

Methods: Mind the Gap
Webinar Series

Using Technology To Understand and Promote Physical Activity Behavior



Presented by:

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National Institutes of Health
Office of Disease Prevention

Using Technology to Understand and Promote Physical Activity Behavior

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NIH Office of Disease Prevention Mind the Gap Webinar
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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

2018 PA Guidelines

How much activity do I need?

Moderate-intensity aerobic activity

Anything that gets your heart beating faster counts.



Muscle-strengthening activity

Do activities that make your muscles work harder than usual.



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

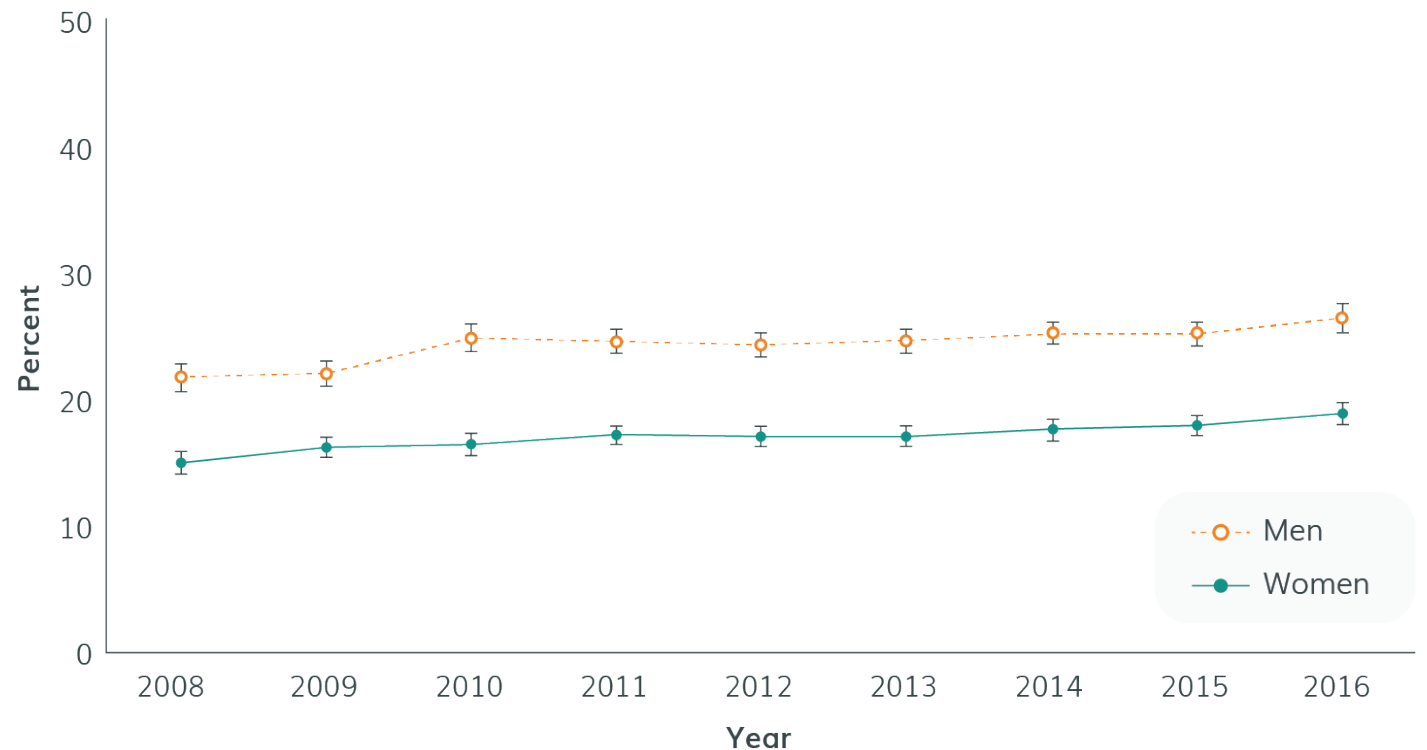
Why Does PA Matter?

Costs of Inadequate Physical Activity*

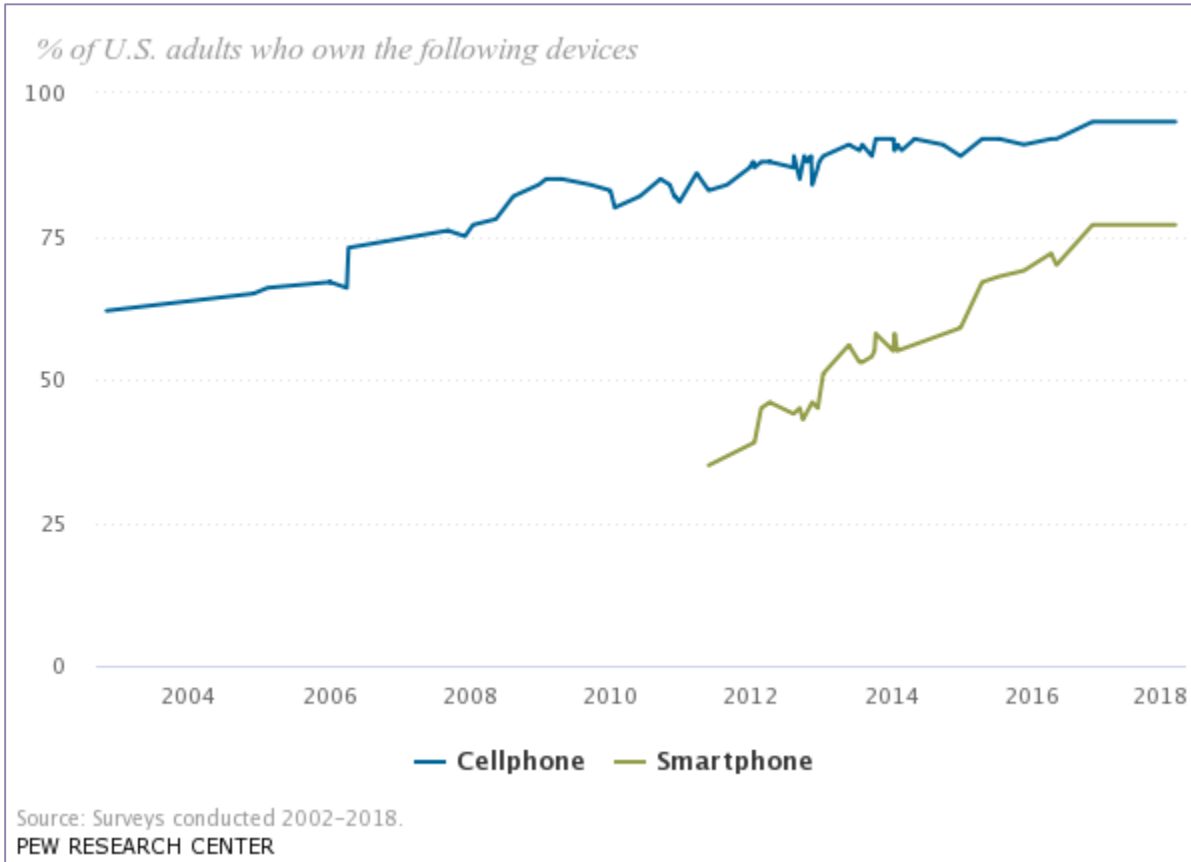
- \$117 billion dollars in annual health care costs
- 10 percent of premature mortality

*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

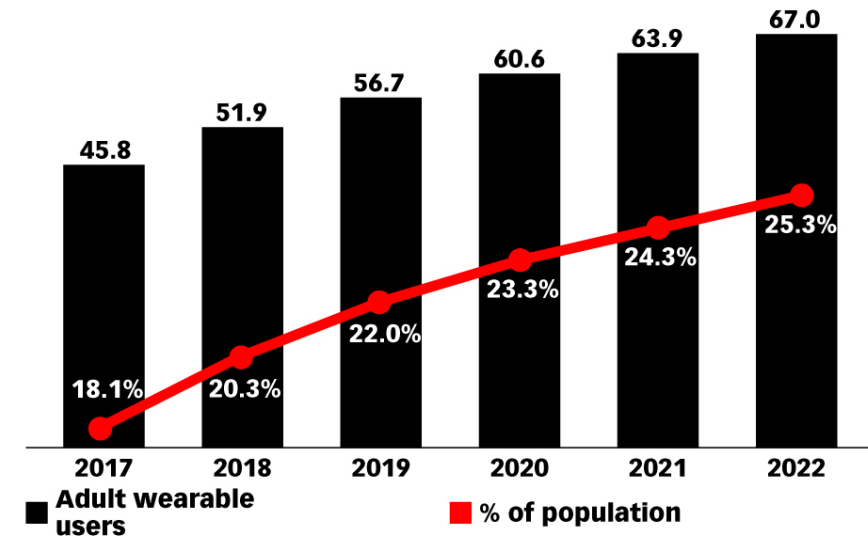


Technology May be a Useful Tool for Understanding and Promoting PA Behavior



96% of Americans own cellphone
81% Own a smartphone

US Adult Wearable Users and Penetration, 2017-2022
millions and % of population



Note: at least once per month; individuals ages 18+ who wear accessories or clothing embedded with electronics, software or sensors that have the ability to connect to the internet (via built-in connectivity or tethering), which in turn collects and exchanges data with a manufacturer, operator or other connected devices

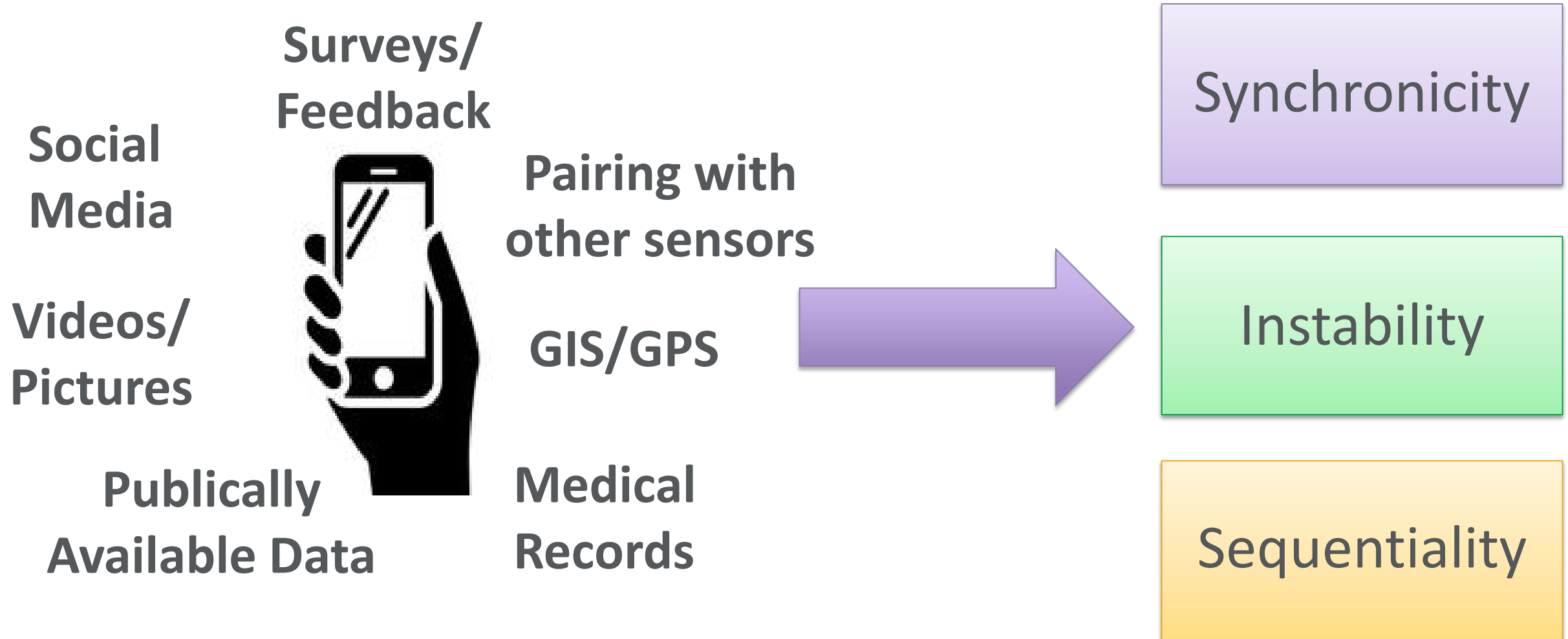
Source: eMarketer, Nov 2018

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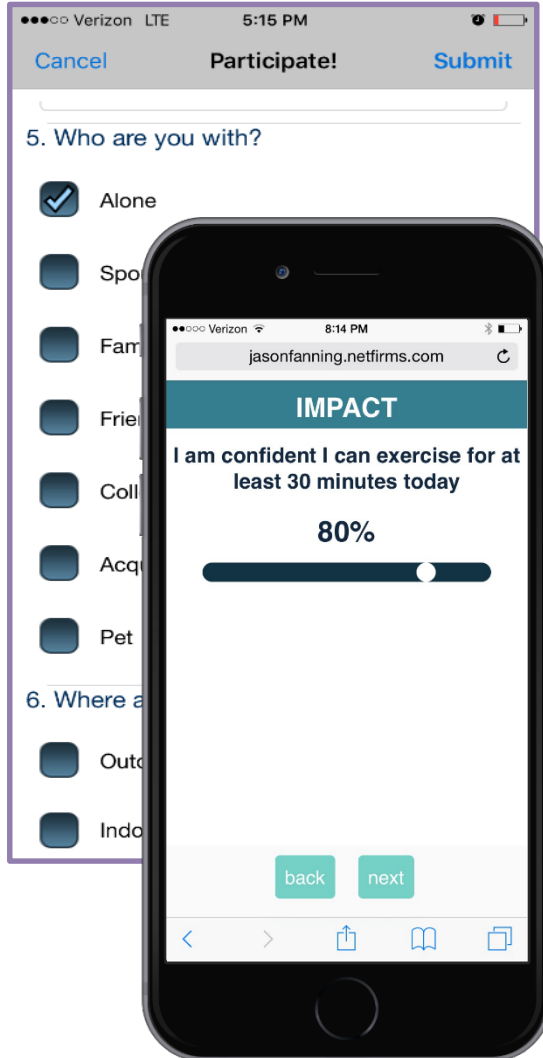
www.eMarketer.com

~22% of Americans own wearables

How Could This Help Us Better Understand PA Behavior?



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



Finding a local walking group can be a great way to get your exercise in and meet new people. Give it a try!

Dislike

Love



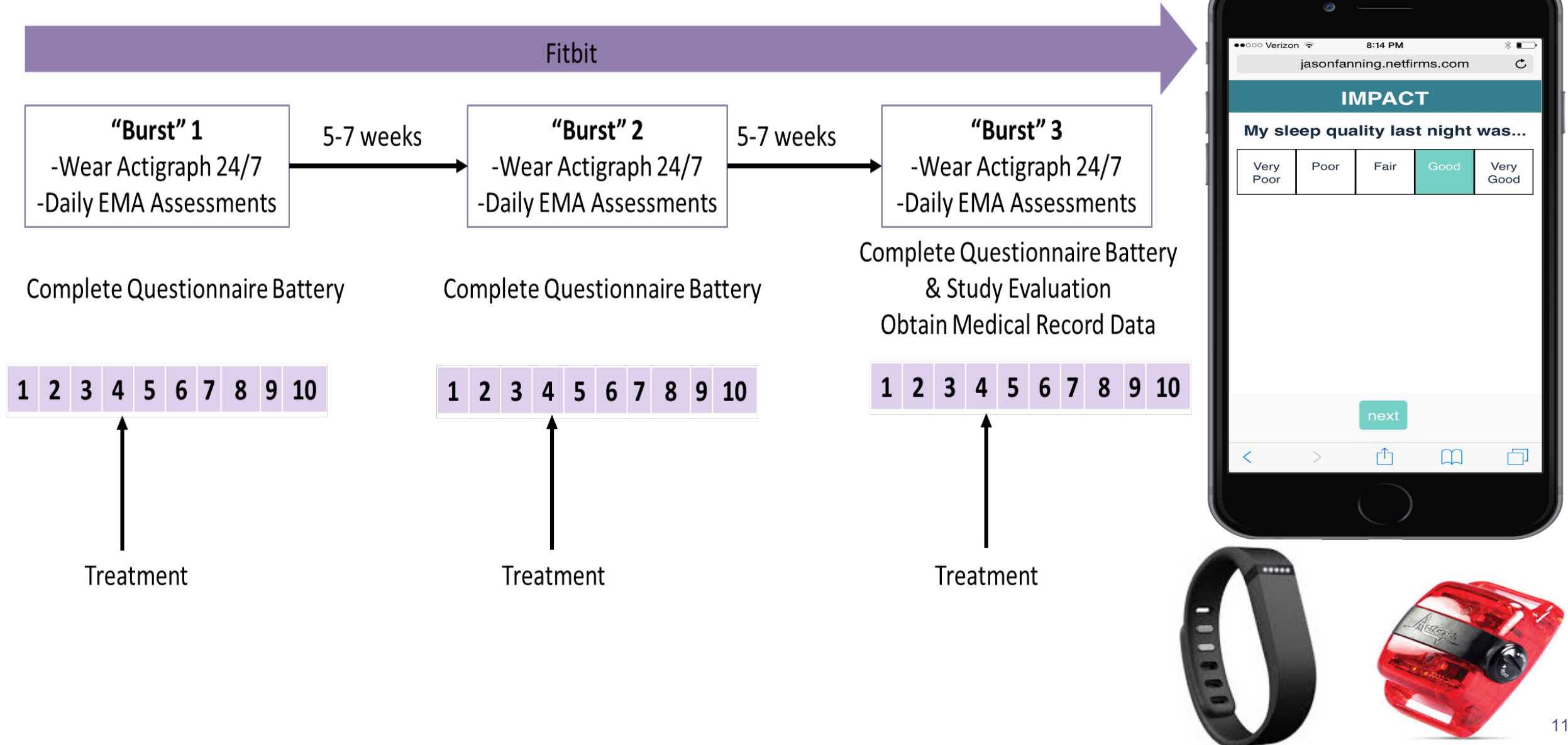
Technology-based PA Interventions

- Meta-analyses demonstrate mixed findings :
 - Significant increase in:
 - Daily steps, MVPA and energy expenditure in interventions with **wearable PA trackers** (standardized mean difference=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)

Using Technology To Understand PA Behavior Real World Example: IMPACT Study

Funded by the Lynn Sage Cancer Foundation

Methods

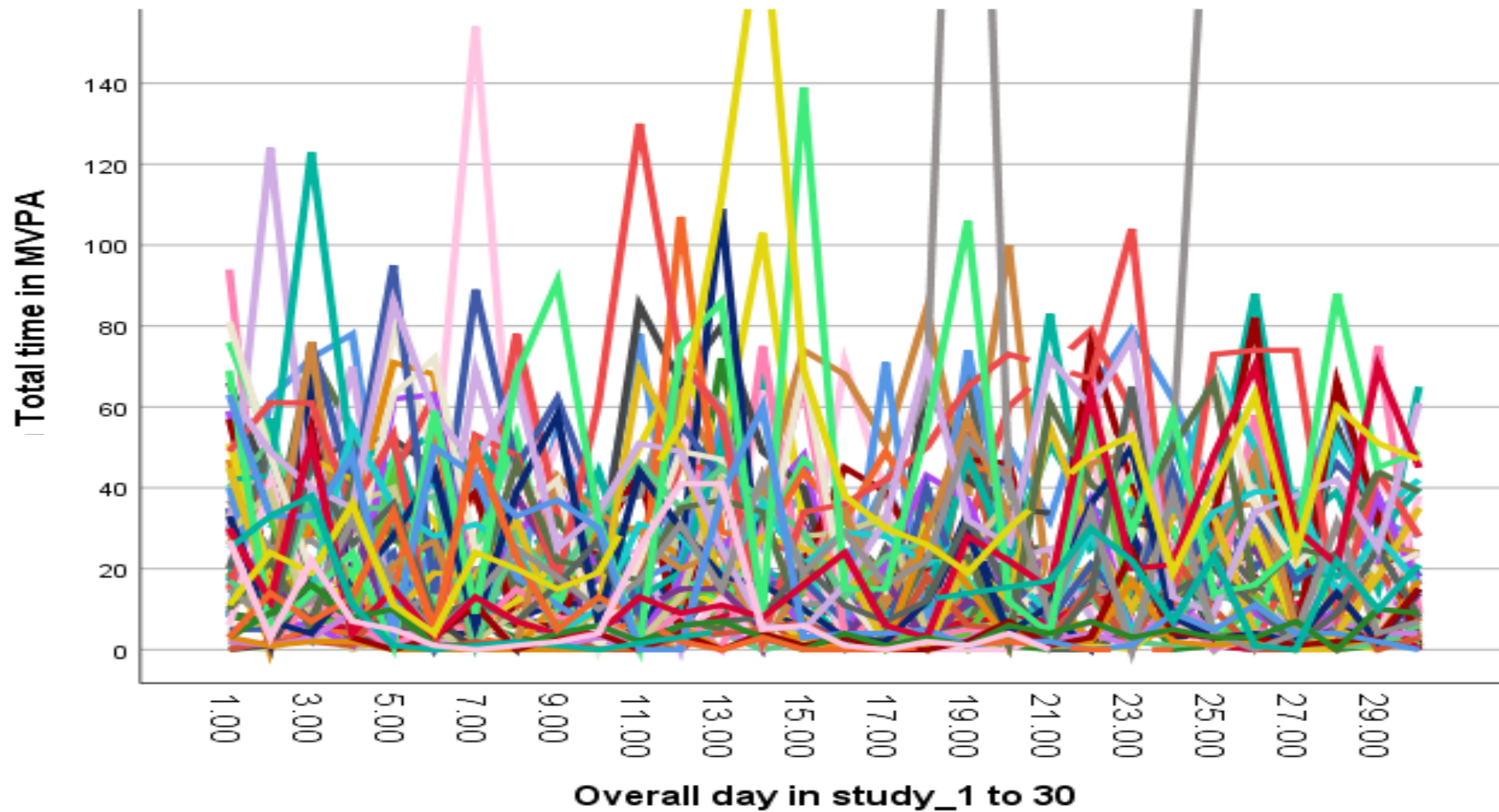


Results: Participants

- 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

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

Individuals MVPA Varies



Results: Daily Symptoms and MVPA

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

Controls for: time point, age, treatment status, disease stage, adjuvant v. neoadjuvant, cumulative number of treatment cycles , BMI, total number of comorbidities, health status and wear time

Preliminary Results: Motivational Factors and MVPA

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

Opportunities and Challenges

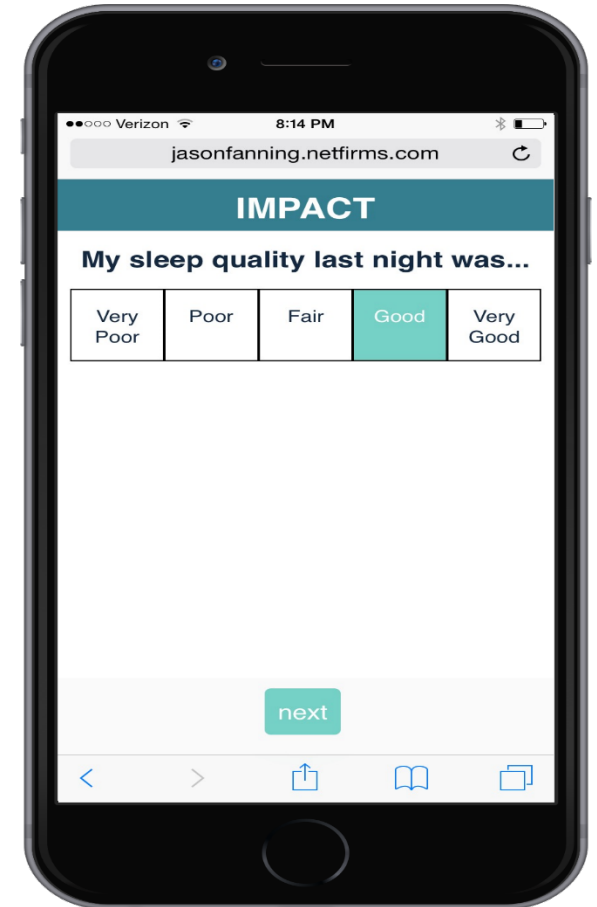
- Opportunities:

- 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



Using Technology To Promote PA: Real World Examples

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

Verizon 1:45 PM 67%

< Search Edit Activity

ACTIVITY

Boot camp: moderate effort

MINUTES

27
28
29
30
31
32
33

RATED PERCEIVED EXERTION (RPE)

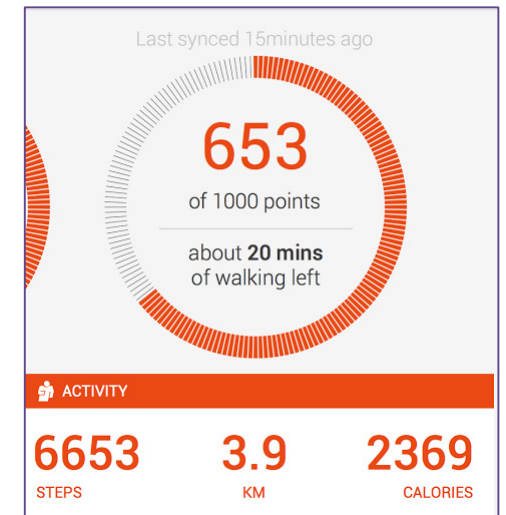
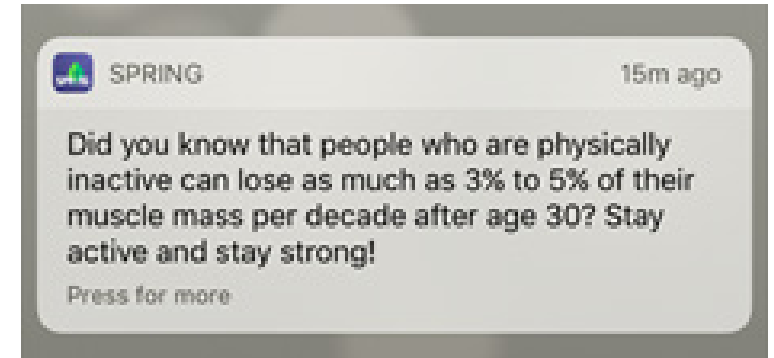
1 at hard 14 15 Hard

ENJOYMENT

3 4 5

Somewhat

CANCEL X ADD ACTIVITY +



Classic Treatment Package Approach

App

Coach

Fitbit

Challenges

Text Messages



**Physical
Activity
Intervention**



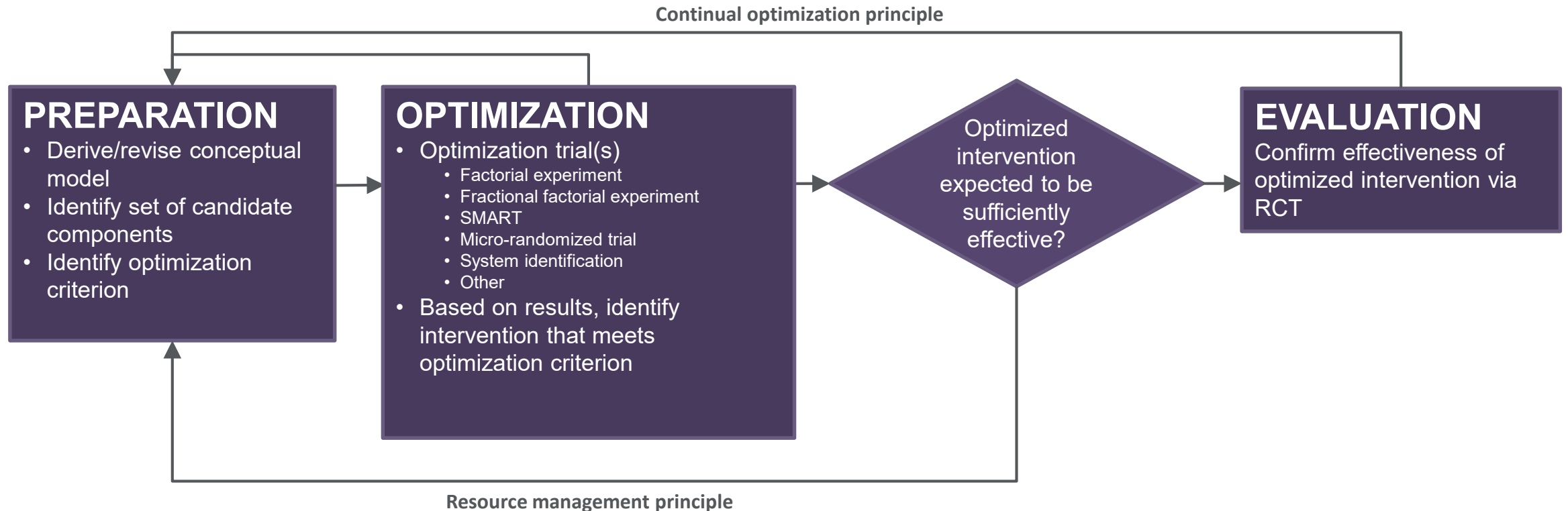
**Evaluate
in RCT**

Limitations of this Approach

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

Multiphase Optimization Strategy (MOST)

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



Fit2Thrive (K07CA196840; R21CA219028)

Preparation Phase

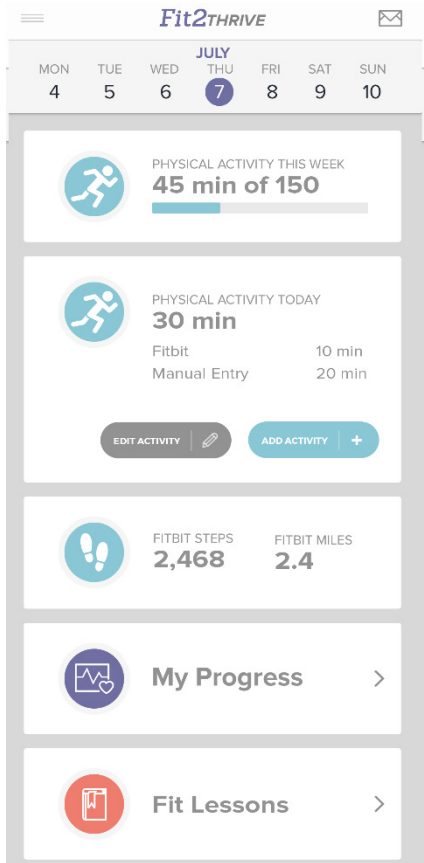
- **Goals:**
 - Understand survivors' interests and preferences for technology-supported PA intervention components via online survey and interviews
 - Use data to develop intervention components to test in Phase 2
 - Engage survivors in intervention development

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

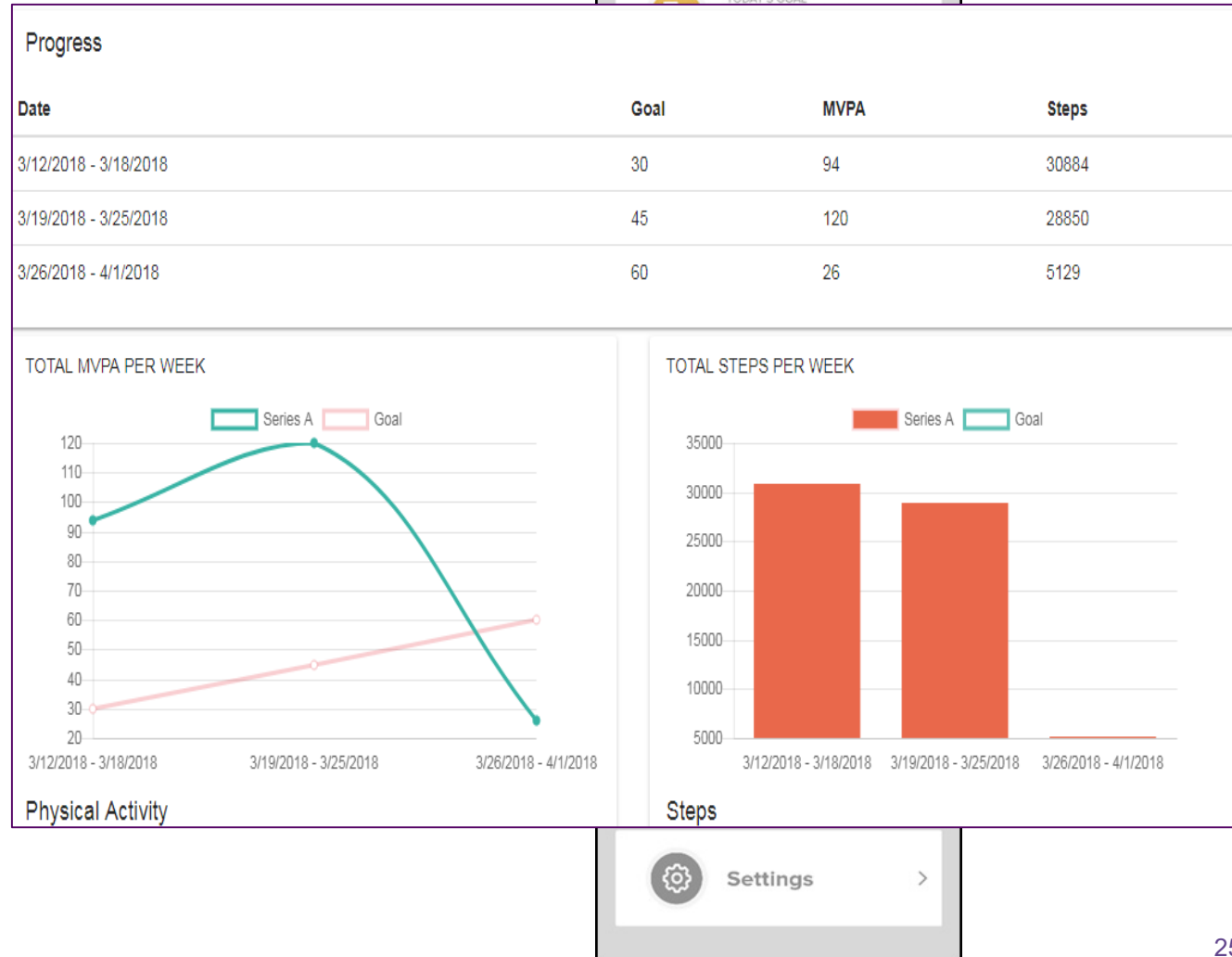
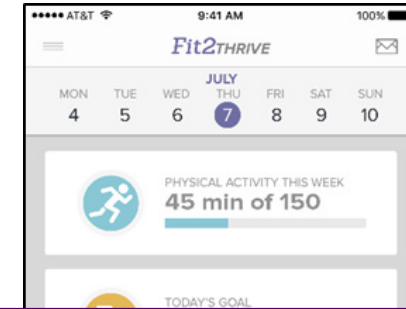
Bi-Weekly
Coaching Calls

Online Gym

Exp Condition	Core Intervention	Coaching Calls	App Type	Fitbit Buddy	Online Gym	Text Messages
1	Yes	No	Standard	No	No	No
2	Yes	No	Standard	No	No	Yes
3	Yes	No	Standard	No	Yes	No
4	Yes	No	Standard	No	Yes	Yes
5	Yes	No	Standard	Yes	No	No
6	Yes	No	Standard	Yes	No	Yes
7	Yes	No	Standard	Yes	Yes	No
8	Yes	No	Standard	Yes	Yes	Yes
9	Yes	No	Deluxe	No	No	No
10	Yes	No	Deluxe	No	No	Yes
11	Yes	No	Deluxe	No	Yes	No
12	Yes	No	Deluxe	No	Yes	Yes
13	Yes	No	Deluxe	Yes	No	No
14	Yes	No	Deluxe	Yes	No	Yes
15	Yes	No	Deluxe	Yes	Yes	No
16	Yes	No	Deluxe	Yes	Yes	Yes
17	Yes	Yes	Standard	No	No	No
18	Yes	Yes	Standard	No	No	Yes
19	Yes	Yes	Standard	No	Yes	No
20	Yes	Yes	Standard	No	Yes	Yes
21	Yes	Yes	Standard	Yes	No	No
22	Yes	Yes	Standard	Yes	No	Yes
23	Yes	Yes	Standard	Yes	Yes	No
24	Yes	Yes	Standard	Yes	Yes	Yes
25	Yes	Yes	Deluxe	No	No	No
26	Yes	Yes	Deluxe	No	No	Yes
27	Yes	Yes	Deluxe	No	Yes	No
28	Yes	Yes	Deluxe	No	Yes	Yes
29	Yes	Yes	Deluxe	Yes	No	No
30	Yes	Yes	Deluxe	Yes	No	Yes
31	Yes	Yes	Deluxe	Yes	Yes	No
32	Yes	Yes	Deluxe	Yes	Yes	Yes

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

Fit2THRIVE

Bi-weekly Buddy Email Week 1-2: Buddy Up!

Fit Buddy Fact

A [study](#) that examined the effect of having a 'buddy' on exercise adherence in individuals with diabetes found that those with a buddy reported that competition, working out together, and nudging each other motivated them to continue exercising and keep monitoring their activity.

Assignment: Engage in a physical activity together

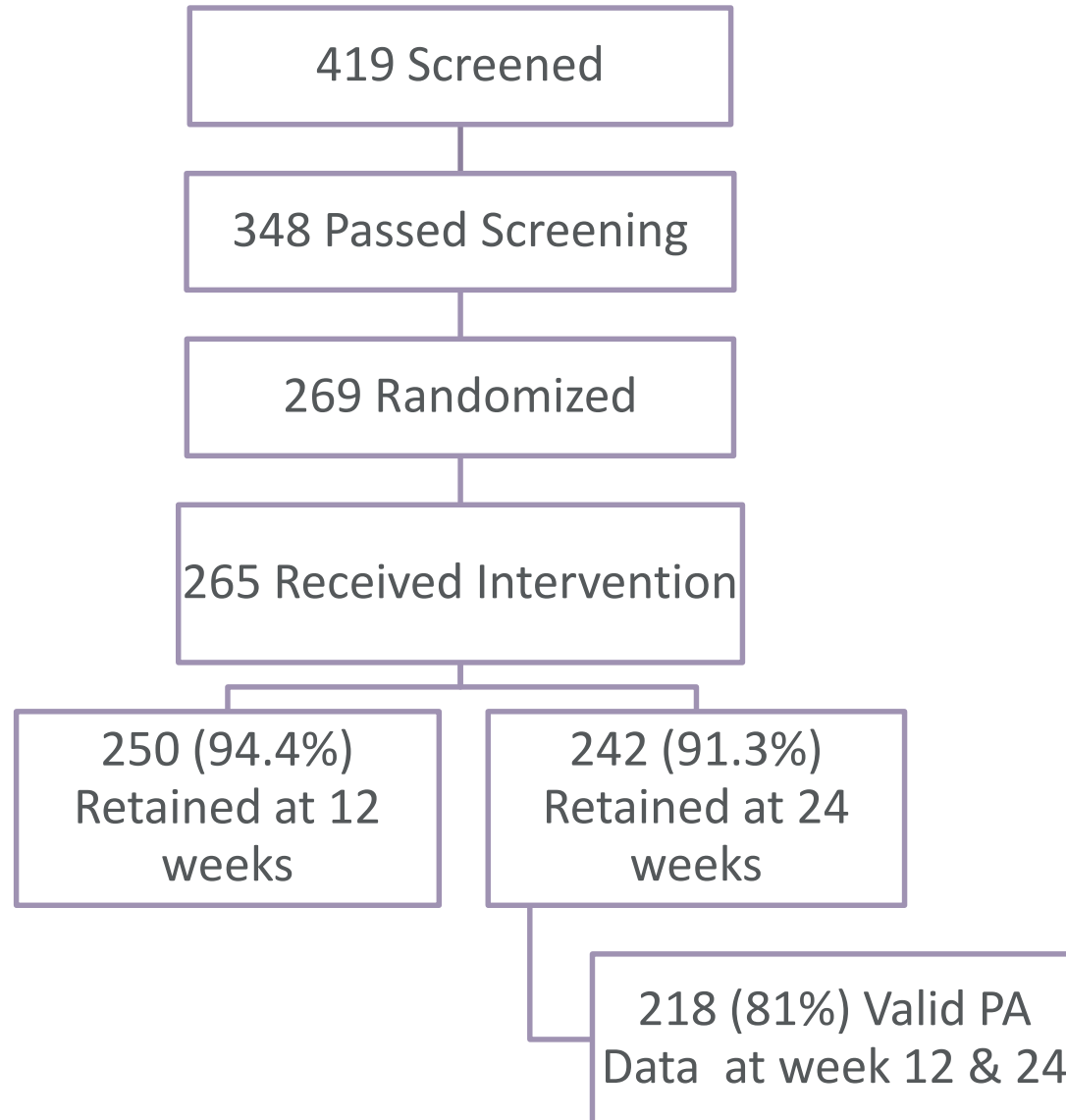
These next two weeks, try to focus on exercising as a team! This can be done either in person, or virtually using technology. The important part is to both participate in the activity to create a positive exercise atmosphere and increase adherence! Below are two ideas for engaging in an activity together.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



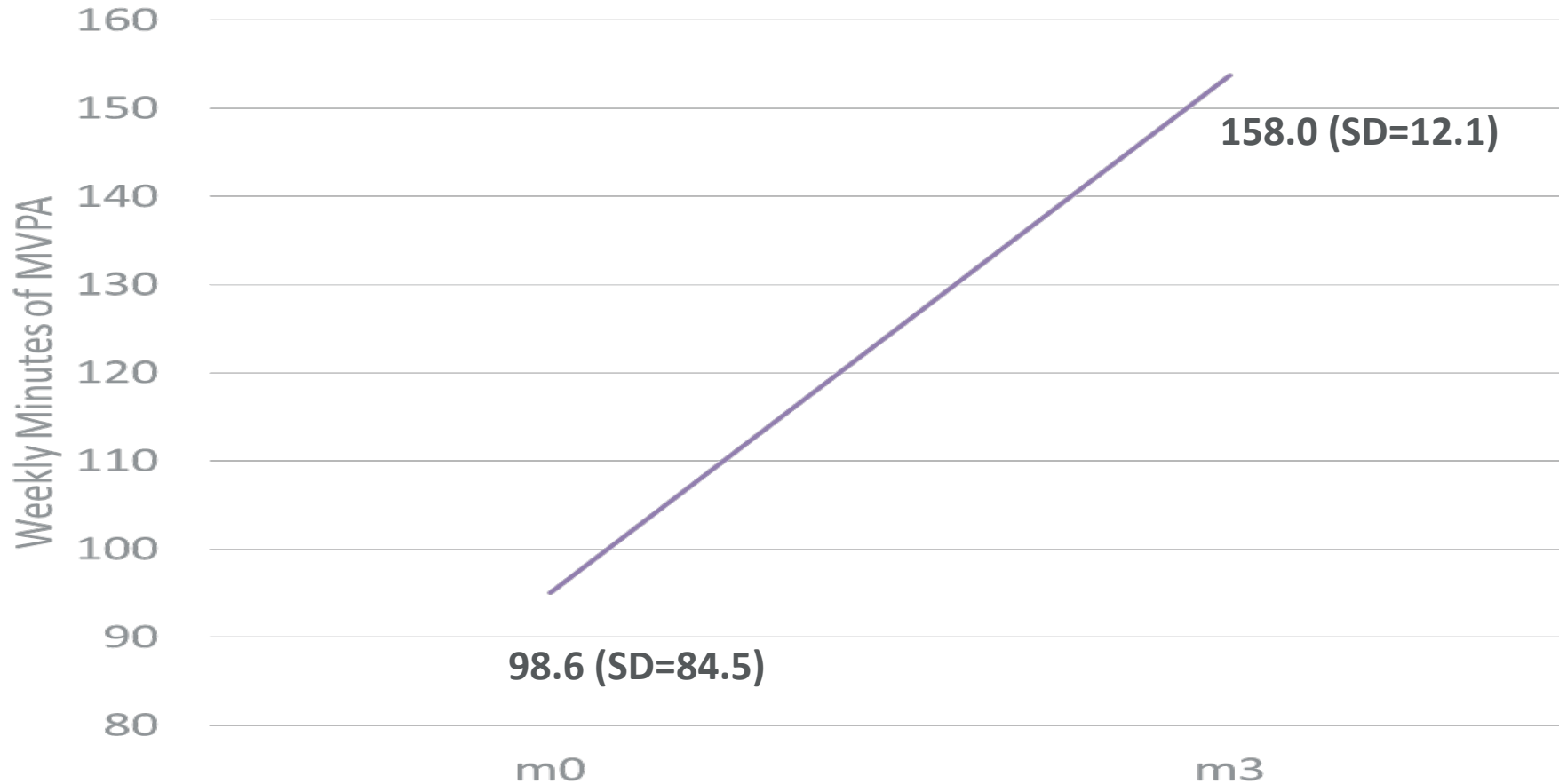
Demographics

- 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% \geq College Degree
- 48.7% Income \geq \$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

Component	Off <i>M</i> (SE)	On <i>M</i> (SE)
Deluxe App	9.9 (1.6)	7.4 (1.5)
Support Calls	8.2 (1.5)	9.0 (1.5)
Online Gym	9.8 (1.5)	7.5 (1.5)
Fitbit Buddy	8.1 (1.5)	9.1 (1.5)
App Notifications	8.1 (1.5)	9.2 (1.5)

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
 ≥ 1 x/week

42%

report
NEVER
used
online
gym

App Notifications

57%

App
notification
marked "read"

Support Calls

99%

support call
complete

Buddy

88%

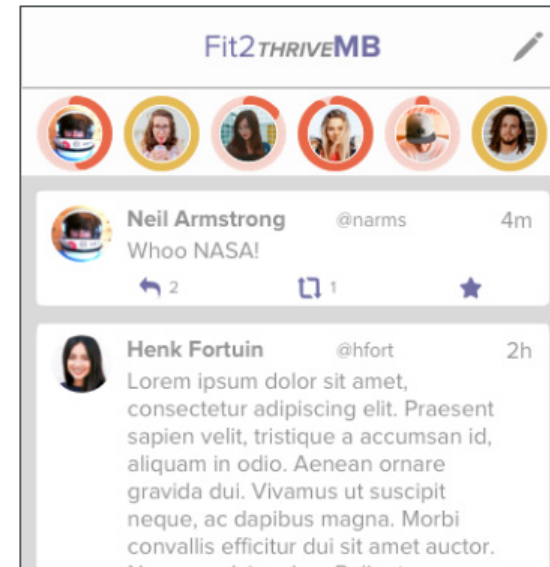
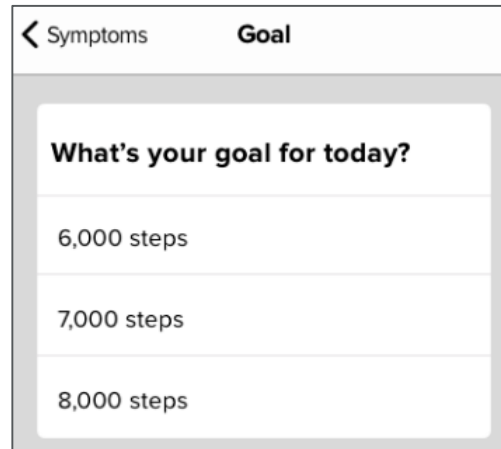
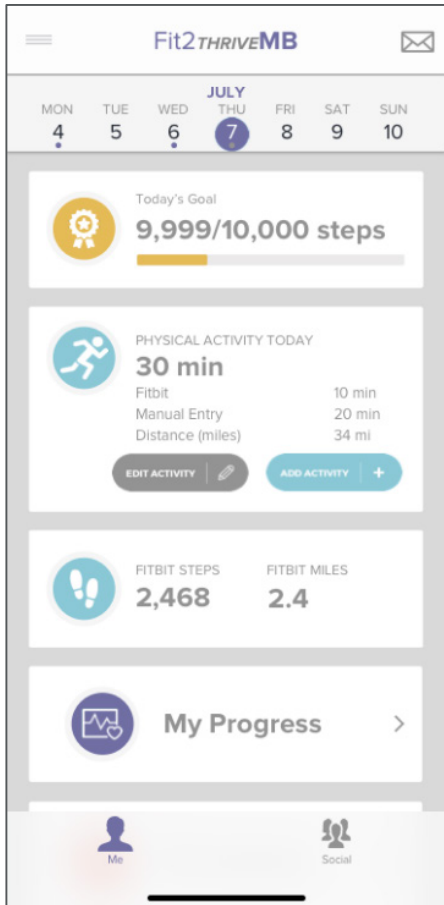
discussed
Fit2Thrive or
Exercising
w/Buddy ≥ 1 x/wk

60%

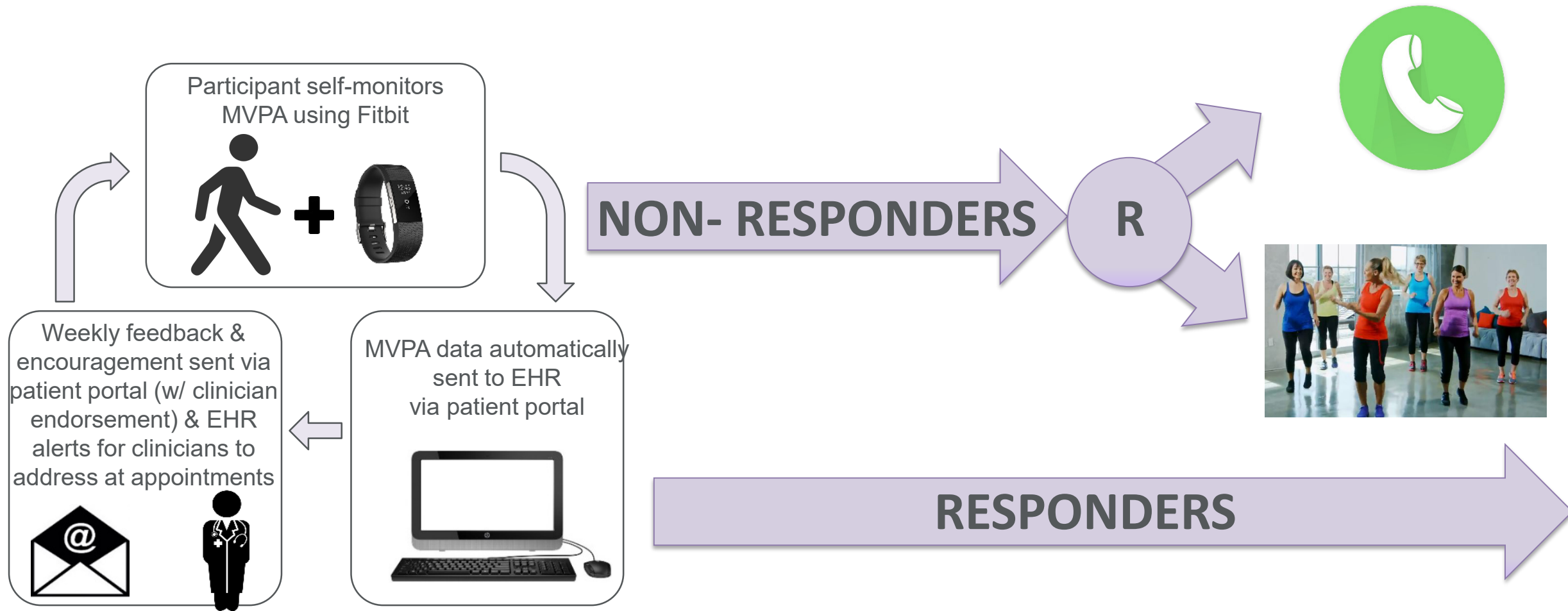
report at least
some support
from Buddy for
exercise each
week

**Stay Tuned
for Deluxe
App Data**

Fit2ThriveMB (R21CA239130)



MyActivity Study (R37CA225877)



* 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

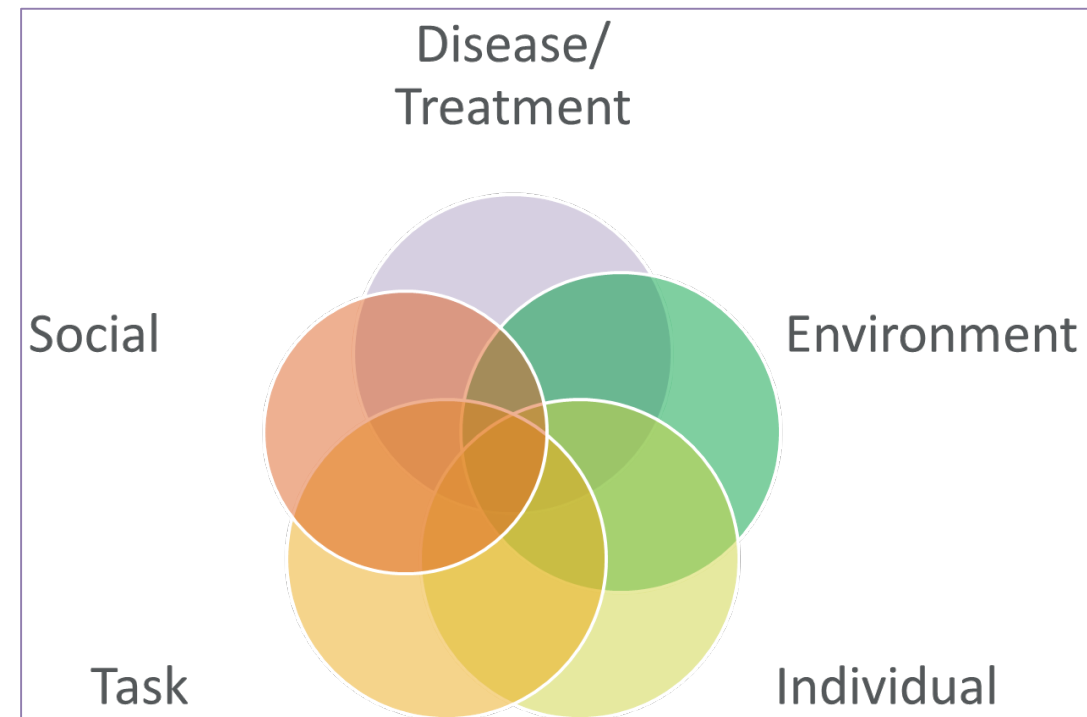


*“The significant problems we face
cannot be solved by the same
level of thinking that created
them.”*

~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?



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Recruitment of Participants

Army of Women

