**Impact of AI Guided Mental Health Clinic among Minorities**

This project evaluates impact of computerized AI intervention on treatment of African Americans with Major Depression. There has been a sudden growth of computer-assisted mental health interventions in treatment of major depression. This has been in part fueled by growth in depression; the percentage of US adults with depression increased from 8.7% in 2017 to 14.4% in 2020 [[[1]](#endnote-1)]. It has also been fueled by shortage of mental health professionals; among U.S. adults 17.9 million cannot get a timely mental health appointment, 7.3 million experience delays in getting prescriptions, and 4.9 million do not have access to care, and more than 25 million live in areas with mental health professional shortage [[[2]](#endnote-2)]. The use of technology in delivery of mental health services can take many different forms, including matching patients to antidepressants [[[3]](#endnote-3)], computer cognitive therapy [[[4]](#endnote-4), [[5]](#endnote-5)], robot-assisted therapy [[[6]](#endnote-6)], phone-based therapy [[[7]](#endnote-7)], and watch and mobile device screening of depression [[[8]](#endnote-8)]. This proposal focuses on AI-based treatment recommendations, available at <http://rapidimprovement.ai>.

|  |
| --- |
| **26.3 million U.S. adults receive virtual mental health services, where AI can supplement clinicians’ care** [[[9]](#endnote-9)] |

Technology assisted mental health services are prevalent. More than $4.5 billion have funded technology- based delivery of mental health services [[[10]](#endnote-10)]. In 5-7 years, these companies have grown from small start-up to serving millions of patients and multimillion dollar revenue: In 2021, (1) Meditopia Inc., revenue of $52,900,000, provided computer-assisted phone-based counseling to more than 18 million patients. (2) Lyra Health Inc., revenue of $338,700,000, provided digital mental health services (3) Spring Health Inc., revenue of $126,000,000, matched employees to mental health services, (4) Meru Health Inc., revenue of $5,000,000, offered digital treatment for depression and reported that 75% of patients experienced remission of depression symptom [[[11]](#endnote-11)]. (5) Iris Telehealth Inc., revenue of $32,200,000, offered tele-psychiatric services to more than 1.5 million patients. (6) Eleanor Health Inc., revenue of $13,500,000, is a comprehensive digital mental health service available in 6 States. (6) Concert Health Inc., revenue of $14,200,000, provided digital mental health services over 12 States. (7) Brightline Inc., revenue of $20,600,000, provided digital counseling to teenagers nationwide. (8) Elemy Inc., revenue of $50,000,000 provided digital services to children who have autism, ADHD, and PTSD. (8) Modern Health Inc., revenue of $58,700,000, enabled employers to provide online counseling and therapy to their employees. (9) Hims and Hers Inc., revenue of $271,900,000, is a publicly traded company that prescribes antidepressants through an online interview, followed by online visit.

Limited information is available on treatment prescribed through technology assisted interventions. It is not clear the extent that clinicians follow either existing guidelines or AI-guided care. Yet, we do know that African Americans have poorer response to antidepressants than Whites [[[12]](#endnote-12)] because most antidepressant recommendations depend on responses of White suburban women [[[13]](#endnote-13)]. Perhaps because of this poor response to treatment, only 37.1% of African Americans with any mental health diagnosis are in treatment [[[14]](#endnote-14)]. In general, three issues are reported as potential areas of concerns with AI-guided care: (i) AI systems “insidiously magnify” current care that has failed to adjust to the needs of minorities [[[15]](#endnote-15)]; (ii) digital interventions are not tested on patients with the highest unmet health care needs and therefore may fail in pragmatic, real world, use [[[16]](#endnote-16)]; and (iii) there may be stronger social bias among minorities for expressing mental health outcomes used to evaluate AI systems [[[17]](#endnote-17)]. In this study, we examine the impact of AI guided care on depressed African Americans.

Methods

The current AI-guided care for depressed patient does not adjust for racial differences. This race-agnostic decision aid, developed by us, has shown to reduce depression remission rates by 17.5% in the general population but its effects on African Americans is not known [[[18]](#endnote-18)]. We used All of Us data [[[19]](#endnote-19)] to retrospectively examine if African American patients who took the AI recommended medications had higher depression remission rates.

|  |
| --- |
| **Table 1: Distribution of Remission Rates** |
|  | **All of US Prescribed Meds** |
| **AI Optimal Meds** | **Yes** | **No** |
| **Recommended** | a (na) | b (nb) |
| **Not recommended** | c (nc) | d (nd) |
| a, b, c, d are percent of patients with remission (ni indicates cases used to calculate remission rates) |

From analysis of All of Us data we will have the joint distribution of AI recommendations, clinicians’ prescriptions and patient’s depression remission. This joint distribution is shown in Table 1. The AI recommendations are based on patient’s medical history, which is available in All of Us data. The clinician’s prescription is also available in All of Us data. The patient’s self-reported depression symptom is not available in All of Us data and this variable was estimated from an index constructed from pre-maturely abandoning the antidepressant [[[20]](#endnote-20)]. This method of retrospective analysis is preferred to random prospective trial because it is more pragmatic. It allows patients with diverse medical history to be included in the study. In prospective randomized studies, patients are restricted to specific medical histories and the findings are not relevant for patients with a variety of medical histories.

|  |
| --- |
| **Table 2: Accuracy of Recommendations** |
|  | Remission  | No Remission |
| Treated as Recommended | a | b |
| Not Treated as Recommended | c | d |
| If Treated as Recommended | e | f |

Table 2 shows the planned analysis. The analysis reports the effect of treating as recommended by AI and the effect of not doing so. We report what would have happened if the patient was not treated as recommended, which is a counterfactual estimate. These methods of evaluation are preferred to random trials that compare two populations of patients, without subjects serving as their own controls. Cells e and f, in Table 2, show the counterfactual situations. The calculation of counterfactuals is done by stratifying on the clinicians’ prescription rates and examining the independent impact of AI recommendation on remission rates [[[21]](#endnote-21)].

**Results**

Table 3 describes the demographic of the population we examined in All of Us.

Additional details to be added.

**Discussion**

Additional details to be added.

**References**

1. Daly M, Sutin AR, Robinson E. Depression reported by US adults in 2017-2018 and March and April 2020. J Affect Disord. 2021 Jan 1;278:131-135. [↑](#endnote-ref-1)
2. <https://www.nami.org/NAMI/media/NAMI-Media/Infographics/NAMI_2020MH_ByTheNumbers_Adults-r.pdf> Retrieved on 1/8/2023 [↑](#endnote-ref-2)
3. Alemi F, Min H, Yousefi M, Becker LK, Hane CA, Nori VS, Wojtusiak J. Effectiveness of common antidepressants: a post market release study. EClinicalMedicine. 2021 Oct 25;41:101171. doi: 10.1016/j.eclinm.2021.101171. PMID: 34877511; PMCID: PMC8633963. [↑](#endnote-ref-3)
4. Wright JH, Mishkind M, Eells TD, Chan SR. Computer-Assisted Cognitive-Behavior Therapy and Mobile Apps for Depression and Anxiety. Curr Psychiatry Rep. 2019 Jun 27;21(7):62. doi: 10.1007/s11920-019-1031-2. PMID: 31250242. [↑](#endnote-ref-4)
5. Dobkin RD, Mann SL, Gara MA, Interian A, Rodriguez KM, Menza M. Telephone-based cognitive behavioral therapy for depression in Parkinson disease: A randomized controlled trial. Neurology. 2020 Apr 21;94(16):e1764-e1773. doi: 10.1212/WNL.0000000000009292. Epub 2020 Apr 1. PMID: 32238507; PMCID: PMC7282876. [↑](#endnote-ref-5)
6. DiPietro J, Kelemen A, Liang Y, Sik-Lanyi C. Computer- and Robot-Assisted Therapies to Aid Social and Intellectual Functioning of Children with Autism Spectrum Disorder. Medicina (Kaunas). 2019 Aug 5;55(8):440. doi: 10.3390/medicina55080440. PMID: 31387274; PMCID: PMC6724404. [↑](#endnote-ref-6)
7. Sun Y, Li Y, Wang J, Chen Q, Bazzano AN, Cao F. Effectiveness of Smartphone-Based Mindfulness Training on Maternal Perinatal Depression: Randomized Controlled Trial. J Med Internet Res. 2021 Jan 27;23(1):e23410. doi: 10.2196/23410. PMID: 33502326; PMCID: PMC7875700. [↑](#endnote-ref-7)
8. Opoku Asare K, Terhorst Y, Vega J, Peltonen E, Lagerspetz E, Ferreira D. Predicting Depression From Smartphone Behavioral Markers Using Machine Learning Methods, Hyperparameter Optimization, and Feature Importance Analysis: Exploratory Study. JMIR Mhealth Uhealth. 2021 Jul 12;9(7):e26540. doi: 10.2196/26540. PMID: 34255713; PMCID: PMC8314163. [↑](#endnote-ref-8)
9. Substance Abuse and Mental Health Services Administration. (2021). Key substance use and mental health indicators in the United States: Results from the 2020 National Survey on Drug Use and Health (HHS Publication No. PEP21-07-01-003, NSDUH Series H-56). Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration. Retrieved from <https://www.samhsa.gov/data/> [↑](#endnote-ref-9)
10. Howarth J. 20 Growing Mental Health Startups In 2023. <https://explodingtopics.com/blog/mental-health-startups>, December 19, 2022 [↑](#endnote-ref-10)
11. Economides M, Ranta K, Nazander A, Hilgert O, Goldin PR, Raevuori A, Forman-Hoffman V. Long-Term Outcomes of a Therapist-Supported, Smartphone-Based Intervention for Elevated Symptoms of Depression and Anxiety: Quasi-experimental, Pre-Postintervention Study JMIR Mhealth Uhealth 2019;7(8):e1428 [↑](#endnote-ref-11)
12. Murphy E, Hou L, Maher BS, Woldehawariat G, Kassem L, Akula N, Laje G, McMahon FJ. Race, genetic ancestry and response to antidepressant treatment for major depression. Neuropsychopharmacology. 2013 Dec;38(13):2598-606. doi: 10.1038/npp.2013.166. Epub 2013 Jul 5. PMID: 23827886; PMCID: PMC3828530. [↑](#endnote-ref-12)
13. Ioannidis JP. Effectiveness of antidepressants: an evidence myth constructed from a thousand randomized trials? Philos Ethics Humanit Med. 2008 May 27;3:14. doi: 10.1186/1747-5341-3-14. PMID: 18505564; PMCID: PMC2412901. [↑](#endnote-ref-13)
14. Substance Abuse and Mental Health Services Administration. (2021). Key substance use and mental health indicators in the United States: Results from the 2020 National Survey on Drug Use and Health (HHS Publication No. PEP21-07-01-003, NSDUH Series H-56). Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration. Retrieved from <https://www.samhsa.gov/data/> [↑](#endnote-ref-14)
15. Torous J, Myrick K, Aguilera A. The need for a new generation of digital mental health tools to support more accessible, effective and equitable care. World Psychiatry. 2023 Feb;22(1):1-2. doi: 10.1002/wps.21058. PMID: 36640397. [↑](#endnote-ref-15)
16. Mathews SC, McShea MJ, Hanley CL, Ravitz A, Labrique AB, Cohen AB. Digital health: a path to validation. NPJ Digit Med. 2019 May 13;2:38. doi: 10.1038/s41746-019-0111-3. PMID: 31304384; PMCID: PMC6550273. [↑](#endnote-ref-16)
17. Mitchell S, Potash E, Barocas S, D'Amour A, Lum K. Algorithmic fairness: Choices, assumptions, and definitions. Annual Review of Statistics and Its Application. 2021 Mar 7;8:141-63. [↑](#endnote-ref-17)
18. Alemi F, Min H, Yousefi M, Becker LK, Hane CA, Nori VS, Wojtusiak J. Effectiveness of common antidepressants: a post market release study. EClinicalMedicine. 2021 Oct 25;41:101171. doi: 10.1016/j.eclinm.2021.101171. PMID: 34877511; PMCID: PMC8633963. [↑](#endnote-ref-18)
19. Mapes BM, Foster CS, Kusnoor SV, Epelbaum MI, AuYoung M, Jenkins G, Lopez-Class M, Richardson-Heron D, Elmi A, Surkan K, Cronin RM, Wilkins CH, Pérez-Stable EJ, Dishman E, Denny JC, Rutter JL; All of Us Research Program. Diversity and inclusion for the All of Us research program: A scoping review. PLoS One. 2020 Jul 1;15(7):e0234962. doi: 10.1371/journal.pone.0234962. PMID: 32609747; PMCID: PMC7329113. [↑](#endnote-ref-19)
20. Alemi F, Aljuaid M, Durbha N, Yousefi M, Min H, Sylvia LG, Nierenberg AA. A surrogate measure for patient reported symptom remission in administrative data. BMC Psychiatry. 2021 Mar 4;21(1):121. doi: 10.1186/s12888-021-03133-1. PMID: 33663440; PMCID: PMC7931356. [↑](#endnote-ref-20)
21. Glymour M, Pearl J, Jewell NP. Causal Inference in Statistics - A Primer. John Wiley and Sons, 2016. [↑](#endnote-ref-21)