total number of comorbidities, health status and wear time
### Preliminary Results: Motivational Factors and MVPA

<table>
<thead>
<tr>
<th>Social Cognitive Variable</th>
<th>Between Subjects β [95% CI]</th>
<th>Within Subjects β [95% CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Efficacy MVPA</td>
<td>0.04 [-0.11, 0.19]</td>
<td>1.9 [1.7, 2.1]</td>
</tr>
<tr>
<td>Physical Outcome Expectations</td>
<td>4.05 [-0.64, 8.76]</td>
<td>3.19 [2.33, 4.04]</td>
</tr>
<tr>
<td>Psychological Outcome Expectations</td>
<td>4.06 [-0.55, 8.70]</td>
<td>2.70 [1.77, 3.63]</td>
</tr>
<tr>
<td>Daily Goal Setting</td>
<td>1.45 [-3.44, 6.33]</td>
<td>4.54 [3.98, 5.10]</td>
</tr>
</tbody>
</table>
Opportunities and Challenges

• Opportunities:
  - Easy to use
  - Widespread adoption
  - Unobtrusive
  - May be more accurate than recalls
  - Provides data on many factors that may influence health behavior

• Challenges
  - Can be burdensome
  - Tech challenges (battery issues, data, not carrying phone, etc.)
  - May be an intervention in and of itself
  - Mindless answering of prompts
  - Privacy concerns
  - Measuring non-aerobic PA

• Need advanced methods for making sense of large volumes of data
Potential Technology-Supported Intervention Features

- Educational Information
- Coach
- Team
- Buddy
- Incentives
- Exergames
- Online group webinars
- Fitbit
- App
  - Scheduler
  - Feedback on progress
  - Activity log or tracker
  - Activity challenges
  - Newsfeed
  - Message boards
- Text Messages
- Exercise videos
Classic Treatment Package Approach

- App
- Coach
- Fitbit
- Challenges
- Text Messages

Physical Activity Intervention

Evaluate in RCT
## Limitations of this Approach

<table>
<thead>
<tr>
<th>Significant Effect</th>
<th>Non-significant Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which components are contributing to effects</td>
<td>Whether any component is worth retaining</td>
</tr>
<tr>
<td>Whether inclusion of one component impacts the effect of another</td>
<td>Whether one component had negative effect that offset positive effect of another</td>
</tr>
<tr>
<td>Whether component’s contribution offsets its cost</td>
<td>Specifically what went wrong and how to do it better next time</td>
</tr>
<tr>
<td>Whether all components are really needed</td>
<td></td>
</tr>
<tr>
<td>How to make intervention more effective, efficient and scalable</td>
<td></td>
</tr>
</tbody>
</table>

Courtesy of Linda Collins
Multiphase Optimization Strategy (MOST)

- Engineering inspired framework for optimizing and evaluating interventions to efficiently and systematically identify most promising intervention components/component levels

**PREPARATION**
- Derive/revise conceptual model
- Identify set of candidate components
- Identify optimization criterion

**OPTIMIZATION**
- Optimization trial(s)
  - Factorial experiment
  - Fractional factorial experiment
  - SMART
  - Micro-randomized trial
  - System identification
  - Other
- Based on results, identify intervention that meets optimization criterion

**EVALUATION**
- Confirm effectiveness of optimized intervention via RCT

Optimized intervention expected to be sufficiently effective?

Continual optimization principle

Resource management principle

Fit2Thrive (K07CA196840; R21CA219028)

Preparation Phase

• Goals:
  • Understand survivors’ interests and preferences for technology-supported PA intervention components via online survey and interviews
  • Use data to develop intervention components to test in Phase 2
  • Engage survivors in intervention development

Optimization Phase

• Goals:
  • Apply MOST using a factorial experiment to:
    • Identify which components/component levels significantly increase average daily minutes of MVPA in BCS (n=256)
    • Build a more scalable intervention made up of only components that:
      • Have a detectable effect on MVPA ($p<0.05$)
      • Cost <$550.00

Considering real world implementation from the start!
Fit2Thrive Intervention

- Fitbit Buddy
- Deluxe App
- App Notifications
- Bi-Weekly Coaching Calls
- Online Gym

Fit2Thrive Intervention is a comprehensive program that includes a Fitbit Buddy, a Deluxe App, and online coaching calls. The program also features bi-weekly coaching calls and notifications for users to track their progress and stay motivated.
<table>
<thead>
<tr>
<th>Exp Condition</th>
<th>Core Intervention</th>
<th>Coaching Calls</th>
<th>App Type</th>
<th>Fitbit Buddy</th>
<th>Online Gym</th>
<th>Text Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td>No</td>
<td>Standard</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td>No</td>
<td>Standard</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td>No</td>
<td>Standard</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td>No</td>
<td>Standard</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>Yes</td>
<td>No</td>
<td>Standard</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
<td>Yes</td>
<td>No</td>
<td>Standard</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>7</td>
<td>Yes</td>
<td>No</td>
<td>Standard</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>Yes</td>
<td>No</td>
<td>Standard</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>Yes</td>
<td>No</td>
<td>Deluxe</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>10</td>
<td>Yes</td>
<td>No</td>
<td>Deluxe</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>11</td>
<td>Yes</td>
<td>No</td>
<td>Deluxe</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>12</td>
<td>Yes</td>
<td>No</td>
<td>Deluxe</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>13</td>
<td>Yes</td>
<td>No</td>
<td>Deluxe</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>14</td>
<td>Yes</td>
<td>No</td>
<td>Deluxe</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>15</td>
<td>Yes</td>
<td>No</td>
<td>Deluxe</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>16</td>
<td>Yes</td>
<td>No</td>
<td>Deluxe</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>17</td>
<td>Yes</td>
<td>Yes</td>
<td>Standard</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>18</td>
<td>Yes</td>
<td>Yes</td>
<td>Standard</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>19</td>
<td>Yes</td>
<td>Yes</td>
<td>Standard</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>20</td>
<td>Yes</td>
<td>Yes</td>
<td>Standard</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>21</td>
<td>Yes</td>
<td>Yes</td>
<td>Standard</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>22</td>
<td>Yes</td>
<td>Yes</td>
<td>Standard</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>23</td>
<td>Yes</td>
<td>Yes</td>
<td>Standard</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>24</td>
<td>Yes</td>
<td>Yes</td>
<td>Standard</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>25</td>
<td>Yes</td>
<td>Yes</td>
<td>Deluxe</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>26</td>
<td>Yes</td>
<td>Yes</td>
<td>Deluxe</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>27</td>
<td>Yes</td>
<td>Yes</td>
<td>Deluxe</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>28</td>
<td>Yes</td>
<td>Yes</td>
<td>Deluxe</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>29</td>
<td>Yes</td>
<td>Yes</td>
<td>Deluxe</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>30</td>
<td>Yes</td>
<td>Yes</td>
<td>Deluxe</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>31</td>
<td>Yes</td>
<td>Yes</td>
<td>Deluxe</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>32</td>
<td>Yes</td>
<td>Yes</td>
<td>Deluxe</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Intervention Implementation

- **Fitbit**

- **Standard App/Deluxe App**
  - Standard= self-monitoring
  - Deluxe= Goal-setting/scheduling , Challenges, Newsfeed

- **Coaching Calls**
  - Bi-weekly to discuss progress and problem-solve
Intervention Implementation

- Tailored Text Messages
  - 2-3 messages per day focused on social cognitive theory constructs and feedback on progress

- On-line Gym
  - Weekly automated email with schedule and links to workouts

- Fitbit Buddy
  - Choose buddy from personal life
  - Sent email to screen/consent and share Fitbit data
  - Buddy sent instructional packet + Fitbit
  - Buddy and participant sent automated, bi-weekly email

Assignment: Engage in a physical activity together

- These next two weeks, try to focus on exercising as a team! This can be done either in person, or virtually using technology. The important part is to both participate in the activity to create a positive exercise atmosphere and increase adherence! Below are two ideas for engaging in an activity together. You can do both each week or split them up and try one this week and one next week.

Partner Workout

- If you are able to meet in person, meet up 2-3 times a week for a walk or cardio exercise. Click here for a partner workout you can do together!

For those buddies without the ability to meet in-person, FaceTiming, Skyping, or talking on the phone while doing a workout are all great replacements for in-person contact. Of course, just be sure you are walking or exercising somewhere safe and remain aware of your surroundings. Another alternative is to schedule a work-out at the same time and text or call each other before and after.
Participants

- 419 Screened
- 348 Passed Screening
- 269 Randomized
- 265 Received Intervention

  - 250 (94.4%) Retained at 12 weeks
  - 242 (91.3%) Retained at 24 weeks
  - 218 (81%) Valid PA Data at week 12 & 24

Demographics

- Age = 44.3; range = 24-75
- Mean BMI = 28.0 (SD = 6.3)
- 46 states + Puerto Rico represented
- 10.5% Non-White
- 6.5% Hispanic/Latina
- 76.5% ≥ College Degree
- 48.7% Income ≥ $100K

Disease Characteristics

- 80.5% Stage 1/2 Disease
- Treatment:
  - 100% Surgery
  - 69.6% Radiation Therapy
  - 68.5% Chemotherapy
- Time Since Diagnosis = 3.0 years (SD = 2.4)
- 59.2% Very Good/Excellent Health Status
Preliminary Week 12 MVPA Results

MVPA significantly increased by 59.3 min/week and 8.5 min/day.
21.5% increase in the # women ≥150 min/week MVPA.
No Differences in MVPA min/day by Component

<table>
<thead>
<tr>
<th>Component</th>
<th>Off $M$ (SE)</th>
<th>On $M$ (SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deluxe App</td>
<td>9.9 (1.6)</td>
<td>7.4 (1.5)</td>
</tr>
<tr>
<td>Support Calls</td>
<td>8.2 (1.5)</td>
<td>9.0 (1.5)</td>
</tr>
<tr>
<td>Online Gym</td>
<td>9.8 (1.5)</td>
<td>7.5 (1.5)</td>
</tr>
<tr>
<td>Fitbit Buddy</td>
<td>8.1 (1.5)</td>
<td>9.1 (1.5)</td>
</tr>
<tr>
<td>App Notifications</td>
<td>8.1 (1.5)</td>
<td>9.2 (1.5)</td>
</tr>
</tbody>
</table>
Preliminary Week 12  Fit2Thrive Acceptability (n=239)
Adherence to Intervention Components

**Core Intervention**
- 67% report using app ≥5-6 x/wk
- 95% days Fitbit worn

**Online Gym**
- 54% report using online gym ≥1x/week
- 42% report NEVER used online gym

**Support Calls**
- 99% support call complete

**App Notifications**
- 57% App notification marked “read”

**Buddy**
- 88% discussed Fit2Thrive or Exercising w/Buddy ≥1x/wk
- 60% report at least some support from Buddy for exercise each week

**Stay Tuned for Deluxe App Data**
Fit2ThriveMB (R21CA239130)
MyActivity Study (R37CA225877)

- Participant self-monitors MVPA using Fitbit
- MVPA data automatically sent to EHR via patient portal
- Weekly feedback & encouragement sent via patient portal (w/ clinician endorsement) & EHR alerts for clinicians to address at appointments

*Non-responders: Met <80% of MVPA goal during previous 4 wks; Responders: Met ≥80% of MVPA goal during previous 4 wks; Assessed every 4 weeks until week 20.*
Opportunities and Challenges

• Opportunities:
  - Easy to use
  - Can reach large number of people where they are
  - Rich data in real-time
  - Low cost
  - Allows for easily turning “on” or “off” components

• Challenges
  - Can be burdensome on participants
  - Tech issues (battery issues, missing data, not carrying phone, syncing, etc.)
  - Sustained engagement
  - Implementation and dissemination at larger scale
  - Keeping up with changes in technology
  - Promoting non-aerobic PA
  - Engaging social networks/social support
“The significant problems we face cannot be solved by the same level of thinking that created them.”

~A. Einstein
Physical Activity Behavior is Complex!

- Technology may allow us to:
  - Better integrate multiple data sources to better understand and promote PA
  - Develop effective interventions with higher scalability
  - More easily answer the questions:
    - What is the best “minimal” intervention? For which outcome?
    - What “dose” and type of PA is needed? For which outcomes enough?
    - What works for whom, when, under what conditions, and for what outcome?
    - How much should we tailor?

King AC et al, 2008 Ann Behav Med, 35(3); McVay MA, 2019, Health Psych, 28(12)
Acknowledgements

All of the study participants who so generously give of their time.

Northwestern University
Bonnie Spring
David Cella
Ron Ackerman
Juned Siddique
William Funk
William Gradishar
Emma Barber
Julia Lee
Whitney Welch
Kara Gavin
Payton Solk
Marilyn Lu
Jennifer La
Erin Cullather
Former Research Asssistants
Undergraduate interns

Penn State University
Linda Collins

University of Alberta
Kerry Courneya

University of Miami
Frank Penedo

Funding Agencies
NCI K07CA196840
NCI R21CA219028
NCI R37CA225877
NCI R21CA239130
Lynn Sage Cancer Research Foundation
Robert H. Lurie Comprehensive Cancer Center
Northwestern University Clinical and Translational Sciences Institute

Recruitment of Participants
Army of Women