

Text Messages to Promote Positive Affect and Physical Activity in Patients with Heart Disease

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Goals

- Review the promise—and prior use—of text message interventions (TMIs) to improve health behaviors in patients with heart disease and related conditions
- Describe a pilot project to test a novel TMI to improve health behaviors in patients with a prior acute coronary syndrome
- Discuss future directions in this field

Background

- Health behaviors
 - Approximately 40% of premature deaths in the U.S. are preventable and related to personal health behaviors
 - Critical to recovery, quality of life, prognosis, and survival across medical illnesses
 - Exceedingly challenging to durably modify
 - A major issue in psychosomatic medicine, which sits at interface of medical illness and behavior

Health Behaviors

- Heart disease is the prototypical illness for which health behaviors are critical
 - Multiple health behaviors are clearly linked to prognosis
 - Most cardiac patients not adherent to recommended behaviors
 - Roughly three-quarters do not fully meet recommendations for diet, exercise, and/or medication adherence
 - Often patients asked to make abrupt (and numerous) changes
- Acute coronary syndrome

Health Behaviors

- Current approaches
 - Cardiac rehabilitation—effective but very much underutilized (1/3)
 - Other in-person programs (e.g., appointments with nutritionist)
 - Numerous visits and substantial patient burden and provider resources
- Study of barriers to cardiac rehabilitation (N=1273)
 - Logistical barriers: distance, transportation, family/work responsibilities.
 - Many felt cardiac rehabilitation unnecessary and were confident that they could manage their heart problems on their own.
- Argues for a self-management approach

mHealth Interventions

- Increasingly, people—patients—are using mobile phones
 - In 2012, 85% of U.S. adults owned a cell phone; 53% of those were smartphone
- 76% of the general population is interested in using mobile technology for monitoring and/or self-management of health.
- Already happening:
 - 52% of smartphone owners use their phones to look up health information, and 19% have at least one health app.

mHealth Interventions

- Mobile health (mHealth) interventions—delivered via mobile, wireless devices:
 - Allow intervention delivery to users anywhere, anytime
 - Such treatments have very low cost and low burden
- Text message interventions (TMIs) may be particularly appealing
 - They represent the lowest burden and intrusion
 - Text messaging is familiar to nearly all cell phone users

Prior TMI Studies

- Wald 2014 (Finland) N=303
 - Patients with hypertension taking medication
 - Text message medication reminders daily for 2 weeks, every other day for 2 weeks, then weekly, for a total of 6 months
 - <80% adherence significantly lower in TMI (9%) than control group (25%)
- Maddison 2015 (New Zealand); N=171 coronary heart disease (CHD) patients
 - Automated text messages plus weekly website videos over 24 weeks
 - Compared to usual care, no improvement in objective exercise capacity
 - TMI: more leisure time physical activity (383 vs. 273 mins/week; $p=.04$), walking (512 mins vs. 361; $p=.02$), and better self-reported general health and self-efficacy

Prior TMI Studies

- Pfaeffli Dale (2015) N=123 CHD patients
 - Text message based cardiac rehab (with internet site support)
 - The intervention led to greater improvements on a composite measure of health behavior at 3 (P=.03) but not 6 months, compared to control group (recommendation to attend cardiac rehabilitation)
 - Medication adherence was better at 6 months (p=.004)

Prior TMI Studies

- Chow (2015): TEXT ME trial N=710 CHD patients
 - TMI group received 4 texts weekly x 6 months with advice, motivational reminders, and support to change lifestyle behaviors.
 - Messages were automated and not interactive
 - Compared to treatment as usual

Table 2. Primary and Secondary End Point Analyses at 6 Months Follow-up^a

Parameter	Mean (95% CI)		Mean Difference (95% CI)	P Value for Difference
	Intervention (n = 352)	Control (n = 358)		
Primary end point				
LDL-C, mg/dL	79 (76 to 82)	84 (81 to 87)	-5 (-9 to 0)	.04
Secondary end points				
Blood pressure, mm Hg				
Systolic	128 (127 to 130)	136 (134 to 137)	-8 (-10 to -5)	<.001
Diastolic	81 (80 to 82)	84 (83 to 85)	-3 (-4 to -2)	<.001
Heart rate, /min	67 (66 to 68)	69 (68 to 70)	-2 (-3 to -0.4)	.01
BMI	29.0 (28.8 to 29.3)	30.3 (30.1 to 30.5)	-1.3 (-1.6 to -0.9)	<.001
Waist circumference, cm	100.6 (99.5 to 101.7)	105.0 (103.9 to 106.1)	-4.4 (-6.0 to -2.8)	<.001
Hip circumference, cm	101.7 (100.5 to 102.9)	106.4 (105.2 to 107.5)	-4.7 (-6.3 to -3.0)	<.001
Cholesterol, mg/dL				
Total	150 (146 to 154)	159 (156 to 163)	-9 (-15 to -4)	<.001
HDL-C	43 (42 to 44)	44 (43 to 45)	-0.4 (-2 to 1)	.55
Triglycerides	140 (132 to 148)	160 (151 to 168)	-20 (-31 to -8)	.001
Total physical activity (MET min/wk)	932 (825 to 1039)	587 (482 to 692)	345 (195 to 495)	<.001
Inactive (<600 MET min/wk), No. (%)	126/338 (37.4)	241/351 (68.8)	0.55 (0.47 to 0.64) ^b	<.001
Current smoking, No. (%)	88/339 (26.0)	152/354 (42.9)	0.61 (0.48 to 0.76) ^b	<.001

Prior TMI Studies

- Review of TMIs for overall health promotion
 - Mean effect size $d=.33$ (.27-.39); $p<.001$)
- Mobile phone programs for secondary prevention of CV disease
 - Factors associated with positive outcomes:
 - Higher message frequency
 - Personalized with tailored advice
 - 2-way messaging
 - Greater engagement by users

Prior TMI Studies

- Summary:
 - Low to moderate study quality
 - Smallish samples often, mixed control groups
 - Often short term outcomes
 - Minimal effects on bigger outcomes (objective, health services)
 - However, now MANY trials:
 - Diverse samples and settings
 - Well-accepted, practical, low cost, not complicated for patients
 - Many seem to work, on different outcomes, with real changes in behavior
 - More recent studies have larger (100-700+ patients) samples, better designs, and TMIs look effective in these higher quality trials

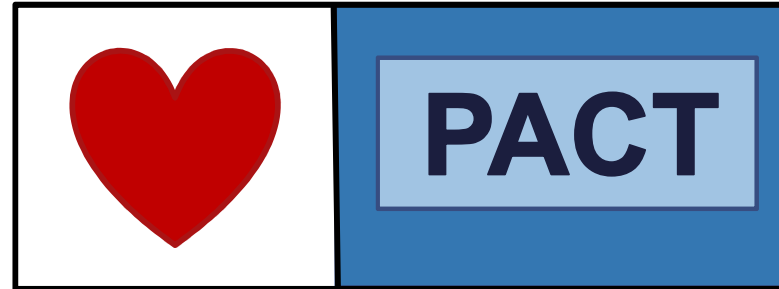
Continued Gaps

Several important gaps regarding mHealth programs:

1. Limited prior study in patients with prior ACS
 - Despite high-risk, high-reward nature of this population
2. No prior study of mental health-based TMIs in medically ill
 - Links between psychological constructs and health/health behaviors
3. No prior study combining psychological and behavioral TMIs in medical cohorts
 - Despite suggestions that a combined approach may be superior
 - Promoting well-being may increase motivation and engagement with health behavior change via optimism, self-efficacy, and vitality.

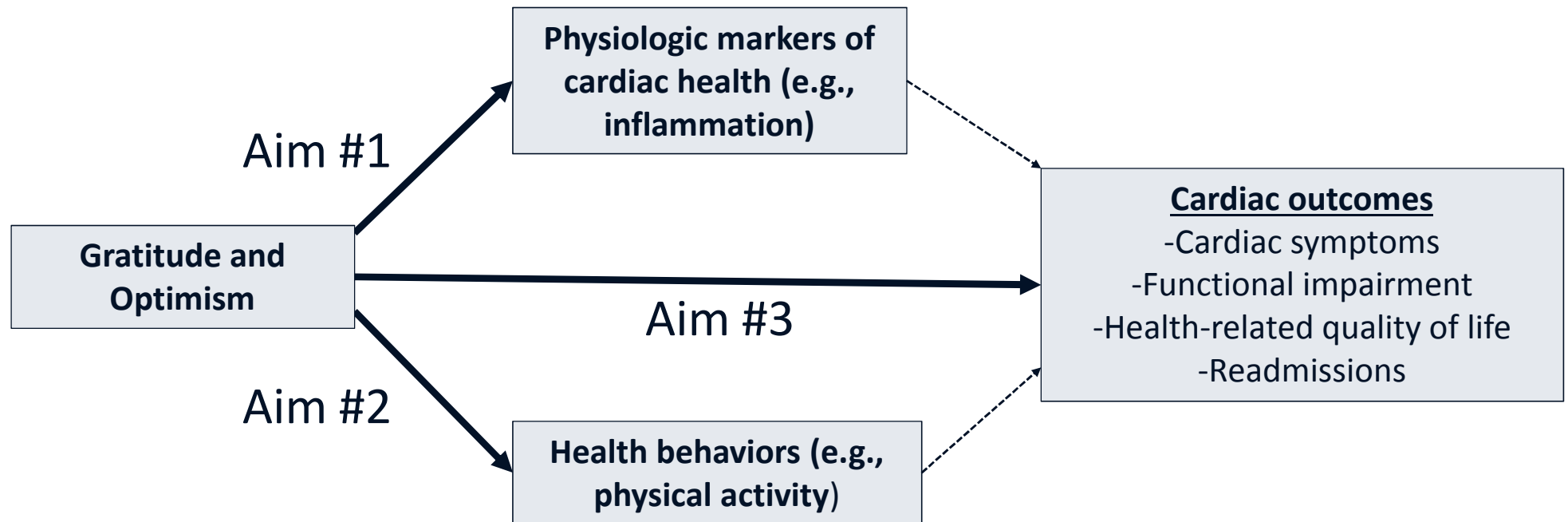
Promoting Activity in Cardiac Patients via Text Messages

The PACT Study



Positive Psychological Constructs

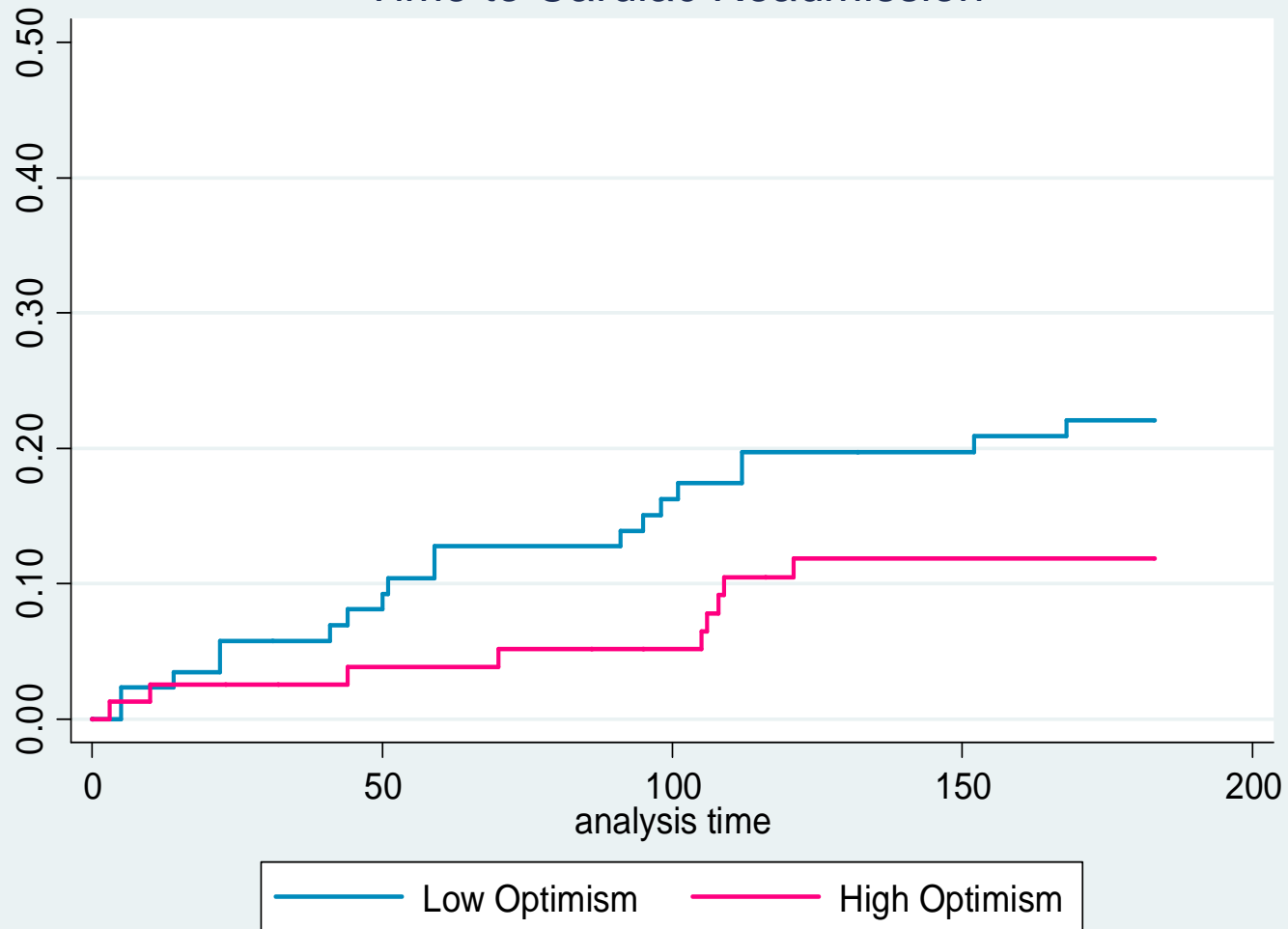
- Links between positive constructs and health outcomes
 - Optimism: Rasmussen meta-analysis (N=83 studies)—reduced cardiac mortality
 - Positive affect (interest, enthusiasm, vitality): NHANES I—reduced CAD onset
 - Positive psychological well-being: Chida meta-analysis (N=50,000)—less mortality
- Positive psychological constructs in patients with heart disease (N=14,624)
 - 65% of all adjusted analyses found significant associations between positive constructs and subsequent health outcomes
 - Meta-analysis: positive constructs were associated with lower rates of rehospitalization or mortality in adjusted analyses (OR =.89; $p < .001$)



Bold arrows denote components of model being tested in this study.



Time to Cardiac Readmission



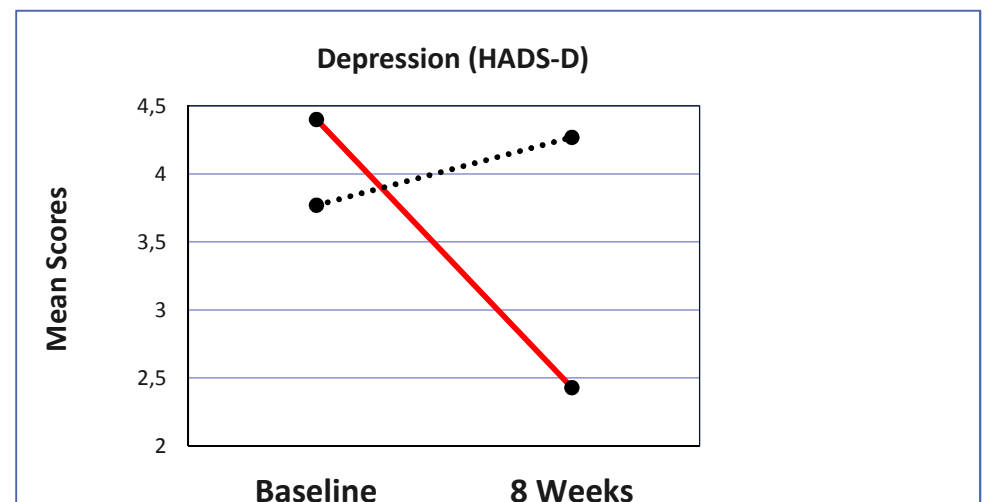
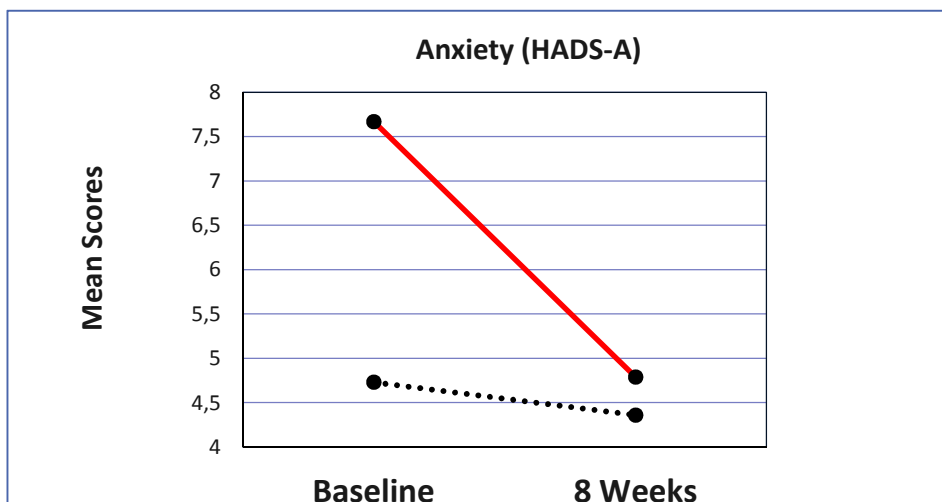
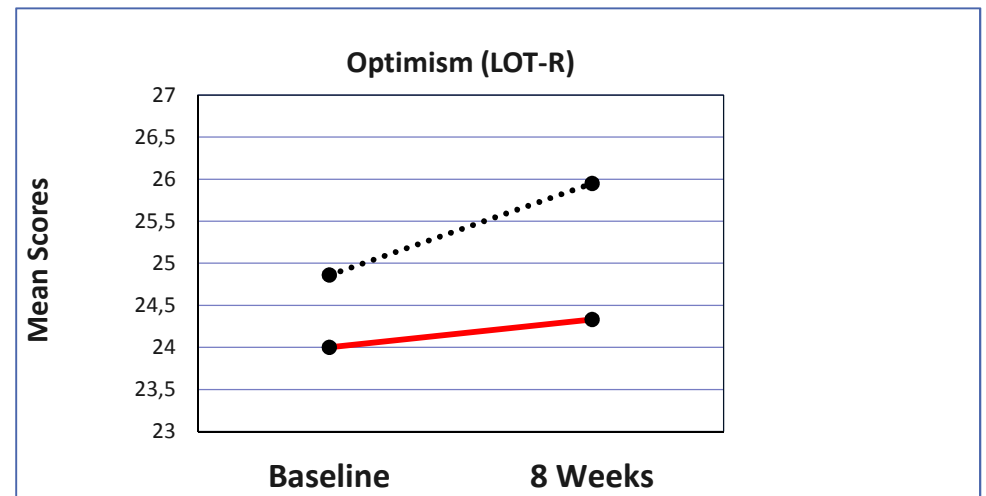
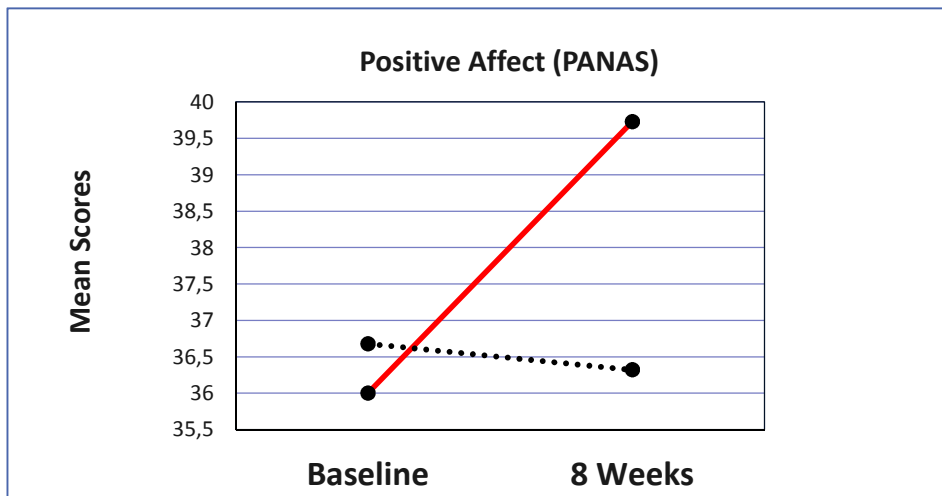
Positive Psychological Interventions

- Specific “PP” activities designed to promote gratitude, altruism, optimism, efficacy, strengths, and positive affect
- Linked to improvement in positive affect and well-being (and reductions in depression) in >6000 healthy persons (including MHealth delivery)
- Simple, well-accepted, little provider or patients training required

PP Studies in Heart Disease

- Initial trial of a PP-based program (N=45)
 - Compared an 8 week phone-based intervention to usual treatment
 - Intervention: Written manual, weekly exercise completion, weekly calls with study trainer
 - Examined effects on positive and negative constructs





— Intervention

..... Treatment as Usual

PACT: Overview

- A one-arm prospective pilot study of a TMI in post-ACS patients designed to promote well-being and physical activity
- Primary goals
 - Assess feasibility of enrollment and text message delivery
 - Assess acceptability of the program by post-ACS patients.
- Secondary goal
 - Assess pre-post impact over the two-week study period

Participants

- Inclusion criteria
 - ACS, defined using consensus criteria and definitions used in post-ACS studies
 - Ability to receive text messages via cellular phone.
- Exclusion criteria
 - Cognitive impairment, assessed via a six-item screen
 - Unable to participate in physical activity or had terminal illness
 - Not fluent in English

Procedures

- *Study timeline, intervention, and assessments*
 - Initial (baseline call):
 - Demographic information and self-report measures.
 - Transmission of test text message.
 - Text message transmission daily for 14 days
 - 14 text messages (fixed order), delivered in an automated manner once daily (8a-6p)
 - No personal info aside from a first name/nickname entered by participant.
 - The messages were delivered via the TextIt server and the Twilio texting program

Sample Messages

Hi Jeff! People who schedule exercise time on their calendar and treat it as an important appointment are much more likely to stay active (and feel great!)

Hi Jeff! Time for a happiness exercise! Take the time to appreciate something today—a friend, a beautiful view, another person's kind act.

Hi Jeff! Use easy tricks to increase your activity: park farther away in a parking lot and take the stairs whenever you can!

Hi Jeff! Time for a happiness exercise! Identify a personal strength—loyalty, kindness, intelligence, humility, humor, determination, or anything else—and try to find a way to use it today!

Hi Jeff! The American Heart Association says that walking is one of the most effective forms of exercise to achieve heart health. Walk whenever you can!

The messages were signed by the *MGH Cardiac Psychiatry Research Program*.

Study Procedures and Assessments

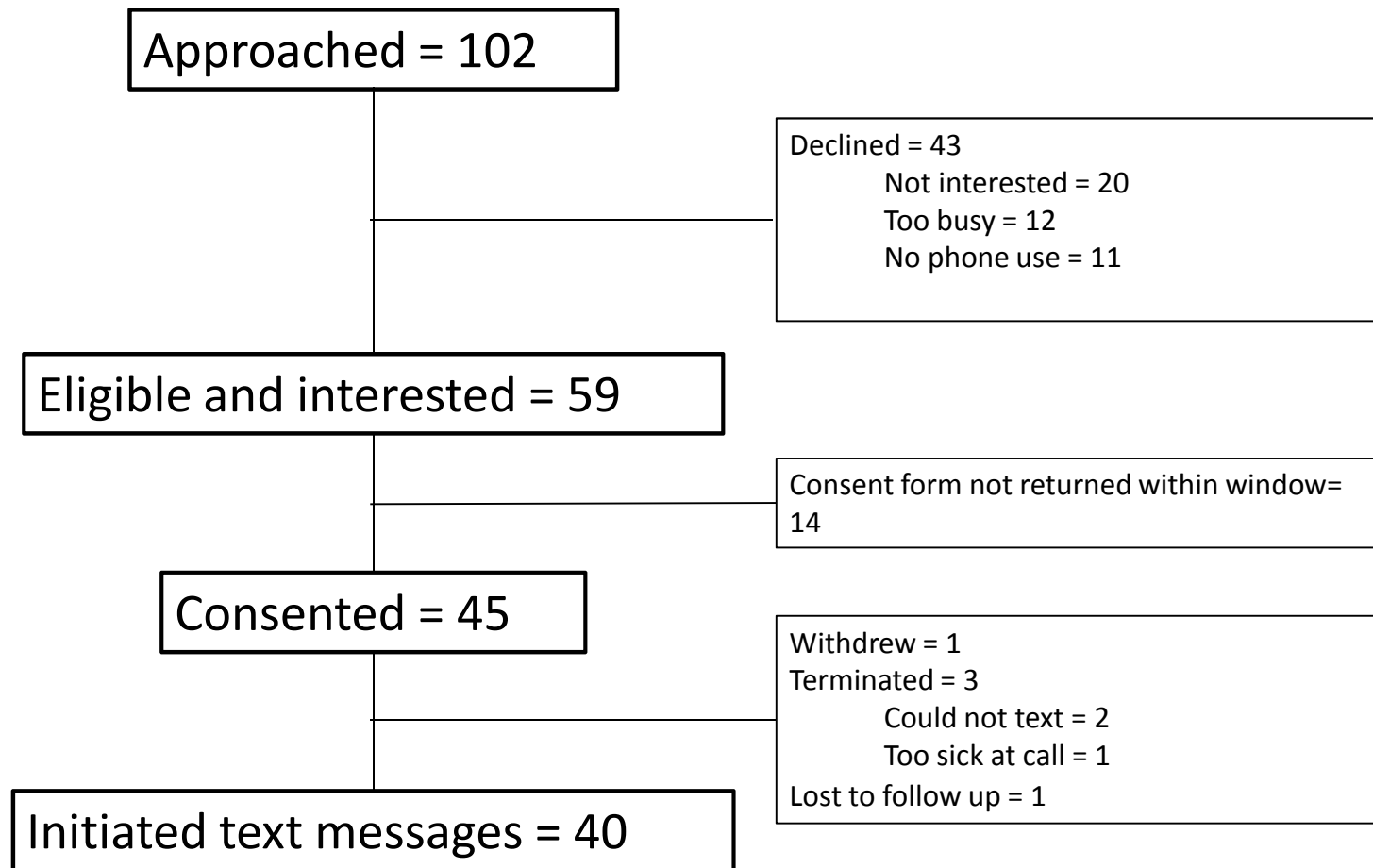
- Follow-up assessments by phone at 2 weeks and 4 weeks
 - 2 weeks: repeat self-report outcome measures and structured qualitative interview (15 minutes) to provide detailed feedback.
 - 4 weeks: repeat self-report measures

Study Outcome Measures

- Primary Aim: Feasibility and acceptability
 - Rates of successful text message delivery
 - Queries regarding whether the program was useful and led to specific actions
 - 1-5 ratings of message type based on content (interview)
- Secondary Aim: Assessment of initial impact:
 - Psychological well-being was assessed via 0-10 Likert scales for positive (happiness, optimism, determination) and negative (depression, anxiety) psychological factors.
 - Self-reported moderate (or greater) physical activity (mins/week) was assessed using a structured, validated two-item measure.

Data Analysis

- Aim #1 (Feasibility)
 - Descriptive statistics (means, proportions, standard deviations) were used for baseline characteristics and feasibility data.
- Aim #2 (Initial impact)
 - Paired t tests were used to analyze pre-post difference in study outcome measures
 - 2 weeks was the primary outcome time point
- Identified themes from post-intervention interviews



Participants

Characteristic	N (%)
Age; mean (SD)	63.8 (10.2)
Male sex	34 (76)
White race	41 (91)
Married	33 (73)
Prior ACS	21 (47)
MI	16 (36)
Charlson Comorbidity Index; mean (SD)	1.7 (1.2)
Antidepressant	7 (16)
Anxiolytic	7 (16)

Results

- Aim #1: Feasibility and Acceptability
 - 100% of text messages (N=560) were received by participants.
 - For the first 37 participants, at the post-intervention interviews:
 - 34 (92%) felt the program was helpful
 - 31 (86%) performed a specific action in response to a text message.
 - On 1-5 ratings of future content areas participants rated:
 - Physical activity information (mean score 4.41)
 - Diet and general health education information (3.95-3.97)
 - PP messaging (3.57-3.81)
 - Medication reminders (2.54)

Results

Measure	Baseline mean (SD)	Post-intervention mean (SD)	Change	Effect size (d)
Psychological constructs (0-10 Likert Scales)				
Happiness	7.51 (2.06)	8.00 (1.37)	+0.49 (p=.098)	.28
Determination	7.73 (1.64)	8.32 (1.35)	+0.58 (p=.002)	.39
Optimism	7.78 (2.10)	7.68 (1.65)	-0.10 (p=.72)	.05
Anxiety	3.02 (2.58)	2.65 (2.46)	-0.37 (p=.35)	.15
Depression	1.62 (2.33)	1.60 (2.20)	-0.02 (p=.91)	.01
Physical activity (min/week)				
Moderate activity	263 (271) min/wk	379 (536) min/wk	+116 (p=.13)	.29

Results

- Positive feedback from interviews
 - Connectedness: “Someone else out there is thinking about me and whether I get off my duff.”
 - Well-being: “The messages communicated, ‘hey! Remember how great you are.’”
 - Focus on health: “Cuts through all the noise...reminds you that you need to take care of yourself” “The very first message asked if I could get an extra 15 minutes of walking. I decided to add 15 minutes to my 45 minute treadmill walk for the rest of my life.”
 - Modality: “A seed was planted for the rest of the day and week...then later I would do some of those healthy or good things.” “It’s a good program because people live off their smartphones.”

Results

- Constructive feedback from interviews
 - Unconnected: “I was not motivated to complete [activities] because there was nobody over me checking to do that.”
 - Quality/Impact: “a lot of it was trivial.” “I smiled and I liked it– but nothing changed...it didn’t trigger anything new or different.”
 - Burden: “Any [activity] that involved somebody else, like calling a friend was not convenient.”

Summary—PACT

- Extends the growing literature on mHealth interventions
 - Novel, two-pronged PP-based psychological-behavioral program
 - High-risk, high-yield population for whom mental health and physical activity are vital for optimal recovery and prognosis.
 - Older adult cohort (mean age ~64)
- Limitations
 - Predominantly male population enrolled from a single site
 - Short-term intervention and assessment period
 - Single-arm nature of this initial study
 - No feedback or tailoring of messages

The Importance of Tailoring

- PACT participants emphasized a need for tailoring
- Individual tailoring of interventions
 - Linked to better engagement in behavioral interventions
 - Associated with greater behavior change
- Tailoring/personalization may be especially important in mHealth
 - No interpersonal interactions
 - Tailoring has been linked with greater effects of TMIs

PERSONAL Project

- **Positive Emotional Response System Of Novel Adaptive Learning**
- Development of an algorithmic text message intervention
- Algorithm allows patient feedback on each message to allow customization of subsequent messages
 - Axes for each message include: psychological vs. physical activity content, information vs. activity, specific health behaviors
- Being piloted at a community site for patients with CHD

Summary

- mHealth interventions, including TMIs, have great promise
 - Increasing population use of mobile phones for health-related tasks
 - Text messaging is very low-cost, low-burden, and can be easily integrated into patients' lives
 - Even simple TMIs appear to be somewhat effective in changing mental health and key health behaviors

Summary

- Optimization of TMIs is still very much needed
 - Better and larger trials have continued to come on-line and show great promise.
- Our own future studies
 - Will use the adaptive, tailored PERSONAL approach
 - Will involve a longer intervention period, longer follow-up assessments, and broader health outcomes in controlled trials.
- Ultimately could have substantial public health implications

Thank You!

