User-Oriented Interface for Monitoring Affective Diseases in Patients with Bipolar Disorder Using Mobile Devices

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Abstract. Nowadays the design of interfaces on mobile devices in the field of mental health is being studied to be applied in the functional criteria related to usability and user experience (UX). This article presents a methodological and conceptual development of an innovative telematics application oriented to control and management relapse prevention in bipolar disorder patients created by the Psychiatry and Clinical Psychology Unit of La Fe Hospital and the Polytechnic University of Valencia. Application called e-therapy aims to control affective diseases in bipolar disorder through the use of computer-assisted tests related to depression and mania among others. Its development and design took into account aspects of functionality and visual usability aimed at people with affective diseases related to mental health. Therapists, psychologists and doctors can monitor and verify patient's mood in real time as well as detect changes in their vital and affective trajectory that allows early intervention and relapse prevention.

Keywords: Mental health · Bipolar disorder · mHealth · Relapse prevention · Affective diseases · User experience

1 Introduction

In 2015, the Global Observatory for Health defined mHealth as the use of mobile and wireless devices for medical practice and as support for public health. The World Health Organization, WHO developed in 2009 a global survey about mHealth in 112 countries concluding several aspects that have been premonitory today and are still working on them:

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- The emergence of mHealth is undergoing significant changes in many private and public health environments. Its implies national health policies must include in their governmental Public health programs projects, future research related to the strategic implementation of new applications based on large scale mHealth environments.
- Some of the barriers found in the implementation of mHealth are related to the control and evaluation of the effectiveness and profitability of Public mHealth applications.
- Although the level of m-Health activity is growing, the evaluation of such activities in the Member States is still very low (21%).
- Security data and privacy of citizens are factors that require legal and political attention to ensure that users are adequately protected.
- States will continue progress in mHealth implementation if they share or develop global standards and architecture of Information and Communication Technologies.

Mental health sector started to develop interactive applications to helps in patient therapies that improve cognitive functions such as attention, perception, executive functions, etc. have derived mainly in creation of applications capable of controlling, monitoring and evaluating the behaviour and mood of the patient to detect symptoms of relapse and thus avoid them.

Nowadays, interactive online applications on mobile devices can improve aspects of educational and social rehabilitation in patients with mental disorders and more specifically with patients with chronic bipolar disorders. In this way, bipolar disorder patients have a better self-understanding of their disease, which will be able have a positive impact on the way of dealing active and consensual way and motivating the sense of monitoring and control from the patient point of view.

As an important part of the psychoeducation and social interventions that patients with a bipolar disorder need is to detect affective diseases related to mania, depression to avoid relapses, hospitalizations or even suicides.

In this way interactive applications related to bipolar disorder have been combined to create control, monitoring and evaluation applications including measurable aspects within the behaviour and mood of the patient to know in real time.

2 Bipolar Disorder

Bipolar disorder can be defined as a psychiatric pathology whose control parameters are focused on its level of severity, chronicity, inheritance and progressive status. A mental disorder is considered to be severe when it has a prolonged duration and ultimately leads to a social and cognitive functional disability is important to the patient.

Bipolar people experiences a permanent oscillation of mood that leads the person to lose the reference point of their habitual mood and emotional psychotic states occur punctually. Altogether, affects mainly to social and affective environment around him [1]. There are three variables related to bipolar disorder: clinical diagnosis, duration and level of disability according to the illness state [2]:

- Clinical Diagnosis considers a severe mental disorder when there are periodic episodes of psychosis. There is an alteration fact in the ability to relate to the social and/or family environment, there is inappropriate behavior or there is an inappropriate or uncontrolled affectivity.

- Disease durations can be considered as severe or chronic when it lasts two or more years. This causes a progressive cognitive and social deterioration point out by the functional control that has been carried out previously for 6 months. National Institute of Mental Health, NIMH, proposes in this dimension criteria more conditioned by functionality than by duration that include aspects as:

  - Receive psychiatric treatment of a greater intensity than standard patient treatment, at least once.
  - Receive continued residential support and other than hospitalization for a sufficient time to create a significant disruption of the person's life situation.
  - Disability of some kind understood as a personal, family, social and labour dysfunction is generated with a moderate to severe intensity over time.

- Bipolar disorder produces a mood regulation and affectivity are altered and moods appear low (depressive episode), exalted (manic episode) or mixture of both (mixed episodes), beyond normal (longer duration or intensity). States among which affective disorders are distributed are [3]:

  - Depression. End or lower state (mood inhibition).
  - Mania. Upper end state (mood exaltation).
  - Euthymic state or normal state.

3 Bipolar Disorder and Social Integration

People with severe and long-term mental disorders like bipolar disorders needs to build a meaningful social and personal life despite suffering serious limitations [4]. Bipolar disorder produces an important change in social and cognitive patient's functionality, especially in their well-being. These changes produce episodes (manic or depressive) with intermediate periods of normal emotional stability or euthymia.

An important aspect that is generated collaterally to the detection and premature relapse prevention in bipolar disorder is the vital change that occurs in the closest environment of the bipolar person that directly affects the family. The need to remain socially and emotionally connected to the environment despite affective disease becomes a key point for patient stability and follow-up. Self-control and awareness about the mental problem helps to therapies, doctors, family and friends becomes an anchor point so as not to be treated as a disabled person and therefore marginalized by society.

According to Appleby, mental health services tend to go beyond traditional clinical care and help patients reintegrate into society, redefining recovery to incorporate quality of life: a job, a decent place to live, friendships and a social life [5].

Social Recovery that many therapists encourage, serves to ensure that bipolar disorder patient normalize his/her social, family and professional environment despite the illness. Social cognition through affective diseases evidences management can provide mechanisms that allow to interact better in certain contexts. With patient's self-reports, therapist can detect any change in their behaviour or in their mood to avoid relapses. There is a

strong correlation between social activity and affective control of the patients in a mental illness. For example, patients with mania are much more communicative than usual, and can make more calls or send more messages. In the same way, patients with depression leave home less, send fewer messages or the duration of their calls are much shorter.

Mobile-assisted therapies in mental health applications should help to control social integration of bipolar patient from an effective monitoring of the public health system. In fact, online applications to create self-reports allows real-time communication with the patient including status information through a series of questions related to their mood, social relationships, consumption of medicines, etc. in real time. In this way, doctor or therapist can create behavioural profiles and trends for a controlled follow-up.

Self-report is an essential tool in psychiatric research of relapse prevention with Bipolar Disorder patients. Self-assessment, control and mood monitoring tools, combined with user-centered health care systems motivate patient feels closer to their doctors due to the immediate response in case of relapse [6]. In fact, this tools are instruments that help patients with Bipolar Disorder to better understand their disease and motivate their empowerment. It allow teach patients to recognize the early signs of recurrence of episodes affective, and allow the individualized mood characterization [7].

There are applications available for monitoring and control of Bipolar Disorder which require the active participation of the patient [8, 9]. New technological approach for mood self-control of patients with a Bipolar Disorder is managed through Ecological momentary assessment, EMA [10]. Use EMA techniques through mobile devices allows individual's status information to be collected in real time, during a given period and with a low level of intrusion into the patient's daily life [11]. The use of such devices for patient monitoring and control, allows a collection data automatically generated daily (for example, number of text messages, number of phone calls, GPS data, voice functions, etc.…), which reflect behavioural activities that may be related to psychopathology and that would not be easily accessible in any other way [12].

4 User Experience (UX) in Mental Health Interactive Applications

User experience (UX) in digital world focuses on internal and external recognition processes of everything that happens to a user when interacting with a mobile application or with a website, including all experiences or evidences that user perceives and feels while using it.

User experience, UX is the result of the interaction evidences among the user, the digital product and the device, influenced by personal, social, environmental, cultural factors for instance that influence the perception of the digital product. The experience is formalized at the user's cognitive level as a positive or negative perception where digital interaction is one of the most important parts that influence the design of the application.

User experience is defined by the International Organization for Standardization (ISO), in ISO 9241-210 as:

> *"The perceptions and responses of a person that result from the anticipated use or use of a product, system or service…"* [13].

Preece indicated that the user experience comprises a set of evidential quality criteria [14] that include three types of criteria; the classic usability criteria such as efficiency, control capacity or learning capacity; the heuristic criteria oriented to stimulation, fun, novelty, emotions [15, 16] and finally the functional criteria based on the aesthetic and visual graphic design of the application [17].

The origin of the methodologies aimed at evaluating the user experience arose in the twentieth century in the field of digital marketing and related to brand perception in digital environments such as the Internet, as an intangible but evaluable aspect, by the user when accessing a specific website or digital application for the purchase of products or services online [18].

Today, patients with a mental illness find that online web environments can limit their capabilities. The use of the internet is considered a very demanding activity from the cognitive point of view that requires not only a good knowledge and understanding of the characteristics of the web, but also the ability to analyse, synthesize, quickly evaluate and apply the information presented, while avoiding the inconsequential details (announcements) and unreliable information, so abundant in digital world [19].

Several cognitive aspects, including attention, perception, memory and executive functioning are often affected in people with a mental illness. These deficiencies may be linked to difficulties in the use of the Web, for example, when searching the Web, changing tasks, retaining and retrieving information, and ignoring distractions to focus attention.

People with mental disorders have received little attention from web accessibility research and user experience. Thus, an exhaustive review of the literature related to the barriers that people with mental illness face when using the web or applications for mobile devices is necessary to ensure that it is inclusive for this type of group. The available knowledge will help professionals to make informed decisions about the removal of barriers that affect people with a mental illness in general, and with bipolar disorder in particular. And if this is not possible, instead facilitation measures can be provided to accommodate this population group.

Emotional aspects play a fundamental role in the user's interaction with an interactive product, because emotional states affect cognitive processes that influence the user's relationship with the application. Psychology provides essential elements to understand and therefore be able to generate empathy. Thought influences the attention, perception and interpretation of any experience.

5 Conceptualization and Design of an Application for Monitoring Affective Status of a Patient with Bipolar Disorder, E-Therapy

Mobile applications in Mental Health offer the possibility of collecting a significant amount of patient information, which should be used, not only to improve and assess their social integration, mood and health, but also to control and even prevent Mental illness in general [20]. Aspects to consider in the design and implementation of applications related to Mental Health focuses on:

– Creating periodic self-reports by the patient.

– Analyse guidelines and states of affective diseases by automatic sampling of patient data.
– Affective diseases recognition through patient behaviour patterns.
– Visualization and graphic interpretation of the data obtained from the patient.
– Communication and therapeutic feedback among patient, doctor and/or therapist.

E-Therapy application developed by the Unit of Psychiatry and Clinical Psychology of the Hospital La Fe and the Polytechnic University of Valencia allows relapse prevention through affective disorders control in patients with bipolar diseases type I and II. At the present a new mobile application of PC version of e-Therapy allows patients to be an active part of early crisis detection. Through a mobile phone application, you will be able to control patient's emotional state and detect early symptoms to promote early intervention. E-therapy allows the management of the following functionalities:

– The self-report.

Information provided by the patient through self-report is essential for the treatment of most mental disorders. Self-report is mainly designed based on the technology available on the mobile device, (speed, interactivity, touch screen, voice recognition, etc. …).

– Automatic sampling of patient data.

Since behaviour is a central factor in mental disorder and the ability to monitoring is crucial. Data on physical behaviour, in terms of activity and mobility, can be sampled through sensors incorporated in the mobile device like accelerometer and location sensors for instance. In addition to automatic physical behaviour sampling, smartphone is also a perfect platform for sampling social behaviour and mood data. Scientifics reviews confirms that there is a strong correlation between social activities and disease status [21].

– Behaviour pattern recognition.

In general, high-level behaviour patterns analysis, activity recognition based on automatic and self-reported data, can be a great value in mental affective disorders treatment.

– Visual and graphic data interpretation obtained from the patient.

There are different approaches to data visualization for control, monitoring and evaluation applications of patients with a Bipolar Disorder based on smartphones. The most basic approach is simply to display the display of raw data, applied in a linear, circular, bar or number chart. This approach is often feasible, since patients are familiar with the visualization of data from paper self-assessment forms.

– Communication and therapeutic feedback.

Since the treatment of mental disorder is based on a combination of pharmacotherapy and psychological treatment, the smartphone can become a therapeutic platform. Adherence to medication is essential in the treatment of mental disorders in general and Bipolar Disorder in particular, since it is often a pre-requisite to stabilize the disease. For this reason, some applications incorporate support for the prescription of medications by the psychiatrist, and to get the patient to adjust to these medical prescriptions. By using an application through a smartphone, the pharmacological treatment can be adjusted in a much

more precise way, because by continuously monitoring the parameters of the disease and compliance with the medication, the doctor can continuously adjust the prescriptions.

Another therapeutic approach that continues to support the use of smartphones and applications in mental illness in general, and in Bipolar Disorder in particular, is to reinforce therapy, basing it on the community and on peer-to-peer support groups. Incorporating a web browser can provide access to many online communities, where patients can share experiences and practical advice.

Direct communication between the patient and his doctor is a fundamental part of the treatment and care of patients with mental illness. Again, the smartphone and its applications become solid tools that allow real-time remote communication through text, images and video. The literature shows that simple SMS used as a reminder for patients with a serious and chronic mental disorder can have a positive impact on treatment [22].

Nowadays e-Therapy is designed to notify patient through messages, once a week, to complete the information requested in the questionnaires. These data are sent to a virtual archive that analyses information automatically and informs the psychotherapist about

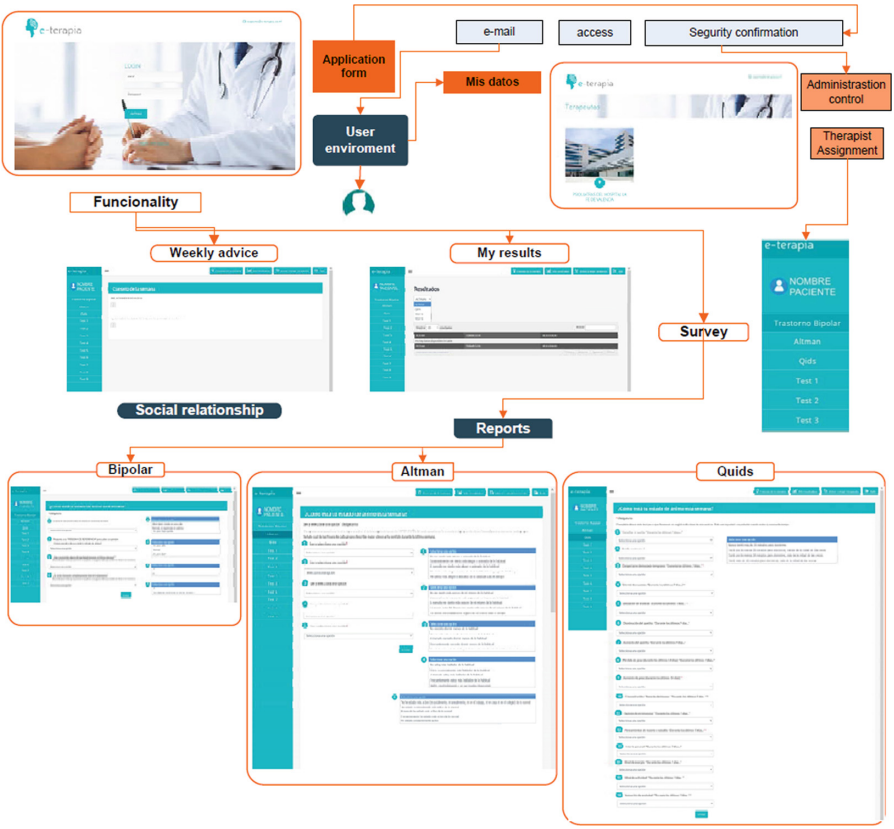

Fig. 1. E-therapy funcionalities (Gallach-Solano 2019)

the risk of relapses of the patient, facilitating that the professional can intervene early, contacting by telephone if he needs it.

Evidences are indicators of aspects such as emotional stability or possible alterations of the patient, and increase the flow of control and communication with the doctor. Currently, it is estimated that about 450 patients with Bipolar Disorders will be able to use the new application (Figs. 1 and 2).

Patients who are using this diseases tool have a number of specific characteristics to be able to be part of this type of therapy:

- Diagnosis of Bipolar I/II Disorder.
- Patient follow-up at the Hospital la Fe.
- Clinical stability and relapse prevention using the application.
- Commitment to psychotherapeutic care and adherence to psychiatric follow-up.
- Owner of a mobile device with Internet access.
- Be familiar with the use of mobile applications.

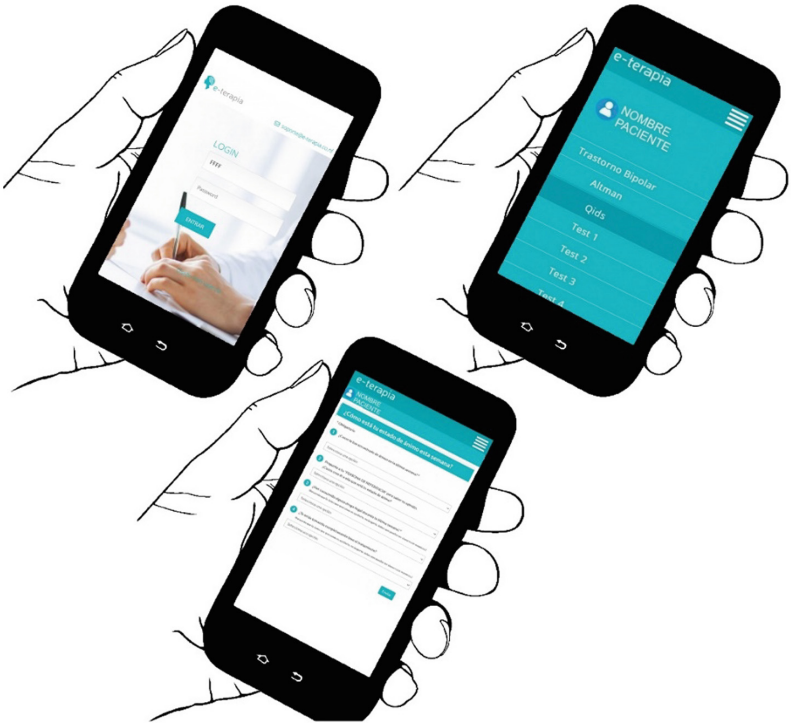

Fig. 2. E-therapy mobile screenshots (Gallach-Solano 2019)

6 Conclusions

MHealth has highlighted the importance of use smartphones becoming an ideal platform to support health care services for patients with a Bipolar Disorder. Information and Communication Technologies, ICT have revolutionized the world in just 20 years. The way of communicating, accessing information and relating to each other has changed, affecting all sectors of today's society, such as economic, educational or health.

Factors such as the emergence of the internet and its increasing use by users, better and faster connectivity between devices and the network, mobile applications for all types of utilities or smart devices more adapted to the daily users' needs are just some of the advances that technology has given us to improve our quality of life in general, and that of people with a serious and chronic mental disorder, in particular.

Health sector has seen an important reef in these advances to adapt them to patient needs in a wide variety of health fields. Mental health applications aimed patient rehabilitation with a serious and chronic mental disorder oriented to affective diseases and relapse prevention control. Patient will be able to maintain cognitive functions (attention, memory, perception, executive functions, etc.), and/or enhance others to replace those affected by the disease. Control, monitoring and assessment tools can manage affective diseases, behavior and mood of the patient detecting relapse symptoms and avoid them. Self-reports are essential tools in psychiatric research, and various graphic instruments of mood are used for self-control in the management and monitoring of depressive and manic symptoms in patients with Bipolar Disorder. Self-assessment, control and mood monitoring tools, combined with user-centered health care systems, have the potential to reach more patients more efficiently, to obtain data on the mood they are in. the patient at all times, and therefore, reduce their suffering, since the patient feels clothed and closer to his doctor due to the immediacy of response in case of relapse.

More than 80% of patients who have tried this application so far, value it very positively, highlighting its usefulness and ease of use. Other advantages that this application represents for the patient, is that it facilitates better monitoring, and easier access to information, and alerts if their therapeutic values are decompensated. In addition, the patient's adherence to pharmacological and psychological treatment is facilitated, thus underlining the commitment to his own recovery.

In addition to the advantages for the user, e-therapy also offers facilities for professional healthcare to control affective diseases patient's follow-up. It can access to the information easily and receive alerts in case that therapeutic evaluation are given outside the range. In this way, the application makes it possible to improve patient monitoring and perform early detections and interventions with the consequent reduction of risks, and significantly improving the patient's quality of life.

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