Design and Evaluation of a Mobile Application for Relapse Prevention to Methamphetamine Use Disorder

Reza Rabiei 1, *, Hamid Moghaddasi 1 and Mina Heidari 1

1Department of Health Information Technology and Management, School of Allied Medical Sciences, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran

*Corresponding author: Department of Health Information Technology and Management, School of Allied Medical Sciences, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran. Tel: +98-2122747373, Email: r.rabiei@sbmu.ac.ir

Received 2019 December 20; Revised 2020 February 10; Accepted 2020 February 18.

Abstract

Background: As a cheap and affordable tool, smartphones technology has provided an opportunity for effective treatment of addiction and relapse prevention.

Objectives: This study aimed to design and evaluate a mobile application for relapse prevention to methamphetamine use disorder.

Patients and Methods: This study was conducted in two stages in 2018. Initially, the features of Marlatt’s cognitive-behavioral model were studied. The conceptual model of the application was then developed according to identifying the users’ needs and features of the Marlatt’s model and based on object-oriented analysis. The coding was performed using Java Script, CSS, and HTML.

After developing the application and its installation in an addiction recovery center, the application was quantitatively evaluated with the participation of five experts in psychology and addiction studies and five patients.

Results: The main requirements of the software were identified in the form of a daily plan for recovery (learning and training materials, relaxation), motivation (motivational messages and encouragement for continuous use of the software), and evaluation of the recovery process. The results of the evaluation showed that 89% of the participants were satisfied with the software usability.

Conclusions: The prevention of relapse to substance use disorders, such as methamphetamine, requires motivation and education. Design and deployment of mobile-based application could be a cost-effective approach for recovery of a variety of addictive behaviors and the follow up of recovery.

Keywords: Methamphetamine, Substance Use Disorders, Relapse Prevention, Mobile Application, Software Design, Validation Study

1. Background

Addiction is a reversible disorder that could cause social problems and is characterized by an array of physical, social, and psychological impacts (1, 2). Over 256 million people aged 15 - 64 across the word suffer from substance use disorder (3). According to the United Nations Office on Drugs and Crime (UNODC) in 2019, more than 35 million people across the world have substance use disorders, of which only one-seventh receive treatment (4).

In recent years, with increasing the drug production around the world, a variety of substances have been produced most notably cannabis, marijuana, and caffeine from the soft drugs category, as well as heroin, cocaine, and methamphetamine from the hard drugs category. In recent years, methamphetamine has been widely used as an addictive substance and it was used only in the US by 1600000 people in 2017 (5, 6). Although reviewing the relevant studies resulted in finding no accurate and exact statistics about methamphetamine use and users in Iran (7, 8), methamphetamine has become one of the most commonly used industrial addictive substances in Iran and the number of users has increased over the last years (8-10).

Methamphetamine is a potent nerve stimulant and is mainly a laboratory-manufactured product and large amounts of this substance can be domestically produced (11). In combination with ketamine, methamphetamine is produced in the form of a tablet known as ecstasy. Methamphetamine has neurotoxic effects and long term use of this substance is associated with harmful effects on neurotransmitters. In addition, methamphetamine dependence is associated with neuropsychiatric disorder (12).

Different approaches have been proposed for the treatment of substance use disorders, in particular for methamphetamine use (13,14). These treatments, depending on the type of addictive substance, include psychological inter-
ventions and medication therapies. However, studies reported that medication therapies could fail without considering psychological and social interventions (15).

The psychological therapies mainly aim to change the behavior related to the substance use disorder (16). Examples of psychological therapies include motivational enhancement therapy (MET) (17), cognitive-behavioral therapies (18), and relapse prevention therapy (18, 19).

In psychological therapy, studies referred to Marlatt’s cognitive-behavioral model of relapse composed of a number of determinants (20-22). These determinants are regarded as an indicator for indicating the likelihood of relapse to substance use (18). The determinants are divided into intrapersonal and interpersonal categories. The first category includes determinants, such as a sense of self-efficacy, outcome expectancies, craving, motivation, coping with stress and temptation, and emotional states (23). The second category emphasizes social support and environmental stimuli (24).

The high cost of treatment and the lack of cost coverage by insurances are among the issues that hinder patients’ participation in recovery plans (25, 26). However, changes to existing therapeutic systems and applying the combination of technology-based therapeutic approaches with conventional ones could be effective (27). Over the last years, there has been an increase in popularity of smartphone use due to their low cost and ease of use that have increased the use of these devices in healthcare (28). According to the studies, individuals with substance use disorder who use technology-based therapeutic approaches, such as smartphone applications are more likely to manage their recovery successfully (25, 26, 29). For this reason, several studies have been conducted in recent years that aimed at designing mobile applications for relapse prevention to substance and alcohol use disorders. Research indicates the potential of smartphone applications in providing educational information about methamphetamine use disorder (30). In a study by Birrell et al. (31), a mobile application was developed for providing evidence-based information about methamphetamine to the public. According to the results of this study, the majority of participants remarked that the application was likely to improve their awareness and understanding of methamphetamine use disorder (31).

In their study, Zhu et al. (32), developed a mobile application based on cognitive approach for improving cognitive impairment and decision-making risk in patients with methamphetamine use disorder. The findings showed that the application could help to improve cognitive impairment and impulsive control (32).

2. Objectives

As discussed above, there have been studies addressing the adoption of mobile applications in treatment of patients with substance use disorder. However, limited research addressed the use of mobile applications in relapse prevention to methamphetamine use disorder. This study aimed to develop and evaluate a mobile application for relapse prevention to methamphetamine use disorder with an approach to Marlatt’s cognitive-behavioral model.

3. Patients and Methods

This study was conducted in two main stages in 2018.

3.1. Software Production

Initially, a literature review was conducted with a focus on the Marlatt’s cognitive-behavioral model (Figure 1). In addition, there was a direct visit to an addiction recovery center to seek experts’ opinion about the subject of the study and to obtain a better understanding of relapse to substance use (methamphetamine) disorder and the associated factors. The views of clinical psychologists and experts in addiction studies were sought in software production.

The conceptual modeling of the software included functional, structural, and behavioral models. The programming of the application was conducted using the html, JavaScript, and CSS languages in the Apache Cordova platform to make sure that the application can be run on a variety of operating systems on smartphones.

3.2. Software Evaluation

Five experts (three clinical psychologists and two experts in addiction studies) together with five patients with methamphetamine use disorder participated in the quantitative evaluation of the application in an addiction recovery center. Patients were randomly selected to take part in this step. The data collection tool was a questionnaire developed based on relevant resources (34-37). The questionnaire was composed of three sections (content quality, learning objectives, and usability) on a five-point Likert scale ranging from very good (score 5) to very poor (score 1). The validity of the questionnaire was checked by five domain experts. The reliability of the questionnaire was also determined by calculating the internal consistency of the questions ($\alpha = 0.87$). Participants were involved in the study on a voluntarily basis and the study was checked in terms of ethical considerations by the Research Ethics Committee of Shahid Beheshti University of Medical Sciences (ref: IR.SBMU.RETECH.REC.1395.886).
4. Results

4.1. Findings Related to the Design and Production of the Application

Based on Marlatt’s model and experts’ opinion, the functional requirements of the application shown in Table 1 were determined, and the related scenarios and use-cases were designed accordingly. Figure 2 illustrates the overall use-case diagram of the application.

As shown in Figure 2, there were eight use-cases for the application. The application was developed based on its conceptual modeling. Figures 3 - 5 illustrate the screens for recovery plans, daily plan, and educational materials, respectively.

According to Figure 3, the recovery plans are composed of three parts: daily plan, motivation, and assessment. By clicking on the daily plan, the user is transferred to this section composed of education and relaxation (Figure 4).

In the screen for daily plan, by clicking on education icon, the user is transferred to educational material screen (Figure 5).

4.2. Findings Related to Evaluation of the Application

The results of evaluation of the application by experts and by patients are shown in Tables 2 and 3, respectively. According to Table 2, the highest mean score was assigned to usability of the application (4.6 ± 0.39). Content quality (4.5 ± 0.46) and learning objective (4.4 ± 0.37) of the application were in the second and third order, respectively. The results of the evaluation for patients indicated that usability (4.6 ± 0.39) and content quality (4.5 ± 0.33) had the highest mean scores, while the mean score for learning objectives was lower than two other dimensions (4.1 ± 0.37).

5. Discussion

According to Marlatt’s model, individuals’ cognition of their substance use disorder and the ways of coping with temptations are key determinants for relapse prevention, and patients with substance use disorder should be provided with educational material. Marsch (38), reported that technology-based therapeutic approaches could help improving the outcomes of addiction recovery. In the present study, a key service of the application develop was...
assigned for patient education including audio, video, and textual materials. This was in line with Gustafson et al.’s (27) study, in which a mobile application was developed to improve outcome for people undergoing alcohol dependence recovery. In their application, there was a specific section for patient education with audio and textual materials to help patients cope with temptation. The findings of the current study and those reported by Gustafson et al. (27), remark the key role of education in relapse prevention. Therefore, developing mobile applications with educational capabilities for people with methamphetamine use disorder appears to improve the recovery outcomes.

In addition to patients’ education, relaxation plays a critical role in relapse prevention and follow up of treatment after patients’ discharge from recovery centers (39). In the current study, there was a relaxation service, as part of the recovery daily plans, to help patients overcome with stress and substance use temptation. This was supported by Gustafson et al. (27), who considered a relaxation capability for their application, which provided users with audio materials. These findings suggest that the relaxation service of applications could improve the coping behavior referred to the phasic responses of the Marlatt’s model, and considering this capability of the software is therefore suggested in the development of similar applications.

In the current study, a key function of the application
Table 1. Functional Requirements of the Mobile Application

| Functional Requirements | Description |
|-------------------------|-------------|
| Registration            | To enable the user to be registered |
| Log in                  | Allowing the user to enter in the application using ID and password |
| Log out                 | To enable the user to end a session and get out of the application |
| Creating user profile   | To enable the user to create his/her profile |
| Setting daily plan      | The application should have a daily recovery plan including educational content in different formats (the videos, audio, and texts) to create a good understanding of the disorder, its recovery, and risky situations; relaxation through music and videos files |
| Motivational aspects    | The application should motivate user with messages, pictures, movies of user’s preference |
| Assessment of the recovery progress | To allow users to go through daily, weekly, and periodical assessment of the recovery process |
| Settings                | To provide users to set motivational messages, reminders, and alerts based on their defined times |
| Presentation of assessment reports | The application should display user-completed Assessments to the therapist. |
| Navigation              | To allow user to search within educational materials (textual, audio, and video files) |

was the motivational capability. The application should permit patients to develop the motivation part of the application based on their own preferences with audio, video, and textual materials. This is supported by Gustafson et al. (27), who reported such a capability for their application. With respect to the tonic process highlighted in the Marlatt’s model (29), attention should be paid to the cognitive processes, part of which refers to the role of motivation in relapse prevention. Therefore, developing the motivation capability of the application by patients might help them to have a better feeling about the recovery process.

Reminding different stages of treatment and the progress of recovery, as well as generating messages for motivation were among the key functions of the application designed in the current study. This findings is in line with other studies, as the application designed in Gustafson et al.’s (27) study supported patients’ in their recovery through generating reminders for continued use of the application and motivation messages. This is also consistent with Stoner and Hendershots (40) study in which a mobile application called AGATE was designed with the capability of sending reminder messages to patients undergoing recovery for alcohol use disorder to improve their adherence to the recovery plans, such as medications that should be taken.

In their study, Rock et al. (41) indicated the positive role of motivational messages sent via short message service (SMS) in smoking cessation intervention. The continuity of treatment and adherence to recovery plans are critical in treatment of people with substance use disorder. Failure in these respects could increase the possibility of relapse to substance use and would be a waste of resources both for patients and for care providers (42). Given the high likelihood of relapse in methamphetamine use disorder and the necessity of follow up after initial recovery, the current study aimed to develop an application for improving the outcome of the recovery process. The findings of the current study and those presented above in other studies could support this notion that capabilities such as, re-
Table 2. Software Evaluation by Experts\(^a\)

| Evaluation Dimensions          | Option (Score) | Values |
|--------------------------------|---------------|--------|
|                                | Very Good (5) | Good (4) | Fair (3) | Poor (2) | Very Poor (1) | Total |
| **Content quality**            |               |         |          |          |               |       |
| Accuracy                       | 5             | 0        | 0        | 0        | 0             | 25 (100) | 5.0 ± 0  |
| Reliability of resources       | 4             | 1        | 0        | 0        | 0             | 24 (96) | 4.8 ± 0.44 |
| Conciseness and comprehensiveness | 0             | 4        | 1        | 0        | 0             | 19 (76) | 3.8 ± 0.44 |
| Educational aspects            | 2             | 3        | 0        | 0        | 0             | 22 (88) | 4.4 ± 0.54 |
| Cultural aspects               | 3             | 2        | 0        | 0        | 0             | 23 (92) | 4.6 ± 0.54 |
| **Total**                      | 14            | 10       | 1        | 0        | 0             | 113 (90.4) | 4.5 ± 0.46 |
| **Learning objectives**        |               |         |          |          |               |       |
| Focusing on user needs         | 1             | 4        | 0        | 0        | 0             | 21 (84) | 4.2 ± 0.44 |
| Feedback presentation          | 5             | 0        | 0        | 0        | 0             | 25 (100) | 5.0 ± 0   |
| Achievability                  | 1             | 4        | 0        | 0        | 0             | 21 (84) | 4.4 ± 0.54 |
| **Total**                      | 7             | 8        | 0        | 0        | 0             | 67 (89) | 4.4 ± 0.37 |
| **Usability**                  |               |         |          |          |               |       |
| Fonts                          | 4             | 1        | 0        | 0        | 0             | 24 (96) | 4.8 ± 0.44 |
| Screen design and layout       | 3             | 1        | 1        | 0        | 0             | 22 (88) | 4.4 ± 0.89 |
| Terminology                    | 3             | 2        | 0        | 0        | 0             | 23 (92) | 4.6 ± 0.54 |
| Ease of use                    | 5             | 0        | 0        | 0        | 0             | 25 (100) | 5.0 ± 0   |
| Ease of learning               | 5             | 0        | 0        | 0        | 0             | 25 (100) | 5.0 ± 0   |
| Navigation (speed and structure) | 5             | 0        | 0        | 0        | 0             | 25 (100) | 5.0 ± 0   |
| Minimum technical requirements | 0             | 3        | 2        | 0        | 0             | 18 64 (%) | 3.6 ± 0.54 |
| Compatibility with different platforms | 4             | 1        | 0        | 0        | 0             | 24 (96) | 4.8 ± 0.44 |
| **Total**                      | 29            | 8        | 3        | 0        | 0             | 186 (93) | 4.6 ± 0.39 |
| **Total**                      | 50            | 26       | 4        | 0        | 0             | 366 (91) | 4.6 ± 0.38 |

\(^a\)Values are expressed as mean ± SD or No. (%).
| Evaluation Dimensions | Option (Score) | Values |
|-----------------------|---------------|--------|
|                       | Very Good (5) | Good (4) | Fair (3) | Poor (2) | Very Poor (1) | Total |
| Content quality       | 5             | 0        | 0        | 0        | 0          | 25 (100) | 5.0 ± 0.0 |
| Accurc                 | 1             | 4        | 0        | 0        | 0          | 21 (84)  | 4.2 ± 0.44 |
| Comprehensibility      | 3             | 1        | 1        | 0        | 0          | 22 (88)  | 4.6 ± 0.54 |
| Conciseness and        | 3             | 2        | 0        | 0        | 0          | 23 (92)  | 4.6 ± 0.54 |
| Cultural aspects       | 1             | 4        | 0        | 0        | 0          | 21 (84)  | 4.2 ± 0.44 |
| Learning objectives    | 13            | 11       | 1        | 0        | 0          | 112 (89) | 4.5 ± 0.33 |
| Focusing on user needs | 0             | 3        | 2        | 0        | 0          | 18 (72)  | 3.6 ± 0.54 |
| Feedback presentation  | 3             | 2        | 0        | 0        | 0          | 21 (92)  | 4.6 ± 0.54 |
| Usability              | 3             | 5        | 2        | 0        | 0          | 41 (82)  | 4.1 ± 0.37 |
| Fonts                 | 4             | 1        | 0        | 0        | 0          | 24 (96)  | 4.8 ± 0.44 |
| Screen design and      | 0             | 4        | 1        | 0        | 0          | 19 (76)  | 3.8 ± 0.44 |
| Terminology            | 5             | 0        | 0        | 0        | 0          | 25 (100) | 5.0 ± 0.0  |
| Ease of use            | 4             | 1        | 0        | 0        | 0          | 24 (96)  | 4.8 ± 0.44 |
| Ease of learning       | 4             | 1        | 0        | 0        | 0          | 24 (96)  | 4.8 ± 0.44 |
| Navigation (speed and  | 5             | 0        | 0        | 0        | 0          | 25 (100) | 5.0 ± 0.0  |
| structure)             |               |          |          |          |            |          |            |
| Minimum technical      | 0             | 3        | 2        | 0        | 0          | 18 (72)  | 3.6 ± 0.54 |
| requirements           |               |          |          |          |            |          |            |
| Compatibility with     | 4             | 1        | 0        | 0        | 0          | 24 (96)  | 4.8 ± 0.44 |
| different platforms    |               |          |          |          |            |          |            |
| Total                  | 42            | 27       | 6        | 0        | 0          | 336 (84) | 4.2 ± 0.38 |

aValues are expressed as mean ± SD or No. (%).

Outcome of addiction recovery.

Footnotes

Authors’ Contribution: Conceptualization and design: Reza Rabiei and Hamid Moghaddasi. Conceptual modelling for application: Reza Rabiei and Hamid Moghaddasi. Application design: Reza Rabiei and Mina Heidari. Application validation: Reza Rabiei and Mina Heidari. Writing-original draft preparation: Reza Rabiei. Writing-review and editing: Reza Rabiei. Approval of final manuscript: all authors.

Conflict of Interests: Authors declare that they have no any conflict interests.

Ethical Approval: This study was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences with code no.: IR.SBMU.RETECH.REC.1395.886

Funding/Support: There was no financial support for the current study.

Informed Consent: There was no intervention on patients, and they were fully informed about the nature of the study and they were asked to only check the mobile application (software) when evaluating the software application.
References

1. Levesque RJR. Encyclopedia of adolescence. USA: Springer Science and Business Media; 2011.
2. Rezapour T, DeVito EE, Sofuoglu M, Ekhtiari H. Perspectives on neuropsychological rehabilitation as an adjunct treatment for addictive disorders: From cognitive improvement to relapse prevention. Prog Brain Res. 2016;224:345-69. doi: 10.1016/bs.pbr.2015.07.022. [PubMed: 26822366].
3. UNODC. Status and trend analysis of illicit drug markets. 2019. Available from: https://www.unodc.org/documents/wdr2015/WDR15_Drug_use_health_consequences.pdf.
4. UNODC. World drug report 2019: 35 million people worldwide suffer from drug use disorders while only 1 in 7 people receive treatment. 2019. Available from: https://www.unodc.org/unodc/en/frontpage/2019/June/world-drug-report-2019-_35-million-people-worldwide-suffer-from-drug-use-disorders-while-only-1-in-7-people-receive-treatment.html.
5. National Institute of Drug Abuse Methamphetamine. 35 million people worldwide suffer from drug use disorders while only 1 in 7 people receive treatment. 2019. Available from: https://www.drugabuse.gov/publications/research-reports/methamphetamine/what-scope-methamphetamine-misuse-in-united-states.
6. Janik P, Kosticova M, Pecenak J, Turcek M. Categorization of psychoactive substances into 'hard drugs' and 'soft drugs': A critical review of terminology used in current scientific literature. Am J Drug Alcohol Abuse. 2017;43(6):836-46. doi: 10.1080/00952990.2017.1335736. [PubMed: 28650668].
7. Ekhtiari H, Alam-Mehrjerdi Z, Hassani-Abharian P, Nouri M, Farnam R, Mokri A. Examination and evaluation of craving-inductive verbal cues among Persian-speaking methamphetamine abusers. Adv Cogn Sci. 2010;12(2):69-82.
8. Alam-mehrjerdi Z, Mokri A, Dolan K. Methamphetamine use and treatment in Iran: A systematic review from the most populated Persian Gulf Country. Asian J Psychiatr. 2015;16:17-25. doi: 10.1016/j.ajp.2015.05.036. [PubMed: 2612323].
9. Goudarzi F, Ansari H, Gholamzadeh S, Zarenezhad M, Farnam R, Mokri A, et al. Evaluation of the frequency, clinical signs and prognosis of drug abuse in poisoning cases referred to Shiraz Shohustari Hospital from September 2008 to September 2010. Iran J Forensic Med. 2016;22(1):7-14.
10. Jaffe JH, Bloor R, Crome I, Carr M, Alam F, Simmons A, et al. A post-marketing study of relative abuse liability of hypnotic sedative drugs. Addiction. 2004;99(2):165-73. doi: 10.1046/j.1360-0443.2003.00671.x. [PubMed: 14756709].
11. Rendell PG, Mazur M, Henry JD. Prospective memory impairment in former users of methamphetamine. Psychopharmacology (Berl). 2009;203(3):509-16. doi: 10.1007/s00213-008-1408-0. [PubMed: 1903763].
12. American Psychiatric Association. Diagnostic and statistical manual of mental disorders (DSM-V), USA: American Psychiatric Association; 2013. doi: 10.1176/appi.books.9780890425596.
13. Australian government department of health ministerial drug and alcohol forum (MDAF). 2019. Available from: https://www.health.gov.au/committees-and-groups/ministerial-drug-and-alcohol-forummdaf?utm_source=nationalstrategy.gov.au&utm_medium=redirect&utm_campaign=digital_transformation.
14. Roozen HG, de Waart R, van der Windt D, van den Brink W, de Jong CA, Kerckhof AJ. A systematic review of the effectiveness of...
of naltrexone in the maintenance treatment of opioid and alcohol dependence. *Eur Neuropsychopharmacol*. 2006;16(5):318-23. doi: 10.1016/j.eunep.2005.11.001. [PubMed: 16360866].

16. Marsch LA, Dallery J. Advances in the psychosocial treatment of addiction: The role of technology in the delivery of evidence-based psychosocial treatment. *Psychiatr Clin North Am*. 2012;35(2):483-93. doi: 10.1016/j.psc.2012.01.009. [PubMed: 22640767]. [PubMed Central: PMC3562794].

17. Miller WR, Westerberg VS, Harris RJ, Tonigan JS. What predicts relapse? Prospective testing of antecedent models. *Addiction*. 1996;91 Suppl:S5-72. [PubMed: 8997760].

18. Marlatt GA, Donovan DM. Relapse prevention: Maintenance strategies in the treatment of addictive behaviors. New York City: Guilford press; 2005.

19. Bhagat R, Bronsert MR, Ward AN, Martin J, Juarez-Colunga E, Glibova NO, et al. National analysis of unplanned readmissions After thoracoscopic versus open lung cancer resection. *Ann Thorac Surg*. 2017;104(6):2782-90. doi: 10.1016/j.athoracsur.2017.08.047. [PubMed: 29102302].

20. Agboola S, Neclll A, Coleman T, Leonardi Bee J. A systematic review of the effectiveness of smoking relapse prevention interventions for abstinent smokers. *Addiction*. 2010;105(8):1360-44. doi: 10.1111/j.1360-0443.2010.02996.x. [PubMed: 2065169].

21. Magill M, Ray LA. Cognitive-behavioral treatment with adult alcoholic and illicit drug users: A meta-analysis of randomized controlled trials. *J Stud Alcohol Drugs*. 2009;70(4):516-27. doi: 10.5288/jad.2009.70.516. [PubMed: 19515291]. [PubMed Central: PMC2696292].

22. Witkiewitz K, Marlatt A. Behavioral therapy across the spectrum. *Alcohol Res Health*. 2011;35(4):313-9. [PubMed: 2158000]. [PubMed Central: PMC3860542].

23. Witkiewitz K, Marlatt GA. Relapse prevention for alcohol and drug problems: That was Zen, this is Tao. *Am Psychol*. 2004;59(4):224-35. doi: 10.1037/0003-066X.59.4.224. [PubMed: 15149263].

24. Hendershot CS, Witkiewitz K, George WH, Marlatt GA. Relapse prevention for addictive behaviors. *Subst Abuse Treat Prev Policy*. 2011;6:1-7. doi: 10.1186/1747-597X-6-17. [PubMed: 21771314]. [PubMed Central: PMC3613910].

25. Bickel WK, Marsch LA, Buchhalter AR, Badger GJ. Computerized behavior therapy for opioid-dependent outpatients: A randomized controlled trial. *Exp Clin Psychopharmacol*. 2008;16(2):322-43. doi: 10.1089/ecp.2004.0013.00012. [PubMed: 1844307]. [PubMed Central: PMC2746734].

26. McKay JR, Van Horrn DH, Oslin DW, Lynch KG, Ivey M, Ward K, et al. A randomized trial of extended telephone-based continuing care for alcohol dependence: Within-treatment use and treatment outcomes. *J Consult Clin Psychol*. 2010;78(6):912-3. doi: 10.1037/a0020700. [PubMed: 20873894]. [PubMed Central: PMC3028847].

27. Gustafson DH, Shaw BR, Isham A, Baker T, Boyle MG, Levy M. Explicating an evidence-based, theoretically informed, mobile technology-based system to improve outcomes for people in recovery for alcohol dependence. Subst Use Misuse. 2011;46(1):96-111. doi: 10.1080/10826084.2011.522413. [PubMed: 21904010]. [PubMed Central: PMC3792722].

28. Darvand A, Samadbeik M, Kafashi M, Abhari S. Acceptance of health information technologies, acceptance of mobile health: A review article. *J Biomed Eng Phys*. 2017;4(4):403-8. [PubMed: 2944577]. [PubMed Central: PMC5809934].

29. Murray E, McCarimbidge J, Khadjesari Z, White IR, Thompson SG, Godfrey C, et al. The DVD-RCT protocol: An on-line randomised controlled trial of an interactive computer-based intervention compared with a standard information website to reduce alcohol consumption among hazardous drinkers. *BMC Public Health*. 2007;7:306. doi: 10.1186/1471-2458-7-306. [PubMed: 17961483]. [PubMed Central: PMC2238765].

30. Chapman C, Champion KE, Birrell L, Deen H, Brierley ME, Stapisni LA, et al. Smartphone apps about crystal methamphetamine (‘Ice’): Systematic search in app stores and assessment of composition and quality. *JMIR Mhealth Uhealth*. 2015;5(1). doi: 10.2196/10442. [PubMed: 30468384]. [PubMed Central: PMC4828025].

31. Bhagat R, Bronsset MR, Ward AN, Martin J, Juarez-Colunga E, Glibova NO, et al. National analysis of unplanned readmissions After thoracoscopic versus open lung cancer resection. *Ann Thorac Surg*. 2017;104(6):2782-90. doi: 10.1016/j.athoracsur.2017.08.047. [PubMed: 29102302].

32. Yen PY, DinehVA, Norman KL. Development of an instrument measuring user satisfaction of the human-computer interface. *Proceedings of the SIGCHI conference on Human factors in computing systems*. ACM; 1988. p. 213-8.

33. Marcell LA. Leveraging technology to enhance addiction treatment and recovery. *J Addict Dis*. 2012;31(3):313-8. doi: 10.1080/10550887.2012.694606. [PubMed: 2287392]. [PubMed Central: PMC3650640].

34. Bock B, Heron K, Jennings E, Morrow K, Cobb V, Magee J, et al. A text message intervention about crystal methamphetamine (‘Ice’) to the community: Co-design and beta testing. *JMIR Mhealth Uhealth*. 2018;6(12). doi: 10.2196/10107. [PubMed: 30573443]. [PubMed Central: PMC6320422].

35. Zhao Y, Jiang H, Su H, Zhong N, Li R, Li X, et al. A Newly designed mobile-based computerized cognitive addiction therapy app for the improvement of cognition impairments and risk decision making in methamphetamine use disorder: Randomized controlled trial. *JMIR Mhealth Uhealth*. 2018;6(6). doi: 10.2196/10292. [PubMed: 29925497]. [PubMed Central: PMC6138989].

36. Marcell LA, Takahashi RE, Girardi ME, Palmer RS, Marlatt GA. Relapse prevention. *An overview of Marlatt’s cognitive-behavioral model*. *Alcohol Res Health*. 1999;23(2):351-60. [PubMed: 10589081]. [PubMed Central: PMC6760427].

37. Chin JP, DiehlVA, Norman KL. Development of an instrument measuring user satisfaction of the human-computer interface. *Proceedings of the SIGCHI conference on Human factors in computing systems*. ACM; 1988. p. 213-8.

38. Hendershot CS, Witkiewitz K, George WH, Marlatt GA. Relapse prevention for addictive behaviors. *Subst Abuse Treat Prev Policy*. 2011;6:1-7. doi: 10.1186/1747-597X-6-17. [PubMed: 21771314]. [PubMed Central: PMC3613910].

39. Sinha R. Chronic stress, drug use, and vulnerability to addiction. *Annu Rev Publ Health*. 2010;31:95-111. doi: 10.1146/annurev.publhealth.30.030408.134453. [PubMed: 19891554]. [PubMed Central: PMC272004].

40. Stone SA, Hendershot CS. A randomized trial evaluating an mHealth system to monitor and enhance adherence to pharmacotherapy for alcohol use disorders. *Addict Sci Clin Pract*. 2012;7(2):8. doi: 10.1186/1940-6400-7-9. [PubMed: 2216310]. [PubMed Central: PMC3507635].

41. Bock B, Heron K, Jennings E, Morrow K, Cobb V, Magee J, et al. A text message delivered smoking cessation intervention: The initial trial of TXT-2-quit: Randomized controlled trial. *JMIR Mhealth Uhealth*. 2013;3(2). doi: 10.2196/mhealth.2522. [PubMed: 25098502]. [PubMed Central: PMC404437].

42. Krishna S, Boren SA, Balas EA. Healthcare via cell phones: A systematic review. *Telemed J E Health*. 2009;15(3):231-40. doi: 10.1089/tmj.2008.0099. [PubMed: 19382860].

43. Walters ST, Ondersma SJ, Ingersoll KS, Rodriguez M, Lerch J, Rosheim ME, et al. MAPIT: development of a web-based intervention targeting substance abuse treatment in the criminal justice system. *J Subst Abuse Treat*. 2014;46(1):60-5. doi: 10.1016/j.jsat.2013.07.003. [PubMed: 23954392]. [PubMed Central: PMC3818291].