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# A pilot study of a smartphone application supporting recovery from drug addiction

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ABSTRACT

*Background:* Mobile health (mHealth) technologies have the potential to facilitate self-monitoring and self-management for individuals with substance use disorders (SUD). S-Health is a bilingual smartphone application based on cognitive behavioral principles and is designed to support recovery from drug addiction by trigger recognition so as to allow practice in-the-moment coping to prevent relapse.

*Method:* For this pilot randomized controlled study, 75 participants were recruited from methadone maintenance treatment clinics and the social worker consortium in Shanghai, China. Participants in the control group ($N = 25$) received text messages from S-Health (e.g., HIV prevention and other educational materials). Participants in the intervention group ($N = 50$) received both text messages and daily surveys on cravings, affects, triggers, responses to triggers, and social contexts.

*Results:* At the end of the 1-month study trial, 26.2% of the intervention group and 50% of the control group had positive urine test results ($p = 0.06$). Also, the number of days using drug in the past week was significantly lower among participants in the intervention group (Mean = 0.71, SD = 1.87) relative to the control group (Mean = 2.20, SD = 3.06) ($p < 0.05$). The two groups did not differ in slopes (i.e., rates of change in outcomes measured weekly) based on the mixed effects model. Participants in the intervention group also preferred answering questions on the cellphone (46.8%) relative to in-person interviews (36.2%).

*Conclusions:* This pilot demonstrated the feasibility and potential benefits to deliver mobile health intervention among participants with SUD. Further research with larger samples over a longer period of time is needed to test the effectiveness of S-Health as a self-monitoring tool supporting recovery from addiction.



## 1. Introduction

Substance use disorders (SUD) can be chronic conditions, with high potential for relapse (McLellan, 2002). According to the Chronic Care Model (CCM), patients themselves are the principal caregiver, and in addition to professional help, their own monitoring and management of chronic conditions is also crucial to improve outcomes and reduce costs (Bodenheimer, Lorig, Holman, & Grumbach, 2002; Bodenheimer, Wagner, & Grumbach, 2002a, 2002b; Wagner et al., 2001). Nevertheless, self-monitoring and self-management can be challenging if patients are not supported by appropriate skills, tools, and assessments. This is particularly problematic in countries or areas with limited access to supportive services. The mHealth offers an option that may be promising.

### 1.1. Treatment options for SUD in Asian countries

Asian countries have the largest overall populations with opioid dependence and amphetamine dependence (Degenhardt et al., 2013). In China and many other Asian countries, heroin has been the primary drug of addiction (Hser, Liang, Lan, Vicknasingam, & Chakrabarti, 2016). More recently, an increasing number of people are using amphetamine-type stimulants (ATS), ketamine, and buprenorphine (Ho, Chen, Broekman, & Mak, 2009; Ho & Zhang, 2016). In Western developed countries, a variety of pharmacologic and behavioral treatments are delivered in many different settings for patients with SUD. However, Asian countries traditionally take punitive measures toward individuals using illicit drugs (e.g., incarcerating individuals using illicit drugs) (Sullivan & Wu, 2007). The HIV epidemics have pushed these countries to gradually embrace harm reduction approaches, as people who inject drugs (PWID) are at high risk for HIV and usually lack resources for testing and treating SUD and HIV (Hser et al., 2016; Nguyen et al., 2017).

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In the case of China, the methadone maintenance treatment (MMT) program, which was initially one of the most important components of China's harm reduction strategies, has now become one voluntary treatment option for individuals using illicit drugs, in addition to other voluntary detoxification and rehabilitation services in healthcare facilities (Sullivan & Wu, 2007; Wu, Wang, Detels, & Bulterys, 2015). Individuals may also be enrolled into community-based treatment and rehabilitation programs, or be admitted into compulsory detoxification and rehabilitation facilities, depending on the severity of drug use behaviors. Those who are released from compulsory programs need also to participate in community-based rehabilitation programs afterwards. In most settings mentioned above, though pharmacological treatments are usually available, psycho-therapeutic services are very scant (Tang, Zhao, Zhao, & Cubells, 2006; Zhang et al., 2013). According to China's Mental Health Law, psycho-therapeutic services can only be provided in healthcare facilities, such as a specialty mental health hospital or the mental health department in a general hospital (Chen et al., 2012). However, healthcare facilities in two-thirds of counties in China do not have any mental health providers, and counseling services outside healthcare facilities are often very expensive and only available in metropolitan areas. The barriers to professional psycho-therapeutic services are not likely to be resolved in the short term (Gao et al., 2010).

In summary, patients in Asian countries in general have limited access to professional SUD treatment services. The limited availability of professional SUD services in these countries further highlights the importance of patients' self-management.

### *1.2. Smartphone as a tool for self-management support in relapse prevention*

As smartphone users increase rapidly over the world, smartphones, which are important vehicles for mobile health (mHealth) technologies, have the potential to provide self-management support at low-cost to populations having barriers to professional psycho-therapeutic services (Gibbons et al., 2011). In 2016, 58% of the total adult population and 85% of those aged 18–34 owned a smartphone in China (Poushter, 2016). Smartphones' short messaging service (SMS) and more complex applications are often the core elements of mHealth programs. For a variety of chronic physical and mental conditions including SUD, mHealth has been found to be effective in supporting self-management in North America (Davis, DiClemente, & Prietula, 2016; Gustafson et al., 2014; Monney, Penzenstadler, Dupraz, Etter, & Khazaal, 2015; Weaver, Horyniak, Jenkinson, Dietze, & Lim, 2013). In Asia, mHealth has also been designed and used to offer psychoeducation and early intervention for substance use, especially alcohol use (Zhang et al., 2014; Zhang & Ho, 2015; Zhang, Fang, & Ho, 2016a; Zhang et al., 2016b; Zhang et al., 2017a; Zhang et al., 2017b).

### *1.3. The present study*

Few studies have examined the efficacy or effectiveness of smartphone applications in the field of illicit drug use (Linas et al., 2015; Monney et al., 2015). To our knowledge none has been reported from Asian countries (Brian & Ben-Zeev, 2014; Li et al., 2014).

We developed a smartphone application, S-Health, to support the self-management of addictive symptoms and recovery for SUD patients with limited access to mental health services (see Fig. 1). S-Health prompts daily surveys and self-initiated surveys to support self-management in real time and natural environments. Surveys in S-Health are designed to help patients better identify triggers (e.g., emotions, places, people), recognize strategies for dealing with those situations, and monitor substance use and deal with cravings, based on the cognitive-behavioral model of many evidence-based relapse prevention therapies (see Appendix A) (Larimer, Palmer, & Marlatt, 1999; Marlatt & Donovan, 2005; Marlatt & George, 1984). Development of S-Health was reported previously (Schulte et al., 2016). This present article reports finding based on a pilot trial which tests the feasibilities and outcomes of S-Health among individuals using illicit drugs in China.

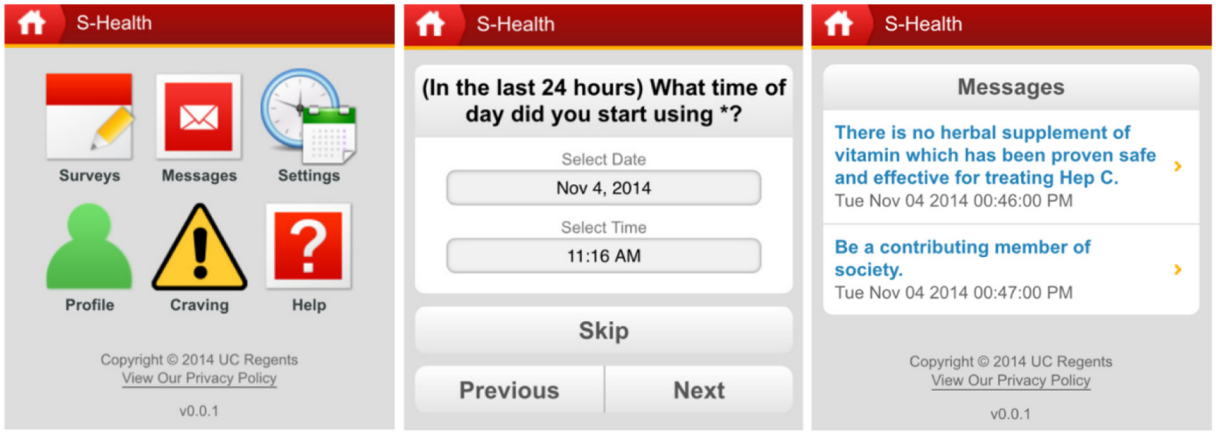
## 2. Methods

### *2.1. Study setting*

We recruited participants from the MMT clinics and the network of social workers in Shanghai, China. As the largest and most developed city in China, Shanghai has approximately 24 million residents and >80,000 registered individuals using illicit drugs. Among the 16 districts in Shanghai, 14 districts have a MMT clinic. There is also a social worker consortium (Shanghai Zi-Qiang consortium) with >1000 social workers who specialize in helping individuals using illicit drugs in the community. Our participants were recruited from the MMT clinics in three districts (Yangpu, Xuhui, Hongkou) and the Shanghai Zi-Qiang consortium.

### *2.2. Study participants*

Eligible participants for this study were adult individuals who had used heroin or other substances in the past 30 days, and had a smartphone. Participants were excluded if he or she had (1) dependence on an illicit substance for which medical detoxification was imminently needed, or (2) presence of clinically significant psychiatric




a. Welcome page

b. A sample question in the daily survey

c. A sample question in the daily survey

**Fig. 1.** Screenshots of S-Health.