Personalised monitoring SYstems for Care in mental HEalth
PSYCHE: Overview

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Consortium overview

Countries involved: Italy, Switzerland, Germany, France, Spain, Ireland

DCU (DUBLIN)
MEYTEC (SEEFELD/BRANDENBURG)
INSERM666 (STRASBOURG)
CSEM (NEUCHÂTEL)
FORENAP (ROUFFACH)
UNIGE (GENEVE)
POLIMI (MILANO)
UPM (MADRID)
UNIPI (PISA)
SMARTEX (PISA)
Bipolar Disorder (BPD)

- Manic-depressive disorder
- Immoderate and unusual mood swing from extremely happy and energized (mania) to extremely sad (depression)
- Damages relationships & performance
- Can be life-threatening: often ends in suicide
- Chronic illness
- Most often diagnosed in adolescence
Bipolar Disorder Statistics (in USA)

- Affects 2.3 million Americans (1.2 percent of the population).
- Approximately 25 percent of consumers experience onset before age 20.
- Seven out of 10 people with bipolar disorder receive one misdiagnosis.
- 30 percent of people with untreated bipolar disorder commit suicide.
- Delayed diagnosis or misdiagnosis contributes to 50 percent of bipolar consumers abusing alcohol or drugs.
- An equal number of men and women develop this illness and it is found among all ages, races, ethnic groups and social classes.
- Average length of time from onset of symptoms to diagnosis is 10 years. Bipolar disorder accounts for approximately $7.6 billion in direct healthcare costs in the U.S.
### Bipolar Disorder Statistics (in Europe)

2.4 million of subjects out of 301.7 million suffer from Bipolar disorders in Europe with a prevalence of 0.8%

<table>
<thead>
<tr>
<th>Diagnosis (DSM-IV)</th>
<th>12-month estimate (million)</th>
<th>Lower range (million)</th>
<th>Upper range (million)</th>
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**Comorbidity**

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## Bipolar Disorder Statistics (in Europe)

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<tr>
<th>Diagnosis (DSM-IV)</th>
<th>Women Total (%)</th>
<th>18–34 (%)</th>
<th>35–49 (%)</th>
<th>50–65 (%)</th>
<th>Total (%)</th>
<th>18–34 (%)</th>
<th>35–49 (%)</th>
<th>50–65 (%)</th>
<th>Total (%)</th>
<th>MI (%)</th>
<th>Expert ratings (%)</th>
<th>Within range (%)</th>
<th>Lower (%)</th>
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5th International Workshop on Ubiquitous Health and Wellness
Major Depressive Episodes

Persistent feelings of:
Sadness
Anxiety
Guilt
Anger
Isolation
Hopelessness
Disturbances in sleep and appetite
Fatigue and loss of interest in sexual activity
Irritability
Lack of motivation
Morbid suicidal ideation
Manic Episodes

Distinct period of:
- Elevated, expansive, irritable mood state
- Racing thoughts
- Low attention span
- Easily distracted
- Impaired judgment
- Spending sprees, unusual behavior
- Substance abuse (esp. alcohol, stimulants)
- Aggressive behavior
- Increased sexual drive
DSM Criteria – Major depression

- A distinct period of abnormally and persistently elevated, expansive, or irritable mood
- DEAD SWAMP acronym (at least 5 out of 9 symptoms)
  - Depressed mood most of the day
  - Energy loss or fatigue
  - Anhedonia
  - Death thoughts (recurrent), suicidal ideation or attempts
  - Sleep disturbances (insomnia, hypersomnia)
  - Worthlessness or excessive guilt
  - Appetite or weight change
  - Mentation decreased (ability to think or concentrate, indecisiveness)
  - Psychomotor agitation or retardation
### DSM Criteria - Mania: cardinal symptoms

- **DIGFAST acronym** (at least 3 out of 7 symptoms)
  - Distractible
  - Increased activity/psychomotor agitation
  - Grandiosity/Super-hero mentality
  - Flight of ideas or racing thoughts
  - Activities that are dangerous or hypersexual
  - Sleep decreased
  - Talkative or pressured speech

### Hypomanic Episode

- **Similarities =**
  - Same symptoms

- **Differences =**
  - Length of time
  - Impairment not as severe

### Mixed episodes

- Both Manic and Major Depressive Episode criteria are met nearly every day for at least a one week period.
Subtypes of bipolar disorders

Bipolar I Disorder = recurrent episodes of mania and depression and at least one full manic or mixed mood episode

Bipolar II Disorder= at least one depressive episode and at least one hypo manic episode, but never experience a full manic or mixed mood episode. Often unrecognized because the hypo manic symptoms may not appear as unusual.

Cyclothymia = short periods of mild depression and short periods of hypomania (lasting a few days to a few weeks), separated by short periods of normal mood.
Diagnosis

- Often very complicated; it mimics many other disorders and has comorbidity (presents with other disorders)
- Half of bipolar children have relatives with bipolar disorder

The Mood Disorder Questionnaire (MDQ)

Instructions:
Please answer each question as best you can.

1. Has there ever been a period of time when you were not your usual self and...
   - you were so irritated that you shouted at people or started fights or arguments? Yes No
   - you felt much more self-confident than usual? Yes No
   - you got much less sleep than usual and found you didn’t really miss it? Yes No
   - you were much more talkative or spoke much faster than usual? Yes No
   - thoughts raced through your head or you couldn’t slow your mind down? Yes No
   - you were so easily distracted by things around you that you had trouble concentrating or staying on track? Yes No
   - you had much more energy than usual? Yes No
   - you were much more active and did many more things than usual? Yes No
   - you were much more social or outgoing than usual for example, you telephoned friends in the middle of the night? Yes No
   - you were much more interested in sex than usual? Yes No
   - you did things that were unusual for you or that other people might have thought were excessive, foolish, or risky? Yes No
   - spending money got you or your family into trouble? Yes No
Vision: new approach to mental disease management

Biochemical screening

Sleep monitoring

Voice analysis

Activity & movement monitoring

Electronic agenda

Data analysis

Measurements & Detection

Interface

Processing

 clinician

Biofeedback & stress management

Daily feedback

Long term feedback

Daily feedback
Mission

Developing a personal monitoring system aiming at:
- giving support to patients
- identifying signal trends indicating detection and prediction of critical events
- providing parameters, indexes and trends for mood state assessment
- predicting and anticipating treatment response at its earlier phases
- alerting professionals in case of clinical events
Goals

- PSYCHE system based on a multi-parametric and naturalistic approach using textile platforms and portable sensing devices for patients affected by mood disorders.
- Novel portable devices for the monitoring of biochemical markers, voice analysis and a behavioral index correlated to patient state.
- Closed loop approach between patients and physicians to facilitate disease management.
- Electronic Health Records (EHR) of the patient to verify the diagnosis and help in prognosis of the illness.
Workpackage interdependencies

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Volunteers Recruitment

User monitoring in supervised environment
- GSR, EEG
- Sleep monitoring
- Biochemical marker
- Internal temperature
- HER (Electronic Health Record)
- Physiological signals
- Activity monitoring
- Posture detection
- Voice monitoring
- Questionnaires for cognitive & emotional assessment

Context awareness in supervised environment:
- Environment temperature
- Noise
- Brightness

User need and system requirements

Hardware platform for multiparametric sensor.

Signal processing

Parameters indexes

Data mining:
- Feature extraction
- Feature reduction
- Data storage

Functional & system validation

Functional & clinical validation

Mood assessment & predictive indexes

User & professional interface

User need and system requirements

Dissemination & Exploitation

Protocol definition

Volunteers Recruitment

Development Phase

Monitoring in supervised environment:
- Biochemical monitoring through portable device
- GSR, EEG, biochemical screening

Monitoring in non-supervised environment:
- HER (Electronic Health Record)
- EA (Electronic Agenda)
- Physiological signals
- Sleep quality
- Activity index
- Behavioral index
- Voice
- Questionnaires for cognitive assessment
- Context awareness

Dissemination

Month 0

Month 3rd

Month 12th

Month 32nd

Month 40th

WP1

WP2

WP3

WP4

WP5

WP6

WP7
Extraction of generic features

- **Physiological features**
- **Body activity features**
- **Speech features**
- **Ambient features**

![Diagram showing various features and sensors connected to a PSYCHE platform for sleep monitoring, movement detection, clinical questionnaires, and a diary.]

- Voice analysis
- Wearable
- Other sensors (weight, blood pressure, etc.)
- PSYCHE platform
- Diary
- Movement detection
- Sleep monitoring
- Clinical questionnaires
Biochemical marker monitoring

- Development of a portable biochemical device to monitor the metabolic conditions of bipolar disorder patients while under treatment with prescription drugs at home with ease of use.

- Give information on effects of prescription drugs in body metabolism by measuring the level of
  - Drug in-take (e.g. concentration of Li+)
  - Metabolite (e.g. glucose/ triglycerides/hormones etc)
Changes in autonomic nervous system tone are known to accompany depression
HRV seems diminished/augmented in depressive states
HRV increased after successful antidepressive treatment

Reduced during daytime in depressive states and increased in euthymic phase prior to relapse, increased in manic phase
Predictor of treatment response
Allows a rough scoring of sleep/wake stages

Both HR and motility can be easily recorded with small and light devices
Sleep and speech features

- **Sleep**: sleep/wake circadian cycles, total sleep time, sleep onset latency
  
  Main state markers of interest moving in correlation with mood
  Easy to provide with actimetry and sleep diary

- **Voice**:
  
  Clear link between mood and some physical variables extracted from speech (fundamental frequency and its variations over time, variation of signal intensity over time, speech segmentation, spectral distribution of energy)
  
  Easy to record and should be well accepted
  Small sensors could be easily integrated in the system
Female Model Design

- Electrodes on the internal side
- Connections done through US and flexible coated stain steel yarns
- Cut and sew process to solve the size issue
Female Prototype

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Male Prototype

Silicone cushion

5th International Workshop on Ubiquitous Health and Wellness
User interface concept

- Patient diary and agenda
  - Fast, easy to use mood tracking
  - Agenda with activity proposal, aiming at building a routine and detecting changes in the routine
  - Capacity to record thoughts and feelings.
  - Visualization of data, with correlations among variables clearly marked.

- Education and motivation
  - Adaptive educational content for patients
  - Memory training, games
  - Goal-setting strategy to motivate patients to adhere to medical treatment and change their lifestyle
Professional interface concept

- Involvement of relatives and friends
  - Education and forums for relatives and significant others
  - Crossed communication patient-relative-professional

- Data visualization for professionals
  - Long-term trends
  - Patient stratification
  - Integration and correlation of data from different sources
  - Communication with other health professionals
Famous People with BPD

**Hollywood:**
- Britney Spears
- Jim Carey
- Robert Downey Jr.
- Linda Hamilton
- Vivien Leigh
- Ben Stiller
- Robin Williams
- Richard Dreyfuss
- Marilyn Monroe
- Tim Burton
- Francis Ford Coppola

**Musicians:**
- Beethoven
- Mozart
- DMX
- Jimi Hendrix
- Axl Rose
- Sting
- Brian Wilson
- Kurt Cobain
- Ozzy Osbourne

**Writers:**
- Edgar Allen Poe
- Mark Twain
- Virginia Woolf
- Charles Dickens
- Ralph Waldo Emerson
- F. Scott Fitzgerald
- Ernest Hemingway
- Kurt Vonnegut
- Emily Dickinson
- T.S. Eliot
- Hans Christian Anderson
- Victor Hugo

**Politicians:**
- Winston Churchill
- Theodore Roosevelt
- Abraham Lincoln
- Napoleon Bonaparte

5th International Workshop on Ubiquitous Health and Wellness
Scientists:
Sir Isaac Newton
Florence Nightingale
Sigmund Freud
Plato

Charles Darwin!

“It isn’t possible to get values and color. You can’t be at the pole and the equator at the same time. You must choose your own line, as I hope to do, and it will probably be color.”
Cyber Blog as dissemination
Thank you!!!