All of Us Project on Antidepressants

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**Abstract**

This study utilizes large Health care dataset provided by the National Institutes of Health's "All of Us" Research Program to focus on precision medicine focusing on the African American patient population. In which have historically been underrepresented in psychiatric research (HHS, 2018). By targeting African American patients diagnosed with major depressive disorder and prescribed antidepressants, this research seeks to refine predictive models to help with the treatment outcomes using advanced analytical methods including cross-validated logistic regression and AI-driven models. Additionally, it evaluates antidepressant treatments against other variables.

The key findings of this study show the possibility of personalized medicine approaches tailored specifically for African American patient demographic. It analyzed 7,081 African American patients, of whom 3,792 discontinued antidepressant treatment after 220 days on average. The models revealed disparities in predictive accuracy of antidepressant responses. Desvenlafaxine prediction accuracy rose up to 83% as opposed to only 33% using general models.

This study highlights several crucial elements affecting treatment outcomes, such as prior medical conditions and history of antidepressant use. Furthermore, it stresses the significance of taking individual health profiles into account when prescribing treatments in order to create more tailored, targeted plans. This research does not only increases the medical and analytical understanding of antidepressants responses among African Americans patients but also provides insights for improving clinical results and personalized healthcare solutions.

**Background:**

National Institutes of Health's ("All of Us" Research Program), launched to create one of the world's largest biomedical data resources for health research. Their goal is to collect detailed health information from one million plus Americans to advance precision medicine-inspired health improvements across America (NIH). The All of us program places great emphasis on diversity, with participants hailing from diverse racial, ethnic and gender minority backgrounds as well as rural residents. Approximately 80% of the data contributed comes from populations that have historically been underrepresented in biomedical research (NIH).

An EHR research describes the definition and classification of major depression from DSM-5 or NHS Read Codes to ensure consistent approach in documenting cases of major depression in clinical environments (Nickson et al., 2023). According to Mayo Clinic, major depressive disorder involves persistent mood or activity impairment for two weeks at least as well as changes in appetite, sleep disturbances and fatigue that significantly impede daily functioning (2022).

 **Methods:**

This study employed data from the All of Us Research Program, an expansive health database designed to facilitate research across diverse populations. To focus on African American patients who were prescribed antidepressants for major depressive disorders. Which is a underrepresented demographic within psychiatric research (HHS, 2018). the primary focus is to increase understanding and develop predictive models tailored specifically towards the group of African American patients who received antidepressant medication.

Participants were considered eligible if they met criteria for major depression and had an antidepressant prescription in the All of us EHR record. Exclusion criteria were set to exclude individuals with incomplete medical records or missing follow-up data, and to define remission as meeting standard clinical criteria.

In this study, it was considered a use different independent variables including medical history, previous antidepressant usage and various clinical factors. Each variable was then checked for presence to ensure it occurred prior to an antidepressant response to remission, and with missing values removed in order to clean the data set for analysis. This process is to minimizes bias and error when creating a predictive modeling set.

The analytical framework employed cross-validated McFadden R2 statistics to measure the predictive accuracy of AI models over small sample sizes and binary logistic regression models, such as logistic regression models. Also, the race-specific and general AI models were employed in this research project in order to account for factors that may hinder drug efficacy; statistical analyses were performed with Python libraries such as sklearn. This research is to identify key influencing antidepressant response, with particular attention paid towards improving predictability for African American patients as indicated in Tables 2 and 3.

**Results**

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| **Table 1 Description of Population**  |
| Description  | Total Number |
| Antidepressants Examined | 15 |
| Individuals Involved | 7081 |
| Antidepressants Discontinued | 3792 |
| Days Followed per individual | 220 |
| Days Antidepressants Continued | 220 |
| Medical Conditions at Baseline | 21 |
| Antidepressants Used Prior to Baseline | 15 |
| Experience with Previous Antidepressants | 2.5 |

**Table 1 notes:**

This table presents an analysis of antidepressant usage among 7,081 African American patients. 15 different antidepressants were examined for their usage patterns across this study population. 7,081 participants were used to assess and monitor the effects and outcomes of antidepressant treatments. Of these participants, 3,792 discontinued their prescribed antidepressant regimen during its duration. Participants continued their antidepressant treatments for an average of 220 days. Participants had an average of 21 medical conditions at the start of the study. the participants had used 15 different antidepressants prior to the start of the date. The average experience rating with previous antidepressants was 2.5.

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| **Table 2: Cross-Validated McFadden R2 in Predicting African Americans Antidepressant Response** |
|  | **Bupropion** | **Desvenlafaxine** | **Trazodone** | **Doxepin** |
| Cases | 2,084 | 49 | 3.608 | 364 |
| Cases with Remission | 416 | 6 | 566 | 57 |
| AI Predictions | 1% | 33% | 0% | 3% |
| AI & Race-Specific Model | 2% | 83% | 19% | 16% |

**Table 2 notes:**
This table provides predictive accuracy of an AI model and a race-specific AI model for African Americans response to different antidepressants. It goes over four antidepressants, Bupropion, Desvenlafaxine, Trazodone, Doxepin. Among 2,084 cases, Bupropion had 416 cases with remissions with 1% AI prediction and 2% with AI & Race-Specific Model. Desvenlafaxine had 49 cases and 6 cases with remission with 33% AI prediction and 83% with AI & Race-Specific Model. Trazodone had 3,608 cases with 566 with remissions with 0% AI prediction and 19% with AI & Race-Specific Model. Doxepin had 364 cases and 57 cases with remission with 3% AI prediction and 16% with AI & Race-Specific Model.

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| **Table 3: Top 5 Factors with Largest Absolute value Added to the AI** |
|  | **Bupropion** | **Desvenlafaxine** | **Trazodone** | **Doxepin** |
| Intercept | -1.47 | -3.2 | -1.93 | -1.8 |
| Top | SR, 0.98 | disease\_34713006, 1.15 | disease\_194437008, 0.82 | disease\_402134005, -1.16 |
| 1st | disease\_254902007, 1.19 | disease\_35489007, -0.57 | rx\_10737, 0.77 | disease\_66590003, -1.03 |
| 2nd | disease\_24782002, 1.05 | rx\_734064, -0.50 | disease\_53741008, -0.64 | disease\_10743008, -1.00 |
| 3rd | disease\_31956009, -0.86 | disease\_56294008, -0.49 | rx\_89013, -0.64 | disease\_14669001, -0.94 |
| 4th | disease\_32398004, -0.77 | DN, -0.45 | disease\_609496007, -0.68 | disease\_193589009, -0.94 |
| 5th | DR, 0.61 | disease\_76581006, 0.46 | disease\_193462001, 0.70 | disease\_200670004, 1.04 |

**Table 3 Note:** The top five factors that significantly contribute to the predictive models for four different antidepressants which are Bupropion, Desvenlafaxine, Trazodone, and Doxepin. For Bupropion, the model's intercept is -1.47 with a coefficient of 0.98. Desvenlafaxine shows a model intercept of -3.2, where disease\_34713006 with a coefficient of 1.15. Trazodone, with an intercept of -1.93, impact from disease\_194437008 at 0.82. The Doxepin's model intercept stands at -1.8 and impact from disease\_402134005 at -1.16.

**Discussion**

 According to table 1, it revealed a high discontinuation rate of antidepressant usage with 3,792 out of 7,081 African American participants stopping their medication. The African American patients who continued their treatment maintained it for a duration, averaging around 220 days. The AI models demonstrated different rates of prediction with significant improvements observed when incorporating other factors. In fact, Desvenlafaxine showed a prediction success rate of 83% in the race-specific AI model compared to the AI prediction rate of 33%. It reveals that both disease conditions and treatment influence the AI model's predictions. Each antidepressant responds differently to the contributing factors.

Patients with multiple health conditions are more likely to face complications with antidepressant efficacy, potentially explaining the high discontinuation observed in this study. There should be a consideration of reviewing past treatments when prescribing new drugs to patients. The disease-specific impacts on antidepressant efficacy and the influence of specific disease codes aligns with known interactions between these conditions and drug metabolism in psychiatric treatments.

The study was focused on four sets of antidepressant and not on all the possible drugs that could be prescribed to patients that are diagnosed with Major depression. It was solely focused on the African American population and not compared with the general population. If the study was to analyze the entire demographic by All of us data, then there would be a huge impact on claims if there a clear difference in remissions compared to other races provided in the dataset. Also, the African American sample size is small and if there was a larger sample size for the algorithm to use then it would increase the accuracy of the model.

The Health policy should focus on improving patient and doctor communication, enhancing updating protocols for major depression diagnosed patients. Also, to consider the patient history when creating treatment plans for the African American patient population. The research can help further prove that the AI prediction tools can help with optimizing antidepressant treatments. Policymakers should focus on enhancing predictive accuracy and treatment outcomes in mental health care to improve African American patient care.

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