Emerging Technology From the arXiv
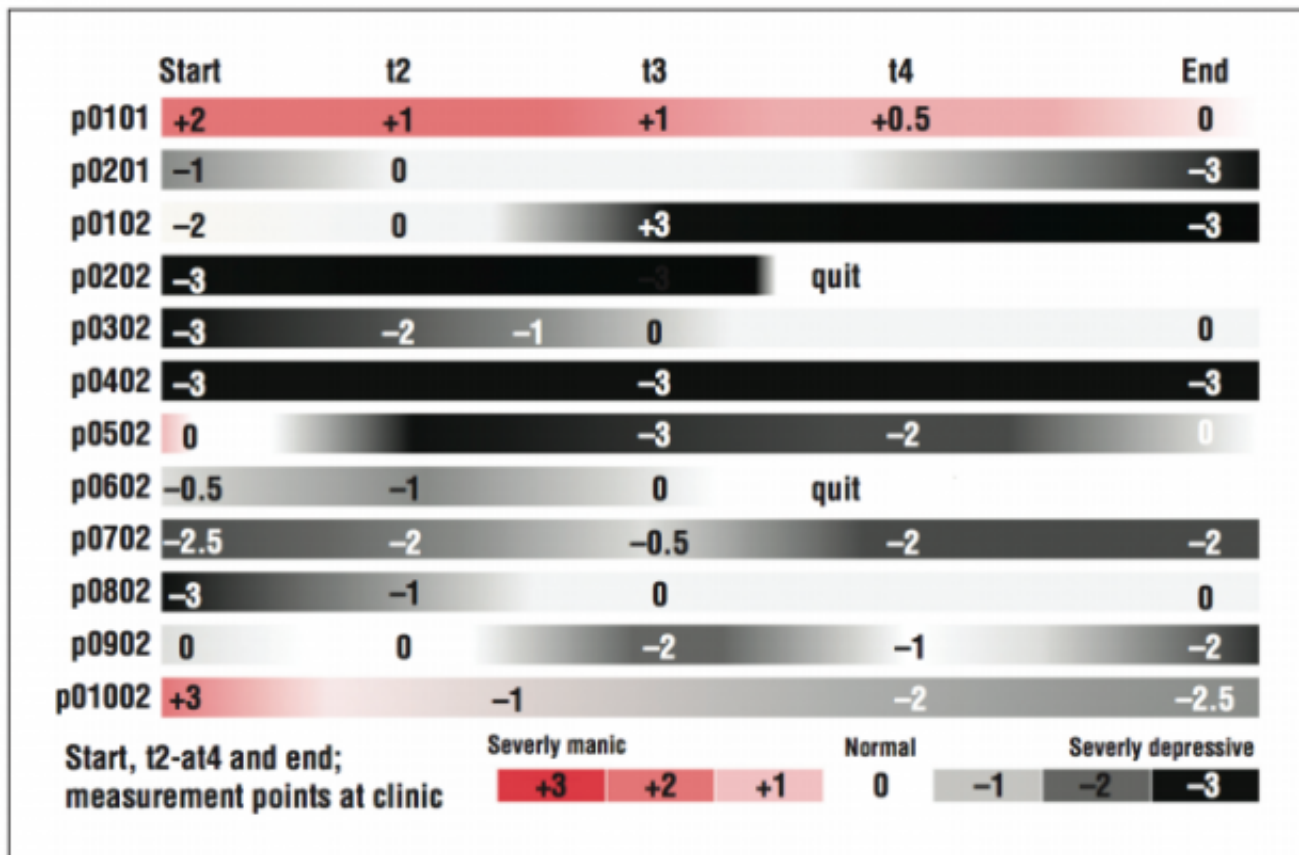**October 12, 2015**

How Your Smartphone Can Detect Bipolar Disorder

The sensors in smartphones can accurately detect the changes in mood that are indicative of bipolar disorder, according to a new study. That could lead to faster treatment and better outcomes for sufferers.

	Start	t2	t3	t4	End
p0101	+2	+1	+1	+0.5	0
p0201	−1	0			−3
p0102	−2	0	+3		−3
p0202	−3		quit		
p0302	−3	−2	−1	0	0
p0402	−3		−3		−3
p0502	0		−3	−2	0
p0602	−0.5	−1	0	quit	
p0702	−2.5	−2	−0.5	−2	−2
p0802	−3	−1	0		0
p0902	0	0	−2	−1	−2
p01002	+3	−1		−2	−2.5

Start, t2-at4 and end;
measurement points at clinic

Severly manic			Normal			Severly depressive	
+3	+2	+1	0	−1	−2	−3	

Bipolar disorder is a condition characterized by mood swings that vary from extreme elation to severe depression. At one end of this spectrum, patients experience extreme highs and hyperactivity, while at the other they feel devastatingly low and lethargic. These moods can change quickly, last for weeks or months, and be separated by long periods of time, sometimes years.

Spotting these mood changes in time to initiate treatment is a difficult business. There are no reliable biomarkers for this condition, so patients are usually given psychological tests designed to measure state of mind. Inevitably, accurate diagnosis often lags the actual changes in mood by some time.

So an accurate way of diagnosing mood changes as they happen would be hugely useful for sufferers and health-care providers alike.

Today, a significant step toward that goal has been achieved by Venet Osmani at the Center for Research and Telecommunication Experimentation for Networked Communities (CREATE-NET) in Trento, Italy. Osmani says the behavior patterns associated with bipolar disorder can be accurately detected by smartphone sensors which allow changes in mood to be spotted as they occur.

People with bipolar disorder often demonstrate well-known behavior patterns that are a signature of their condition. For example, the manic phase is often characterized by hyperactivity, which can be measured by an accelerometer and with a GPS device, by rapid speech, which can be monitored by speech analysis and by frequent conversations, which can be monitored through phone records.

By contrast, patients in the depressive stage of this condition demonstrate much changed levels of all these behaviors.

So a smartphone is an ideal device to track these indicators. Osmani gave smartphones to 12 patients with bipolar disorder and monitored their activity over a period of 12 weeks in 2012 and 2013. During this time, at three-week intervals each patient visited the clinic, where his or her mental state was determined by conventional methods. This gave a ground-truth reading against which the smartphone data could be compared.

Osmani was interested in two outcomes. The first was the ability to detect changes in mood and the second was the precision with which this can be done — how often the data gave false alarms.

The results are hugely promising. Activity and location data together gave a good indication of the patient mood but more impressively, accurately predicted a change in this mood 94 percent of the time. And combining this with an analysis of patient phone calls increased the predictive success to over 97 percent. "Almost all changes were detected with almost no false alarms," says Osmani.

That's an impressive result that has significant implications for people with this condition. "One of the important aspects of this work is the possibility of the early detection of changes in a patient's state with high precision and recall, facilitating timely intervention and thus leading to better treatment outcomes," says Osmani.

Of course, there are limitations to this work. For example, it covers only 12 patients over 12 weeks. So a longer study involving a larger number of patients would surely provide better insight. What's more, sensor technology is rapidly evolving and could provide much higher resolution data in these kinds of studies.

Osmani says more work is planned and that a follow up study is planned. That should lead to better outcomes for a condition that regularly mystifies patients and healthcare providers alike.

Ref: arxiv.org/abs/1510.01665 : Smartphones in Mental Health: Detecting Depressive and Manic Episodes

Tagged: Mobile

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