

Smartphone-based measurement of cognition and physical function in older emergency department patients

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Acknowledgements



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Investigator Support Program



Falls in ED Patients

Interventions to address increasing fall-related ED visits are a **major** EM research priority

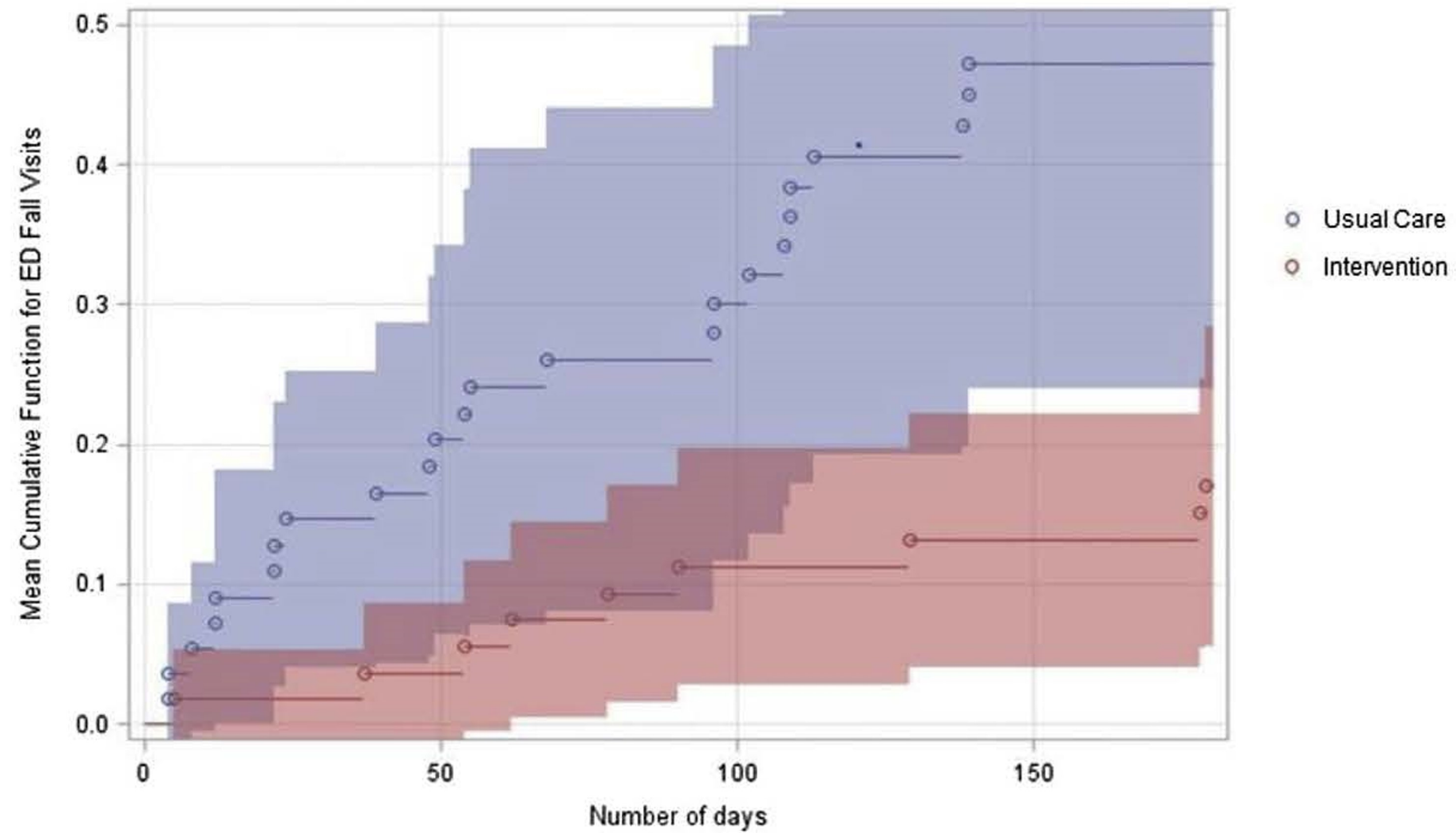
(Hammouda 2021)

Falls cause **3 Million** annual ED visits
(CDC)

Falls are a **sentinel** event



GAPcare I Results



All Participants	110	106	100	96
Intervention	55	53	47	44
Usual Care	55	53	53	52

GAPcare I Results



Feasibility

Fall diaries often incomplete or lost

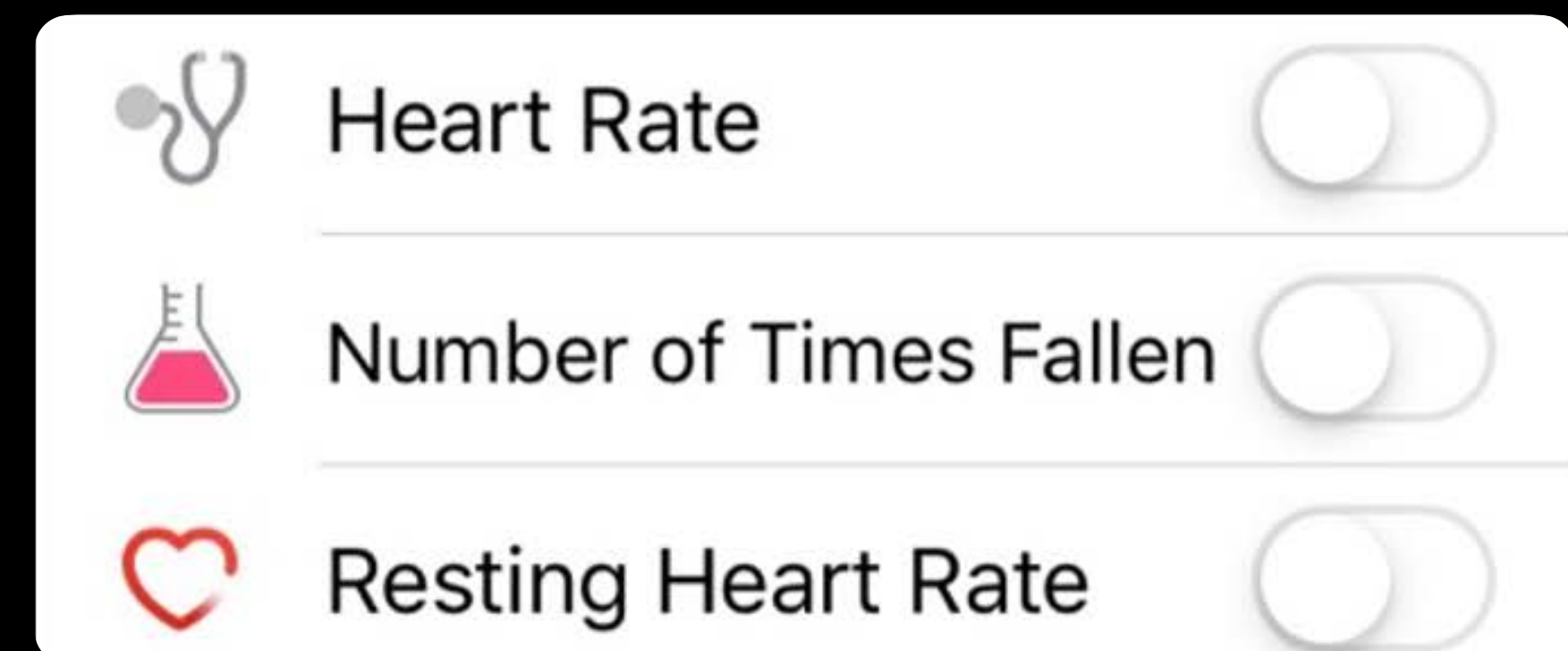
Acceptability

Memory impairment impacted fall recall

Initial efficacy to reduce recurrent ED visits promising

Control patients didn't see PT and received less assessment of function

Accelerometer and gyroscope sensors can measure and track memory, balance, gait, and falls



Aim1.a. FIELD TESTING PHASE

Jul 2019 - Jun 2020

Qual data
collection

Qual data
analysis

Qual data
results

Aim1.b. INTEGRATION

Jul 2020 - Jan 2021

Qual results inform
GAPcare II design, then
testing in small open trial

Aim2 CLINICAL TRIAL PHASE

Jan 2021 - Jan 2024

Quan data
collection

Quan data
analysis

Quan data
results

Feb - Jul 2024

Final analysis and
dissemination

Methods

1

PROGRAM SURVEY

Program demographic and fall surveys into REDCap

2

HEALTHKIT MEASURES

Select Apple "HealthKit" measures relevant to falls

3

ACTIVE TASKS

Select ResearchKit ActiveTasks to include

4

ENABLE API

Use an Application Programming Interface to enable immediate transfer of data from the app into REDCap

5

PILOT TESTING
Test app usability among a small group of people in the research team

6

FIELD TEST AMONG PATIENTS

Begin recruitment in the emergency department

Steps to creating a research app for Apple Watch

Instruments

Sensor data, ActiveTasks, Qualitative interviews

COGNITION

Trail making test
Stroop
Reaction time



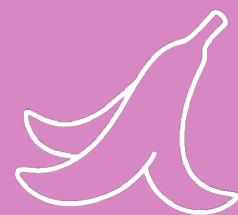
MOBILITY

Gait and balance
Timed walk



FALLS

HealthKit fall events
User survey



FEASIBILITY & ACCEPTABILITY

Y
Semi-structured
interview



USABILITY

Semi structured
interviews



EFFICACY

Electronic health
record & surveys of
fall related ED visits





Field Testing Protocol

Perform basic device competencies under direct supervision

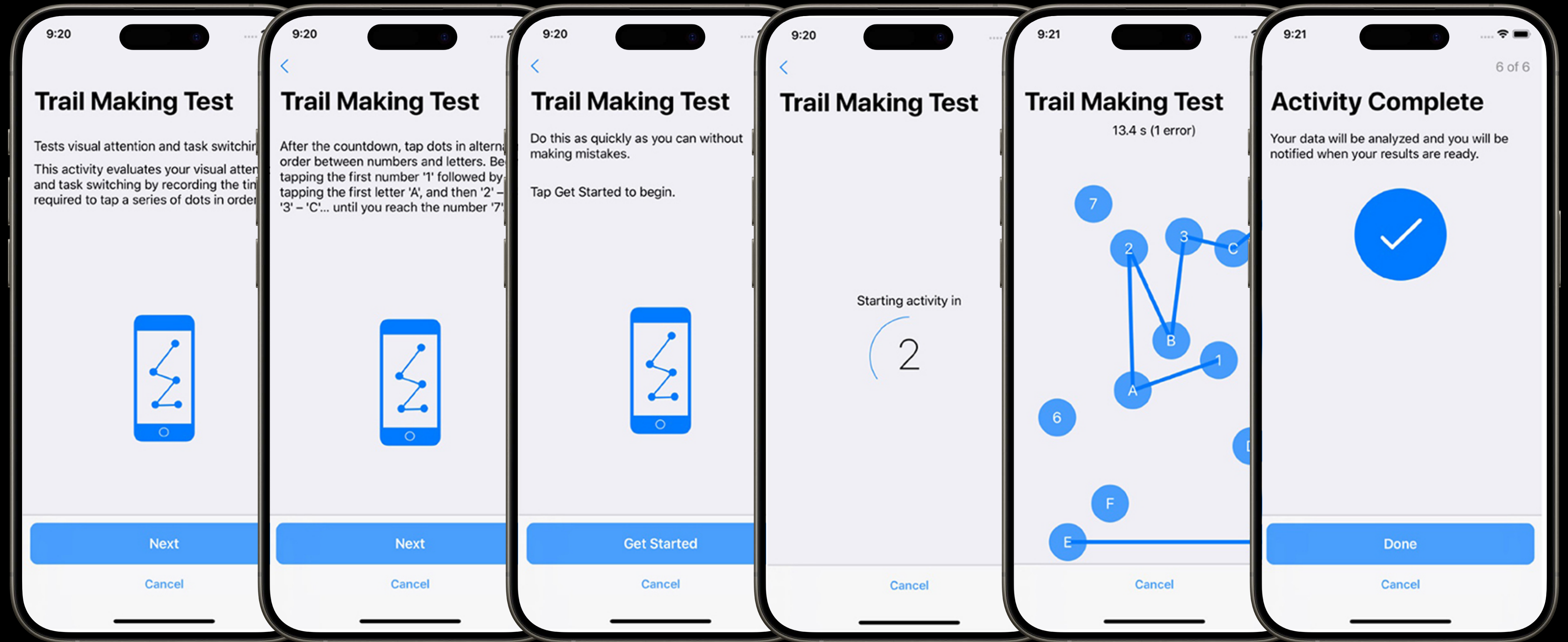
Access the app & do gait speed test

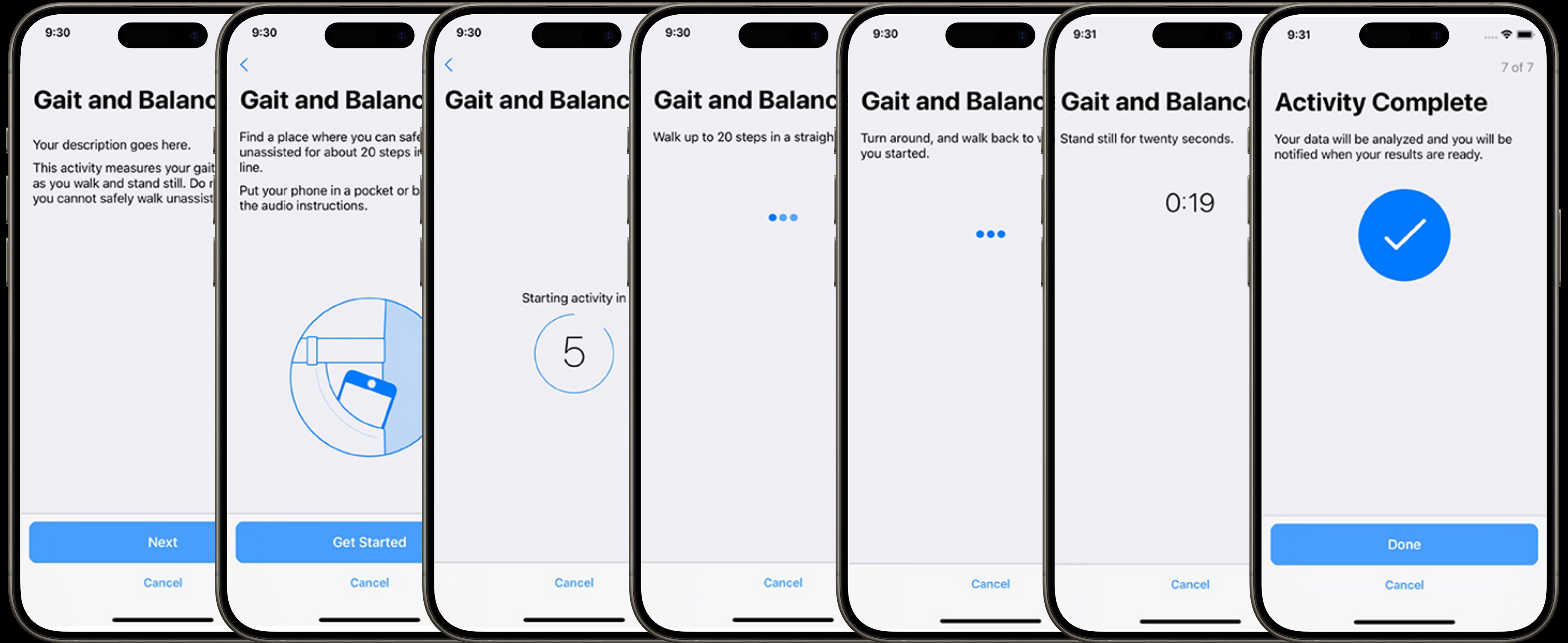
Take the device home and use it

Perform tasks at home under supervision

Perform tasks at home with telephone support






Perform all the tasks for 30 days














Event Name: **Active tasks 1**




Participant ID [REDACTED]



Cognition (Trail Making Test)   [-active_t...gtest.zip \(0.01 MB\)](#)
 [Upload new version](#) or  [Remove file](#) or  [Send-It](#)



Cognition (Reaction time)  
 [Upload file](#)



Cognition (Stroop)  
 [Upload file](#)



Motor (gait and balance)  
 [Upload file](#)

Motor (Timed walk)  
 [Upload file](#)



active_tasks_event  

active_tasks_start  

active_tasks_end  

active_tasks_status  

Form Status

Complete?  

[Save & Exit Form](#) [Save & ...](#)

[-- Cancel --](#)



Feasibility Study: Findings



Results

Of 197 participants, 48% were between 74 – 85 years old

68% were women, and 88% were non-Hispanic

70% had some functional limitations, 12% had dementia

53% had on fall in prior 3 months



77%



77%



68-87%



18-20%



77%



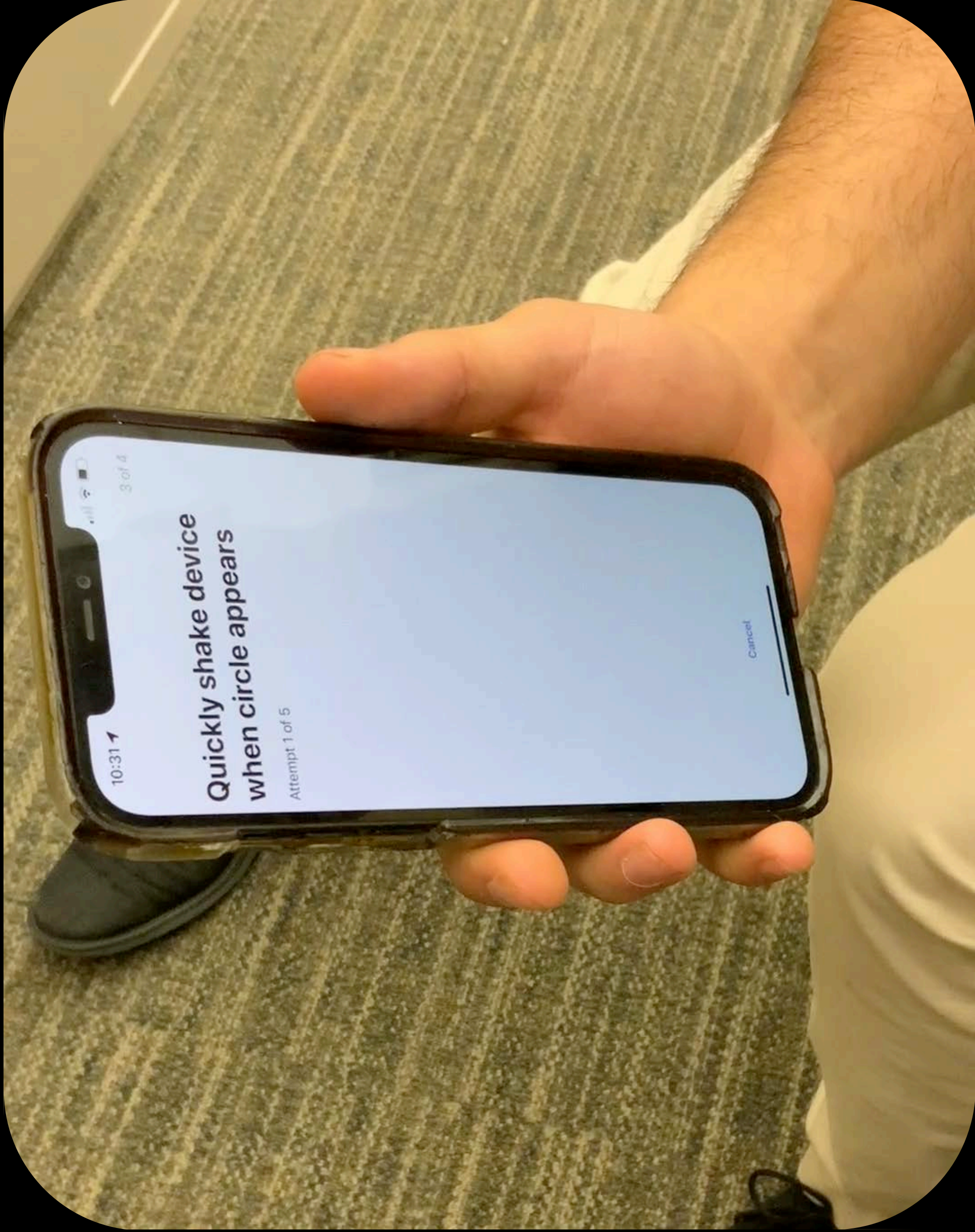
68-87%

Injury 15%
Tasks were 7% “too hard”
Tech issue 7%



18-20%

Fear of falling 32%
Pain 14%
Injury 10%



10:31

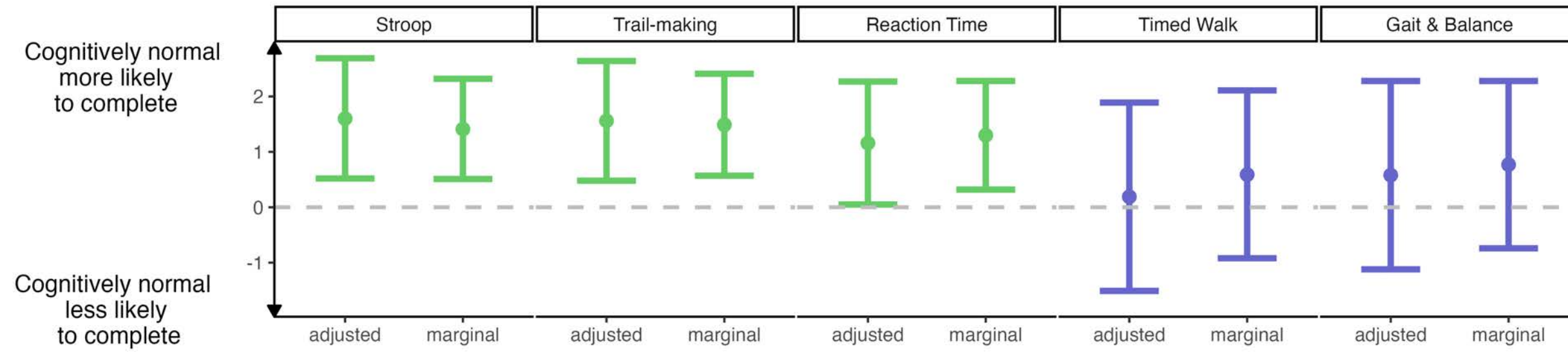
3 of 4

**Quickly shake device
when circle appears**

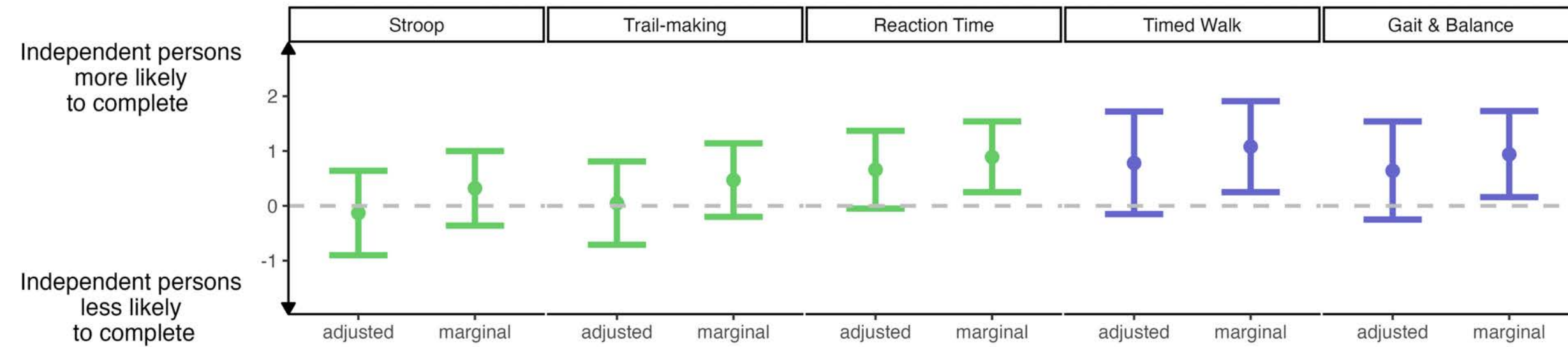
Attempt 1 of 5

Cancel

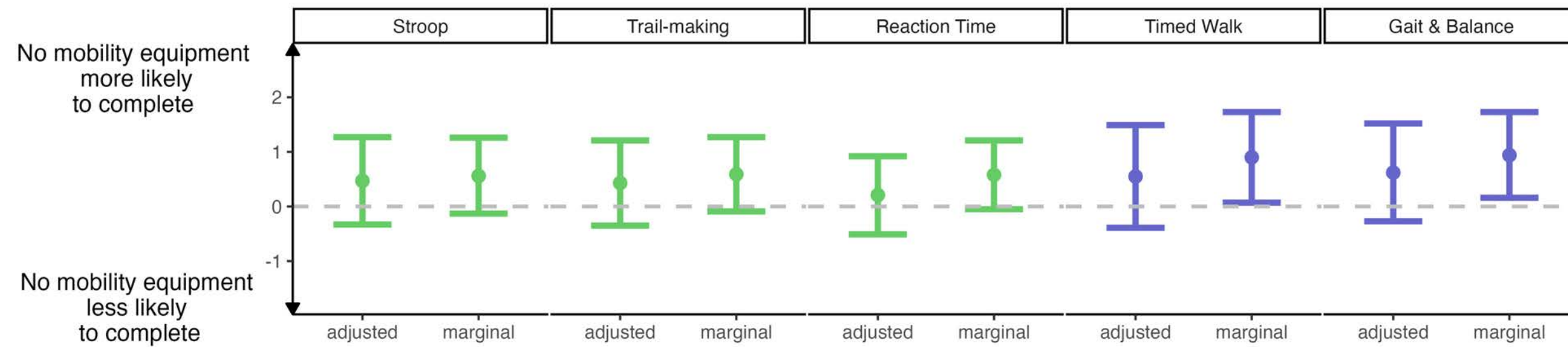
(A) Association between Cognitively Normal (SIS 4-6) and Completion



(B) Association between Complete Functional Independence (BI=20) and Completion



(C) Association between No Use of Mobility Equipment and Completion



Lessons Learned & Future Directions



Classify different phenotypes of fallers

Design interventions targeting these phenotypes

Deliver alerts when early warning signs of falls occur

Determine fall severity to inform need for ED testing & referrals

Considerations

Usability

Cost: Apple Watch, iPhone, data plan, developer, analysis

Expertise

“I avoid technology...I can barely navigate a computer...I knew...my abilities were limited. I didn't anticipate that it would be a piece of cake.”

“I found this pretty seamless. I didn't have any real difficulty.”

Conclusions

Integrating smartphone-based measure in “austere” environments is feasible with the right team

Digital measures can standardize assessments, reduce staff burden, improve efficient and effective patient care

Many older adults embrace technology with the right training and support





Christopher Metts, MD, Linda Resnik, PhD, Roland C. Merchant, MD, MPH, ScD, Vincent Mor, PhD, Andrew Leroux, PhD, Samantha Roberts, MPH, Sarah Berry, MD, MPH, Hillary Lum, MD, PhD, Brianne Bettcher, PhD



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