AI and the Future of Psychiatry

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Disclosures

- I have received research grants from and/or served as an advisor or board member to health and tech businesses. I am a minor share holder in start ups whose products are not discussed here.

- I will discuss off-label uses of software

Objectives

- Historical perspective

- Unmet needs

- Views of end users (clinicians, consumers)

- Evidence base

- Ethical framework

Pressing Unmet Needs in Mental Health

- ~400M people worldwide
  - Suicide #2 cause of death in youth

- $16 trillion by 2030

- Stigma

- Low funding, lack of parity

- Poor access to care

- Social factors

- Deep phenotyping

https://www.weforum.org/press/2019/07/how-to-use-technology-ethically-to-increase-access-to-mental-healthcare

Psychiatry shortage escalates as mental health needs grow

Shortage of Psychiatrists

A population of 100,000 people should be supported by 14.7 psychiatrists [1]

In the U.S., only five states and D.C. meet or surpass this goal, with the national average being 8.9 psychiatrists per 100,000 people [1]

- Severe Shortage
- High Shortage
- Moderate Shortage
- No Shortage
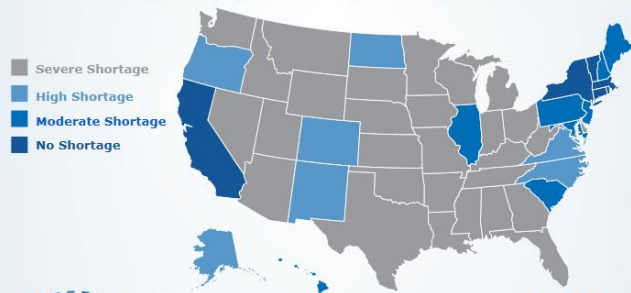
96% of counties in the U.S. had an unmet need for psychiatrists [8]

By 2025, there will be an estimated 12% deficit in the psychiatry workforce [2]

59% of active psychiatrists are close to retirement [3]

60% of adults with a mental illness did not receive mental health services last year

Shortage has led to...

Appointment wait times up to a month or longer [5]

Sessions that last only 15 minutes on average [6]

A marked increase in provider burnout due to more time spent working [7]

1. Merritt Hawkins. 2015. Psychiatry: "The Silent Shortage." Dallas, Texas
2. Agency for Healthcare Research and Quality. (2009). Healthcare Cost and Utilization Project, Nationwide Emergency Department.
3. Merritt Hawkins. 2015. Psychiatry: "The Silent Shortage." Dallas, Texas
4. Merritt Hawkins. 2015. Psychiatry: "The Silent Shortage." Dallas, Texas
5. National Council for Behavioral Health. 2017. The Psychiatric Shortage Causes and Solutions. Washington DC:
6. National Council for Behavioral Health. 2017. The Psychiatric Shortage Causes and Solutions. Washington DC:
7. Shanafelt, T., et al. (December 2015) Changes in Burnout and Satisfaction with Work-Life Balance in Physicians and the General US Working Population Between 2011 and 2014. Mayo Clinic Proceedings
8. Thomas KC, Ellis AR, Konrad TR, Holzer CE, Morrissey JP. County-level estimates of mental health professional shortage in the United States. Psychiatr Serv 2009;60:1323-8

INSIGHT
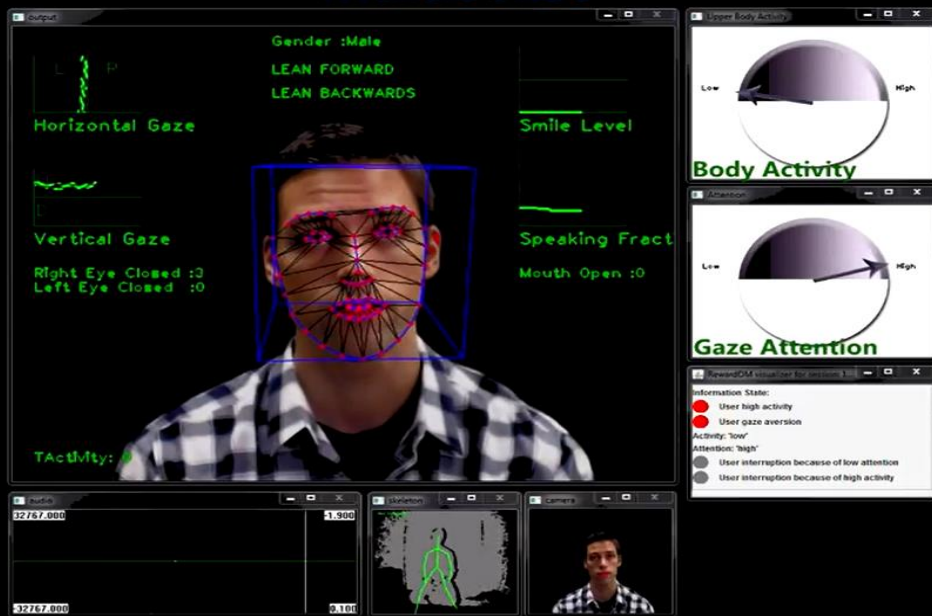
SimSensei's gestures match what it's saying.

WORLD
ECONOMIC
FORUM

2019 Global Future Council on Neurotechnology

White Paper

Empowering 8 Billion Minds
Enabling Better Mental Health
for All via the Ethical Adoption
of Technologies

Four Actions to Scale AI/ML Technology for Mental Health

1. **Create a governance structure** to support the broad and ethical use of new technology in mental healthcare (including the collection and use of big data), ensuring that innovations meet the five ethical imperatives listed above.

2. **Develop regulation** that is grounded in human rights law, and nimble enough to enable and encourage innovation while keeping pace with technological advances when it comes to ensuring safety and efficacy.

3. **Embed responsible practice into new technology designs** to ensure the technologies being developed for mental healthcare have people's best interests at their core, with a primary focus on those with lived experience.

4. **Adopt a "test and learn" approach in implementing technology-led mental healthcare** services in ways that allow continual assessment and improvement and that flag unintended consequences quickly.
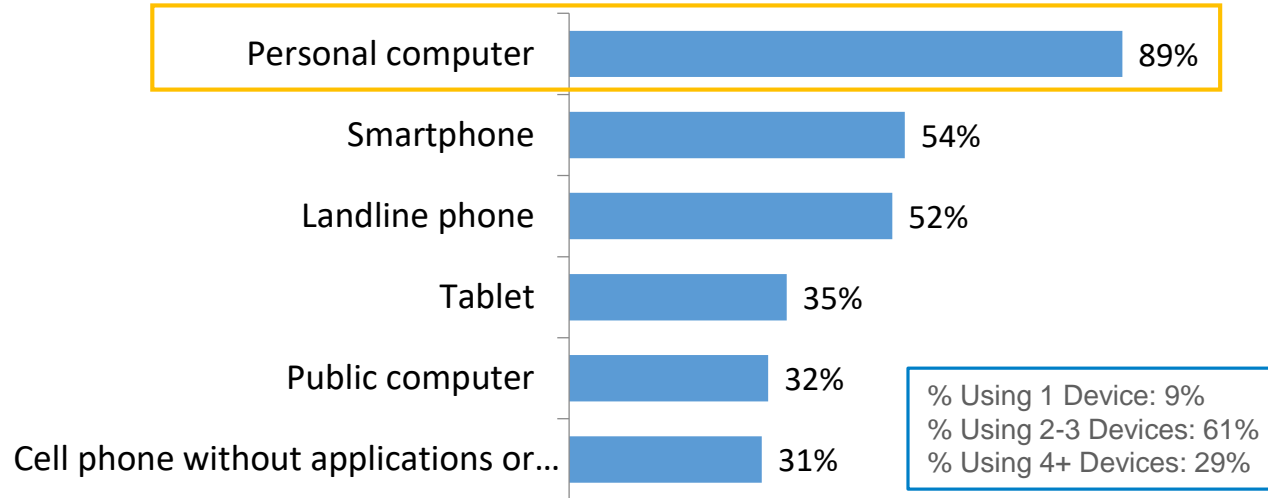
How do patients view technology?

90% have access to a PC and 54% have access to smartphone. 60% have access to 2-3 devices.

N= 457 with Schizophrenia

Device	Percentage
Personal computer	89%
Smartphone	54%
Landline phone	52%
Tablet	35%
Public computer	32%
Cell phone without applications or…	31%

% Using 1 Device: 9%
% Using 2-3 Devices: 61%
% Using 4+ Devices: 29%

Over two thirds (68%) of those aged 18-34 with schizophrenia have access to a Smartphone compared to 48% of 35-46 year olds and 44% of 47-64 year olds with schizophrenia. Sixty eight percent of older adults (47-64) with schizophrenia are more likely to have access to a landline telephone than their younger counterparts (46% for 18-34, 47% for 35-46).

BASE: ALL QUALIFIED RESPONDENTS (n=457)
Q1b Which technological devices do you currently have access to? Select all that apply.

9

National Alliance on Mental Illness

Will Technology help with Recovery?

Two-thirds anticipate that technology will become a bigger part of their recovery in the future.

"In the coming years, I anticipate technology will become a bigger part of my recovery."

■ Stronly disagree   ■ Somewhat disagree

66%

| 17% | 17% | 44% | 22% |
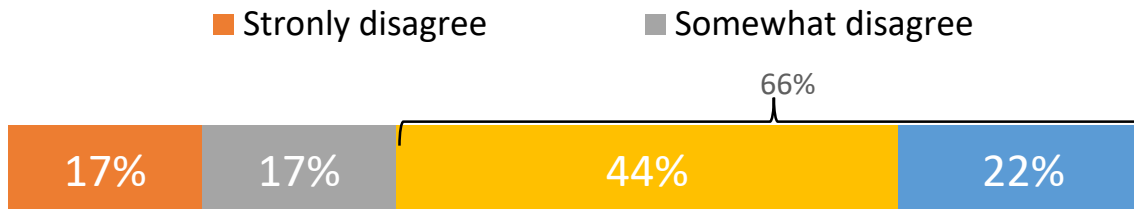
18-46 year olds with schizophrenia are more likely to "strongly agree" that technology will become a bigger part of their recovery than their older counterparts (47-64).

Those who often use technology to cope with schizophrenia are more likely to agree with this statement than those who rarely use technology to cope.

Q13 Please indicate how much you disagree or agree with the following? "In the coming years, I anticipate technology will become a bigger part of my recovery."
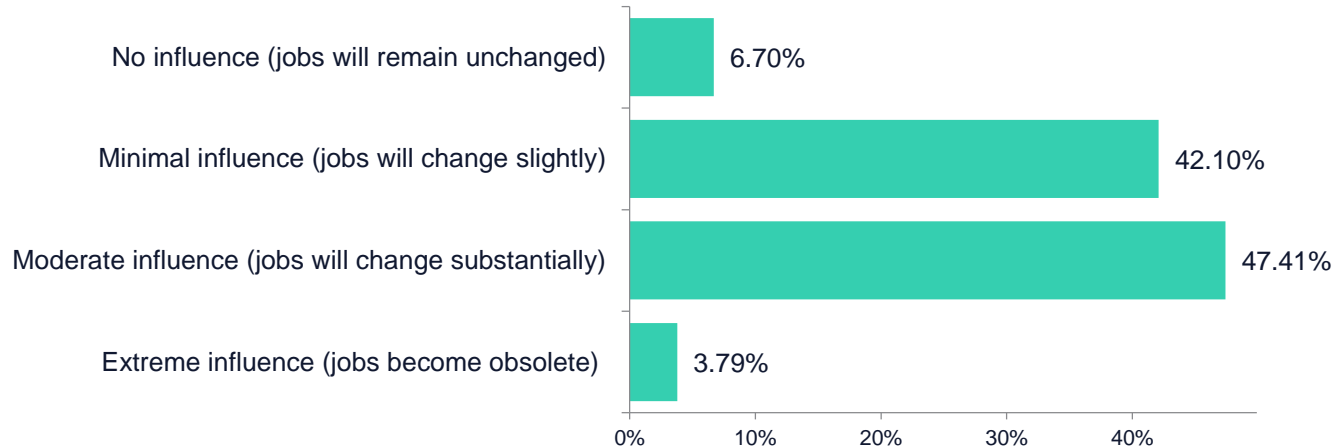
nami
National Alliance on Mental Illness

How do Psychiatrists View AI/Future Technologies?

2019 Global Survey by Sermo with Duke and Harvard

- Online survey using Sermo's global registered physician network and survey platform

- 791 Psychiatrists in 22 countries

- Age 20s to 65+; 1/3rd under 45 years

- Private practice 35.0%; Public clinics 52.0%, Academia 13.0%

Doraiswamy PM, Blease C, Bodner K. AI and the Future of Psychiatry. arXiv:1907.12386 [cs.CY]

In 25 years, of the following options, in your opinion what is the likely impact of artificial intelligence/machine learning on the work of PSYCHIATRISTS?

No influence (jobs will remain unchanged) — 6.70%

Minimal influence (jobs will change slightly) — 42.10%

Moderate influence (jobs will change substantially) — 47.41%

Extreme influence (jobs become obsolete) — 3.79%

0% 10% 20% 30% 40%

In your opinion what is the likelihood that future technology will able to <u>replace</u> human doctors to perform these tasks as well as or better than the average psychiatrist?

Here, we look at Q1S1v1 split as unlikely vs likely. There are only two tasks (outside the ± 2.5% margin of error) that the majority of respondents feel technology is likely to replace, highlighted in teal.

	Unlikely (Extremely unlikely, unlikely, somewhat unlikely)	Likely (Somewhat likely, likely, extremely likely)
Interview psychiatric patients in a range of settings to obtain medical history.	58%	42%
Perform a mental status examination.	67%	33%
Synthesize patient information to reach diagnoses.	46%	54%
Analyze patient information to detect suicidal thoughts.	52%	48%
Analyze patient information to detect acute homicidal thoughts.	58%	42%
Analyze patient information to establish prognoses.	49%	51%
Evaluate when to refer patients to outpatient versus inpatient treatment.	55%	45%
Formulate personalized medication and/or therapy treatment plans for patients.	53%	47%
Provide empathetic care to patients.	83%	17%
Provide documentation (e.g., update medical records) about patients.	25%	75%

2019 Sermo/Duke/Harvard Survey

Brief comments by psychiatrists about the potential benefits of AI/ML in psychiatry

Possible Benefits:

- "Eliminate the human error; Less medical errors, more standardized protocols, better outcomes."

- "The patient can answer more truthfully to artificial intelligence and to accept the encouragement-support more objectively."

- "Making standardized plans and doing standard assessments."

- "Less bias due to race or gender, can use big data more efficiently than humans."

- "It will be of great benefit in areas where there is shortage of psychiatrists. Scalability of treatment."

- "Providing practical guidance for beginners psychiatrists."

- "AI will also help us elucidate etiologies of brain diseases that are currently opaque to us."

# Brief comments by psychiatrists about the potential harms of AI/ML in psychiatry

Risks/Disadvantages:

- "Lack of empathy/no humanity would jeopardize therapeutic process."

- "AI won't be able to assess patient's mental status comprehensively, and therefore will lead to diagnostic and treatment errors."

- "There is a possibility that the process for the machine to reach a diagnosis could turn into a black box process."

- "There is a stigma associated with mental health treatment already and am not sure how talking to an AI would help."

- "Less privacy and more fatalism in general."

- "If time saved is used (by administrators) to increase psychiatrists' patient loads, it might lead to greater burnout."

- "Risks of worsening dehumanization", "worsening psychotic symptoms with avatars"

- "Physicians will forsake creative clinical thinking."

# Stigma: Can Virtual Human Interviewers Breaking Down Barriers?

N=29, After 1 yr deployment to Afghanistan

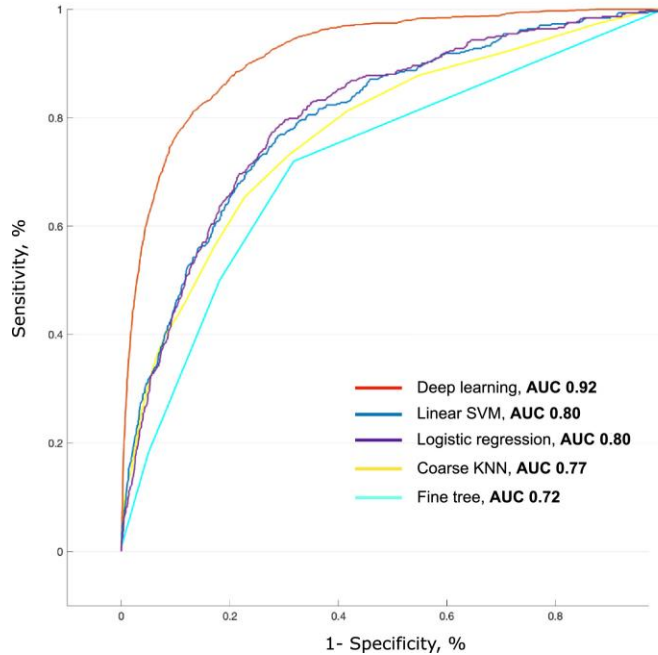Lucas et al. Frontiers in Robotics &AI, 2017
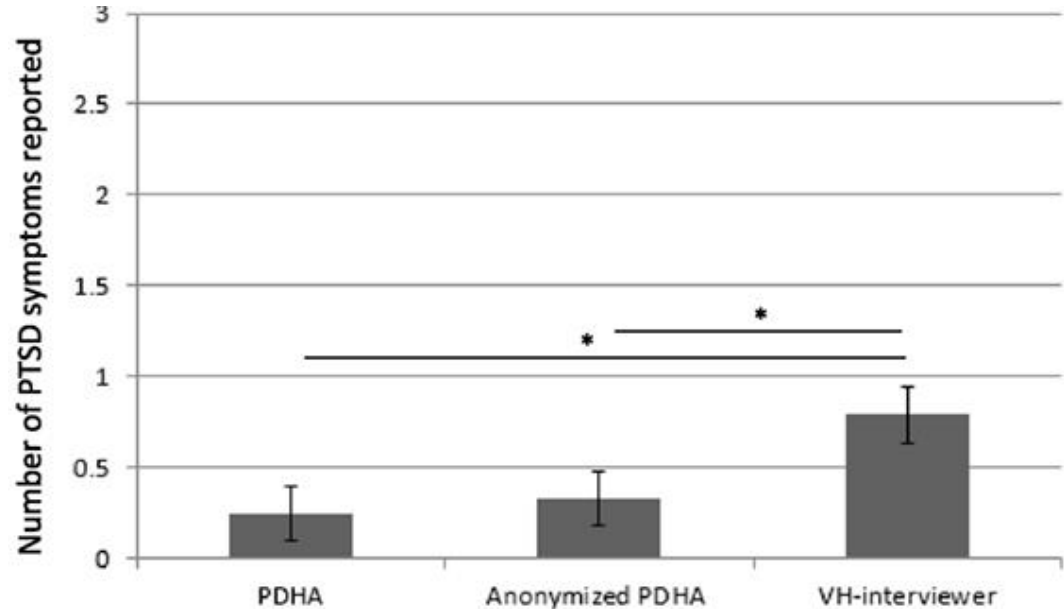
Can AI detect Alzheimer's disease 5 years before diagnosis?

- MCI subjects at risk for Alzheimer's
- >30 baseline and longitudinal variables
  - Demographics
  - Cognitive testing
  - ADLs
  - Brain MRI variables
  - Beta-amyloid and Tau
  - FDG PET scan
- Unbiased multilayer clustering algorithm
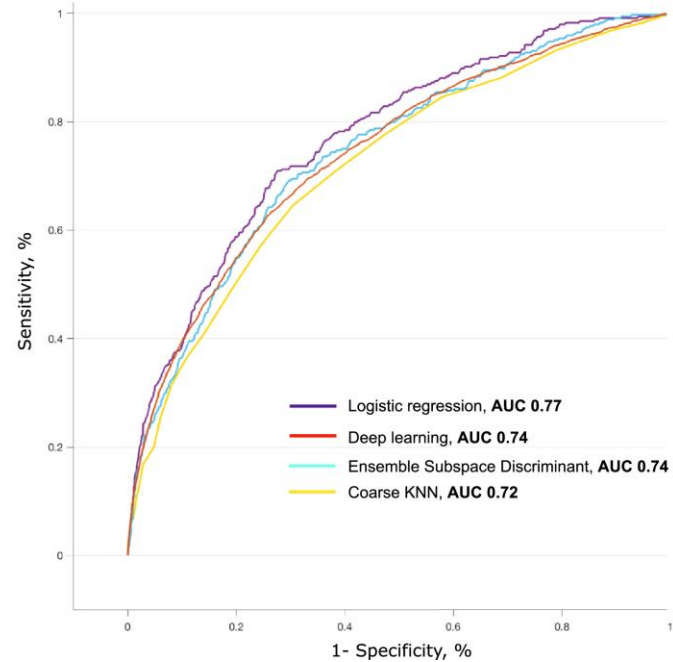- Validation in second dataset

562 LMCI patients

184 slow decliners

240 rapid decliners

Identified clusters
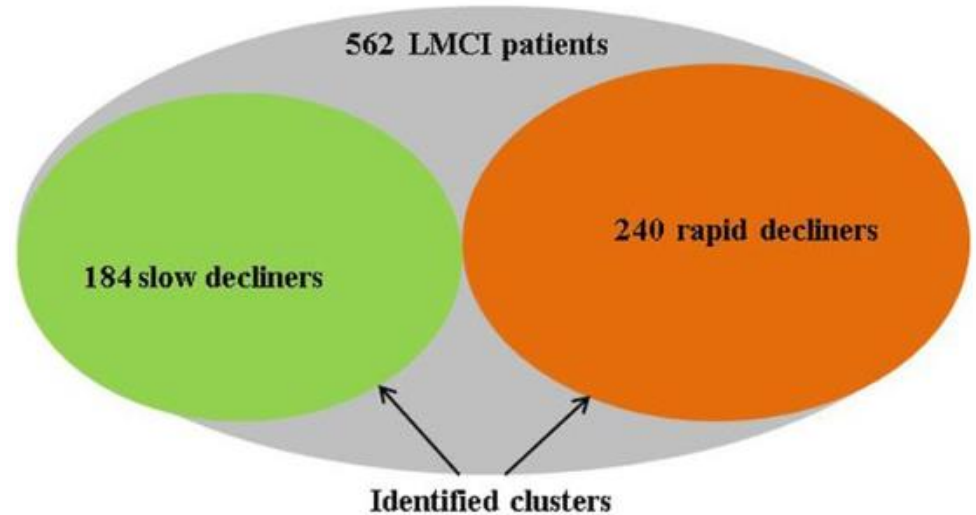
Can AI/ML Predict a Future Depressive Episode?

A Prediction of Depression in NHANES 2013-2014

Deep learning, **AUC 0.92**
Linear SVM, **AUC 0.80**
Logistic regression, **AUC 0.80**
Coarse KNN, **AUC 0.77**
Fine tree, **AUC 0.72**

B Estimation of Depression in K-NHANES through a model trained with NHANES

Logistic regression, **AUC 0.77**
Deep learning, **AUC 0.74**
Ensemble Subspace Discriminant, **AUC 0.74**
Coarse KNN, **AUC 0.72**
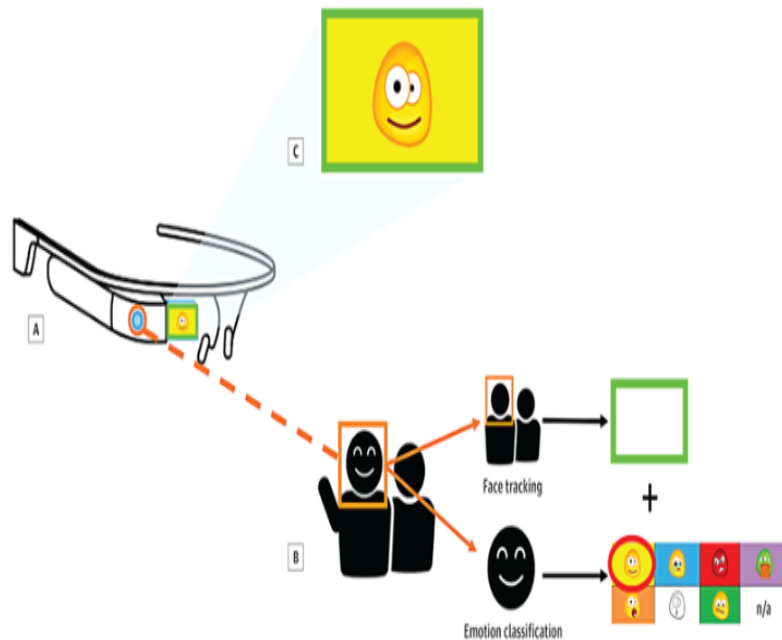
Oh J et al. J Affective Dis 2019

Effect of Wearable Digital Intervention for Improving Socialization in Children With Autism Spectrum Disorder

A Randomized Clinical Trial

Catalin Voss, MS[1]; Jessey Schwartz, BA[2]; Jena Daniels, BS[2]; et al

》Author Affiliations | Article Information

The effect of smartphone-based monitoring on illness activity in bipolar disorder: the MONARCA II randomized controlled single-blinded trial.

Faurholt-Jepsen M[1], Frost M[2], Christensen EM[1], Bardram JE[3], Vinberg M[1], Kessing LV[1].

⊕ **Author information**

Abstract

BACKGROUND: Recently, the MONARCA I randomized controlled trial (RCT) was the first to investigate the effect of smartphone-based monitoring in bipolar disorder (BD). Findings suggested that smartphone-based monitoring sustained depressive but reduced manic symptoms. The present RCT investigated the effect of a new smartphone-based system on the severity of depressive and manic symptoms in BD.

METHODS: Randomized controlled single-blind parallel-group trial. Patients with BD, previously treated at The Copenhagen Clinic for Affective Disorder, Denmark and currently treated at community psychiatric centres, private psychiatrists or GPs were randomized to the use of a smartphone-based system or to standard treatment for 9 months. Primary outcomes: differences in depressive and manic symptoms between the groups.

RESULTS: A total of 129 patients with BD (ICD-10) were included. Intention-to-treat analyses showed no statistically significant effect of smartphone-based monitoring on depressive (B = 0.61, 95% CI -0.77 to 2.00, p = 0.38) and manic (B = -0.25, 95% CI -1.1 to 0.59, p = 0.56) symptoms. The intervention group reported higher quality of life and lower perceived stress compared with the control group. In sub-analyses, the intervention group had higher risk of depressive episodes, but lower risk of manic episodes compared with the control group.

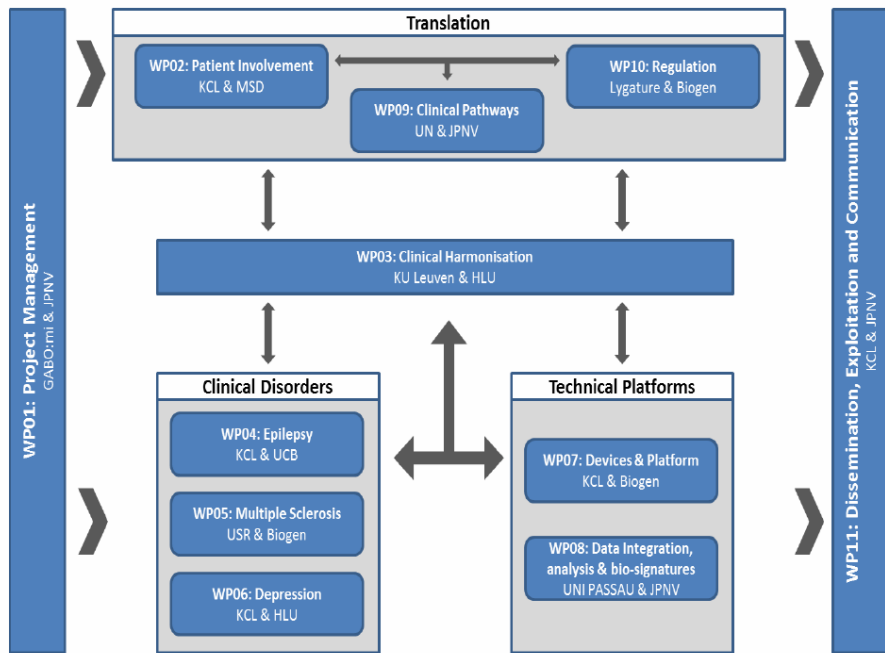# LARGER SCALE PUBLIC-PRIVATE EFFORTS WILL BE REQUIRED
Remote **A**ssessment of **D**isease and **R**elapse (RADAR-CNS)

RADAR-CNS

im!
Innovative Medicines Initiative

PUBLIC RELEASE: 26-APR-2016
Smartphones and wearables could revolutionize medical care for people with brain disorders
New collaborative research program will explore potential of wearable devices to help prevent and treat depression, multiple sclerosis and epilepsy

WP01: Project Management
GABO·mi & JPNV

Translation

| WP02: Patient Involvement KCL & MSD | WP10: Regulation Lygature & Biogen |

WP09: Clinical Pathways UN & JPNV

WP03: Clinical Harmonisation KU Leuven & HLU

Clinical Disorders

WP04: Epilepsy KCL & UCB

WP05: Multiple Sclerosis USR & Biogen

WP06: Depression KCL & HLU

Technical Platforms

WP07: Devices & Platform KCL & Biogen

WP08: Data Integration, analysis & bio-signatures UNI PASSAU & JPNV

WP11: Dissemination, Exploitation and Communication
KCL & JPNV

RADAR-CNS is jointly led by King's College London and Janssen Pharmaceutica NV, funded by the Innovative Medicines Initiative (a Public Private Partnership established between the European Federation of Pharmaceutical Industries and Associations (EFPIA) and the European Union) and includes 24 organizations from across Europe and the US. The program brings together experts from diverse fields including clinical research, engineering, computer science, information technology, data analytics and health services.

5 years, ~ 22M Euros

Empowering 8 Billion Minds through Ethical Adoption of Technology

Video

https://vimeo.com/user100349956