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Reprint of Using ecological momentary assessments to predict relapse after adult substance use treatment☆

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HIGHLIGHTS

- 81% of ecological momentary assessments (EMA) were completed.
- Substance use was reported on average in 2.7% of the EMAs.
- EMA responses were classified into six categories and used to predict future use.
- Predictors of use included substance use patterns, negative affect, and craving.
- This could be used to help monitor, provide feedback, and guide relapse prevention.

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ABSTRACT

Background: A key component of relapse prevention is to self-monitor the internal (feelings or cravings) and external (people, places, activities) factors associated with relapse. Smartphones can deliver ecological momentary assessments (EMA) to help individuals self-monitor. The purpose of this exploratory study was to develop a model for predicting an individual's risk of future substance use after each EMA and validate it using a multi-level model controlling for repeated measures on persons.

Methods: Data are from 21,897 observations from 43 adults following their initial episode of substance use treatment in Chicago from 2015 to 2016. Participants were provided smartphones for six months and asked to complete two to three minute EMAs at five random times per day (81% completion). In any given EMA, 2.7% reported substance use and 8% reported any use in the next five completed EMA. Chi-square Automatic Interaction Detector (CHAID) was used to classify EMAs into six levels of risk and then validated with a hierarchical linear model (HLM).

Results: The major predictors of substance use in the next five completed EMAs were substance use pattern over the current and prior five EMAs (no recent/current use, either recent or current use [but not both], continued use [both recent and current]), negative affect (feelings), and craving (rating). Negative affect was important for EMAs with no current or recent use reported; craving was important for EMAs with either recent or current use; and neither mattered for EMAs with continued use. The CHAID gradated EMA risk from 0.7% to 36.6% of the next five completed EMAs with substance use reported. It also gradated risk of "any" use in the next five completed EMAs from 3% to 82%.

Conclusions: This study demonstrated the potential of using smartphone-based EMAs to monitor and provide feedback for relapse prevention in future studies.

1. Introduction

The American Psychiatric Association (APA;, 2013) and World Health Organization (WHO;, 2016) define substance use disorders (SUD) as a chronic, tenacious pattern of use and related problems. < 11% of individuals in need of SUD treatment seek treatment and of these, 40% to 60% relapse within the next year (SAMHSA, 2008). Moreover, research shows that: a) prolonged substance use alters the

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brain (Koob & Volkow, 2016; Volkow et al., 1992, 1993; Yanes et al., 2018), b) recovery for many individuals is marked by cycles of abstinence, relapse, and repeated treatments, often spanning many years before resulting in stable recovery, permanent disability, or death and, for many, it can take years and even decades to recover from substance use disorders (Dennis & Scott, 2007, 2012; Scott & Dennis, 2009, 2011).

As the country strives to reduce healthcare costs, the development of practical and effective strategies for managing this condition is vital. General public health models have managed other chronic conditions through ongoing monitoring and early re-intervention techniques shown to alleviate symptoms and restore functioning (Scott & Dennis, 2011). The monitoring aspect of these models typically focuses on factors known to exacerbate the condition. Similarly, relapse prevention theory posits that the interaction between individual factors (e.g., feelings, craving, motivation) and external or environmental factors (e.g., exposure to drugs, locations associated with using, activities) can increase the risk of relapse (Witkiewitz & Kirouadc, 2015).

Research indicates that the pattern of recent substance use (e.g., abstinence, lapse, relapse) is one of the strongest predictors of subsequent substance use in the near future (Witkiewitz & Kirouadc, 2015; Witkiewitz & Marlatt, 2005). Two other factors, craving (Serre, Fatseas, Swendsen, & Auriacombe, 2015) and negative affect (Epstein et al., 2009; Heckman et al., 2015; Moore et al., 2014), have also been shown to predict subsequent use of tobacco, alcohol, and other drugs. However, the exact nature of the relationship among these three variables needs further attention as earlier research suggests that there may be interactions between the pattern of use and both general indices of use (Chih et al., 2014) and specific factors such as craving (Serre et al., 2015).

Like other chronic conditions, recovery from substance use can likely be enhanced by a person's ability to self-monitor the interplay of internal (e.g., feelings or craving) and external factors (e.g., people, places, activities) shown to influence recovery trajectories (Barlow, Wright, Sheasby, Turner, & Hainsworth, 2002; Raynor & Pope, 2016). However, while monitoring may be a necessary component of self-management, it is only the first step. For other chronic conditions such as diabetes, for which symptoms and conditions that worsen the condition are known to the physician and the person (e.g., too much sugar), the connection between internal and external factors and relapse is often missed for individuals with SUD. For example, results from an earlier pilot, revealed that individuals varied in their ability to recognize in real-time the interaction between internal and external risk factors and how they related to their risk of future use. In some instances, individuals indicated that no internal or external factors impacted their desire to use—yet they reported using. Others were better at making the connections and then accessing interventions.

Accounting for variation in risk factors within individuals over time to maximize positive outcomes is key to precision medicine (Acion et al., 2017). The expanded availability and power of mobile phones and Ecological Momentary Assessments (EMA) have created the opportunity to prompt people to reliably self-monitor in a wide array of daily situations, to document in real time the impact of these factors on their relapse risk and recovery, and to provide people with real-time feedback on their risk of future substance use (Heron, Everhart, McHale, & Smyth, 2017; Wen, Schneider, Stone, & Spruijt-Metz, 2017). While this does not eliminate the person's need to eventually make these connections on their own, it does provide another teaching tool during the learning process while decreasing the likelihood of future use. Failure to engage individuals in the active self-management of their condition during their daily routines in their natural environments undermines the potential for improved sustained functioning (Jenkins, McAlaney, & McCambridge, 2009).

The purpose of this exploratory study was to develop a model for "predicting" an individual's risk of future substance use at the time of each EMA and validate the model using a multi-level model controlling for repeated measures on persons. These analyses provide a unique perspective as they consider how multiple factors interact in real time to "predict" risk of future substance use. Results from this study may help forge the gap that has long vexed recovery efforts by providing the real-time connection between internal and external factors that put a person at risk of future use and immediate access to interventions that reduce that risk.

2. Material and methods

2.1. Design

This paper uses preliminary data from the Smartphone Recovery Support Services (SRSS) experiment that is summarized below and discussed at length elsewhere (Scott, Dennis, & Gustafson, 2017). Participants were recruited following their initial episode of substance use treatment at two agencies that provided outpatient (including methadone) or residential treatment. All participants completed a research interview and urine screen after their initial episode of treatment and at three and six months post-enrollment, as well as additional urine screens at two office visits during the first month (over 97% completed each wave). Participants were randomized to one of four conditions: (1) EMA only that included five EMAs delivered at random times throughout the day, (2) Ecological Momentary Intervention (EMI) only that provided continuous access to a study-specific version of the Addiction Comprehensive Health Enhancement Support System (A-CHESS; Gustafson et al., 2014), (3) both EMA and EMI, or (4) a control group. The first three groups also received a smartphone and a 10GB/month data plan. This paper uses the subset of 43 participants in the EMA-only condition who completed their six-month interview between July 2015 and February 2017.

2.2. Participants

Individuals were eligible if they: (1) were 18 years old or older, (2) met at least one past year symptom of SUD based on the GAIN-Q3 (described further below) and admission to SUD treatment, (3) lived in Chicago, (4) could communicate in English, and (5) were cognitively able to provide informed consent. Individuals were ineligible if they: (1) lived outside Chicago or planned to live outside of Chicago during the next six months, (2) expected to be in jail, prison, or another setting that would prevent the use of smartphones, (3) were unable to use a smartphone because of a disability or health condition, (4) were unwilling to learn to use a smartphone or to complete a survey using a smartphone, (5) were admitted to a treatment program that provides intensive services post discharge, (6) had a recovery coach and had been in contact with the recovery coach in the last 30 days, (7) failed the Short Blessed cognitive impairment test (Katzman et al., 1983), or (8) had ever been diagnosed with, or told by a physician that they have, schizophrenia and/or are bi-polar. Of the 323 who completed the screening process through2016, 301 (93%) agreed to participate and were randomized. Over the six-month period, participants could earn a total of $160: $40 first interview/training, $25 for each of the two office visits in the first month, and $35 for each of the interviews at three and six months post-enrollment. There was no monetary compensation provided to participants for completing the EMAs. The study was conducted under the supervision of the authors' Institutional Review Boards and a data safety monitor.

At baseline, 63% of participants were male with an average age of 43.6 years (SD = 11.8). They were 72% African American, 19% Caucasian, 2% Hispanic, and 7% mixed/other races. Most (56%) had a high school diploma or equivalent and 23% had been employed 1 or more of the past 90 days. Based on standardized intake interviews (discussed further below), most had a history of being physically, sexually, or emotionally victimized (84%), homeless (77%), and/or involved in the justice system (74%). At the time of enrollment (an average of 2 weeks post discharge from SUD treatment), 44% were