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Research paper

Longitudinal mood monitoring in bipolar disorder: Course of illness as revealed through a short messaging service

Rebecca F. McKnight[a,*], Amy C. Bilderbeck[a], David J. Miklowitz[a,b], Christopher Hinds[a], Guy M. Goodwin[a], John R. Geddes[a]

[a] Department of Psychiatry, University of Oxford, Warneford Hospital, Oxford OX3 7JX, UK
[b] UCLA Semel Institute for Neuroscience and Human Behavior, Division of Child and Adolescent Psychiatry & David Geffen School of Medicine at UCLA, Los Angeles, USA

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ABSTRACT

Background: Online self-monitoring of mood can be used to investigate differences in course patterns across patient groups. This study explored the feasibility of remote symptom capture with True Colours, a self-rated online mood monitoring tool completed on a weekly basis.

Methods: Participants with bipolar disorder (N = 297) completed weekly depression and mania questionnaires over an average of 27.5 months (range 1 –81 months). Subgroups defined by sex, age, and bipolar I vs. II status were compared on time in various mood states, number of episodes, and week-to-week mood variability.

Results: Compliance with weekly questionnaires was generally high (median, 92% of weeks). Mood symptoms occurred for an average of 55.4% of weeks across the follow-up period. Females spent more time with hypomanic/manic and depressive symptoms and had more depressive episodes compared to males. Younger participants were found to experience more hypomanic/manic episodes and showed greater variability in mood symptoms than older participants. No significant differences in mood symptoms or variability were observed between bipolar I and II patients.

Limitations: This was a naturalistic study with a heterogeneous cohort, and did not include a control group. True Colours does not identify mood fluctuations that may occur in the days between weekly assessments.

Conclusions: Monitoring moods through an online tool is both feasible and informative regarding course of illness in patients with bipolar disorder. Interventions aiming to reduce mood variability and manic/hypomanic episodes in the early phases of bipolar disorder may enhance the long-term symptomatic course of the illness.

1. Background

Most modern treatment guidelines are oriented toward an episodic model of bipolar disorder (BD) in which the focus is on the treatment and prevention of acute episodes. The course of bipolar disorder, however, is highly heterogeneous. Although distinct episodes are clearly present in the majority of patients, many have significant inter-episode mood instability rather than euthymia (Henry et al., 2008; MacQueen et al., 2003). Mood instability – usually described as rapid and frequent movement away from the euthymic state – appears to lower the threshold for relapse into more severe mood episodes and has a chronic negative impact upon quality of life and functional ability (Bauer et al., 2009; Judd et al., 2000; Perlis et al., 2006). Mood instability is both a key feature of both bipolar 1 and bipolar 2 disorder (Judd and Akiskal, 2003; Judd et al., 2003, 2002) and a risk factor for developing BD (Howes et al., 2011).

Standard clinical assessments – such as the Life Chart methodology – are retrospective, with the inherent problem of recall bias (Denicoff et al., 1997). Further, course of illness data have usually been measured in small samples followed over short time periods (Denicoff et al., 2000). There is some evidence that paper-based daily mood monitoring can provide detailed mood variability data, but is practical only over short periods (Proudfoot et al., 2014). A reliable method of daily or weekly mood recording using remote monitoring may facilitate recognition of prodromal symptoms of new episodes. The increasing accessibility of portable and wearable technologies enables the tracking of both subjective and objective data related to mood and functioning (Faurholt-Jepsen et al., 2015a, 2015b). Such approaches have been found to be both acceptable and feasible in patients with serious mental illness (Naslund et al., 2015).

To date, only a few studies have described the use of such technology in BD, or reported mood data gathered by this method. Scharer

Abbreviations: BD, Bipolar Disorder; IQR, Interquartile Range; QIDS, Quick Inventory of Depression Symptomatology; ASRM, Altman Self-Rating Mania Scale

* Corresponding author.
E-mail address: rebecca.mcknight@psych.ox.ac.uk (R.F. McKnight).

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et al. (2002) reported a feasibility study in which they adapted the National Institute of Mental Health Prospective Life-Chart Form for use on a handheld computer (Scharer et al., 2002). Patients found this a preferable method to written forms and found it beneficial to be playing an active role in their treatment. Similarly, Bauer et al. used a home computer based mood monitoring system in BD and reported a very low rate of missing data (Bauer et al., 2004). The only study to date to compare a clinician-rated mood scale to a self-reported computer scale in BD found high correlations between the two methods (Chinman et al., 2004). There are also numerous publically available smartphone/tablet applications for personal mood monitoring available. A systematic review of in 2015 suggested that whilst these are a potentially therapeutic tool, those available at present are not written along evidence-based lines and primarily do not use validated mood rating approaches (Nicholas et al., 2015).

Our group has demonstrated the feasibility of using a remote monitoring system ("True Colours") for the prospective collection of self-reported symptom ratings in bipolar disorder using text messaging, email, and internet-based technologies (Bopp et al., 2010; Miklowitz et al., 2012). Supporting the validity of this form of data collection, patient reported outcomes collected via True Colours have provided the basis for linking mood instability to biases in cognition in bipolar disorder. Longitudinal collection of self-report data via True Colours also formed the basis of evaluating a psychoeducational intervention for bipolar disorder (Bilderbeck et al., 2016). Thus, our motivation for developing this system has been manifold, including the potential for large volumes of curated data to provide insights into patterns of illness. In addition, access to one's own mood reports can help patients to understand and manage their illness more effectively, potentially improving clinical outcomes and reducing the need for high intensity professional input.

Here, we aimed to describe the range of mood phenotypes experienced by a new larger cohort of bipolar patients. More specifically, we aimed to examine the acceptability of the True Colours system, understand and quantify the course of mood symptoms experienced in BD, and examine course patterns using a mood variability score.

2. Methods

2.1. The OXTEXT-1 cohort

OXTEXT-1 is a cohort study of participants (≥16 years of age) with a DSM-IV diagnosis of bipolar disorder type I, 2 or not-otherwise-specified (NOS) (APA, 2000). The diagnosis of cyclothymia was excluded. To qualify for inclusion, patients must also be in treatment with a psychiatrist and be willing to use SMS/internet to monitor their mood. Patients are recruited from Oxfordshire and surrounding counties through outpatient psychiatric clinics, inpatient wards, advertising in other local health services and general practitioners. All participants attend a 3 h screening and assessment session, during which they complete a clinical interview which is conducted by a member of the research team and audio-recorded for later confirmation of diagnosis by a research psychiatrist. All patients are provided with training for and are registered to use the True Colours remote monitoring system (see below). Whilst enrolled in the cohort individuals continue treatment as usual, consisting of contact with an outpatient psychiatrist, medications, psychological treatments and admission to hospital if necessary. OXTEXT-1 is not a treatment intervention: for information and risk monitoring purposes, treating psychiatrists receive the weekly data submitted by their patients and it is available to patients online.

Patients can be in any mood state at enrolment but must have capacity to give consent: those who are too unwell initially are contacted again once their mood stabilises. Written informed consent is obtained from all patients before registration in the cohort; ethical approval was granted by Oxfordshire REC 'A' (REC reference no. 10/H0604/13). Recruitment into the cohort began in 2010 and is ongoing. Here, data were extracted and analysed from all participants (N = 367) recruited between 8th July 2010 and 7th August 2013.

2.2. True Colours prospective mood monitoring

The True Colours symptom monitoring system uses SMS texting and email to provide an inexpensive and practical means of submitting and reviewing self-reported symptom data for patients and clinicians. Participants are requested by a weekly SMS/email (at a time and day specified by the patient) to reply with responses to a depression scale (Quick Inventory of Depressive Symptomatology, a 16-item self-report version [QIDS-SR]) (Rush et al., 2003) and a mania scale (Altman Self-Rating Mania Scale [ASRM]) (Altman et al., 1997). Patients are given convenient mini versions of the scales and merely need to respond with a series of digits representing their question answers. One prompt is sent if a response is not received within 24 h. True colours is an ongoing system with no set participation time. The True Colours system has been described in more detail elsewhere (Bopp et al., 2010).

2.3. Statistical analysis

A macro within Microsoft Excel (Microsoft, 2010) was used to estimate the proportion of missing data and proportion of full days a patient had spent in each mood state. Missing data were defined as any 7-day period during which no data were received. Mood states were defined as per the validated questionnaire cut-offs: a mood episode was defined as being ASRM > 5 for > 1 consecutive week (Altman et al., 1997) (mania) and/or QIDS > 10 (Rush et al., 2003) for > 2 consecutive weeks (depression). Concurrent scores of ASRM > 5 and QIDS > 10 were seen as indicative of a mixed state.

Mood instability was calculated as a root mean square successive difference score (rmssd): the square-root of the number of mood changes per week, where one change is a one integer change in QIDS/ASRM score (Gershon, 2015; Gershon, 2015; Jahng et al., 2008a, 2008b). The square root function was used to allow a wide spread of variation values to be easily compared. For example, if the QIDS score was 4, 5, 7 on weeks 1, 2, 3, there would be 1 change between weeks 1 and 2, and 2 changes between weeks 2 and 3. Squaring and summing these change gives a total of 5 over 3 weeks or 2.5 changes per transition-point. Variability would thus be calculated as $\sqrt{2.5} = 1.58$ (Jahng et al., 2008a, 2008b). Evidence is starting to emerge of the relevance of rmssd scores to the treating clinician (Stange et al., 2016).

Most of the variables were positively skewed (i.e., more patients reported lower scores on the QIDS and ASRM than higher scores). Non-parametric analyses (i.e., Kruskal-Wallis one-way analysis of variance for age and diagnosis, and the Wilcoxon Rank Sum test for gender) were used to compare between groups (gender, age, diagnosis) using a significant alpha < 0.05. Independent variables included age (< 20 years, 21–40, 41–60, > 60 years), gender and diagnosis (bipolar 1,2,NOS); dependent variables were time spent in mood state, mood episodes per year and mood variability score. Cohen's D was used to calculate effect sizes. SPSS.v.20 (2011) was used for all calculations.

3. Results

3.1. Characteristics of the OXTEXT-1 cohort

Thirty-nine participants had withdrawn from OXTEXT-1 since enrolment, and six were lost to follow-up, leaving 297 active participants (91.7%). 66.9% of the cohort were female with a mean age of 41 years [SD ± 13, range 16–76] (Fig. 1). The baseline characteristics of the participants are shown in Table 1. Of these 297 participants, current medication data was only available for 265 (89%) due to procedural changes during the course of the trial.