

A Clustering Method to Identify Mental Health Patient Groups with Similar Treatment Outcomes

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Abstract— A person's complete emotional, psychological, and social well-being is referred to as their mental health. It has an impact on how people feel, think, and act, as well as how they act and react to obstacles in life. Maintaining positive relationships, accomplishing goals, and living a satisfying life all depend on having good mental health. No matter what one's age, gender, race, or financial situation may be, mental health concerns can present themselves in a variety of ways and can affect everyone. Anxiety disorders, sadness, bipolar disorder, and schizophrenia are typical mental health issues. An individual's capacity to work, study, and sustain relationships can all be significantly impacted by mental health issues. Thankfully, there are a variety of treatments available, including counseling, medications, and dietary adjustments. Prioritizing mental health and getting treatment when needed are crucial.

In the present study we analyze the treatments such as home treatments, early intervention and assertive outreach which were done focusing patients of United Kingdom. For this purpose, K-means clustering technique is used to cluster patients with similar disorders to categorize easily for their treatments. As a result of a considerable portion of the general population experiencing mental health issues at home point in their lives, mental health is a growingly important issue in the UK. Thus, this research will immensely help to get precautions at the correct time and to minimize mental disorders.

Keywords—Mental health, treatments, persons, issues, K-means clustering

I. INTRODUCTION

In and of its own, mental wellness does not exist. It is a crucial and vital component of total health. The ability to form and maintain affectionate relationships with others, to participate in the social roles typically played in their culture, to manage change, recognize, acknowledge, and communicate positive actions and thoughts, as well as to manage emotions like sadness, are all indications of one's mental health. A person's mental health offers them a sense of self-worth, control, and comprehension of how their body and mind work. Environmental, social, psychological, and biological factors can have an impact

on mental health, just like they can with mental illness. In order to create healthy communities, which in turn can advance mental health, interaction between individuals and society becomes essential.

Internal variables that make someone more susceptible to mental illness include a lack of emotional resilience, low self-esteem and social standing, a sense of helplessness and being trapped, issues with one's sexuality or sexual orientation, social isolation, and poor integration. Poor social conditions (housing, poverty, unemployment), discrimination or abuse, cultural conflict, stigma, and a lack of autonomy have all been mentioned as external factors that contribute to this vulnerability.

A person in good mental health will have a strong sense of who they are, be able to build solid relationships, and still feel at ease by themselves. The Mental Health Foundation (MHF, 2008) notes that mental health is defined by how people think and feel about themselves and their lives, and that it affects their ability to initiate, develop, and sustain mutually emotionally satisfying relationships. The core senses of mental health are trust, challenge, competency, accomplishment, and humor. Additionally, they offer the capacities to develop psychologically, emotionally, intellectually, and spiritually. It is believed that one's mental health has an impact on their capacity to operate, take advantage of opportunities, and engage fully in family, job, community, and peer interactions. Physical and mental health are closely related since they both directly and indirectly influence one another. Thus, it is conceivable to propose that mental health is a condition of equilibrium in which a person is at peace with themselves, able to operate socially and to take care of both their basic and higher-functioning requirements. Positive functionality entails effectively navigating change, interpersonal interactions, and emotions.

Causes for mental health are complex and vary from person to person. Genetics, trauma and life events, brain chemistry, substance abuse, environmental factors, medical conditions, and social factors can become a factor which can contribute to develop someone's mental health issues. They are genetics, environmental factors, brain chemical

imbalances, medical conditions, abuse of drug and alcohol, significant life events and brain chemistries.

Mental issues can be treated in different ways such as home treatments, early intervention, and assertive outreach.

A. *Home treatments*

Even though it is always advisable to seek professional assistance for mental health difficulties, there are some at-home remedies that can be beneficial for managing symptoms and fostering mental wellbeing. Self-care practices, meditation and mindfulness, social support, therapy apps and online resources and meditation can be taken as examples for home treatments.

B. *Early Intervention*

Early intervention and treatment of mental health problems before they worsen or become chronic is referred to as early intervention for mental health concerns. The sooner help is provided, the more likely it is that the patient will recover swiftly and avoid developing new problems. Psychotherapy, medication, self-help tactics, support groups, family therapy and early psychosis intervention can be taken as the ways early intervention treatments happen.

By identifying mental health issues early and providing appropriate treatment, individuals can avoid more severe complications, improve their quality of life, and achieve better long-term outcomes.

C. *Assertive outreach*

Assertive outreach is a form of therapy strategy that focuses on giving people with severe and enduring mental health problems who might have trouble interacting with conventional mental health services intense, community-based support. Assertive outreach aims to offer continuing assistance and care to people in their natural settings, such as their homes or communities, in order to improve their independence and quality of life. Those who have previously failed to interact with conventional mental health services or who frequently end up in the hospital or face other crises may benefit from assertive outreach therapies. Assertive outreach can enhance results and reduce the necessity of additional intense treatments by offering continuous support and care in the individual's home environment. Regular contact, multidisciplinary team, flexibility, and holistic approach can be taken as the ways assertive outreach method work.

An older person's capacity to perform fundamental daily tasks can be significantly impacted by mental health issues, which can lower their independence, autonomy, and quality of life. Making a diagnosis is the first step in minimizing these detrimental effects. Unfortunately, too

many older people struggle on without the right support or any help at all since mental health issues are frequently left misdiagnosed and untreated.

It seems unlikely that the older adult population of today will acknowledge mental illness or use mental health services. Regarding the definition of mental illness, there are numerous stigmas. Many senior citizens consider mental illness to be a show of weakness and are reluctant to confess they have issues, especially if they worry about losing their independence. Too many individuals believe that sadness and dementia symptoms are inevitable parts of aging. Additionally, many older persons lack access to and availability of services.

The World Federation for Mental Health selected older people's mental health and wellness as the 2013 World Mental Health Day's topic. This is an excellent time to consider the global status of older persons with mental illnesses. This issue of Mental Health in Family Medicine is a contribution to this thought and a confirmation that working together between teams of primary care providers and experts in geriatric mental health is not only feasible, but also imperative.

The data from the Community Mental Health Activity (Community MHA) Omnibus return and the quarterly data from the Mental Health Minimum Dataset (MHMDS) version 4 are combined in this document as a background quality report. The normal quarterly MHMDS reports' main goal is to inform the public, commissioners, and the DH on adult specialist mental health services that are financed by the NHS. The normal quarterly MHMDS reports' main goal is to inform the public, commissioners, and the DH on adult specialist mental health services that are financed by the NHS.

II. LITERATURE REVIEW

A. *Mental health of UK firefighters*

This research paper investigates the psychological state of UK firefighters. According to the study, which featured a survey of 548 firefighters, mental health illnesses are more common among firefighters than in the general population. According to the study, firemen are more likely to experience PTSD, sadness, and anxiety. The study also discovered that characteristics related to the workplace, such as trauma exposure, demanding jobs, and a lack of social support, were linked to an elevated risk for mental health issues. The study emphasizes the significance of offering firefighters mental health support and addressing workplace conditions that exacerbate poor mental health. The results of this study can guide actions and laws intended to enhance the mental health of UK firefighters.

B. Latent profiles of childhood psychological maltreatment and their links to adult mental health in China and the UK

This study investigates the connections between latent profiles of childhood psychological abuse and adult mental health in China and the UK. 821 individuals from both nations participated in the study overall and filled out a self-report questionnaire. Four unique profiles of psychological abuse—low maltreatment, moderate-to-high covert maltreatment, moderate-to-high overt maltreatment, and severe and pervasive maltreatment—were discovered using latent profile analysis. According to the study, both countries' greatest rates of adult mental health issues, such as PTSD and depression, were connected with the severe and pervasive maltreatment profile. Moreover, a profile of moderate to severe overt abuse was linked to higher levels of mental health issues. The study emphasizes the significance of recognizing and treating child psychological abuse in order to prevent long term mental health consequences.

C. The Impact of COVID-19 on Farmers' Mental Health: A Case Study of the UK

The study looks into how COVID-19 has affected the mental health of farmers in the UK. 14 farmers and 4 stakeholders that work with farmers were interviewed as part of the study's case study methodology. The COVID-19 epidemic has significantly impacted the mental health of farmers in the UK, according to the study. Increased financial strains, social isolation, and worries about the future of agriculture have all been brought on by the pandemic. Farmers now experience higher levels of stress, worry, and despair as a result of these issues. The survey also discovered that because of perceived stigma and a lack of knowledge about available support, farmers were hesitant to seek help for their mental health issues. The results of this investigation show the need for targeted mental health support for farmers, as well as increases awareness and education on mental health issues in the farming community.

D. At home or in hospital: Home treatment and mental health stigma

The stigma associated to home care for mental health patients is explored in the article "At home or in hospital: Home treatment and mental health stigma" by Allerdiena A Hubbeling and Jared G Smith. Although home therapy provides a number of benefits over hospitalization, including cheaper costs and more comfort, the authors contend that it is frequently stigmatized as a less desirable or "second-best" choice. The essay looks at the causes of this stigma, such as cultural misconceptions about mental illness and the idea that receiving care at home amounts to "giving up" on the patient. The authors contend that in order to overcome this stigma, attitudes toward mental

illness must change, and the advantages of home therapy must be better understood. They also emphasize how crucial it is to offer sufficient assistance.

E. Work-From-Home in the New Normal: A Phenomenological Inquiry into Employees' Mental Health

The effect of the COVID-19 epidemic on the mental health of workers who work from home is examined in the article "Work-From-Home in the New Normal: A Phenomenological Exploration into Employees' Mental Health" by Mumtaz Ali Memon, Saba Shaikh, Muhammad Zeeshan Mirza, and Hiram Ting. The authors study employee experiences and views using a phenomenological approach, paying particular attention to the benefits and challenges that come with working remotely. The article addresses a number of important themes that arose from the investigation, such as the challenges of juggling work and personal obligations, the value of social support, and the requirement for distinct lines separating work from non-work activities. The writers also go over some possible advantages of working remotely, like more freedom and shorter commutes. Overall, the article recommends that while remote work has both advantages and disadvantages, it is important for employers to prioritize the mental health and well-being of their employees, particularly in the context of the pandemic.

F. Health behaviors and subsequent mental health problems during the COVID-19 pandemic: A longitudinal analysis of adults in the UK

The study "Health behaviors and subsequent mental health problems during the COVID-19 pandemic: A longitudinal analysis of adults in the UK" looked at the relationship between COVID-19-related health behaviors and subsequent mental health issues in people in the UK. The COVID-19 Social Study, a longitudinal panel survey with more than 70,000 participants, provided the data for the study.

According to the study, maintaining healthy habits like regular exercise and a balanced diet was linked to less instances of mental health issues during the epidemic. On the other hand, harmful behaviors like smoking, consuming alcohol, and binge eating were linked to increased rates of ensuing mental health issues. The study also discovered that people who at the beginning of the epidemic reported higher levels of stress, worry, and depression were more likely to engage in harmful behaviors and less likely to engage in beneficial ones.

G. g. A systematic review of the predictors of health service utilization by adults with mental disorders in the UK

A systematic review that was published under the title "A systematic review of the predictors of health service utilization by adults with mental disorders in the UK" looked at studies done in the country to determine the predictors or characteristics that affect how often adults with mental disorders use health services. To comprehend the factors that affect how people with mental disorders seek and use health services in the UK, the review examined a number of studies.

The systematic review's conclusions identified a number of determinants of health service use by persons in the UK who have mental illnesses. These predictors included clinical criteria including the kind and severity of mental disorders, co-occurring physical health issues, and the intensity of the symptoms, as well as sociodemographic factors like age, gender, ethnicity, and socioeconomic position. Access to healthcare resources, the availability of social support, cultural considerations, and individual ideas regarding mental health and treatment were additional predictors.

III. PROBLEM STATEMENT

Clustering is unsupervised data mining technique that identifying and grouping similar data points in larger datasets without concern for the specific outcomes. It is a process of grouping records and observations to create a class of items with similar characteristics' cluster is a group of records that are similar to choose in another cluster. Clustering is critical in data mining applications such as scientific data exploration, information retrieval, text mining, visual data base applications and web analysis. There are many industries where using an unsupervised learning algorithm can be beneficial and insightful sellers want to group similar consumers for targeted marketing campaigns, biologists want to find plants with similar characteristics, and so on. We will investigate whether it is appropriate to use clustering techniques to categorize medical patients.

We'll look at anonymous people who have been with mental illness. Patients with similar characteristics may respond to similar mental health discourses, outcomes of patients with similar characteristics to those being treated.

IV. METHODOLOGY

K-Means Clustering is an unsupervised learning method used to solve clustering problems in machine learning or data science. The algorithm aims to minimize the variance of the data points within each cluster and maximize the variance between the clusters. The K in "k-means" refers to the predetermined number of clusters that the algorithm aims to identify. The user specifies this number at the start of the algorithm. The algorithm then randomly selects K

initial cluster centers, which are used to assign each data point to a cluster. which divides the disordered dataset into several clusters. For an example, if $K=2$, two clusters will be produced, if $K=3$, three clusters will be produced, and so on. It enables us to cluster the data into different groups and provides a convenient method for discovering group categories in an unlabeled dataset without the need for training. It is a centroid-based algorithm, with a centroid for each cluster.

Data collection

The data set comes from the open data program of the UK government.

The Mental Health Minimum Data Set (MHMDS) is a routine data return from providers of adult secondary mental health services funded by the NHS that is created as part of providing services to patients. The Monthly Mental Health Dataset Reports have replaced this dataset. The Mental Health Minimum Data Set (MHMDS) is a routine data return from providers of adult secondary mental health services funded by the NHS that is created as part of providing services to patients.

It has information on every adult (including senior citizens) over the age of 18 who receives specialised secondary mental health treatments supported by the NHS and who is, or may be, experiencing, a mental illness. When children and teenagers under the age of 18 are receiving treatment from an early intervention program or a specialized adult secondary mental health service, they should be included as well.

About data set

Excel reference tables in a style similar to prior years that include aggregate numbers of people in contact with these services, inpatient activities, care contacts, and uses of restrictive interventions in inpatient services.

Data from 69 NHS-funded providers were included in this dataset. The tentative data was separated into the following groups:

There have been 120,259 episodes of home treatment so far this year.

247,854 assessments have been made by the Crisis Resolution team so far this year, and 98,280 patients have received home treatment.

At the end of the quarter, there were 21,886 patients being treated by Early Intervention teams;

At the end of the quarter, 19,843 people were getting Assertive Outreach services.

Data pre processing

Before moving on to data pre-processing install two packages called cluster and factorextra to analyze the data. After Import the data set used the head (), tail () functions to get a quick view of data set and used dim () function to check how many rows and columns are in the data frame.

According to data frame there are 151 rows and 9 columns. Before we begin clustering, we should conduct some exploratory data analysis to better understand the data set's attributes. we checked the dataset for any null or NA values, and if any were found, we had to remove them. Then we inspected the dataset's summary by using summery () function.

By using normalize function then we normalize the data set. Remove organization column before normalize and after normalize again add the organization column.

V. RESULTS AND DISCUSSION

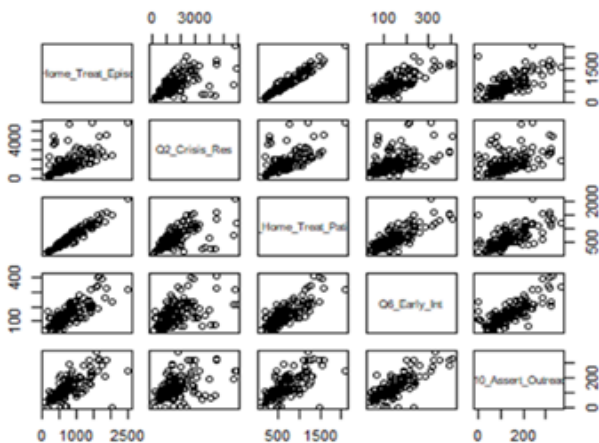


Figure 1 – Correlation plot

This plot created by using pairs () Function. The pairs () function can be very useful for quickly visualizing the pairwise relationships between multiple variables in a dataset. It can help identify potential patterns and relationships between variables. This plot shows the relationship between the home treat episodes and assert outreach. This creates the visualization and helps understand the large amount of data in a single figure.

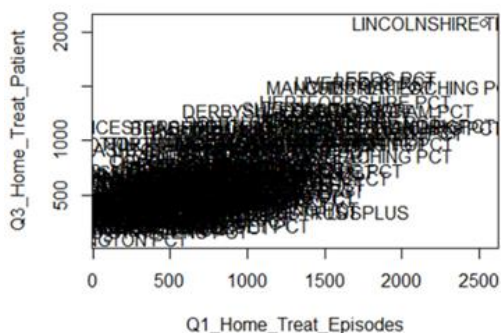


Figure 2

This scatterplot shows the relationship between the number of patients treated at home and the number of episodes treated at home

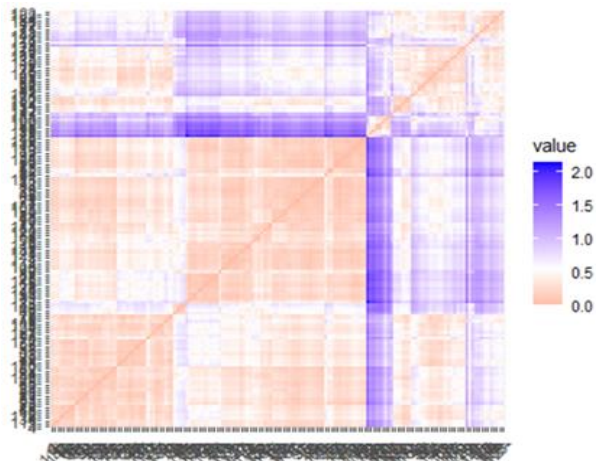


Figure 3 - Correlation plot

The fviz dist () function is the Simple way to visualize distance matrices. This function is a part of the factoextra package in R, and it is used to create graphical representations of distance matrices. Specifically, it is used to visualize the distances between observations or variables. The red color indicates the high similarity and blue color indicates the low similarity. The color level is proportional to the value of dissimilarity between observations where pure red represents zero and pure blue represents one.

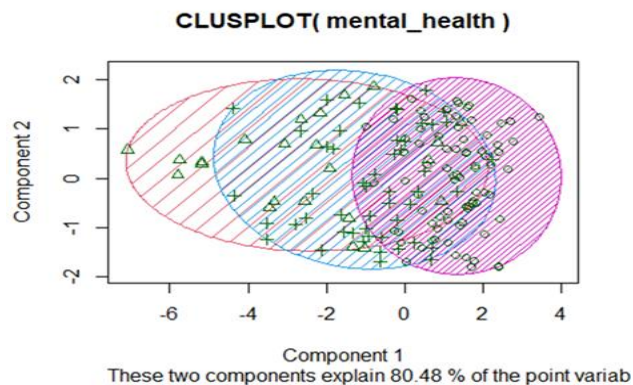


Figure 4 – Cluster Plot

The clustplot() function is used to create the plot. The clustplot() function in R is used to create a scatter plot matrix that visualizes the results of a clustering analysis. It is part of the cluster package in R. This is useful tool for exploring the results of a clustering analysis and identifying any patterns or trends in the data.

Above plot represented the K means clustering. We use K=3 therefore above figure shows the three clusters. These three cluster sets connect with each clusters therefore there having a strong relationship.

VI. CONCLUSION

K means clustering is one of the most widely used clustering algorithms. Also in our case, k -means Cluster analysis was the most appropriate. Clustering can be a useful tool for identifying patterns in mental health data and improving our understanding of mental health problems. We were able to identify significant clusters. Clustering can be a valuable tool for mental health research when used responsibly and ethically. It can help identify subgroups of individuals with similar symptoms or risk factors, which can lead to more targeted and effective interventions. We were able to get a sense of similar mental illness patients and what they had in common attributes after analyzing those clusters. Relevant parties can then treat them according to their similarities.

As a result of a considerable portion of the general population experiencing mental health issues at home point in their lives, mental health is a growingly important issue in the UK. As there have been more reports of anxiety, depression and other mental health problems in the general public due to the COVID-19 epidemic, it has become even more important that mental health is. The UK government has made efforts to enhance mental health services and assistance because it understands the significance of mental health. To address the difficulties and obstacles that people seeking mental health help, particularly those from marginalized populations, experience however much needs to be done. According to research promoting mental health and wellbeing requires early intervention, prevention and access to mental health services. To reduce stigma and increase awareness of mental health issues, it is crucial to keep finding mental health services and assistance.

VII. FUTURE WORK

Learning k-means cluster analysis by trying to solve problems such as healthcare, economy etc. Expecting to use k-means cluster analysis for the real-world problem. And Can Estimate future fertility rates in the UK based on present trends and patterns.

K-means clustering can be used to identify patient groups with similar treatment outcomes, which can help healthcare providers personalize treatment plans for individual patients. And also can be used to identify high-risk patient groups based on demographics, medical history, and other factors. This can help healthcare providers target preventive interventions to those who need it most.

Increased focus on prevention. This may involve strategies such as early intervention for young people, promoting good mental health in workplaces, and addressing social determinants of mental health. And can use more innovative treatments to treat.

REFERENCES

- Wolffe, T. a. M., Robinson, A., Clinton, A., Turrell, L., & Stec, A. A. (2023). Mental health of UK firefighters. *Scientific Reports*, 13(1). <https://doi.org/10.1038/s41598-022-24834-x>
- Xiao, Z., Obsuth, I., Meinck, F., & Murray, A. L. (2023). Latent profiles of childhood psychological maltreatment and their links to adult mental health in China and the UK. *Child and Adolescent Psychiatry and Mental Health*, 17(1). <https://doi.org/10.1186/s13034-023-00572-4>
- Rose, D. C., Shortland, F., Hall, J., Hurley, P., Little, R., Nye, C., & Lobley, M. (2022). The Impact of COVID-19 on Farmers' Mental Health: A Case Study of the UK. *Journal of Agromedicine*, 1–19. <https://doi.org/10.1080/1059924x.2022.2137616>
- Hubbeling, A., & Smith, J. B. (2022). At home or in hospital: Home treatment and mental health stigma. *International Journal of Social Psychiatry*, 002076402110095. <https://doi.org/10.1177/00207640211009558>
- Memon, M. A., Shaikh, S., Mirza, M. Z., Obaid, A., Muenjohn, N., & Ting, H. (2022). Work-From-Home in the New Normal: A Phenomenological Inquiry into Employees' Mental Health. *International Journal of Environmental Research and Public Health*, 20(1), 48. <https://doi.org/10.3390/ijerph20010048>
- What causes mental health problems? (n.d.). *Mind*. <https://www.mind.org.uk/information-support/types-of-mental-health-problems/mental-health-problems-introduction/causes/>
- About Mental Health. (n.d.). <https://www.cdc.gov/mentalhealth/learn/index.htm>
- World Health Organization: WHO. (2019, December)
- Mental health. https://www.who.int/health-topics/mental-health#tab_