



Digital Therapeutics: Implications for Precision Treatment of Psychiatric Disorders

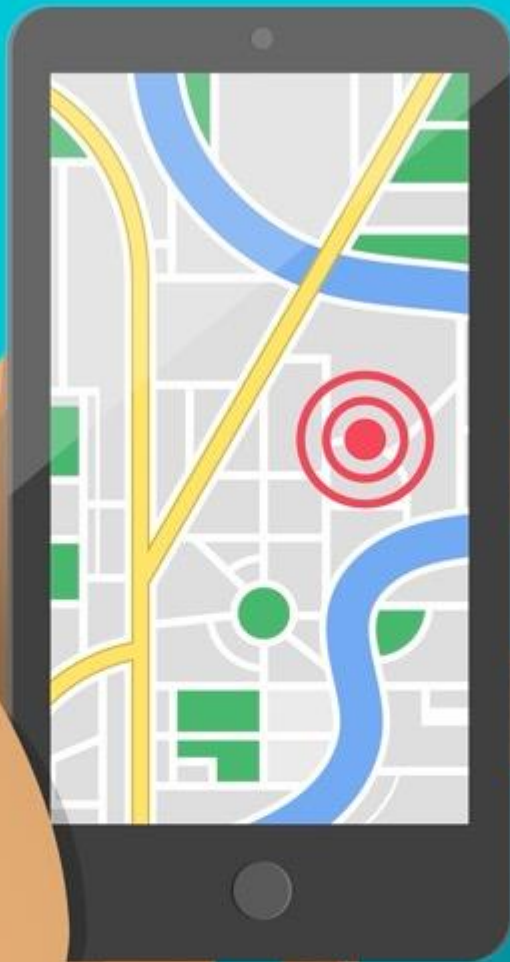


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Massachusetts General Hospital,
Harvard Medical School



DISCLOSURES

- Guilford Publications, New Harbinger Publications, Oxford University Press, Springer, Elsevier Publications
- Brattleboro Retreat, International Obsessive Compulsive Disorder Foundation, Tourette Association of America, Association for Behavioral and Cognitive Therapies
- National Institute of Mental Health
- Koa Health, Inc.
- Noom, Inc.
- One Mind (PsyberGuide)



ROAD MAP

Global Mental Health
Crisis

Technology as a
Solution

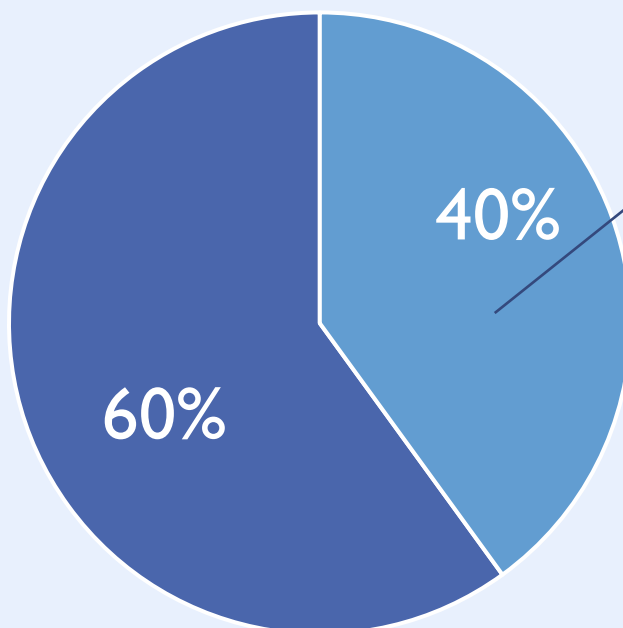
Internet & Smartphone
Solutions

Bias and Diversity
Considerations

Chatbots, Social Media
Platforms, Virtual Reality

Comprehensive Mental
Health Platform

OF THOSE WITH 12-MONTH PSYCHIATRIC DIAGNOSES



■ No Care ■ Care

38.9% received at
least “minimally
adequate” care

Wang et al., 2005

The background is a stylized, geometric landscape composed of various shades of teal and light blue. The shapes are angular and layered, creating a sense of depth. On the left side, a small, dark silhouette of a person in a suit stands with their back to the viewer, looking towards the right. A long, thin shadow is cast from the person onto the ground. In the center-right of the image, a large, white rectangular box with a thin black border contains the text "BARRIERS TO MENTAL HEALTHCARE" in a bold, black, sans-serif font.

BARRIERS TO MENTAL HEALTHCARE

PATIENT-LEVEL BARRIERS



Shame & Stigma

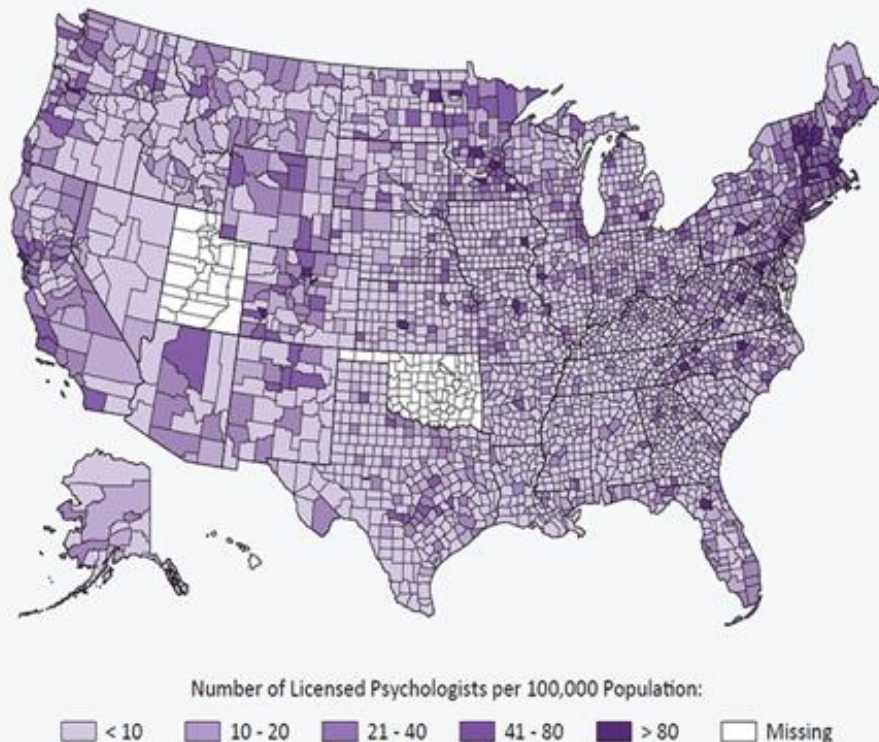


Financial Barriers

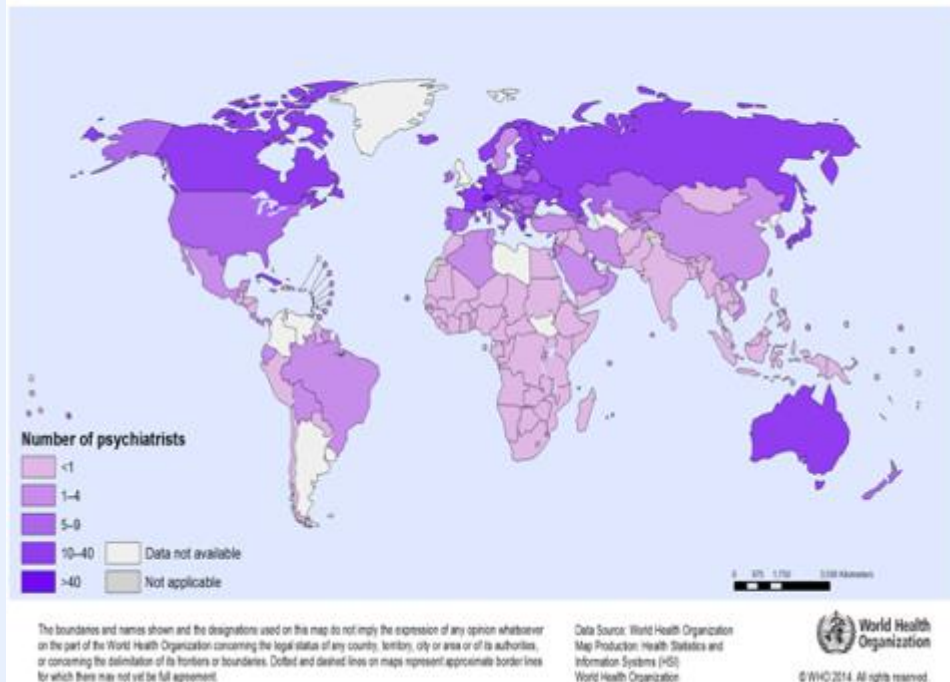


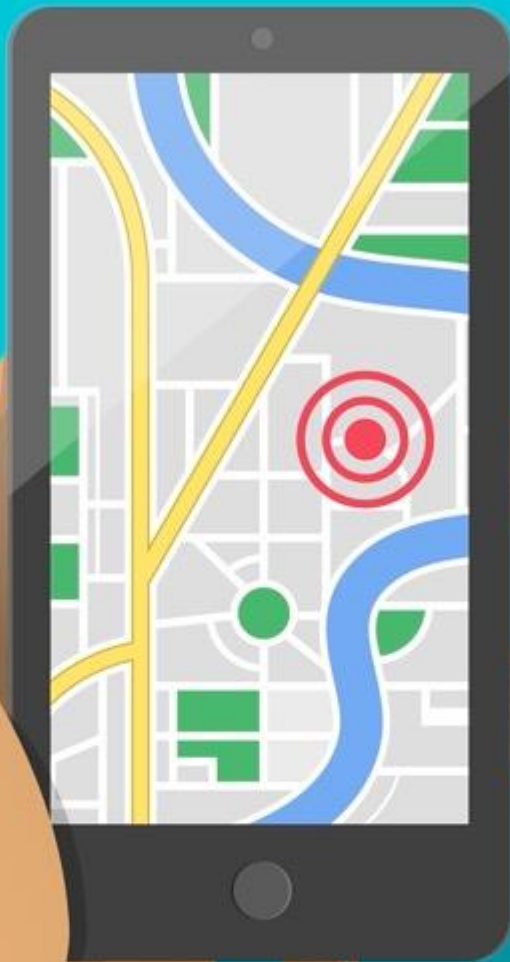
Logistical Issues

PROVIDER SHORTAGE



Psychiatrists working in mental health (per 100 000 population), 2011





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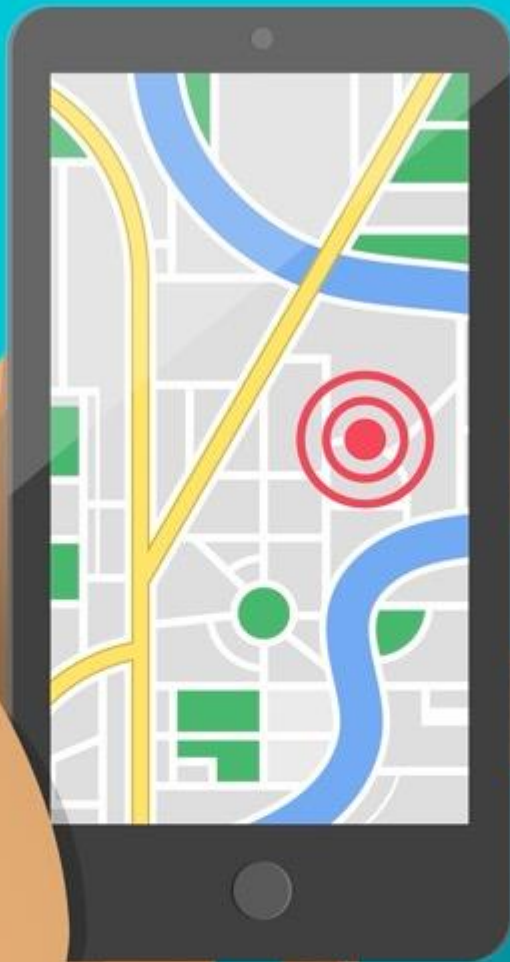
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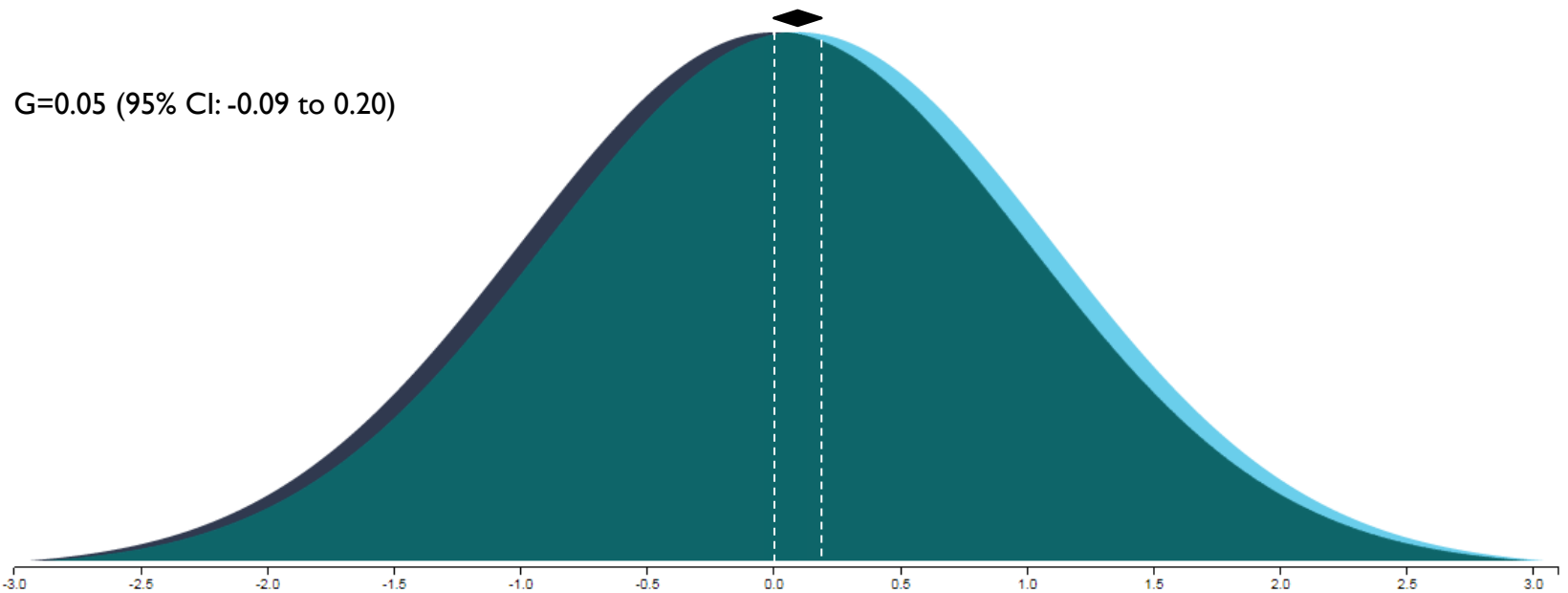
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INTERNET CBT





GUIDED I-CBT IS EQUIVALENT TO
IN-PERSON CBT



I-CBT VS. CONTROL

- Major Depressive Disorder ($g = 0.67$)
- Panic Disorder ($g = 1.31$)
- Seasonal Affective Disorder ($g = 0.92$)
- Generalized Anxiety Disorder ($g = 0.70$)
- Post-Traumatic Stress Disorder ($g = 0.71$)



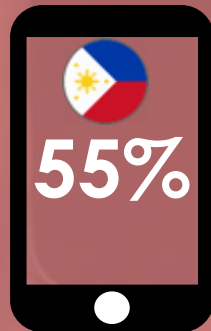
SMARTPHONE PENETRATION

Your smartphone is always-on, always-with-you, and knows where you are

Mexico



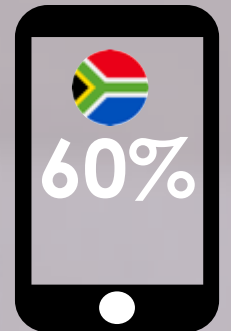
Philippines



Brazil



S. Africa



=76%

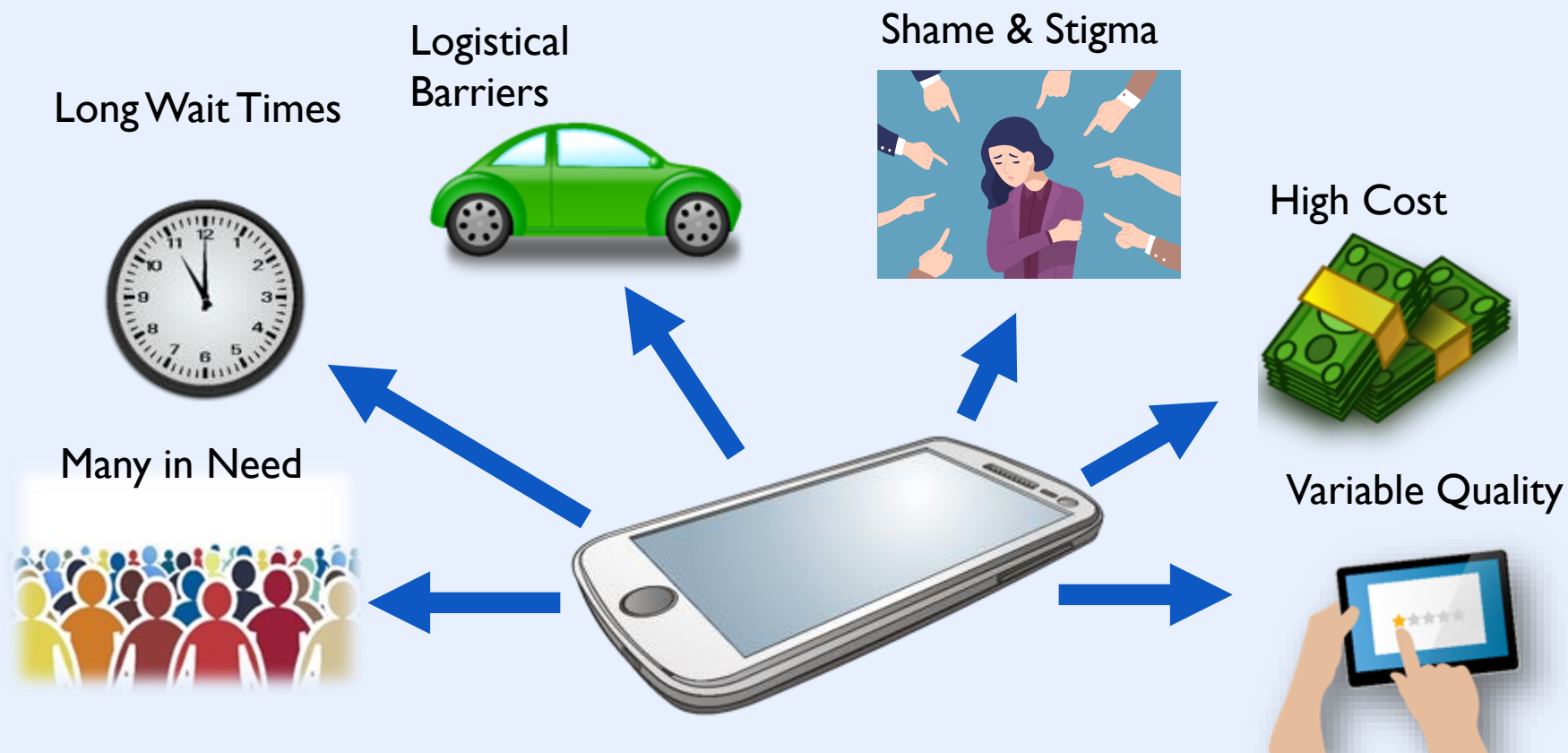


=78%



=81%

PHONE-BASED TREATMENTS ADDRESS KEY BARRIERS





**There are over
10,000 apps
dedicated to
mental health**

Marshall et al., 2019



reSET



MindDoc



PTSD Coach



Daylio



Bloom



Perspectives



Smoke Free



Thought Diary



CBT Companion



MindHub



Paw Patrol



Mental Health Hub



ThoughtChalle...



BetterHelp



Youper



Mood App



I Am Sober



Lifehelp



ReGain



Headspace





Full-Fledged Treatment



Perspectives

With a Therapist



Recovery
Record

Single Skill

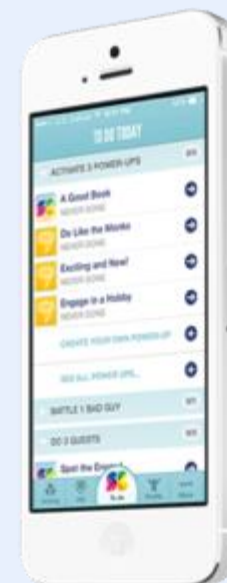


Daily Feats

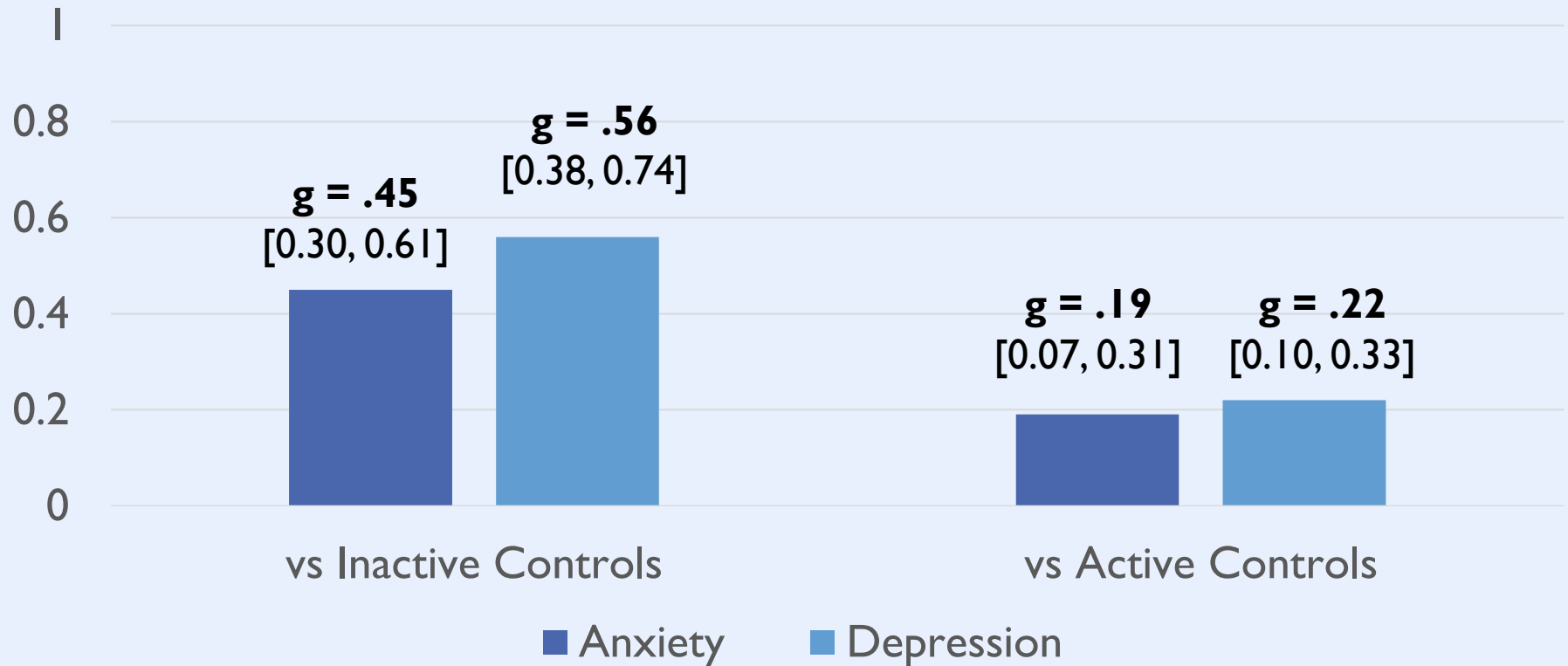
Symptom Monitoring



T2 Mood
Tracker



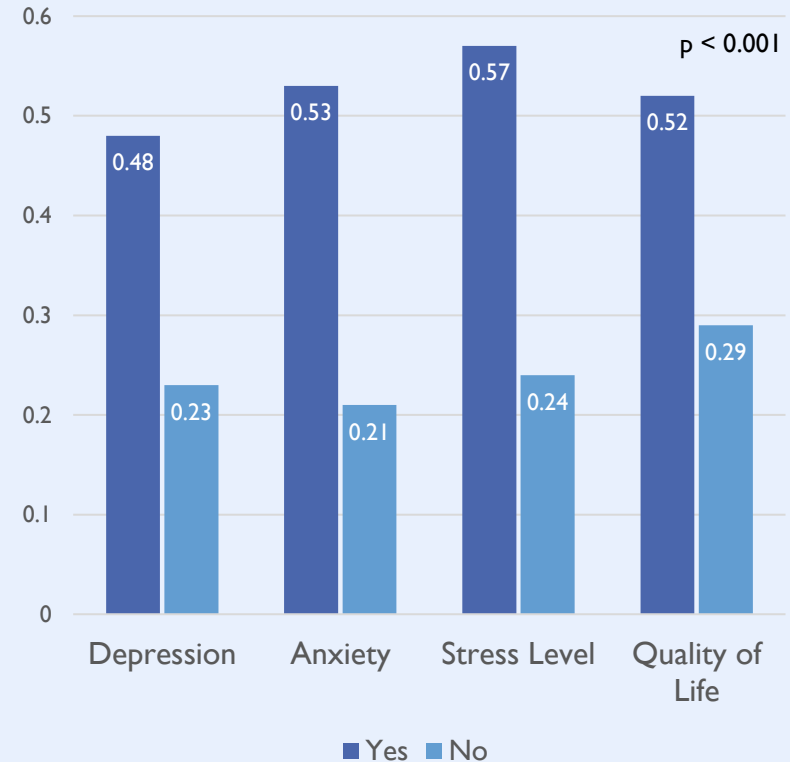
EFFICACY OF APPS



WHAT DO THEY WORK FOR?

APPS ARE USEFUL FOR IMPROVING:

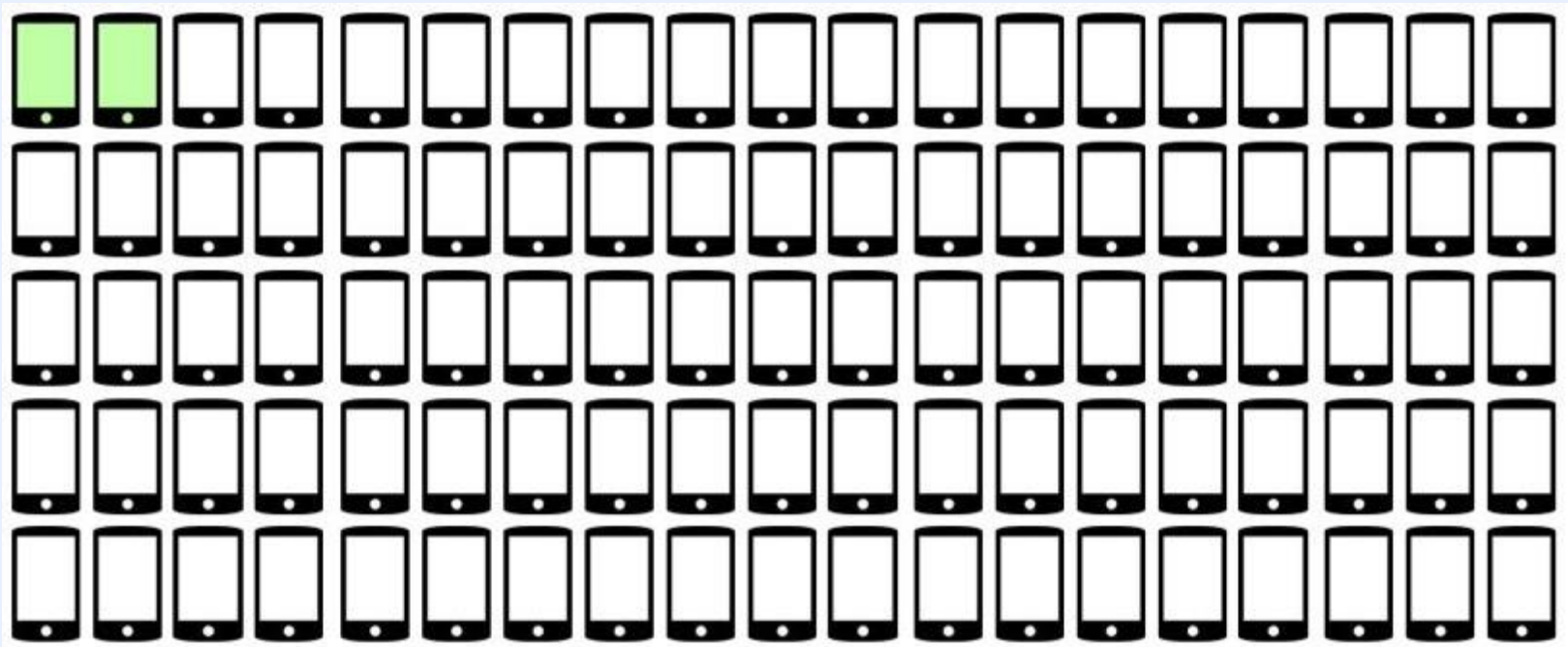
- Depression ($g = .28$)
- Generalized Anxiety ($g = .30$)
- Social Anxiety ($g = .58$)
- General Psychiatric Distress ($g = .40$)
- Stress Level ($g = .35$)
- Positive Affect ($g = .44$)
- Quality of Life ($g = .35$)



Professional guidance significantly increases effect sizes

A close-up photograph of a person's torso and hands. The person is wearing a dark blue button-down shirt with a fine white dot pattern. They are holding a black smartphone with both hands, their fingers positioned as if they are about to tap the screen. On their left wrist, a black digital watch with a silver-colored metal link bracelet is visible. On their right wrist, a thin gold-colored chain bracelet is visible. A semi-transparent white rectangular box is centered over the image, containing the text "LEARNING CURVE: EVIDENCE" in a bold, black, sans-serif font.

LEARNING CURVE: EVIDENCE



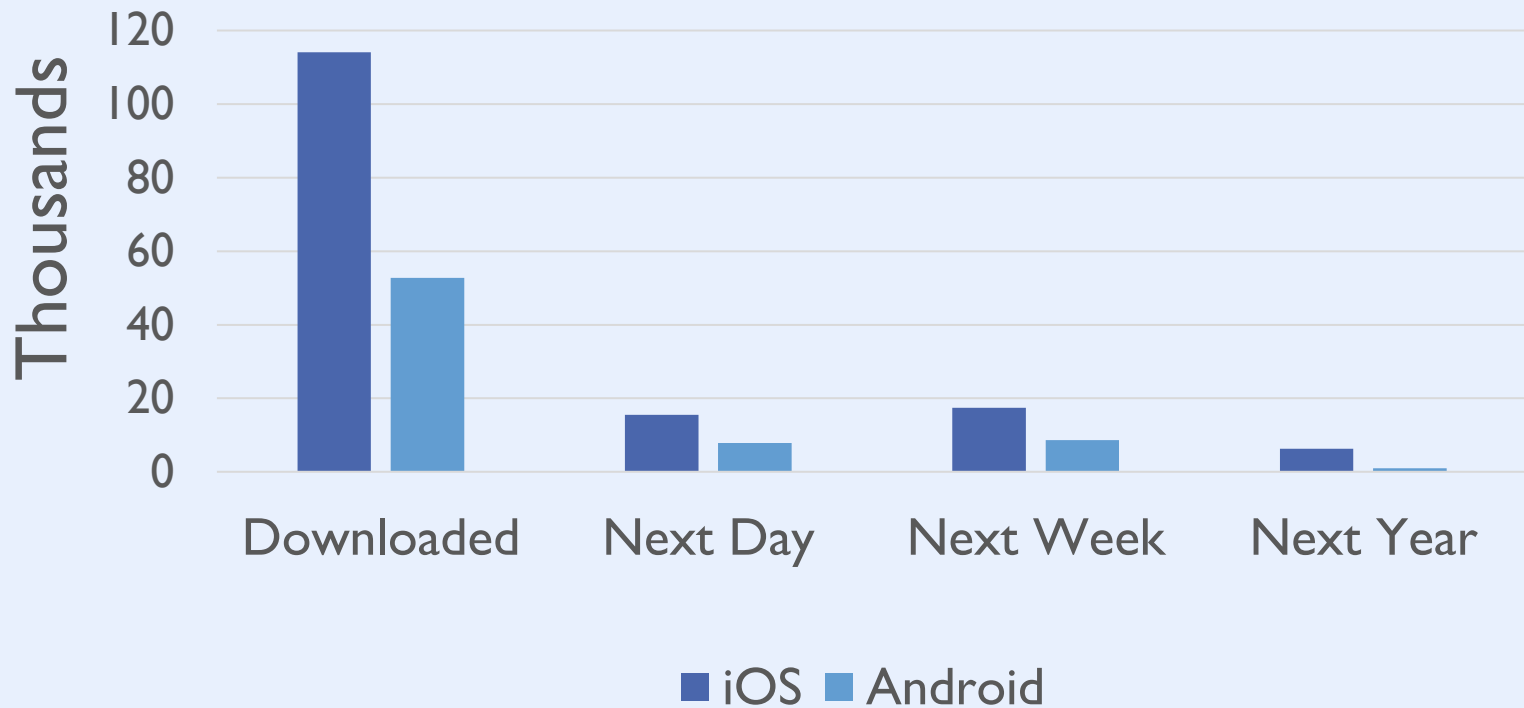
RESEARCH TRIALS PER DEPRESSION APP

A blurred background of a classroom with several students' hands raised in the air, suggesting an interactive learning environment. The text is overlaid on a semi-transparent white rectangle in the center.

LEARNING CURVE: ENGAGEMENT



CURRENT TRENDS IN ENGAGEMENT





COMMON REASONS FOR APP DISCONTINUATION



POOR USABILITY

- **Unhelpful in emergency**
- Difficult/unenjoyable to use
- Takes too long to enter data
- Discovered hidden costs

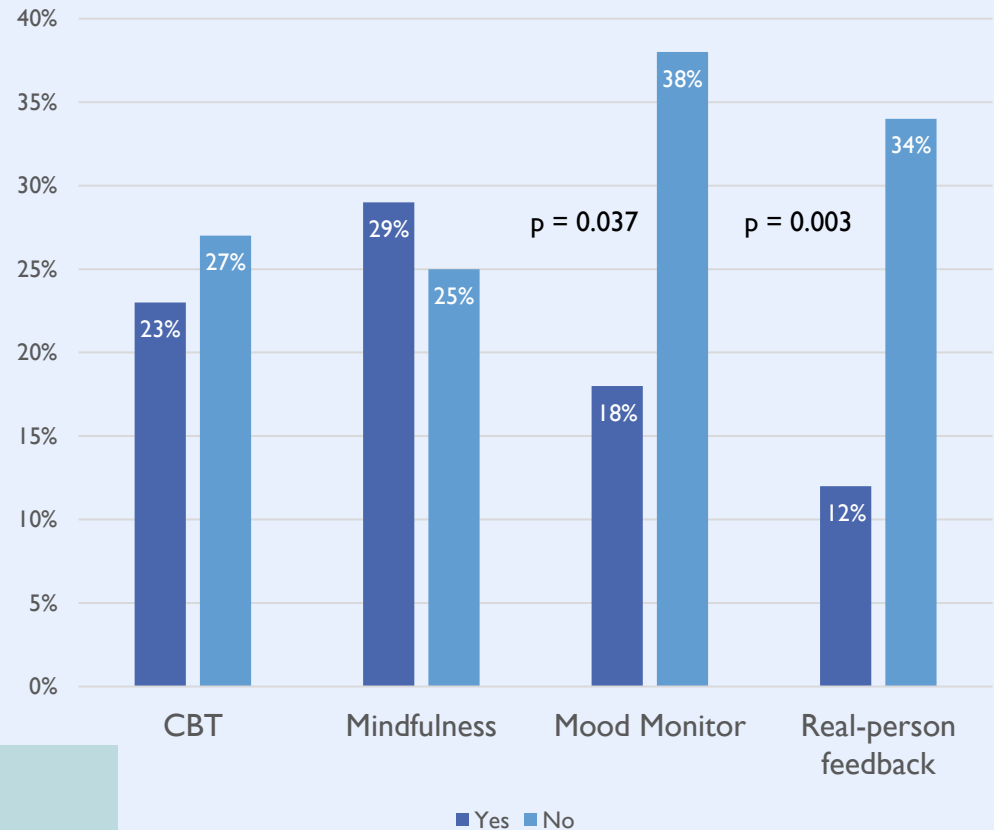
LACK OF TRUST

- **Questions of effectiveness or usefulness (71%)**
- Bold claims create skepticism
- Too many apps/lack of regulation

PRIVACY CONCERNS

- **Concerns about data privacy (59%)**
- Only 8% will share data with a tech company
- Lack of transparent privacy policies

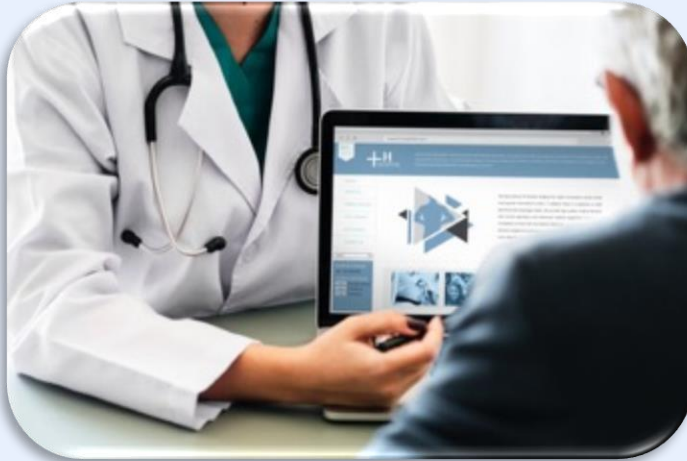
Treatment Element and Dropout Rate



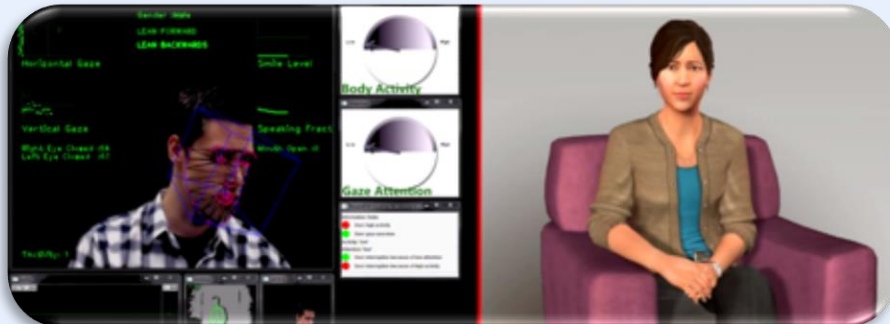
1. Torous et al., 2018; 2. Lipschitz et al., 2019; 3. Torous et al., 2019



Therapist Assisted



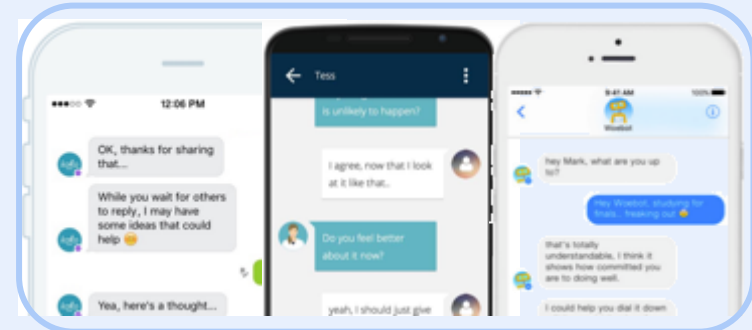
AI Therapists



SimSensei



Chatbots



koko

X² AI

Woebot

Peer-Support

Need to talk?


Connect with caring people for text chat, online therapy & counseling

Free, anonymous and confidential online text chat with trained listeners, online therapists & counselors

[Get Started](#)

28,365,732
Conversations

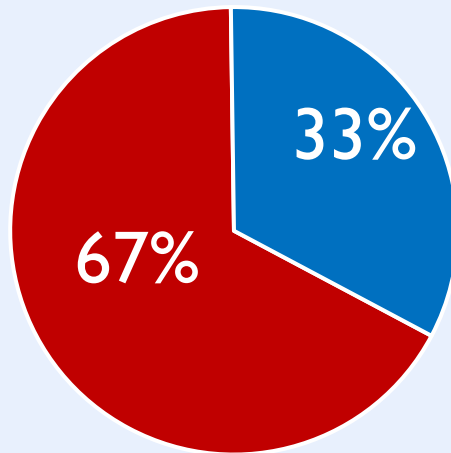
The World's Largest Emotional Support System



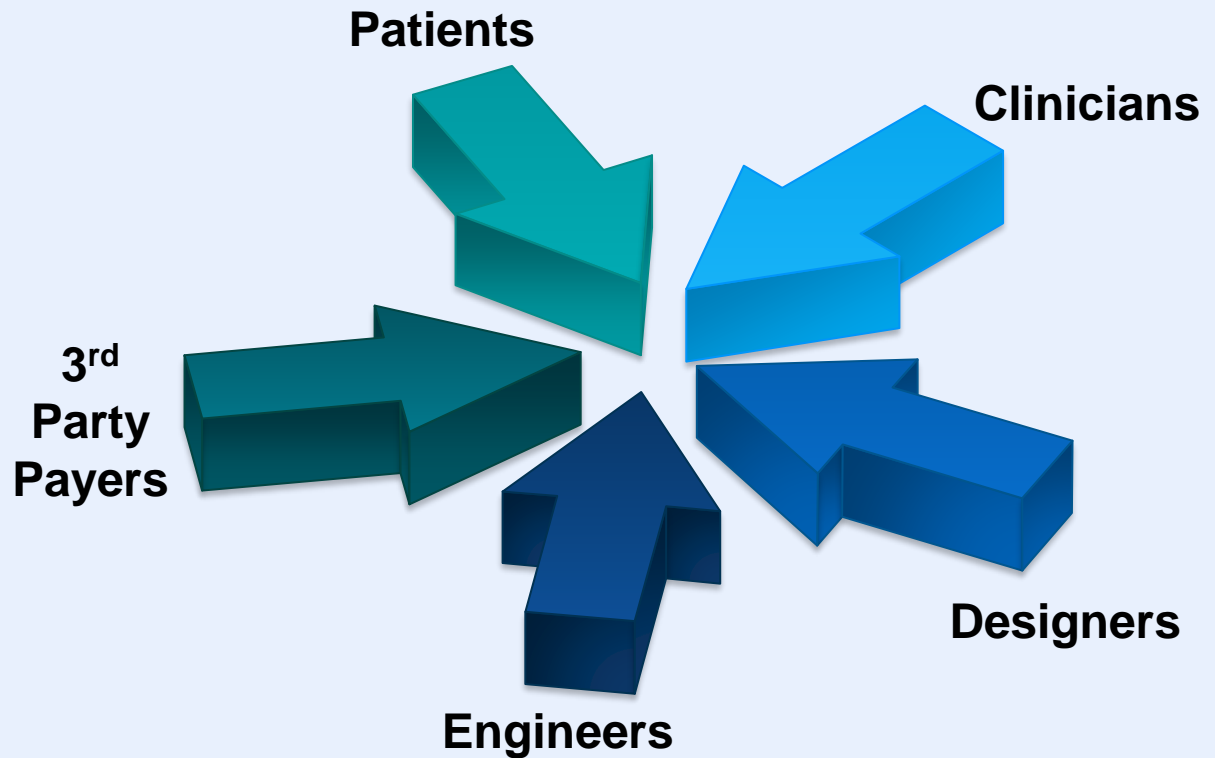


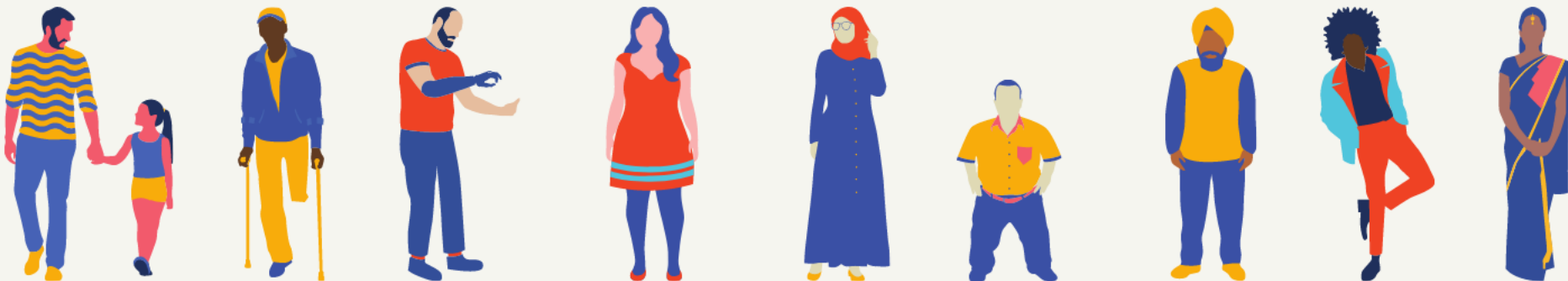
STAKEHOLDER INVOLVEMENT FROM THE START

Input from Healthcare Professionals



■ No Input





PERSONALIZATION: JUST IN TIME INTERVENTIONS



SMARTPHONE SENSOR-BASED TECHNOLOGY

Accelerometer:
Movement



Heart Rate



WiFi: Location



Outdoor
Light



Camera:
Facial Expression



Screen
on/off:
Sleep



Microphone:
Vocal Tone



GPS:
Location



Bluetooth:
Social Proximity



JUST IN TIME INTERVENTIONS¹

- Great potential
- Active (short questionnaires) and passive (sensor) data can be used to prompt personalized real time interventions
- Currently only 1% of marketplace apps support sensor use
- This will change soon

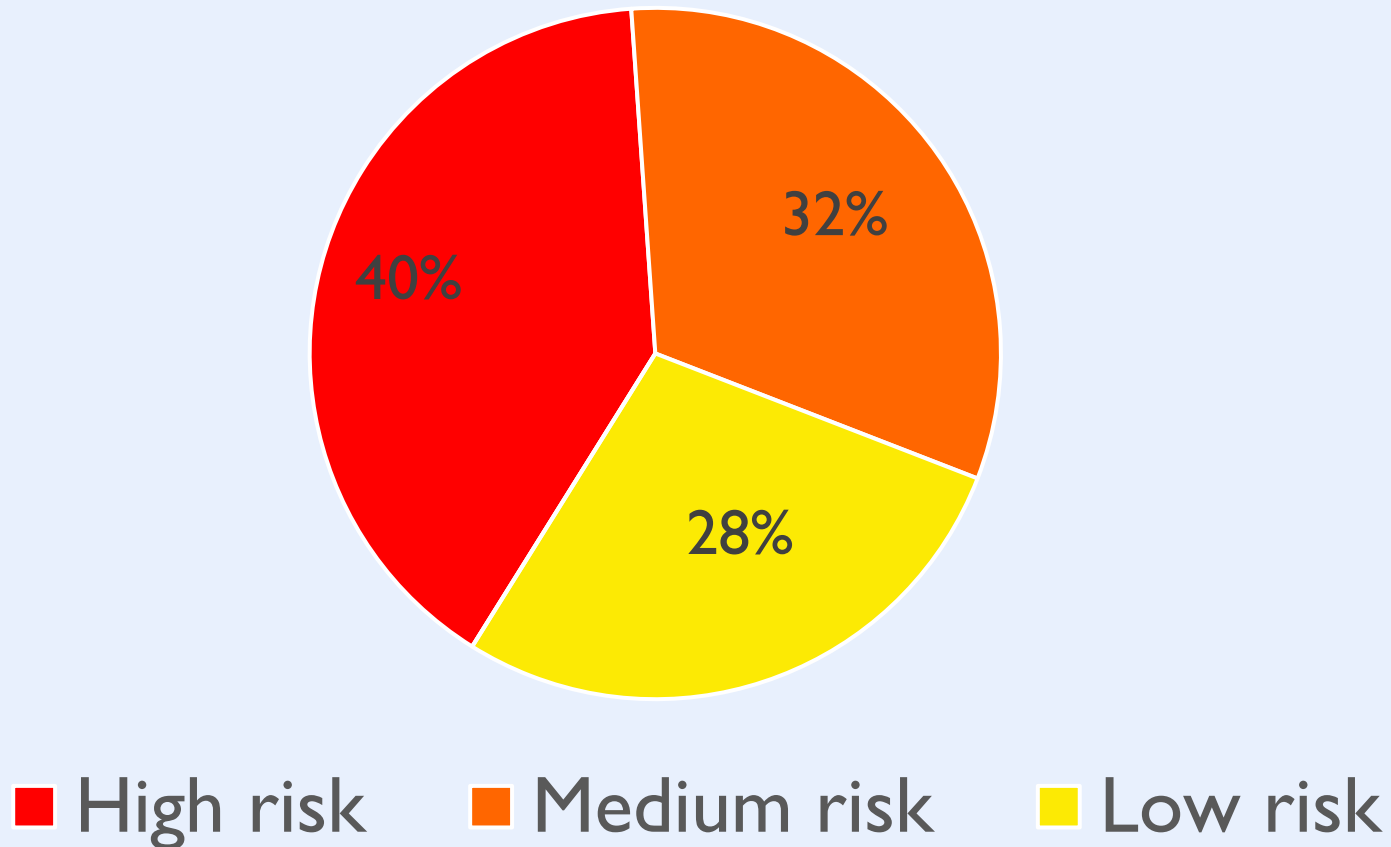


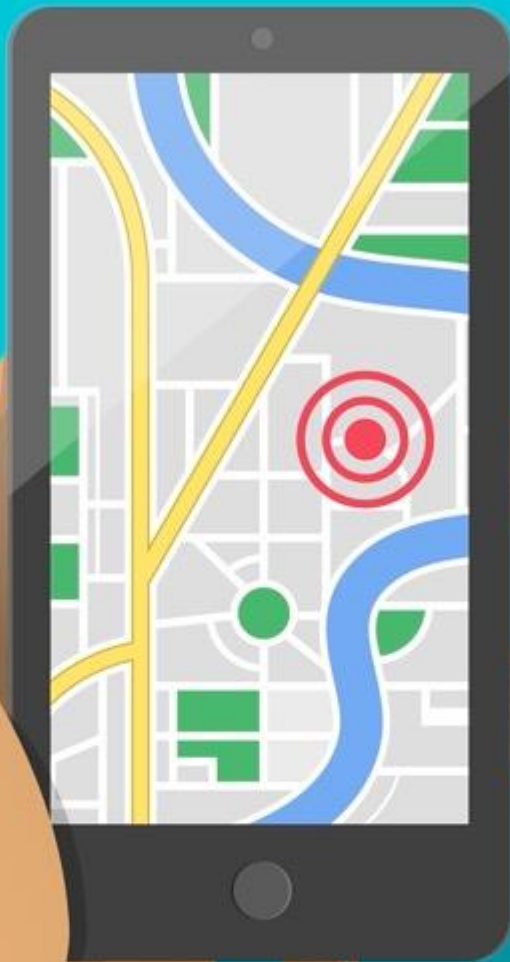


LEARNING CURVE: SECURITY



RISK TO USERS' PRIVACY ACROSS 43 HEALTH APPS





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DIVERSITY CONSIDERATIONS

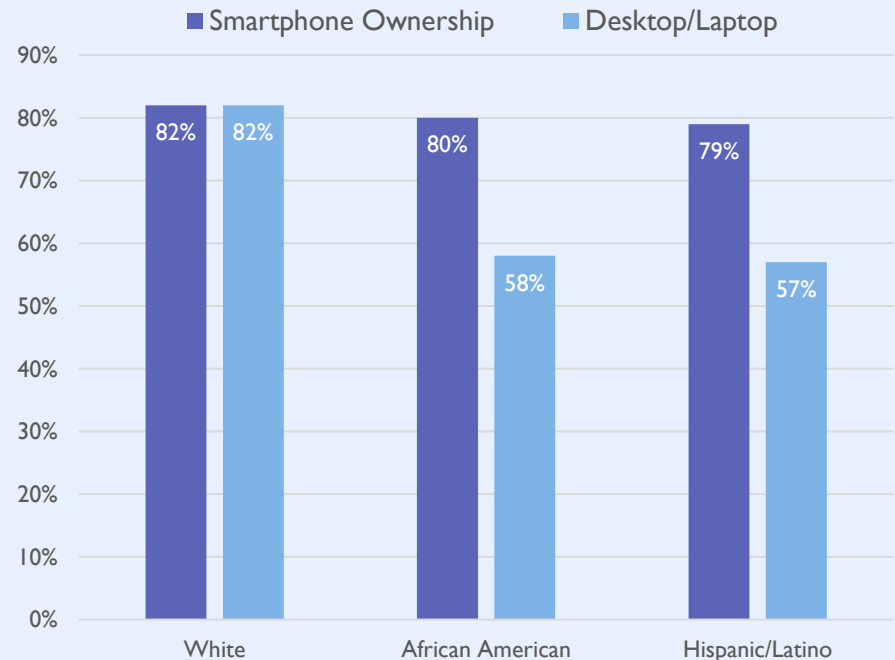
Underserved populations suffer the poorest health outcomes

African American and Latinx use smartphones to access health information more frequently than Whites

African -American: 75% own a smartphone, and 23% own a cellphone

Latinx, 77% own a smartphone, and 20% own a cellphone

Digital health interventions could alleviate mental health disparities





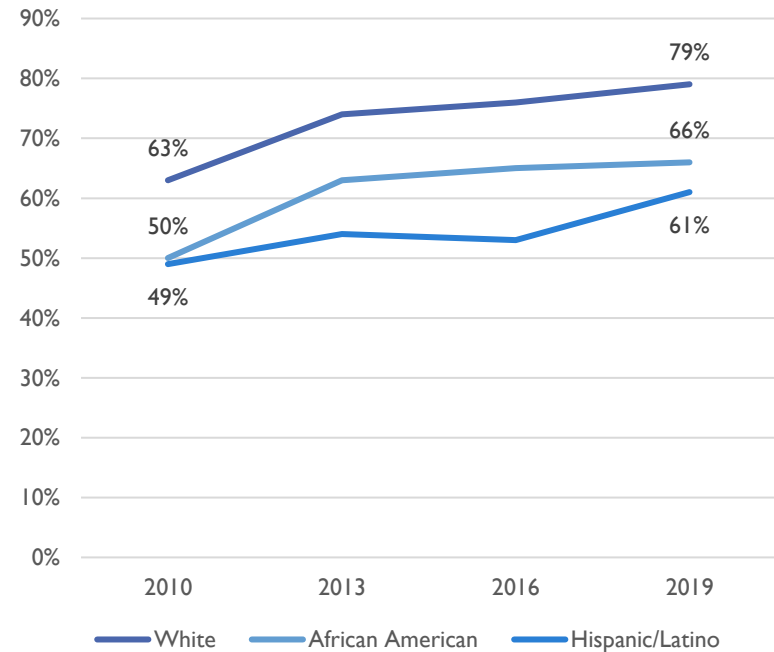
TECHNOLOGY DEMOGRAPHICS

LGBTQ: Higher rates of seeking health information and resources online

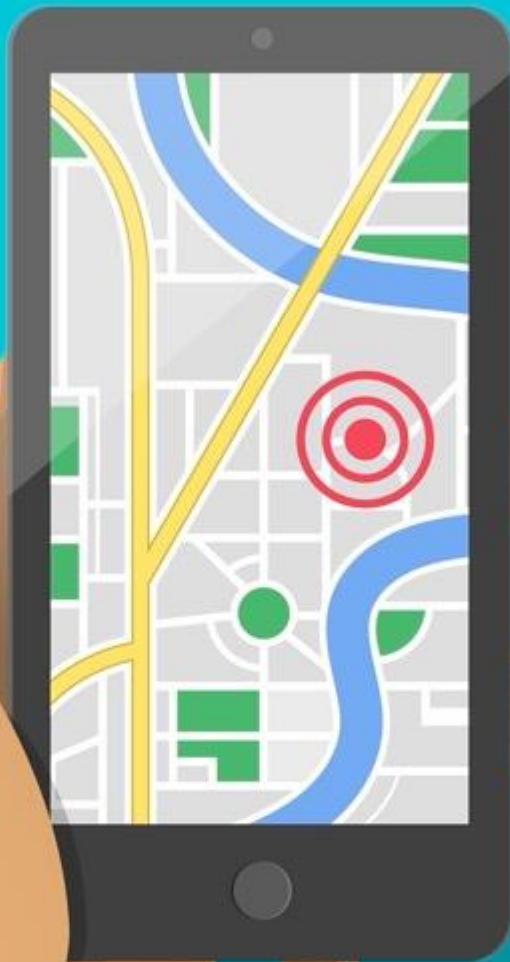
Homeless Individuals: 58% own a smartphone, 86% have an Android

Rural Populations: 65% own a smartphone, 61% have home internet access

Home Internet Access



Messages must be designed to meet the **literacy, language, cultural** and **motivational** needs of the population



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INNOVATIVE DIGITAL INTERVENTIONS¹

- **Chatbots**

- Automated conversational interfaces, can detect and respond to immediate needs
- Some individuals feel more comfortable conversing with a chatbot
- Widely used in many commercially available apps



- **Social media Platforms**

- Patterns of social media use can be used to detect individual worsening of symptoms (i.e., Schizophrenia relapse)
- Platforms use personalized therapy combined with social connections (i.e., Moderated Online Social Therapy platform)



- **Virtual Reality**

- Can create and control personalized, real-world exposures in a safe, convenient environment
- Can be used for mindfulness and relaxation



AREAS OF IMPROVEMENT¹



- **Chatbots**

- Limited in recognizing serious mental health concerns and providing appropriate responses (i.e., suicidal ideation, domestic violence)
- Privacy concerns



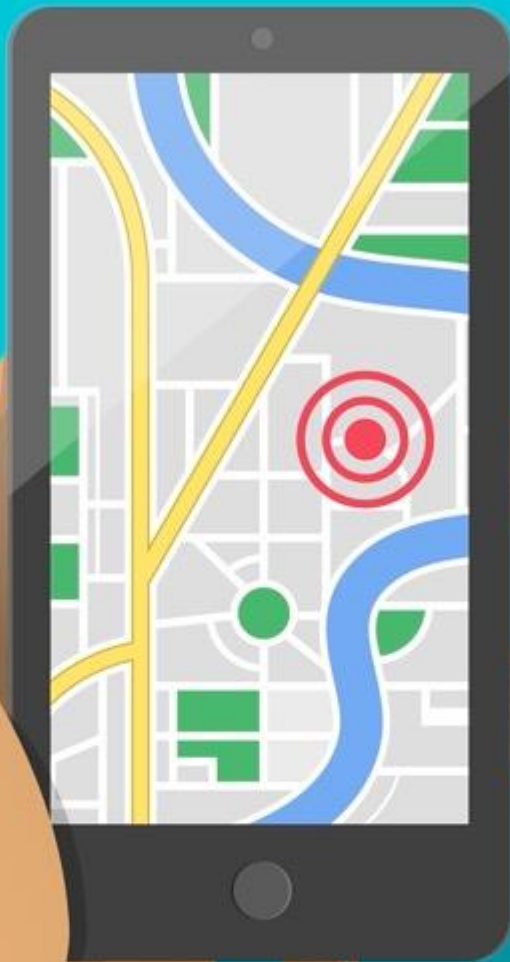
- **Social media Platforms**

- Stigma and disinformation are widespread
- Ethical concerns when using social media for treatment

- **Virtual Reality**

- Mostly inaccessible and unfamiliar to the general public





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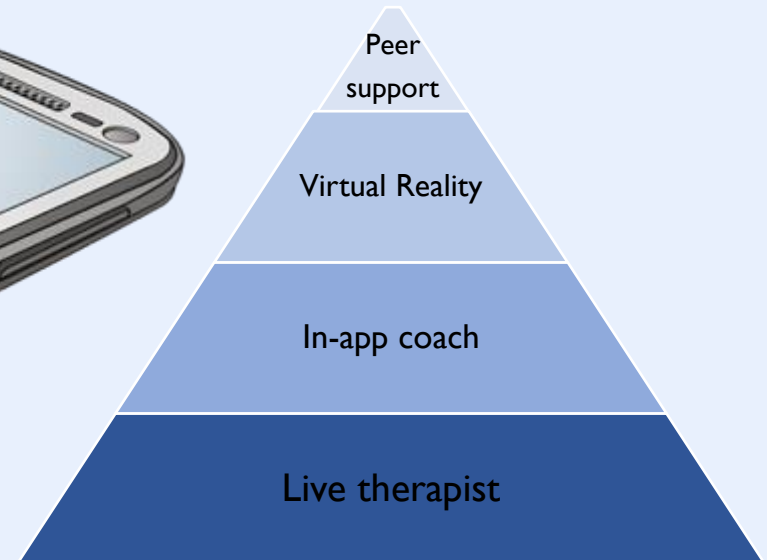
ASSESSMENT



Machine Learning/AI



Level of Care





SUMMARY AND CONCLUSIONS

- *Mental Health Crisis*
 - Most individuals with mental health issues are not getting care
- *Technology*
 - Offers scalable approaches to assessment and personalized treatment
 - Will continue to evolve rapidly
 - Need to minimize risks and maximize benefits for our patients.



ACKNOWLEDGEMENTS



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