AN ASSESSMENT OF MEDICATION PATTERN CHANGES IN PRESCRIPTION RECEIVED BY YOUTH OFFENDERS IN DIVISON OF YOUTH SERVICES FACILITIES THROUGH TELEPSYCHIATRY

A Thesis Presented to
The Faculty of the Graduate Faculty
At the University of Missouri, Columbia

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science

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May, 2018
The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

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A candidate for the degree of

Master of Science

And hereby certify that, in their opinion, it is worthy of acceptance.

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ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to Dr. Abu Saleh Mohammad Mosa for his invaluable guidance and continuous encouragement throughout this work. He is a great mentor, teacher and patiently addressed numerous questions throughout the thesis.

I would also like to thank Dr. Sue Boren for valuable advising, and constant support in the last two years, my fellow lab member Mandhadi Vasanthi for her continuous assistance, and Sadia Akter for her help with the statistical analysis.

I would like to extend my thanks to Dr. Laine Young Walker for the helpful inputs and suggestions and for serving on the committee and reviewing my master’s Thesis.

- Dhinakaran Rajendran
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Abstract

The prevalence of mental health disorders is much higher in juvenile justice system than in youth in general population. Two-third of the youths under juvenile justice system suffer from one or more diagnosable mental health conditions. Board certified child psychiatry services are appropriate for treating mental health disorders among youths. However, these services are not available within the proximity of the rehabilitation facilities. Telehealth is an alternate solution to bridge the gap. Telehealth is a method for remote communication of information to facilitate clinical care. Clinical data of 773 youth offenders was collected from MUPC Cerner PowerChart in REDCap database. The data was separated into prior prescription use and prescribed medication. The data was then analyzed using R software and results were produced. On comparison of medication prescribed prior to the telehealth intervention to the prescribed medication through telehealth, there is a decrease in the prescription of Anti-psychotics, Mood Stabilizers and Alpha Agonists. Medication prescribed during the first visit when compared to the medication prescribed in the subsequent visits, we found out that there is a decrease in the prescription of Anxiolytics, Alpha agonists, Stimulants and Sleep medication. Tele-psychiatry achieves its goal of enhancing psychiatric service to youth in the rehabilitation facilities by increasing the level of care and decrease in prescription medications.
Chapter 1: Introduction

1.1 Background
Polypharmacy is the practice of prescribing/administering two or more medicines to treat a single disease condition or multiple conditions in one patient. According to the National Association of State Mental Health Program Directors, the most frequently used definition of psychiatric polypharmacy is the administration of two or more psychotropic drugs to treat a single mental health condition in an individual\(^1\).

The primary objective of this research is to conduct a retrospective analysis of medications prescribed to the psychiatric youth patients at various Missouri Division of Youth Services Rehabilitation Centers and compare the number of medications during the first and the last visit with the prognosis of the disorder taken into consideration. The patients were seen via telehealth by the psychiatrists at the University of Missouri Psychiatric Center. This study aims to provide results regarding the prescription pattern of the psychiatrists, medication management, symptom control, and the factors influencing the polypharmacy prescription.

Few types of polypharmacy are\(^1\):

- Same-class polypharmacy
  - i. Multiple-Class polypharmacy
  - ii. Adjunctive polypharmacy
  - iii. Augmentation polypharmacy
  - iv. Total polypharmacy
Problems related to polypharmacy are not only limited to the possibility of cumulative toxicity or vulnerability to adverse events (side effects by drug interactions) but also the medication regimen would turn complex leading to issues with compliance.

1.2. Definitions of Terms
The following terms were used throughout this report:

a) Telehealth/Telemedicine: Telehealth, also known as telemedicine, has been defined as the intervention of a telecommunication device in the diagnosis, treatment and overall care and well-being of patients who are at remote locations.

b) Tele psychiatry: It is a branch of telehealth that focuses on the mental health care applications. Defined as the use of communication technologies to provide psychiatric services to patients in remote locations.

c) Polypharmacy: Use of multiple medications (2 or more) in a single patient to treat a single condition or multiple conditions.

d) Abnormal Involuntary Movement Scale score: The Abnormal Involuntary Movement Scale is a rating scale use to measure involuntary movements known as Tardive Dyskinesia. Tardive Dyskinesia develops as a side effect of long-term treatment of antipsychotics.

e) Vanderbilt ADHD Diagnostic Scales: Used by healthcare professionals to help diagnose ADHD in children aged between 6 and 12 use The Vanderbilt Assessment scales.

f) Sleep Log: It is a tool used by doctors and patients in the diagnosis and treatment of any sleep related disorder, mostly insomnia or nightmares.
1.3. Objective
The objective of this project is to understand the changes in the prescription pattern. It is achieved by two hypotheses. The first hypothesis is to compare the prior prescriptions that were prescribed to the patient before the first visit via telehealth (which is documented as the medication used for every patient in the first visit and is taken as the baseline) with medication prescribed via telehealth from the first visit to the last visit (which is documented as the medication to be used in every visit). The second hypothesis is to compare the medication prescribed via telehealth in the first visit (which is considered as the baseline) to medication prescribed in the subsequent visits.
Chapter 2: Review of Literature

The incidence and prevalence of mental health disorders among children and youth in rural communities are similar between those in urban communities. The prevalence of mental disorders is much higher in the juvenile justice setting, than in youth in the general population. Estimates reveal that approximately two-thirds of youth encountering the juvenile justice system suffer from one or more diagnosable mental health conditions. Moreover, large number of high-risk youth (substance abusers, neglected youth) go through the juvenile justice system. Various types of mental health disorders encountered in such settings include disruptive, substance abuse, anxiety and mood disorders. Studies suggest that more than quarter of the youth should be receiving mental health treatment or counselling when in the juvenile justice systems. Without treatment, the mental health conditions are bound to worsen, ultimately contributing to negative social outcomes or rebound to the offensive activities. There is a tremendous demand on the justice systems to respond to the mental health needs of the youth offenders.

Professional psychiatric care, providing appropriate case by case mental health analysis and services, will stabilize the individual, reduce the involvement in anti-social activities, promote law abiding behaviors and, thus reducing their chance of being rearrested. Substance abuse treatment plans can tremendously reduce the substance use among juvenile offenders, which will have an impact in their later stages of life, like not reverting to such abusive practices, resulting in reductions in drug offences. Addressing the mental health needs can greatly reduce the criminal activity and violent offending in serious juvenile offenders. Appropriate treatment produces long-standing changes in the criminal behavior of the youth, reducing the chances to go back to the previous lifestyle.
However, a report from 2012 by the Association of American Medical Colleges reported that there were only 7,706 active Child and Adolescent psychiatrics practicing in the U.S., which is one psychiatrist for the population of 40,105\textsuperscript{14}. There is severe misdistribution of such professionals, with children in the rural areas and children in low socio-economic standards have a remarkably reduced access\textsuperscript{15}. The ratio of child and adolescent psychiatrists, where the state of Missouri was below the national average of 8.67 child and adolescent psychiatrists per 100,000 youth in 2001, at 7.1 for the same population\textsuperscript{16}. A study by Becevic et al. found out that majority of the mental health care providers both in-person and via telehealth are located in the urban areas along the I-70 corridor in Missouri-Kansas city, Columbia, and St. Louis\textsuperscript{17}.

Since there is a severe shortage of child and the adolescent psychiatrists in the rural areas and within the proximity of the juvenile justice facilities in Missouri, professional psychiatry services are offered either by primary care physicians or by transporting the youth to a psychiatric center or a visit by the psychiatrist will travel to the facility. These practices have three disadvantages. First, primary care providers do not have adequate training to provide consultation on psychiatric problems among youth, resulting in substandard care\textsuperscript{18}. Second, the certified psychiatrist will lose their valuable time if they need to travel to the facility; instead, the time could be utilized to cover the physician shortage. Third, transporting the youth to a child psychiatry facility requires a lot of planning and is a waste of valuable resources.

A review of literature on administration of psychotropic drugs by Rittmannsberger(2002) reported that there is a significant increase in the trend of polypharmacy from 1970 to 2000. The trend of polypharmacy is not only prevalent in adults but also in children and
adolescents. Comer et al. conducted a survey and reported that there is a 19% prevalence of using medications belonging to the same drug class, in a nationally representative sample of 3,466 children and adolescents\(^\text{19}\). Polypharmacy is more common in patients with diagnosis of schizophrenia, schizotypal and delusional disorders\(^\text{20}\). The most commonly prescribed medications in order were antidepressants followed by ADHD medications, Anti-psychotics and sedative hypnotics. Anti-depressants and ADHD medications were frequently co-prescribed followed by antipsychotics and sedative hypnotics. Multi-class polypharmacy is the most widely seen type followed by same-class polypharmacy. In multi-class polypharmacy, combining a SSRI (like bupropion) with a sedative hypnotic (like benzodiazepines). Use of benzodiazepines in different doses is a common phenomenon in same-class polypharmacy\(^\text{21}\).

The primary reason for polypharmacy prescribing during discharge, according to National Association of State Mental Health Program Directors (NASMHPD), is because the clinical provider feels that the current psychotropic medication being used is ineffective\(^\text{22}\). According to a survey conducted by Sernyak and Osenheck (2004) 65% of the clinicians they surveyed cited unmanageable disease and 39% cited an unsuccessful stich attempt. The five factors associated with the increase in polypharmacy as indicated by Ghaemi, et al. (2002) are Scientific, Clinical, Economic, Political and cultural factors\(^\text{23}\). Disease factors, patient factors, physician factors and sociological factors are the other 4 factors which have a significant impact on rise in polypharmacy\(^\text{24}\). Certain methods targeted at patient diagnosis include, compliance education, psycho education to the family.

Goh et al. (2011) suggested that polypharmacy in psychiatry could be monitored and regulated through proper clinical titration following protocols and guidelines\(^\text{26}\). A
treatment algorithm was implemented for patients accepted into Early Psychosis intervention program (EPIP) by Chong et al., who compared the prescription patterns (before and after implementation of the treatment algorithm). This study found a significant decrease in the antipsychotic polypharmacy use\textsuperscript{20}. Education, guidelines and algorithms are effective ways to reduce and avoid irrational psychotropic polypharmacy.\textsuperscript{27} On examining records of 223 children, aged 3 years with ADHD at a Michigan cohort showed that 127 patients received psychotropic medication. Greater than one-third of the patients were on multiple medication solely for ADHD or for a comorbid condition\textsuperscript{28}.

2.1. Telehealth
The president’s freedom commission on mental health 2003, highlights the importance of telecommunications (telehealth) as a promising source of providing access to evidence based mental health services to the rural areas and remote locations\textsuperscript{29}. Telehealth, also known as telemedicine, has been defined as the intervention of a telecommunication device in the diagnosis, treatment and overall care and well-being of patients who are at remote locations\textsuperscript{3}. It has been demonstrated, as an effective way to overcome barriers like providing specialty care to communities located in rural and remote areas. It can also bridge the gap in providing services to underserved population, where there is a shortage of specialists\textsuperscript{30}. Telepsychiatry, is a branch of telehealth that focuses on the mental health care applications. Defined as the use of communication technologies to provide psychiatric services to patients in remote locations\textsuperscript{31}. It involves a psychiatrist, psychiatric nurse practitioners and a patient meeting in real-time video conference technology. Telepsychiatry is a good alternative which could be used to monitor the patients remotely. It allows for effective diagnosis of mental health disorders, treatment, education, counselling, consultation and various health care activities. Patient access is improved and
satisfaction is high with telehealth services in general\textsuperscript{32}. Research has documented the effectiveness of telehealth to treat mental health conditions like anxiety, depression. Also, it is effective in treating incarcerated population\textsuperscript{33}.

The data used in this study was collected from 773 individual patients charts. The patients were present at 16 different Missouri Division of Youth Services rehabilitative facilities and they were seen via telehealth by psychiatrists at the University of Missouri Psychiatric Center.

2.2. Telehealth Implementation for Missouri Division of Youth Services
The University of Missouri Department of Psychiatry child and adolescent division has operated since 1967 and its telehealth program was started in 2002. The Missouri Division of Youth Services (DYS) has collaborated with the MU Department of Psychiatry in order to enhance the provision of psychiatric services to youth in the rehabilitation (correctional) facilities through the utilization of telehealth. The various locations at which DYS facilities are spread across the state of Missouri are shown in the Figure 1. Telehealth allows DYS facilities to access providers at MU Department of Psychiatry remotely from locations all over the state, thereby increasing the level of access to psychiatric services for DYS youth. Figure 2 presents the telehealth model that was implemented for 18 DYS rehabilitation facilities.
Figure 1: DYS Sites Spread Across the State of Missouri
Chapter 3: Methods

3.1. Tools and Applications
The following tools are used in this research project:

i. REDCap

ii. Citrix Receiver

iii. PowerChart

iv. R and RStudio

v. Visual Basic

vi. Microsoft Excel

3.1.1 REDCap
REDCap (Research Electronic Data Capture) is a browser based, metadata-driven EDC software solution and workflow methodology designing clinical and transitional research databases. It is a web-application used for building and managing surveys, responses and databases. In this project REDCap is used to design data collection forms. REDCap allows the user to redesign the form or add additional features in the design form as the data collection was iterative.

Figure 2: Screenshot of REDCap Website
3.1.2 Citrix Receiver
It is a client software which is necessary to access applications hosted on Citrix servers from a remote authorized device. This tool provides access to XenApp/XenDesktop installations from different types of client devices like Mac OS X, iPad, Windows, Linux. In this project the Citrix receiver was used to access the Cerner power chart (EMR) to explore the patient health records and capture the required data.

![Citrix Receiver Screenshot](image)

Figure 3: Screenshot of Citrix Receiver

3.1.3. PowerChart
PowerChart is an electronic medical record with elements that are intended to work across various operations and departments. It makes the organization more efficient and effective by streamlining the workflow of the clinicians onto one screen including administrative and clinical functions. In this project, Cerner PowerChart was used. It is used to store and access patients’ health information. It contains information like demographics,
medications, clinical notes, vitals, laboratory results, and discharge summary. As it provides a complete picture of a patient’s health, it was as the data source for this project.

![PowerChart Organizer for Rajendran GRA, Dhinakaran](image)

*Figure 4: Screenshot of PowerChart*

### 3.1.4. R and RStudio

R is a free programming language with input and output facilities used for data analysis. It is effective in handling and storage of data. RStudio is an Integrated Development Environment (IDE) for the statistical programming software R. It contains a console and an editor. It can be used for statistical analysis, producing summaries, and creating graphs.
In this project it was used for data analysis. Data from the REDCap database was exported into this tool for further analysis.

![Screenshot of R studio](image)

**Figure 5: Screenshot of R studio**

### 3.1.5. Microsoft Visual Basic for Applications (VBA)

VBA is an object-oriented programming language. In this project it was used in some steps of the data analysis. The data collected in REDCap, exported into CSV format and linked to Microsoft Visual Basic for Applications to perform tasks.
3.1.6. Microsoft Excel
A tool developed by Microsoft containing various spreadsheet templates and data analysis tools including the Visual Basic. In this project it was used for data cleaning and in few steps of data analysis.
3.2. IRB Approval
The research project with project number 1213074 was submitted electronically to the University of Missouri Institutional Review Board (IRB) and it was reviewed and approved by the board.

3.3. Data Collection
The data of 773 patient records was collected from the PowerChart Electronic Medical Record into the REDCap database. A total of 14 forms were created in the REDCap tool to capture the data into appropriate sections. The forms include Patient identifier, Patient demographics, Visit details, Vitals, Chief complaint, Psychiatric evaluation, Problems and Goals, Assessment, Lab results, Medication used, Medication to be used, Sleep log data, ADHD Vanderbilt summary, AIMS exam results. Except for the forms patient identifier, patient demographics and psychiatric evaluation, every other form is repeated for each visit. Each form is provided with a complete, incomplete and an unverified option at the bottom to indicate the completeness of data collection for that form. The form patient identifier collects the following items with their codes: Name, Date of Birth, First Visit Date, MRN, Site Name, and Site Security Level. The form Patient Demographics contains Race, Gender, and Height in centimeter. The form Visit details contains Visit Date, Visit Time, FIN, Type of Visit, Name of the attending Psychiatrist. The form Vitals contain Systolic Blood Pressure, Diastolic Blood Pressure, Pulse, weight in pounds. The Chief Complaint form contains Chief Complaint which is a text box, which is used to copy the text from the patient record to REDCap, Chief Complaints, which are checkboxes containing the frequently encountered chief complaints in children and adolescent psychiatry. The next form is Psychiatric Evaluation which contains Past Psychiatric History, Substance abuse history, School History, Family History, Past Medical History.
The next form Problems and Goals contains Problems, Problem List, Goals, and Goals List. The next form Assessment contains Assessment from Clinical Notes and a checkbox of Assessment. Various disorders frequently encountered by the psychiatrists which are listed in the checkboxes. The next form, Lab Results, contains tests advised by the doctor. In the same form a section named, Name of the tests, contains 10 check boxes of frequently ordered laboratory tests. The next section contains the interpretations of the results. The checkboxes for this section contains the following: Normal, abnormal, not indicated.

The next form, Medication used, is about the medication which was used by the patient prior to the intervention by tele psychiatry. The clinical notes for this section is collected in a text box. Medication name which contains various psychotropic medications with main focus on anti-depressants, antipsychotics, mood stabilizers and sedative hypnotics. The next field in this form is Duration of Use, which is a text box. The next form Medication to be used, which contains the medication prescribed by the doctor, is like the above form with Plan by the Doctor, Medication Name and Duration of Use. The next form Sleep Log Data is a notes box, Sleep log Data which contains radio buttons for three options Normal/Adequate, Initial Insomnia, Middle insomnia, Nightmares, Not indicated. The next form ADHD Vanderbilt contains Inference from Vanderbilt Forms, which is a notes box and Inference from Vanderbilt forms, which is checkboxes containing seven options. The final form is AIMS Exam, which is a notes box used to collect the summary of AIMS exam.

3.4. Classification of the Medication into Drug Classes
After the completion of data collection, the medications are classified into 8 different categories based on their categories by a child and adolescent psychiatrist. They are as follows:
Table 1: Medication Classes and their Description

<table>
<thead>
<tr>
<th>Class Medications</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antipsychotics</td>
<td>Class of drugs used in the short-term treatment of mental disorders like unipolar and bi-polar disorders. It is also used to treat symptoms like hallucinations, aggression and mania.</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>Class of drugs used to treat depression</td>
</tr>
<tr>
<td>Anxiolytics</td>
<td>Drugs used to treat anxiety related disorders are called anti-anxiety drugs, they are also called as Anxiolytics.</td>
</tr>
<tr>
<td>Mood stabilizers</td>
<td>Drugs used to treat Bipolar disorder especially the mania stage of the disease. They control the violent mood swings in bipolar patients.</td>
</tr>
<tr>
<td>Non-stimulants</td>
<td>Drugs which are used to treat ADHD when a patient presents with serious side effects from using drugs in the Stimulant category.</td>
</tr>
<tr>
<td>Stimulants</td>
<td>These are the first choice of drugs used for the treatment of ADHD. However, these medications have side effects including insomnia and headache.</td>
</tr>
<tr>
<td>Sleep Medication</td>
<td>Class of drugs used to induce sleep.</td>
</tr>
<tr>
<td>Alpha Agonists</td>
<td>Class of drugs which are used to treat ADHD and PTSD in children.</td>
</tr>
</tbody>
</table>

This step is useful in grouping the data collected into categories in the next stages of the project. A report titled Medication by name was generated in the REDCap. The steps used in that process are explained in fig 25.

Figure 8: Steps in Creating the Report Medication by Name
The report contains information of medication used and medication prescribed for each patient at all the visits. A screen shot of how the report looks like in REDCap is shown in figure 26.

![Figure 9: Report in REDCap- Medication by Name](image)

The report is then exported from REDCap in CSV format as shown in figure 27. The CSV file is downloaded and duplicated. The duplicated file is saved as an excel workbook in xlsx format.

![Figure 10: Exporting the Report 'Medication by name'](image)
Chapter 4: Data Pre-Processing and Analysis

4.1. Data Pre-Processing

The CSV file downloaded is opened in RStudio using the code shown in table 1 in Appendix B and a screen shot of a portion of the table is shown in figure 11.

![Table 1](image)

Figure 11: Medication by Name in RStudio

The rows containing NA are omitted by using the code shown table 2 in Appendix B in R. The medications were then grouped into classes based on their categories mentioned in chapter 2. They are also grouped as prior medication and medication prescribed. The code used to group them into categories is shown in table 3 in Appendix B.

Once the grouping is completed, a table containing only the record ID, visits and the Medication used and medication to be used categories is created.

Once the new table is created, it is exported from RStudio in the CSV format and the CSV file is duplicated and opened in excel. The table is made into two tables, the first one containing prior medication (drug classes) and medication prescribed (drug classes).
Whereas the second table contains only the medication prescribed through telepsychiatry (drug classes).

In the table containing prior medication (drug classes) and medication prescribed through telepsychiatry (drug classes), the difference between the number of medications (drug classes) of visit 1 medication used (which is the medication the patient was using prior to the telehealth intervention) and the medication prescribed from visit 1 to the final visit is found out by using the VLOOKUP function of excel. The table is saved as CSV file to be uploaded in RStudio for further analysis.

In the table medication prescribed through telepsychiatry (drug classes), the difference between the medication prescribed in the subsequent visits and the medication prescribed in the first visit is found by using the code shown in table 4 in VBA excel. The table is saved as CSV file to be uploaded in RStudio for further analysis.

To make it simple for explanation, let us call the first table (Where the prescriptions prior to the intervention and the medication prescribed through Telepsychiatry are compared) created as Table A and the second table as Table B (Where, medications prescribed in the first visit are compared to the medications prescribed in the subsequent visits). Now Table A is opened in RStudio for further analysis. To know the frequency of the decrease or increase in medication and to create and download a CSV file for the same for individual classes, the code in table 5 of Appendix B is used.

Similar analysis is also performed on the Table B and individual CSV files for various classes showing the frequency of increase or decrease in the prescription is downloaded.
The difference can be seen between the two tables as the table with prior medication starts from Visit 1 whereas the table with medication prescribed through telepsychiatry starts from visit 2. It is because in Table B the difference is of the medication prescribed in first visit and the subsequent visits. Whereas in the first table it is the difference between the prior used medication and medication prescribed from visit 1 to final visit.

4.2. Statistical Analysis
The data collected is highly skewed. Parametric tests assume that the data have a normal distribution pattern and are not suitable for analysis of this data. As the non-parametric tests have very few or zero assumptions regarding the distribution of the data, they are used in the analysis of the data collected. The non-parametric tests used were Kruskal-Wallis test and Wilcoxon Rank-Sum Test.

To find out if there is any significance between the Total decrease in prescription, No change in prescription and Total increase in prescription Kruskal-Wallis test is performed on the data computed for each medication class. Kruskal-Wallis test is a non-parametric method, alternative to the one-way ANOVA, for comparison of two or more independent groups. If the calculated mean of each of the three groups is not equal then the null hypothesis is rejected and further analysis is conducted using the Wilcoxon Rank-Sum Test, which computes the pairwise comparison. The Wilcoxon Rank-Sum Test is also a non-parametric test which compares two paired groups and calculates the difference between each set of pairs. If in the pairwise comparison the P value is less than 0.05 then there is a significant difference between the groups, if the P value is greater than 0.05 then there is no significant difference between the groups.
Chapter 5: Results

5.1. Graphs Comparing Prior Used Medication before the Intervention with Medication Prescribed Through Telehealth

The tables and graphs for each different class generated from Table A (Where the prescriptions prior to the intervention and the medication prescribed through telepsychiatry are compared) are as follows:

Antipsychotics

![Longitudinal Comparison of Total Decrease in Prescription vs. Total Increase in Prescription of Antipsychotics](image)

*Figure 12: Longitudinal Comparison of Total Decrease in Prescription vs. Total Increase in Prescription of Antipsychotics*

From figure 12, it is evident that in the initial visits there is an initial increase in the prescription for Anti-psychotics when compared to the prescription of Anti-psychotics before the intervention (Telepsychiatry visit is the intervention point here). But, from visit number 4 there is a change in the trend, there is a decrease in prescription for Anti-psychotics, which is consistent till the last visit. Further analysis by the Kruskal-Wallis
Test and Pairwise Wilcoxon Rank Sum Test shows that the difference between increase and decrease in prescription of Antipsychotics is not significant. The difference in changes in the prescription of Antipsychotics is shown in figure 43 of Appendix D. The code used for the Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test is shown in table 9 of Appendix B.

Antidepressants

![Longitudinal Comparison of Total Decrease in Prescription vs. Total Increase in Prescription of Antidepressants](image)

*Figure 13: Longitudinal Comparison of Total Decrease in Prescription vs. Total Increase in Prescription of Antidepressants*

From figure 13, it is evident that there is an increase in prescription of Antidepressants when compared to the use before the intervention. Analysis by Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test shows that the increase in the prescription is not statistically significant. The statistically different changes in the prescription of Antidepressants is shown in figure 44 in Appendix D. The code used for the Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test is shown in table 10 of Appendix B.
**Anxiolytics**

From figure 14, it can be observed that prescription for Anxiolytics has increased compared to the decrease in prescription and the difference is consistent throughout. Analysis by Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test shows that the increase in the prescription is statistically significant. The difference in changes in the prescription of Anxiolytics is shown in figure 45 in Appendix D. The code used for the Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test is shown in table 11 in Appendix B.
Mood Stabilizers

From figure 15, it can be observed that in the initial visits there is an increase in prescription of Mood stabilizers, but the trend seems to be reversed from visit 4, from which there is decrease in prescription compared to the prior used prescription of mood stabilizers. Analysis by Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test shows that the decrease in the prescription is not statistically significant. The difference in changes in the prescription of Mood Stabilizers is shown in figure 46 in Appendix D. The code used for the Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test is shown in table 12 of Appendix B.
Non-stimulants

Figure 16: Longitudinal Comparison of Total Decrease in Prescription vs. Total Increase in Prescription of Non-Stimulants

Figure 16 shows that there is a constant increase in persecution of Non-Stimulants. Analysis by Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test shows that the increase in the prescription is not statistically significant. Difference in prescription changes of Non-Stimulants is shown in figure 47 in Appendix D. The code used for the Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test is shown in table 13 of Appendix B.
Figure 17 shows that there is a constant increase in prescription of stimulants. Analysis by Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test shows that the increase in the prescription is not statistically significant. Figure 48 in Appendix D shows the difference in the changes in prescription of Stimulants. The code used for the Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test is shown in table 14 of Appendix B.
Figure 18: Longitudinal Comparison of Total Decrease in Prescription vs. Total Increase in Prescription of Sleep Medication

Figure 18 shows clear increase in the prescription of Sleep medication. Analysis by Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test shows that the increase in the prescription is statistically significant. Difference in changes in prescription of the sleep medication can be seen in figure 49 of Appendix D. The code used for the Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test is shown in table 15 of Appendix B.
Figure 19 shows that there is a decrease in the prescription of alpha agonists, however Analysis by Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test shows that the decrease in the prescription is statistically significant. Figure 50 of Appendix D shows the difference between the prescription changes in Alpha Agonists. The code used for the Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test is shown in table 16 of Appendix B.
Summary of results for Prior Used Medication (Before the Intervention through Telepsychiatry)

Table 2: Summary of Results for Prescribed Medication

<table>
<thead>
<tr>
<th>Medication Class</th>
<th>Interpretation from the Graphs</th>
<th>Kruskal-Wallis Test results</th>
<th>Pairwise Wilcoxon Rank Test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antipsychotics</td>
<td>Decrease in prescription</td>
<td>Significant Difference between groups. P Value= 0.00098</td>
<td>P Value=0.372, Not significant</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>Increase in prescription</td>
<td>Significant Difference between groups. P value=0.0065</td>
<td>P Value=0.35 , Not significant</td>
</tr>
<tr>
<td>Anxiolytics</td>
<td>Increase in prescription</td>
<td>Significant Difference between groups. P value=0.0087</td>
<td>P Value=0.043, Significant</td>
</tr>
<tr>
<td>Alpha-agonists</td>
<td>Decrease in prescription</td>
<td>Significant Difference between groups. P value= 0.0065</td>
<td>P Value=0.011, Significant</td>
</tr>
<tr>
<td>Mood Stabilizers</td>
<td>Decrease in prescription</td>
<td>Significant Difference between groups. P value=0.0029</td>
<td>P Value=0.2011, Not significant</td>
</tr>
<tr>
<td>Non-Stimulants</td>
<td>Increase in prescription</td>
<td>Significant Difference between groups. P value=3.915e-06</td>
<td>P Value=0.09675, Not significant</td>
</tr>
<tr>
<td>Stimulants</td>
<td>Increase in prescription</td>
<td>Significant Difference between groups. P value=0.00079</td>
<td>P Value=0.096, Not significant</td>
</tr>
<tr>
<td>Sleep Medication</td>
<td>Increase in prescription</td>
<td>Significant Difference between groups. P value=3.711e-07</td>
<td>P Value=9.8e-06, Significant</td>
</tr>
</tbody>
</table>

5.2. Tables and Graphs for the Comparison of Medication Prescribed During the First Visit to the Subsequent Visits
The tables and graphs for each different class generated from Table B (Where, medications prescribed in the first visit are compared to the medications prescribed in the subsequent visits) are as follows:
Antipsychotics

From the figure 20, there is an increase in Antipsychotic medication prescribed in first visit to the subsequent visits. On analysis using the Kruskal-Wallis Test, the data shows that there is significant difference between the Total decrease in prescription, No change in prescription and Total Increase in prescription groups. Further analysis by Pairwise Wilcoxon Rank Sum Test between the pairs revealed that there is no much statistically significant difference between the Decrease in prescription and Increase in prescription groups although Increase in the prescription group is higher. The figure 51 in Appendix D shows the insignificant difference between the three groups. The R Code Used for Kruskal-Wallis Test and Pairwise Wilcoxon Test on Antipsychotics is shown in table 17 of Appendix B.
Antidepressants

From figure 21, it can be noted that initially there is decrease in prescription of Antidepressants but as the visits increase the prescription for Anti-depressants also increased. On analysis by the Kruskal-Wallis Test and pairwise Wilcoxon test, there is no statistically significant difference between the increase and decrease in the prescription of Antidepressants, although the decrease in prescription is slightly higher. The figure 52 in Appendix D shows the insignificant difference between the three groups. Code Used for Kruskal-Wallis Test and Pairwise Wilcoxon Test on Anti-Depressants is shown in table 18 of Appendix B.
Anxiolytics

From figure 22, it can be observed that there is a decrease in the prescription of Anxiolytics, but to measure the significance of decrease, the Kruskal-Wallis Test and pairwise Wilcoxon test are performed. The results show that there is not much statistically significant decrease in the prescription of Anxiolytics. The figure 53 in Appendix D shows the insignificant difference between the three groups. The code used for the analysis is shown in table 19 in Appendix B.
Mood Stabilizers

From the figure 23, the trend of increase in prescription of Mood stabilizers can be noticed. Further analysis by the Kruskal-Wallis Test and pairwise Wilcoxon test show that there is a statistically significant increase in the prescription of Mood stabilizers. The figure 54 of Appendix D shows the difference between the three groups. The code used for the analysis is shown below in table 20.
Non-stimulants

It can be observed from the figure 24, that there is a mixed trend of increase and decrease in prescription of Non-Stimulants. Further analysis by the Kruskal-Wallis Test and pairwise Wilcoxon test show that there is not much statistically significant increase in the prescription of Non-stimulants. The figure 55 of Appendix D shows the insignificant difference between the three groups. The code used Code Used for Kruskal-Wallis Test & Pairwise Wilcoxon Rank Sum Test is in the table 21.
Stimulants

It can be observed from the figure 25 there is mixed trend of increase and decrease in prescription of Stimulants. Further analysis by the Kruskal-Wallis Test and pairwise Wilcoxon test show that there is not much statistically significant increase in the prescription of stimulants. The figure 56 shows the difference between the three groups. The code used for the Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test is shown in table 22.
Sleep Medication

It can be observed from the figure 26 there is a mixed trend of increase and decrease in prescription of Sleep medication. Further analysis by the Kruskal-Wallis Test and pairwise Wilcoxon test show that there is not much statistically significant increase in the prescription of sleep medication. The figure 57 shows the insignificant difference between the three groups. The code used for the Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test is shown in table 23.

Alpha Agonists
It can be observed from the figure 27 there is a decrease in prescription of Alpha agonists. Further analysis by the Kruskal-Wallis Test and Pairwise Wilcoxon test show that there is not much statistically significant increase in the prescription of Alpha Agonists. The figure
shows the insignificant difference between the three groups. The code used for the Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test is shown in table 24.

![Longitudinal Comparison of Total Decrease in Prescription vs. Total Increase in Prescription of Alpha Agonists](image)

**Figure 27: Longitudinal Comparison of Total Decrease in Prescription vs. Total Increase in Prescription of Alpha Agonists**

### Summary of Results for Prescribed Medication

**Table 3: Summary of Results for Medication to be prescribed**

<table>
<thead>
<tr>
<th>Medication Class</th>
<th>Interpretation from the Graphs</th>
<th>Kruskal-Wallis Test results</th>
<th>Pairwise Wilcoxon test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antipsychotics</td>
<td>Increase in prescription</td>
<td>Significant Difference between groups, P value=0.0115</td>
<td>P Value=0.158, Not significant</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>Decrease in prescription</td>
<td>Significant Difference between groups, P value=0.01869</td>
<td>P Value=0.9, Not significant</td>
</tr>
<tr>
<td>Anxiolytics</td>
<td>Decrease in prescription</td>
<td>Significant Difference between groups, P value=1.898e-06</td>
<td>P Value=0.06, Not Significant</td>
</tr>
<tr>
<td>Alpha-agonists</td>
<td>Decrease in prescription</td>
<td>Significant Difference between groups, P value=4.728e-05</td>
<td>P Value=0.352, Not Significant</td>
</tr>
<tr>
<td>Mood Stabilizers</td>
<td>Increase in prescription</td>
<td>Significant Difference between groups, P value=0.008236</td>
<td>P Value=0.034, significant</td>
</tr>
<tr>
<td>Non-Stimulants</td>
<td>Decrease in prescription</td>
<td>Significant Difference between groups, P value=1.606e-05</td>
<td>P Value=0.849, Not significant</td>
</tr>
<tr>
<td>Stimulants</td>
<td>Decrease in prescription</td>
<td>Significant Difference between groups, P value=0.01059</td>
<td>P Value=0.303, Not significant</td>
</tr>
<tr>
<td>Sleep Medication</td>
<td>Decrease in prescription</td>
<td>Significant Difference between groups, P value=0.02857</td>
<td>P Value=578, Not Significant</td>
</tr>
</tbody>
</table>
Chapter 6: Discussion and Conclusion

In this project, we have collected the data using the traditional chart review, where the data collector manually copied the required fields from clinical notes of each patient for each visit. This process was time consuming and exhausting. The results of this study show that there is huge increase in the prescription of sleep medication compared to the medication use before the intervention. It would be interesting to know if the increase is evidence based or based on patient requests. The results also indicate that, although not statistically significant, decrease in prescription of one class of medication leads to increase in prescription of a different class.

In summary, when the medication prescribed prior to the telehealth intervention is compared to the prescribed medication through telehealth, there is a decrease in the prescription of Anti-psychotics, Mood Stabilizers and Alpha Agonists. Further in-depth analysis must be performed to know what other classes of medication are prescribed replacing them, to exactly analyze the increase in prescription of other medication classes. Similarly, when the medication prescribed during the first visit is compared to the medication prescribed in the subsequent visits, there is a decrease in the prescription of Anxiolytics, Alpha agonists, Stimulants and Sleep medication. However, it would be interesting to further analyze the data to know prescription pattern meaning what other classes have replaced the above-mentioned classes.
6.1. Future Work
Prescription patterns of individual psychiatrists for different disorders could be found out and used in quality improvement purposes. Data mining and NLP techniques can be performed on the free text captured from clinical notes to know any changes in the dose, frequency and to know what classes of medication are prescribed replacing them, to analyze the increase in prescription of other medication.

This data can be used to determine the various treatment responses among the youth offenders presenting with similar mental health conditions. The impact of alternative interventions can be studied on different outcomes like the prescription patterns, disease prognosis, and inmate satisfaction.

6.2. Limitations
This research was faced with limitations like missing patient records, incomplete forms. It is to be mentioned that only psychotropic drugs are considered, and drugs used to treat other conditions are not.
References


orkforce_issues/child_and_adolescent_psychiatry_workforce_crisis-solutions_to_improve_access_to_care.pdf


Survey of Discharge Prescriptions From a Tertiary Care Psychiatric Institution.


Appendices

Appendix A: Forms Used in Data Collection

Figure 28: Patient Identifier Form

Figure 29: Patient Demographics Form
Figure 30: Visit Details Form

Figure 31: Vitals Form

Figure 32: Chief Complaints Form
Figure 33: Screenshot of one of the sections in the Psychiatric Evaluation Form

Figure 34: Screenshot of the Problems and Goals Form
Figure 35: Screenshot of the Assessment Form

Figure 36: Screenshot of the Lab Results Form
Figure 37: Screenshot of the Medication Used Form

Figure 38: Screenshot of the Medication to Be Used Form
Figure 39: Screenshot of the Sleep Log Form

Figure 40: Screenshot of the Vanderbilt Form
**Figure 41: Screenshot of the AIMS Summary**

<table>
<thead>
<tr>
<th>Data Collection Instrument</th>
<th>Patient</th>
<th>Visit 1</th>
<th>Visit 2</th>
<th>Visit 3</th>
<th>Visit 4</th>
<th>Visit 5</th>
<th>Visit 6</th>
<th>Visit 7</th>
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<th>Visit 9</th>
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</tr>
</tbody>
</table>

**Figure 42: Example of Longitudinal Mapping for Each Patient**
Appendix B: Code Used in R for Analysis

Table 4: Code Used to Open the Report 'Medication by name' in Rstudio

Meds=read.csv("C:/Users/rajendrand.UMHS-USERS/Desktop/Medication_report.csv")

Table 5: R Code to Omit NA from the Data Frame Meds

Meds<- na.omit(Meds)

Table 6: R Code to Categorize Medications

meds <- transform(meds, med_used_Antipsychotic= (meds$med_used_names___risperidone + meds$med_used_names___quetiapine + meds$med_used_names___aripiprazole + meds$med_used_names___paliperidone + meds$med_used_names___olanzapine + meds$med_used_names___lurasidone + meds$med_used_names___chlorpromazine + meds$med_used_names___ziprasidone + meds$med_used_names___haloperidol))

meds <- transform(meds, med_tobe_Antipsychotic= (meds$medi_name___risperidone+meds$medi_name___lurasidone+meds$medi_name___quetiapine+meds$medi_name___aripiprazole+meds$medi_name___paliperidone+meds$medi_name___olanzapine+meds$medi_name___lurasidone+meds$medi_name___chlorpromazine+meds$medi_name___ziprasidone+meds$medi_name___haloperidol))

meds <- transform(meds, med_used_MoodStabilizer= (meds$med_used_names___divalproex + meds$med_used_names___carbamazepine + meds$med_used_names___lithium + meds$med_used_names___topiramine+meds$med_used_names___depakote_dr + meds$med_used_names___lamotrigine + meds$med_used_names___oxcarbazapine + meds$med_used_names___gabapentin + meds$med_used_names___valproicacid))

meds <- transform(meds, med_tobe_MoodStabilizer=(meds$medi_name___divalproex + meds$medi_name___carbamazepine + meds$medi_name___lithium + meds$medi_name___topiramine + meds$medi_name___depakote_dr + meds$medi_name___lamotrigine + meds$medi_name___oxcarbazapine + meds$medi_name___gabapentin + meds$medi_name___valproicacid))

meds <- transform(meds, med_used_Antidepressants=(meds$med_used_names___sertraline + meds$med_used_names___buproprion + meds$med_used_names___escitalopram + meds$med_used_names___fluoxetine + meds$med_used_names___zoloft + meds$med_used_names___mitrazapine+meds$med_used_names___citalopram + meds$med_used_names___venlafaxine+)
meds$med_used_names___vilazodone+ medus$med_used_names___clomipramine+
meds$med_used_names___paroxetine))

meds <- transform(meds, med_tobe_Antidepressants=(meds$medi_name___sertraline +
meds$medi_name___bupropion +
meds$medi_name___esictalopram + meds$medi_name___fluoxetine +
meds$medi_name___zoloft +
meds$medi_name___citalopram +
meds$medi_name___venlafaxine +
meds$medi_name___vilazodone+meds$medi_name___paroxetine +
meds$medi_name___clomipramine))

meds <- transform(meds, med_used_Antianxiety=(meds$med_used_names___buspirone +
meds$med_used_names___clonazepam +
meds$med_used_names___alprazolam + meds$med_used_names___temazepam))

meds <- transform(meds, med_tobe_Antianxiety=(meds$medi_name___buspirone +
meds$medi_name___clonazepam +
meds$medi_name___temazepam))

meds <- transform(meds, med_used_Stimulant=(meds$med_used_names___methylphendate +
meds$med_used_names___lisdexamfetamine +
meds$med_used_names___dexamethylphenidate + meds$med_used_names___adderall +
meds$med_used_names___amphetamine ))

meds <- transform(meds, med_tobe_Stimulant=(meds$medi_name___methylphendate +
meds$medi_name___lisdexamfetamine +
meds$medi_name___dexamethylphenidate + meds$medi_name___adderall +
meds$medi_name___amphetamine ))

meds <- transform(meds, med_used_Non_stimulant=(meds$med_used_names___atomoxetine))

meds <- transform(meds, med_tobe_Non_stimulant=(meds$medi_name___atomoxetine))

meds <- transform(meds, med_used_sleep=(meds$med_used_names___trazodone +
meds$med_used_names___melatonin +
meds$med_used_names___benadryl + meds$med_used_names___hydroxyzine))

meds <- transform(meds, med_tobe_sleep=(meds$medi_name___trazodone +
meds$medi_name___melatonin +
meds$medi_name___benadryl +
meds$medi_name___hydroxyzine))

meds <- transform(meds, med_used_Algos=(meds$med_used_names___clonidine +
meds$med_used_names___prazosin))

meds <- transform(meds, med_tobe_Algos=(meds$medi_name___clonidine +
meds$medi_name___prazosin))
B 1: Code Used for Statistical Analysis

B 1.1: Code Used for Statistical Analysis of Prior Used Medication

Table 7: VBA Code used to calculate the Difference between Medications prescribed in First Visit Vs Subsequent Visits

```vba
Sub parser()
'Worksheets("New Name").
Set sh1 =Worksheets("Sheet1")
Set sh2 =Worksheets("Sheet2")
Set sh3 =Worksheets("Sheet3")
firstVisitRow = 0
rowID = 1
patientID = 0
sh3rowID = 2
For Each rw In sh1.Rows
  For Each col In rw.Columns
    rwID = rw.Row
collID = col.Column
    If cellVal = "" Then
      Exit For
    End If
    If rowID = 1 Then
    Else
      If patientID <> sh1.Cells(rwID, 2).Value Then
        firstVisit = rw
        firstVisitRow = rw.Row
        MsgBox (firstVisitRow)
      End If
      If col.Column < 4 Then
      If patientID = sh1.Cells(rw.Row, 2).Value Then
      End If
    Else
      If patientID = sh1.Cells(rw.Row, 2).Value Then
      End If
    End If
    Next col
    If patientID = sh1.Cells(rw.Row, 2).Value Then
      sh3rowID = sh3rowID + 1
    End If
    'MsgBox (sh1.Cells(rw.Row, 1).Value)
    patientID = sh1.Cells(rw.Row, 2).Value
    If patientID = "" Then
      Exit For
    End If
  rowID = rowID + 1
Next rw
MsgBox (rowID)
End Sub
```
Table 8: Code Used to Find the Frequency of Increase or Decrease in Medication

```r
finally=read.csv("C:/Users/rajendrand.UMHS-USERS/BoxSync/Dhinakaran-Mosa/Finally.csv")
FinallyUsedAntiPsychotic<-as.data.frame(
  table(finally$redcap_event_name,finally$Difference.AntiPsychotic))
FinallyUsedAntiPsychoticsplitted <- spread(FinallyUsedAntiPsychotic, key = Var2, value = Freq)
write.csv(FinallyUsedAntiPsychoticsplitted , "C:/Users/rajendrand.UMHS-USERS/BoxSync/Dhinakaran-Mosa/FinallyUsedAntiPsychoticsplitted.csv")

FinallyUsedMoodStabilizer<-as.data.frame(
  table(finally$redcap_event_name,finally$Difference.MoodStabilizer))
FinallyUsedMoodStabilizersplitted <- spread(FinallyUsedMoodStabilizer, key = Var2, value = Freq)
write.csv(FinallyUsedMoodStabilizersplitted , "C:/Users/rajendrand.UMHS-USERS/BoxSync/Dhinakaran-Mosa/FinallyUsedMoodStabilizersplitted.csv")

FinallyUsedAntiDepressants<-as.data.frame(
  table(finally$redcap_event_name,finally$Difference.AntiDepressants))
FinallyUsedAntiDepressantssplitted <- spread(FinallyUsedAntiDepressants, key = Var2, value = Freq)
write.csv(FinallyUsedAntiDepressantssplitted , "C:/Users/rajendrand.UMHS-USERS/BoxSync/Dhinakaran-Mosa/FinallyUsedAntiDepressantssplitted.csv")

FinallyUsedAntiAnxiety<-as.data.frame(
  table(finally$redcap_event_name,finally$Difference.ANTiAnxiety))
FinallyUsedAntiAnxietysplitted <- spread(FinallyUsedAntiAnxiety, key = Var2, value = Freq)
write.csv(FinallyUsedAntiAnxietysplitted , "C:/Users/rajendrand.UMHS-USERS/BoxSync/Dhinakaran-Mosa/FinallyUsedAntiAnxietysplitted.csv")

FinallyUsedStimulant<-as.data.frame(
  table(finally$redcap_event_name,finally$Difference.Stimulant))
FinallyUsedStimulantsplitted <- spread(FinallyUsedStimulant, key = Var2, value = Freq)
write.csv(FinallyUsedStimulantsplitted , "C:/Users/rajendrand.UMHS-USERS/BoxSync/Dhinakaran-Mosa/FinallyUsedAntiStimulantsplitted.csv")

FinallyUsedNonStimulant<-as.data.frame(
  table(finally$redcap_event_name,finally$Difference.NonStimulant))
FinallyUsedNonStimulantsplitted <- spread(FinallyUsedNonStimulant, key = Var2, value = Freq)
write.csv(FinallyUsedNonStimulantsplitted , "C:/Users/rajendrand.UMHS-USERS/BoxSync/Dhinakaran-Mosa/FinallyUsedNonStimulantsplitted.csv")

FinallyUsedAlphaAgonists<-as.data.frame(
  table(finally$redcap_event_name,finally$Difference.AlphaAgonists))
FinallyUsedAlphaAgonistssplitted <- spread(FinallyUsedAlphaAgonists, key = Var2, value = Freq)
```

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write.csv(FinallyUsedAlphaAgonistssplitted , "C:/Users/rajendrand.UMHS-USERS/Box Sync/Dhinakaran-Mosa/FinallyUsedAlphaAgonistssplitted.csv")

FinallyUsedSleep<-as.data.frame(
  table(finally$redcap_event_name,finally$Difference.Sleep))
FinallyUsedSleepsplitted <- spread(FinallyUsedSleep, key = Var2, value = Freq)
write.csv(FinallyUsedSleepsplitted , "C:/Users/rajendrand.UMHS-USERS/Box Sync/Dhinakaran-Mosa/FinallyUsedSleepsplitted.csv")

Table 9: Code Used for Kruskal-Wallis Test & Pairwise Wilcoxon Rank Sum Test on Antipsychotics

```
testData
tkruskal.test(value ~ variable, data = testData)
pairwise.wilcox.test(testData$value, testData$variable,p.adjust.method = "BH")
data: testData$value and testData$variable
  prescription_noChange prescription_incr
precription_incr 0.075 -
precription_decr 0.204 0.372
P value adjustment method: BH
```

Table 10: Code Used for Kruskal-Wallis Test & Pairwise Wilcoxon Rank Sum Test on Antidepressants

```
testData
tkruskal.test(value ~ variable, data = testData)
data: testData$value and testData$variable
  prescription_noChange prescription_incr
precription_incr 0.13 -
precription_decr 0.11 0.37
P value adjustment method: BH
```

Table 11: Code Used for Kruskal-Wallis Test & Pairwise Wilcoxon Rank Sum Test on Anxiolytics

```
testData
tkruskal.test(value ~ variable, data = testData)
pairwise.wilcox.test(testData$value, testData$variable,p.adjust.method = "BH")
data: testData$value and testData$variable
  prescription_noChange prescription_incr
precription_incr 8.9e-05 -
precription_decr 9.1e-06 0.043
```

Table 12: Code Used for Kruskal-Wallis Test & Pairwise Wilcoxon Rank Sum Test on Mood Stabilizers

```
Kruskal-Wallis rank sum test
data: value by variable
Kruskal-Wallis chi-squared = 11.661, df = 2, p-value = 0.002937
Pairwise comparisons using Wilcoxon rank sum test
data: testData$value and testData$variable
  prescription_noChange prescription_incr
precription_incr 0.0066 -
precription_decr 0.0179 0.2011
P value adjustment method: BH
```
Table 13: Code Used for Kruskal-Wallis Test & Pairwise Wilcoxon Rank Sum Test on Non-Stimulants

<table>
<thead>
<tr>
<th>data: value by variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kruskal-Wallis chi-squared = 24.901, df = 2, p-value = 3.915e-06</td>
</tr>
<tr>
<td>Pairwise comparisons using Wilcoxon rank sum test</td>
</tr>
<tr>
<td>data: testData$value and testData$variable</td>
</tr>
<tr>
<td>prescription_noChange prescription_incr</td>
</tr>
<tr>
<td>prescription_incr 0.00019 -</td>
</tr>
<tr>
<td>prescription_decr 2.8e-05 0.09675</td>
</tr>
<tr>
<td>P value adjustment method: BH</td>
</tr>
</tbody>
</table>

Table 14: Code Used for Kruskal-Wallis Test & Pairwise Wilcoxon Rank Sum Test on Stimulants

<table>
<thead>
<tr>
<th>Kruskal-Wallis rank sum test</th>
</tr>
</thead>
<tbody>
<tr>
<td>data: value by variable</td>
</tr>
<tr>
<td>Kruskal-Wallis chi-squared = 14.437, df = 2, p-value = 0.0007329</td>
</tr>
<tr>
<td>Pairwise comparisons using Wilcoxon rank sum test</td>
</tr>
<tr>
<td>data: testData$value and testData$variable</td>
</tr>
<tr>
<td>prescription_noChange prescription_incr</td>
</tr>
<tr>
<td>prescription_incr 0.0129 -</td>
</tr>
<tr>
<td>prescription_decr 0.0018 0.0920</td>
</tr>
<tr>
<td>P value adjustment method: BH</td>
</tr>
</tbody>
</table>

Table 15: Code Used for Kruskal-Wallis Test & Pairwise Wilcoxon Rank Sum Test on Sleep Medication

<table>
<thead>
<tr>
<th>Kruskal-Wallis rank sum test</th>
</tr>
</thead>
<tbody>
<tr>
<td>data: value by variable</td>
</tr>
<tr>
<td>Kruskal-Wallis chi-squared = 29.614, df = 2, p-value = 3.711e-07</td>
</tr>
<tr>
<td>Pairwise comparisons using Wilcoxon rank sum test</td>
</tr>
<tr>
<td>data: testData$value and testData$variable</td>
</tr>
<tr>
<td>prescription_noChange prescription_incr</td>
</tr>
<tr>
<td>prescription_incr 0.4 -</td>
</tr>
<tr>
<td>prescription_decr 3.7e-06 9.8e-06</td>
</tr>
</tbody>
</table>

Table 16: Code Used for Kruskal-Wallis Test & Pairwise Wilcoxon Rank Sum Test on Alpha Agonists

<table>
<thead>
<tr>
<th>Kruskal-Wallis rank sum test</th>
</tr>
</thead>
<tbody>
<tr>
<td>data: value by variable</td>
</tr>
<tr>
<td>Kruskal-Wallis chi-squared = 10.066, df = 2, p-value = 0.00652</td>
</tr>
<tr>
<td>&gt; pairwise.wilcox.test(testData$value, testData$variable,p.adjust.method = &quot;BH&quot;)</td>
</tr>
<tr>
<td>Pairwise comparisons using Wilcoxon rank sum test</td>
</tr>
<tr>
<td>data: testData$value and testData$variable</td>
</tr>
<tr>
<td>prescription_noChange prescription_incr</td>
</tr>
<tr>
<td>prescription_incr 0.018 -</td>
</tr>
<tr>
<td>prescription_decr 0.704 0.011</td>
</tr>
</tbody>
</table>
B 1.2: Code Used for Statistical Analysis of Prescribed Medication

Table 17: The R Code Used for Kruskal-Wallis Test and Pairwise Wilcoxon Test on Antipsychotics

```r
> kruskal.test(value ~ variable, data = testData)
  Kruskal-Wallis rank sum test
data:  value by variable
Kruskal-Wallis chi-squared = 8.9303, df = 2, p-value = 0.0115
> pairwise.wilcox.test(testData$value, testData$variable,p.adjust.method = "BH")
  Pairwise comparisons using Wilcoxon rank sum test
data:  testData$value and testData$variable
  prescription_noChange prescription_incr
precription_incr 0.043 -
precription_decr 0.029 0.158
P value adjustment method: BH
```

Table 18: R Code Used for Kruskal-Wallis Test and Pairwise Wilcoxon Test on Antidepressants

```r
> kruskal.test(value ~ variable, data = testData)
  Kruskal-Wallis rank sum test
data:  value by variable
Kruskal-Wallis chi-squared = 7.9601, df = 2, p-value = 0.01869
> pairwise.wilcox.test(testData$value, testData$variable,p.adjust.method = "BH")
  Pairwise comparisons using Wilcoxon rank sum test
data:  testData$value and testData$variable
  prescription_noChange prescription_incr
precription_incr 0.03 -
precription_decr 0.030.99
P value adjustment method: BH
```

Table 19: R Code Used for Kruskal-Wallis Test and Pairwise Wilcoxon Test on Anxiolytics

```r
> kruskal.test(value ~ variable, data = testData)
  Kruskal-Wallis rank sum test
data:  value by variable
Kruskal-Wallis chi-squared = 26.349, df = 2, p-value = 1.898e-06
> pairwise.wilcox.test(testData$value, testData$variable,p.adjust.method = "BH")
  Pairwise comparisons using Wilcoxon rank sum test
data:  testData$value and testData$variable
  prescription_noChange prescription_incr
precription_incr 2.5e-05 -
precription_decr 8.9e-05 0.06
P value adjustment method: BH
```

Table 20: Code Used for Kruskal-Wallis Test and Pairwise Wilcoxon Test on Mood Stabilizers

```r
> kruskal.test(value ~ variable, data = testData)
  Kruskal-Wallis rank sum test
data:  value by variable
Kruskal-Wallis chi-squared = 14.204, df = 2, p-value = 0.0008236
> pairwise.wilcox.test(testData$value, testData$variable,p.adjust.method = "BH")
  Pairwise comparisons using Wilcoxon rank sum test
```

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Table 21: Code Used for Kruskal-Wallis Test & Pairwise Wilcoxon Rank Sum Test on Non-Stimulants

```r
data: testData$value and testData$variable
precription_noChange precription_incr
precription_incr 0.0240 -
precription_decr 0.0026 0.0343
P value adjustment method: BH

> kruskal.test(value ~ variable, data = testData)
  Kruskal-Wallis rank sum test
data: value by variable
Kruskal-Wallis chi-squared = 22.078, df = 2, p-value = 1.606e-05
> pairwise.wilcox.test(testData$value, testData$variable,p.adjust.method = "BH")
  Pairwise comparisons using Wilcoxon rank sum test
data: testData$value and testData$variable
precription_noChange precription_incr
precription_incr 0.00014 -
precription_decr 0.00014 0.30303
P value adjustment method: BH
```

Table 22: Code Used for Kruskal-Wallis Test & Pairwise Wilcoxon Rank Sum Test on Stimulants

```r
> kruskal.test(value ~ variable, data = testData)
  Kruskal-Wallis rank sum test
data: value by variable
Kruskal-Wallis chi-squared = 9.0952, df = 2, p-value = 0.01059
> pairwise.wilcox.test(testData$value, testData$variable,p.adjust.method = "BH")
  Pairwise comparisons using Wilcoxon rank sum test
data: testData$value and testData$variable
precription_noChange precription_incr
precription_incr 0.017 -
precription_decr 0.017 0.849
P value adjustment method: BH
```

Table 23: Code Used for the Kruskal-Wallis Test and Pairwise Wilcoxon Rank Sum Test on Sleep Medication

```r
> kruskal.test(value ~ variable, data = testData)
  Kruskal-Wallis rank sum test
data: value by variable
Kruskal-Wallis chi-squared = 7.1105, df = 2, p-value = 0.02857
> pairwise.wilcox.test(testData$value, testData$variable,p.adjust.method = "BH")
  Pairwise comparisons using Wilcoxon rank sum test
data: testData$value and testData$variable
precription_noChange precription_incr
precription_incr 0.047 -
precription_decr 0.047 0.578
P value adjustment method: BH
```
Table 24: Code Used for Kruskal-Wallis Test & Pairwise Wilcoxon Rank Sum Test on Alpha Agonists

<table>
<thead>
<tr>
<th>&gt; kruskal.test(value ~ variable, data = testData)</th>
</tr>
</thead>
<tbody>
<tr>
<td>data: value by variable</td>
</tr>
<tr>
<td>Kruskal-Wallis chi-squared = 19.919, df = 2, p-value = 4.728e-05</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>&gt; pairwise.wilcox.test(testData$value, testData$variable, p.adjust.method = &quot;BH&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>data: testData$value and testData$variable</td>
</tr>
<tr>
<td>prescription_noChange prescription_incr</td>
</tr>
<tr>
<td>prescription_incr 0.00019 -</td>
</tr>
<tr>
<td>prescription_decr 0.00062 0.35292</td>
</tr>
<tr>
<td>P value adjustment method: BH</td>
</tr>
</tbody>
</table>
Appendix C: Tables Showing Frequency of Increase and Decrease of Prescription

Appendix C 1: Tables Showing Frequency of Increase and Decrease of Prior Used Medication

Table 25: Frequency of increase or decrease in Medication of Antipsychotics

<table>
<thead>
<tr>
<th>Visits</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>19</td>
<td>513</td>
<td>40</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>3</td>
<td>31</td>
<td>446</td>
<td>51</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>4</td>
<td>40</td>
<td>396</td>
<td>47</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>4</td>
<td>43</td>
<td>337</td>
<td>40</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>3</td>
<td>38</td>
<td>285</td>
<td>30</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>2</td>
<td>38</td>
<td>205</td>
<td>26</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 26: Frequency of Increase or decrease in Medication of Antidepressants

<table>
<thead>
<tr>
<th>Visits</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>27</td>
<td>478</td>
<td>68</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>33</td>
<td>414</td>
<td>80</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>31</td>
<td>379</td>
<td>78</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>30</td>
<td>334</td>
<td>59</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>25</td>
<td>271</td>
<td>59</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>24</td>
<td>197</td>
<td>51</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>20</td>
<td>146</td>
<td>41</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>14</td>
<td>110</td>
<td>27</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 27: Frequency of Increase or decrease in Medication of Anxiolytics

<table>
<thead>
<tr>
<th>Visits</th>
<th>-1</th>
<th>0</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>566</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>519</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>474</td>
<td>12</td>
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Table 28: Frequency of Increase or decrease in Medication for Mood Stabilizers

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Table 29: Frequency of Increase or decrease in Medication of Non-Stimulants

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Table 30: Frequency of Increase or decrease in Medication of Stimulants

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### Table 31: Frequency of Increase or decrease in Medication for Sleep Medication

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### Table 32: Frequency of Increase or decrease in Medication of Alpha Agonists

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### Appendix C 2: Tables Showing Frequency of Increase and Decrease of Prescribed Medication

#### Table 33: Frequency of increase or decrease in Medication of Antipsychotics

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Table 34: Frequency of Increase or decrease in Medication of Antidepressants

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Table 35: Frequency of Increase or decrease in Medication of Anxiolytics

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Table 36: Frequency of Increase or decrease in Medication of Mood Stabilizers

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Table 37: Frequency of Increase or decrease in Medication of Non-Stimulants

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### Table 38: Frequency of Increase or decrease in Medication of Stimulants

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### Table 39: Frequency of Increase or decrease in Medication of Sleep Medication

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### Table 40: Frequency of Increase or decrease in Medication of Alpha-Agonists

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Appendix D: Box Plots

Appendix D 1: Box Plots Showing the Difference Between Increase and Decrease of Prior Used Medication

Figure 43: Difference between the Changes in Prescription for Antipsychotics

Figure 44: Difference between the Changes in Prescription of Antidepressants
Figure 45: Difference between the Changes in Prescription of Anxiolytics

Figure 46: Difference between the Changes in Prescription of Mood Stabilizers
Figure 47: Difference between the Changes in Prescription of Non-Stimulants

Figure 48: Difference between the Changes in Prescription of Stimulants
Figure 49: Difference between the Changes in Prescription of Sleep Medication

Figure 50: Difference between the Changes in the Prescription of Alpha Agonists
Appendix D 2: Box Plots Showing the Difference Between Increase and Decrease of Medication Prescribed

Figure 51: Difference between the Changes in the Prescription of Antipsychotics

Figure 52: Difference between the Changes in the Prescription of Anti-Depressants
Figure 53: Difference between the Changes in the Prescription of Anxiolytics

Figure 54: Difference between the Changes in the Prescription of Mood Stabilizers
Figure 55: Difference between the Changes in the Prescription of Non-Stimulants

Figure 55: Difference between the Changes in the Prescription of Stimulants
Figure 56: Difference between the Changes in the Prescription of Sleep Medication

Figure 57: Difference between the Changes in the Prescription of Alpha Agonists