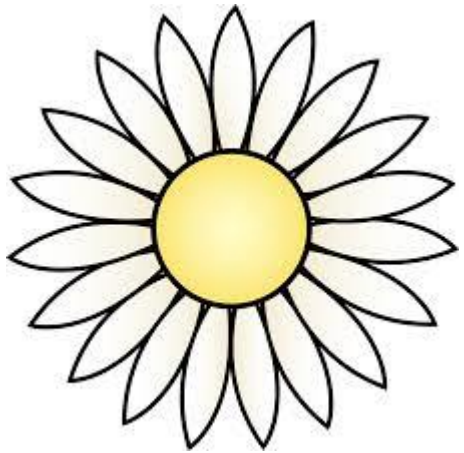
Datamind: Addressing youth depression & suicide in Finland

Junction 2019 Helsinki Hackathon
CGI/Sitra Healthtech Challenge:
Reimagine mental health care



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The problem: Approximately 20-25% of Finnish youth have mental health issues

Depression

Anxiety

Eating disorder

Self-harm, suicidal ideation & suicide

The implications: Moral & economic

Youth suicide is a national tragedy

Youth depression & mental health problems lead to non-productive adults

Pension & welfare systems rely on productive economy; else unsustainable

FINLAND DISPATCH

It's Cold, Dark and Lacks Parking. But Is This Finnish Town the World's Happiest?

The New York Times

By Patrick Kingsley

Dec. 24, 2018

News 20.3.2019 11:55 | updated 20.3.2019 12:43

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Finland: Still the happiest country in the world (says UN report)

The UN's seventh annual World Happiness Report ranks the countries of the world on "how happy their citizens perceive themselves to be".

LIFESTYLE

Finland: from suicide hotspot to world's happiest country

SAM KINGSLEY
AGENCE FRANCE-PRESSE

Vantaa, Finland / Sat, April 13, 2019 / 05:09 pm

by The Jakarta Post

United Nations Sustainable Development Solutions Network: World Happiness Report (2019)

Overall rank	Country or region	Score	GDP per capita	Social support	Healthy life expectancy	Freedom to make life choices	Generosity	Perceptions of corruption
1	Finland	7.769	1.340	1.587	0.986	0.596	0.153	0.393
2	Denmark	7.600	1.383	1.573	0.996	0.592	0.252	0.410
3	Norway	7.554	1.488	1.582	1.028	0.603	0.271	0.341
7	Sweden	7.343	1.387	1.487	1.009	0.574	0.267	0.373
9	Canada	7.278	1.365	1.505	1.039	0.584	0.285	0.308
19	United States	6.892	1.433	1.457	0.874	0.454	0.280	0.128
68	Russia	5.648	1.183	1.452	0.726	0.334	0.082	0.031

United Nations Sustainable Development Solutions Network: World Happiness Report (2019)

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1	Finland	7.769	1.340	1.587	0.986	0.596	0.153	0.393
147	Haiti	3.597	0.323	0.688	0.449	0.026	0.419	0.110
152	Rwanda	3.334	0.359	0.711	0.614	0.555	0.217	0.411
153	Tanzania	3.231	0.476	0.885	0.499	0.417	0.276	0.147
156	South Sudan	2.853	0.306	0.575	0.295	0.010	0.202	0.091

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News 10.9.2010 13:44 | updated 4.6.2012 22:30

High Suicide Rate among Finnish Youths

Nearly 1,000 young people die at their own hand in Finland every year. Finland ranks close to the top in youth suicide tables, as one in 10 suicides in the country are among under 24-year-olds.

News 22.2.2005 9:18 | updated 23.5.2012 15:32

Teen Suicides Linked to Recession

The number of accidential deaths of children and teens have fallen steadily here in Finland over the past 30 years. However, a new report shows that the last servere economic recession was hard on boys in their teen years - the number of suicides in this age group more than doubled in the early 90s.

News 17.12.2018 18:30 | updated 17.12.2018 18:45

Finland sees more suicides than EU average

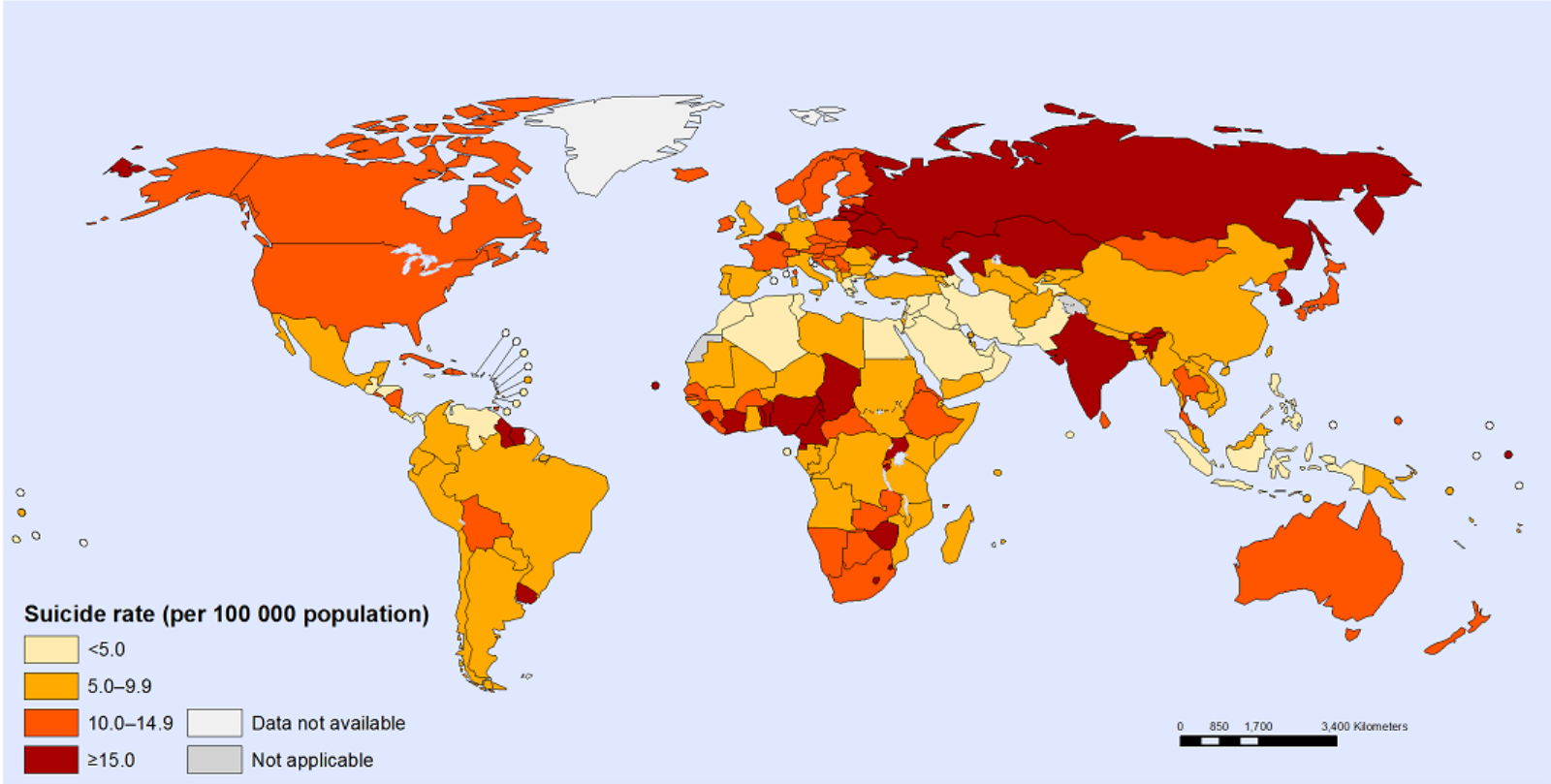
After decades of declining numbers of self-inflicted deaths, Finland's suicide rate increased for the second year in a row last year.

News 1.3.2018 18:07 | updated 1.3.2018 18:13

Helsinki suicide prevention centre opens

The suicide prevention centres, now operating in Helsinki and Kuopio, require no referral and are free of charge.

Age-standardized suicide rates (per 100 000 population), both sexes, 2016

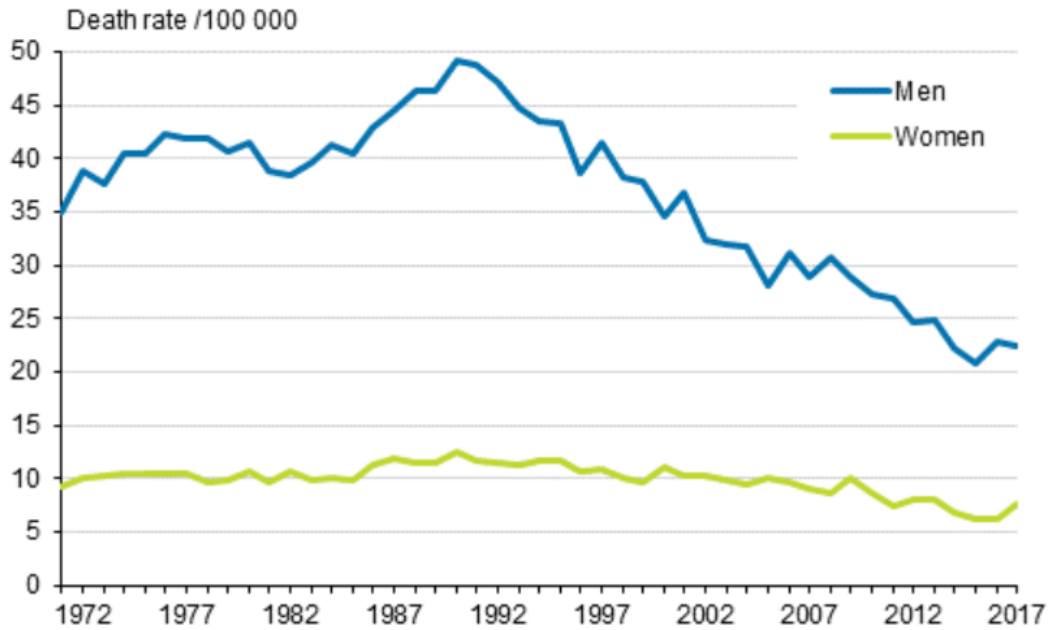


Data Source: World Health Organization
Map Production: Information Evidence and Research (IER)
World Health Organization

World Health Organization

Suicide rates in Finland have dropped over past 20 years …

Figure 12. Suicides mortality 1971 to 2017



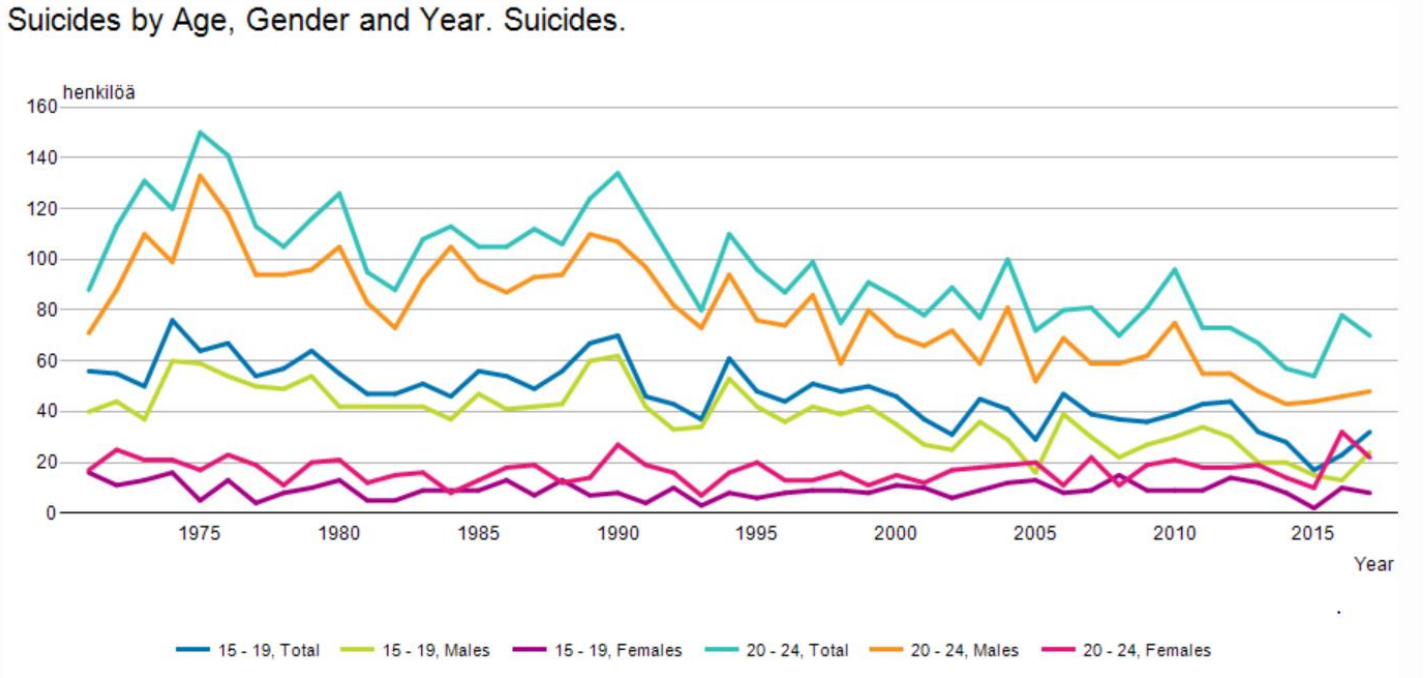
Source: Causes of death, Statistics Finland

Men commit more suicides than women

Rates have dropped over past 20 years, mainly amongst the middle-aged

For >65, suicide mortality in Finland did not differ from EU average

Suicide rates in Finland have dropped over past 20 years … but not so much for youth



Youth suicide rates have not dropped as much and in fact have recently risen slightly

(Suicide as cause of death for young people often dominates because mortality due to other causes is low)

Finnish young people (15-24) suicide mortality in Finland is high compared to EU average

There is a problem!

New national suicide prevention program (part of Finnish national mental health strategy for 2019-2030)

Objective is to reduce suicide rates 10% (goal of the WHO for all member countries) by:

Increase training of social and health professionals

More efficient use of evidence-based practices and new electronic methods in particular

Closely monitor those who attempted suicide; offer appropriate services immediately after attempt

Offer support to family of suicide victims / survivors

More cooperation between experts, early support offered by organisations / health care system

Strongly support high-quality and humane care culture

Prevention is better & cheaper than cure: Investment during (early) childhood is critical[1]

Young mothers & infants (pre-natal & post-natal)

Health, diet, avoidance of drugs & alcohol, social support

(Finland & Nordic countries are good at this)

We propose this in addition: Peer mentoring of young parents

Mothers

Fathers

[1]It takes a village to raise a child -- African proverb

But young adulthood is difficult, with many pressures

School & life decisions

Peers

Sexuality

Social media

Some ideas to improve youth mental health

Data-driven triage & assessment of depression severity

Severe -> Immediate assistance (currently there is an unacceptable delay)

Moderate-to-mild -> Peer-support, referral

Volunteer organization[1] connected to Mieli[2] that can match at-risk youth to trained & supervised peer support:

In-person meetings

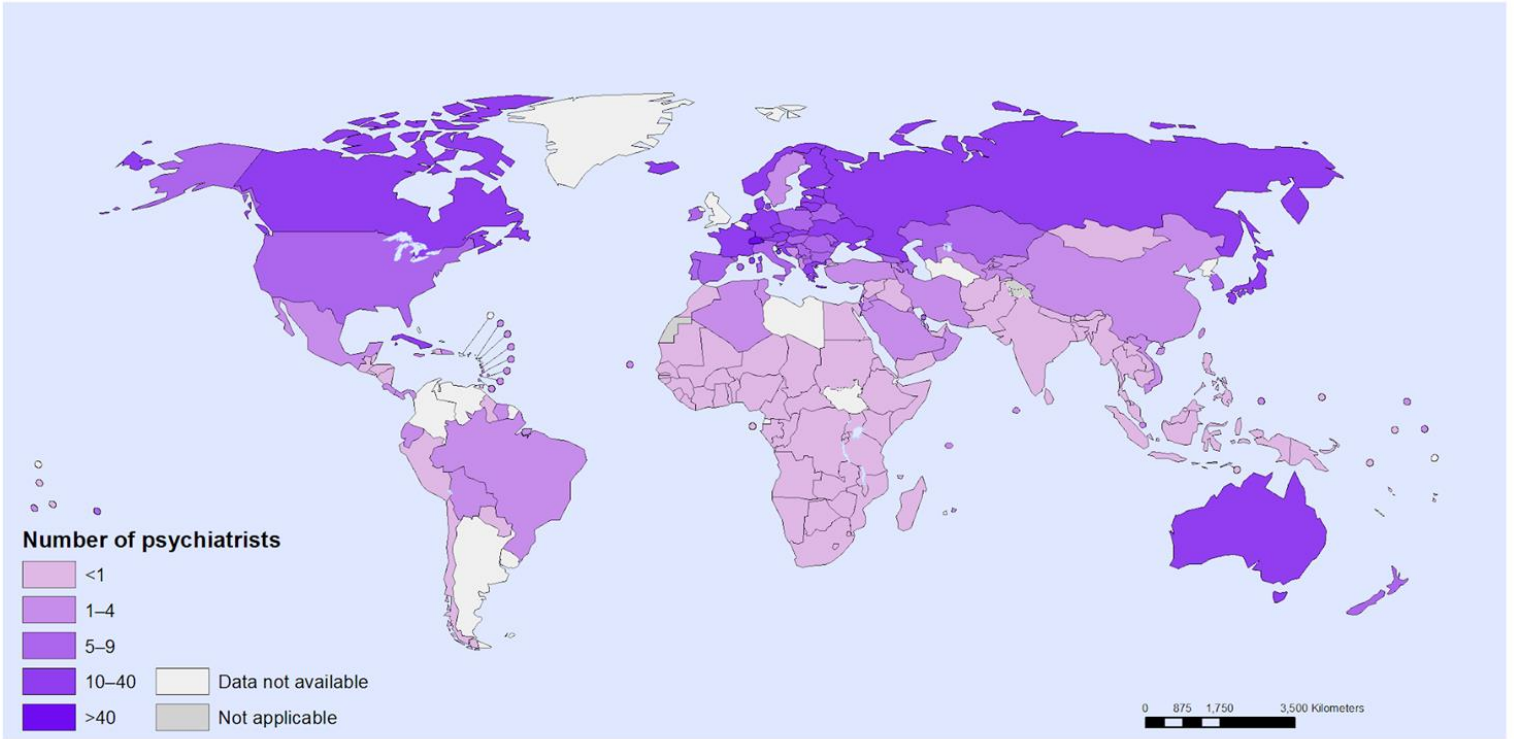
Video conferencing

Longitudinal tracking of treatment outcomes

[1]Analogous to Big Brothers & Big Sisters USA

[2]Mental Health Finland

Psychiatrists working in mental health (per 100 000 population), 2011



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Health Statistics and Information Systems (HSI)
World Health Organization

World Health Organization

Common data-driven approach to classifying degree of depression: Patient Health Questionnaire[1] (If initial assessment PHQ-2 > 2, then if PHQ-9 > 9 -> depression serious)

How often have they been bothered by the following over the past 2 weeks?

0=Not at all 1=Several days 2=More than half the days 3=Nearly every day

1. **Little interest or pleasure** in doing things?
2. Feeling down, **depressed**, or hopeless?
3. Trouble falling or staying asleep, or **sleeping** too much?
4. Feeling **tired** or having little energy?
5. Poor **appetite** or overeating?
6. Feeling bad about yourself - or that you are a **failure** or have let yourself or your family down?
7. **Trouble concentrating** on things, such as reading the newspaper or watching television?
8. **Moving or speaking so slowly** that other people could have noticed?
   Or the opposite - being so fidgety or **restless** that you have been moving around a lot more than usual?
9. **Thoughts that you would be better off dead**, or of **hurting yourself** in some way?

[1]Diagnostic and Statistical Manual of Mental Disorders (DSM-IV & V)

Interpretation of PHQ-9 score

PHQ-9 Score	Depression severity	Suggested Intervention
0-4	None-minimal	None
5-9	Mild	Repeat PHQ-9 at follow-up
10-14	Moderate	Make treatment plan, consider counseling, follow-up, and/or prescription drugs
15-19	Moderately Severe	Prescribe prescription drugs and counseling
20-27	Severe	Prescribe prescription drugs. If there are poor responses to treatment, immediately refer the patient to a mental health specialist for counseling.

Data our app will gather

PHQ-9 data to classify severity

Free-form text in form of short biography will be used to confirm degree of severity or at-risk status

Bio can identify type of mental health issue and personalize the proposed treatment

Bio text will be analyzed with natural language processing (NLP) techniques

- sentiment analysis
- word2vec, doc2vec

Data from multiple other sources

Training algorithm – phase 1

- Data cleaning and normalization
- Concatenate the feature vectors $\overrightarrow{v_1}, \ldots, \overrightarrow{v_n}$ to create feature vector $\vec{v}$
- Perform PCA to create vector $\overrightarrow{v'}$
- Apply clustering, possibly DBSCAN (algorithm that doesn't have a parameter for the number of clusters)

Training algorithm – phase 2

- $P \leftarrow$ Choose randomly $\alpha * ClusterSize$ people from each cluster
- $P' \leftarrow$ Random permutation of P
- For each $p \in P'$
    - let a psychologist and psychiatrist decide about severity, urgency, and treatment
- $Q \leftarrow$ Construct priority-queue and insert everyone in the cluster based on the cluster's priority
- For people with priority -1, suggest alternative solution

Root causes analysis and depression prediction

- For a patient construct feature matrix over time $\begin{bmatrix} f_{1_{t_1}} & \cdots & f_{1_{t_m}} \\ \vdots & \ddots & \vdots \\ f_{n_{t_1}} & \cdots & f_{n_{t_m}} \end{bmatrix}$
- Apply clustering for the matrix (output is vector of clusters $\begin{pmatrix} c_{t_1} \\ \vdots \\ c_{t_m} \end{pmatrix}$ over time)
- See the features that have changed that made the patient move between different clusters

Our app: Use cases

Prospective patients & patients

Carers

- Primary care physicians, psychologists & counselors
- Teachers
- Patient’s parents (if under 18)
- Peer counselors

Researchers: Good data may allow classification of depression subtype & more focused treatment (see: “Applying a neural circuit taxonomy in depression and anxiety for personalized psychiatry”, LM Williams, et al., Personalized Psychiatry, 499-519, 2020)

Privacy & data security: Stakeholders

Patient

Patient’s parents (if under 18)

Doctor

Mieli

The Future ….

Addressing youth depression through data-driven precision psychiatry

Treatment-resistant depression is a hard problem

Recent fMRI studies suggest that depressive disorders actually consist of multiple subtypes with their individual mechanisms and distinctive symptoms (if resolved on fine-enough and accurate scale)

Tasks:

(1) identify subtype (good data can help)

(2) neurobiologists can decipher mechanism

(3) finally prescribe appropriate treatment

In short, we desire to use a scalpel, not a blunderbuss

Fernandes *et al. BMC Medicine* (2017) 15:80
DOI 10.1186/s12916-017-0849-x

BMC Medicine

OPINION Open Access

The new field of 'precision psychiatry'

Brisa S. Fernandes[1,2,3*], Leanne M. Williams[4,5], Johann Steiner[6], Marion Leboyer[7], André F. Carvalho[8] and Michael Berk[1,2,9,10]

Abstract

Background: Precision medicine is a new and important topic in psychiatry. Psychiatry has not yet benefited from the advanced diagnostic and therapeutic technologies that form an integral part of other clinical specialties. Thus, the vision of precision medicine as applied to psychiatry – 'precision psychiatry' – promises to be even more transformative than in other fields of medicine, which have already lessened the translational gap.

Leanne M.Williams, Andrea N.Goldstein-Piekarski, 'Chapter 42 - Applying a **neural circuit taxonomy** in depression and anxiety for personalized psychiatry', Personalized Psychiatry, Pages 499-519, 2020

Example: The treatment-resistant 'Anhedonia' subtype is attributed to errors in the default mode and reward circuits. Research suggests two specific treatment approaches are successful: transcranial magnetic stimulation or pramipexole (a Parkinson's drug)