A MACHINE LEARNING MODEL FOR SOBRIETY AND RELAPSE ANALYSIS IN DRUG REHABILITATION

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Abstract

Drug abuse has become so paramount among members of society. Although, the initial decision to take drugs is typically voluntary among victims. As drugs are constantly been used, the ability to exert self-control on them is relatively impaired. Thus, abuse is witnessed in different age groups, gender, and celebrities from all walks of life. While addicts become such owing to several factors of curiosity and peer pressure, recreational purpose, source of inspiration, and more, the effect of these drugs can lead to depression, brain stimulation, and hallucination. Managing drug abuse through behavioral or pharmacological means is intended to help addicts stop habitual drug use. Oftentimes, rehab is not effective because the desired change is absent while a proper technological-driven approach to track sobriety and relapse in compulsive drug seeking and usage is also missing. Consequently, in this research, user-friendly and interactive sobriety and relapse predictive management application is developed. Here, addicts' behavioral and demographics with major relapse monitoring factors were clustered to predict the likelihood of relapse. The relapse predictive system using cognitive behavioral patterns, adopts the logistic regression algorithm of the Bayesian network for both training and testing. The essence is to ascertain users' addiction level, analyze and track sobriety and relapse in order to uncover drug addiction patterns, discover the probability of relapse occurrence towards recommending sustainable rehabilitation decision support.

1.0 INTRODUCTION

Drug abuse or substance abuse refers to the use of certain chemicals for the purpose of creating pleasurable effects on the brain. Among several other examples of drugs, alcohol, tobacco, cocaine are the most common in the public domain [1]. Overtime, from constant and persistent drug consumption, addiction becomes eminent. This is because the urge cannot be resisted, no matter how much harm the drugs may cause or is still causing to the body system [2]. Thus, addiction is defined as a chronic, relapsing disorder characterized by compulsive drug seeking and use despite adverse consequences. This is a disease that affects the brain and behavior of victims.

Around the world, there are over 190 million drug users and the problem of drug addiction has been increasing at alarming rates, especially among young adults under the age of 30.

With ever increasing cases of drug abuse daily, a need for drug rehabilitation becomes imminent. The goal of drug rehab among others is to learn about addiction, break addictive cycle, while building healthy lifestyle in victims. By this, addict start to cease drug abuse, in a way to dodge the psychological, legal, financial, social, and physical concerns; that can be triggered, especially by extreme abuse [3].

From scientific research, relapse rates for drug rehabilitation usually are in the range of 50% to 90% [4]. Although, relapse has been estimated to be very expensive in developed countries, based on survey led by the Nigeria's National Bureau of Statistics (NBS) and the Center for Research and Information on Substance Abuse in January, 2019; 14.3 million people (nearly 15% of the adult population) reported a "considerable level" of use of psychoactive drugs [5]. This is a rate much higher than the 2016 global average. With only 19 medical centers in Nigeria offering drug rehabilitation, and 7 of these centers requiring assessment surveys before commencement of treatment (UNODC), it is no surprise that two-thirds of these addicts in the country relapse yearly.

While some addicts strongly desiring to come off drugs, recovering from an addiction is not seamless. It will take a significant amount of willpower and self-discipline to achieve and maintain long-term sobriety. Aside this, the social, health, myths and physiological effect of this decisions has increased relapse in rehabilitation exercise. With advances in technology, leveraging technology with rehabilitation has become the central focus towards relapse management in modern day drug abuse rehabilitation processes. Although, users can also become technology addict, finding balance between technology addition and drug rehabilitation process using technology ensures that relapse process is not totally dependent on technology but the processes are encapsulated for effective tracking and analyzing for relapse pattern detection, analysis and decision support. In section 2, an overview of related works is presented just as the proposed works is discussed in section 3. In section 4, an evaluation of the proposed system with existing solution is presented before conclusion in section 5.

2.0 LITERATURE REVIEW

Health Information Technology (Health IT) is a broad term that describes the technology and infrastructure used to record, analyze, and share patient health data. The introduction of Health technology has continued to play key role in expanding access to diagnostic services, increase coordination between patient and healthcare providers, while helping to overcome physical distances between patients and healthcare givers [6]. This and more has helped in promoting equality in HIT support over the years. Among a wide varieties of significant areas in HIT, the use of technology in drug abuse management is also important and paramount as others. Globally, drug abuse have become a complex health and social challenge that is affecting millions of people irrespective of race, ethnicity or gender. With this growing drug abuse socio and economic challenges, the process of seeking a way out for addicts has brought about the process of drug rehabilitation.

Drug rehabilitation services provide treatment and support, which helps addicts improve the way they live their lives while helping addicts get off or reduce their use of drugs. The treatment programs emphasize the creation of daily routines that is full of productive activities and counseling sessions to help keep patients engaged and eliminate distractions. The rehab process makes sobriety a priority while maintaining a balanced lifestyle that patients can stick to post-treatment. It basically involves many components, which focus directly on the addict's drug use; and factors towards restoring the drug addict to productive membership in the family and society, while enabling him or her experience the rewards associated with abstinence [7]. Thus, after due treatments, addicts start to cease drug abuse, which inherently ease it effect on the psychological, legal, financial, social, and physical concerns; that are been triggered, by excessive usage of drug. To this end, [8] proposed that accurate and precise relapse prediction model is needed to implement a well-timed relapse prevention plan, this can also prevent relapse while helping an addict stay sober for a longer period of time.

Thus, it is important to understand that the technical advancements made in drug treatment aren't designed to substitute a licensed counselor or residential treatment program. Instead, the emerging apps, websites and online resources provide valuable information, crucial emotional support and guidance. To this end, in evaluating methods that works best for predicting successful rehabilitation treatment using real life large database, [9] developed a Treatment Episode Data Set-Discharges (TEDS-D) model. This uses statistical analysis to compare results of classical analytical strategies that are commonly used to address prediction of

treatment success. From the dataset analysis, the learning algorithm shows greater promise in predicting substance use disorder treatment in patients. Consequently, [10] developed a Brief Addiction Monitor (BAM) as a tool to gather data with Bayesian network model used for analysis in order to provide a self- monitoring service to addicts with the goal of reducing relapse. In addition, as mobile health application were developed using an adaptive intervention approach to prevent relapse in drug addict, [11] used a model that mined data from social media platform "Reddit", Generative Adversarial Networks (GAN) to predict the addiction relapses.

Consequently, [12] identifies major relapse in an addict by finding the relationship between relapse and socio-environmental variables such as age, education status and economic static of an addict. Here, Logistic regression was used to analyses the relapse predictors and the chi-square and independent t-tests were used to evaluate the statistical significance of each predictor. In the research, low literacy, employment status, age and social cycle were major predictors to relapse. For efficiency rate in rehabilitation process, [13], developed a Community Based Addiction Rehabilitation Electronic System (CARES) due to shortage in staff and the high turnover rate to improve the efficiency of community-based drug rehabilitation and to ultimately help drug users stay sober.

Despite the developments and opportunities created in robotics, telehealth technology, and sensor devices for the treatment of psychological disorders, an effective system that will address the burden of mental health conditions with more emphasis on relapse from addictive drugs is highly required using clinical and cliental data [14]. This is important because of the pitfalls for drug addicts enrolled in rehabilitation programs [15], which cannot be tracked and properly analyzed for enhanced relapse prediction and decision support. Thus, to effectively manage the relapsing nature of addicts, it is important to leverage the use of technology most especially smartphones and machine learning algorithms to help predict probabilities of relapse in a patient so as to prevent high billing costs and also a tool to facilitate a quick access to therapy. This is discuss in section 3 as follows.

3.0 REHAB AND WELLNESS APP FOR SOBRIETY AND RELAPSE ANALYSIS IN DRUG ADDICT

The developed Relapse Prediction System uses cognitive behavioral patterns, which adopts the logistic regression algorithm of the Bayesian network for both its training and testing. The system involves getting demographics which includes major relapse factors as preliminary input at the first instance towards predicting the likelihood of relapse in an addict. From the preliminary data, the model functionalities were integrated to effectively predict the probability of a drug addict relapsing based on recurring factors and patterns. This is illustrated in in figure one (1)
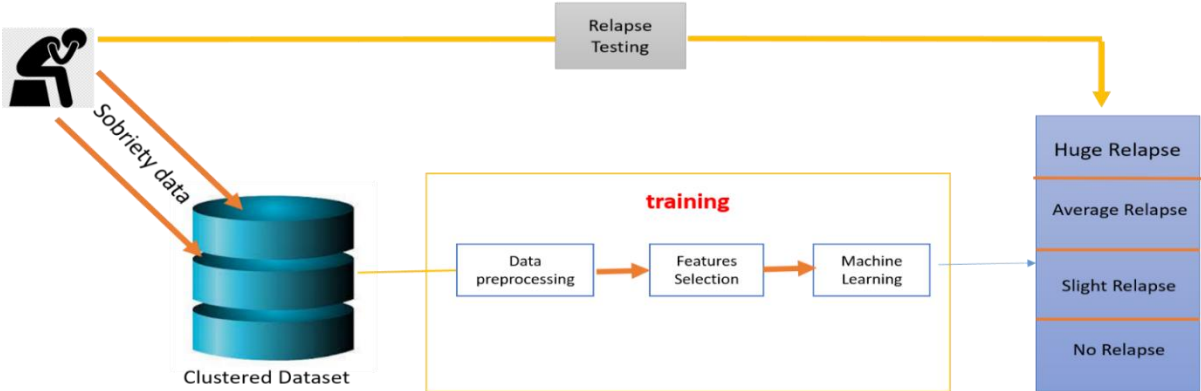

Figure 1. Relapse-Wellbeing Management Application

From figure 1, the addict monitoring patterns begins with a day-to-day data clustering of Sobriety and Relapse data from users. Thus, aside the preliminary information received from addicts on first login, other S&RD for clustering includes the mood checker, a digital thought journal, a relapse questionnaire that is based on the Brief Addiction Monitor Revised (BAM-R), and the users Profile of Mood States (POMS). These are clustered as dataset for preprocessing, feature selection and machine learning. The Sobriety tracker through the mobile application keeps track of addict sobriety and relapse status based on patterns. This information is clustered

daily at every login instance of the user and the data is stored for training and predictive analysis.

From the clustered dataset, the mood checker and thought journal work hand-in-hand via the app. It imitates a physical rehabilitation session where a rehabilitating addict jots down how he/she feels and why they feel that way at any time of the day. It basically adapts the Circumplex Mood Model developed by James Russell; this helps to show mood dynamics (different causes of mood changes). The user can use this whenever they feel strong emotions or feelings.

Therefore, from optimal feature selection stage, the Logic Regression classification algorithm models the relationship between the influential factors and relapse patterns; thus, making it a very useful tool in predicting the probability of an occurrence of relapse in four distinct categories. The obtained score during testing defines the sobriety and relapse status of an addict at that instance. This is presented in table 1:

Table 1: Sobriety and Relapse Categories

S/N	S&R Score	S&R Category
1.	0 – 0.24	No Relapse
2.	0.25 – 0.49	Slight Relapse
3.	0.50 – 0.74	Average Relapse
4.	0.75 – 1.0	Huge Relapse

The classification is required frequently to enhance medical practitioners with upper hand diagnostic information for necessary relapse monitoring and control mechanism. Here, nine independent subset variables, which forms primary input for digital rehabilitation as presented in the table two (2)

Table 2: Independent Variable and their Description

INDEPENDENT VARIABLE	DESCRIPTION
Age	Current age of addict
Gender	Sex of addict
Age at first taking drug	Initial age when started taking drug
Family history	Do their parent, siblings or relatives take drugs?
Stress level	Do they stress? At what time of the day do they stress most? What day of the week do they stress the most?
Mood	Do they have mood swings often?
Self-motivation	How motivated are they to get rehabilitation?
Type of drug used	What type of drug does patient use?

In section four (4) Sample design, experiment and evaluation is presented for consideration.

4.0 DESIGN, EXPERIMENTS AND EVALUATION

For the preliminary experiment, a total of 3000 records, representing unique individuals on drug addiction and all its constituents is presented. First, an analysis and the breakdown of all the key characteristics (questions) and the answers is presented in the figure:
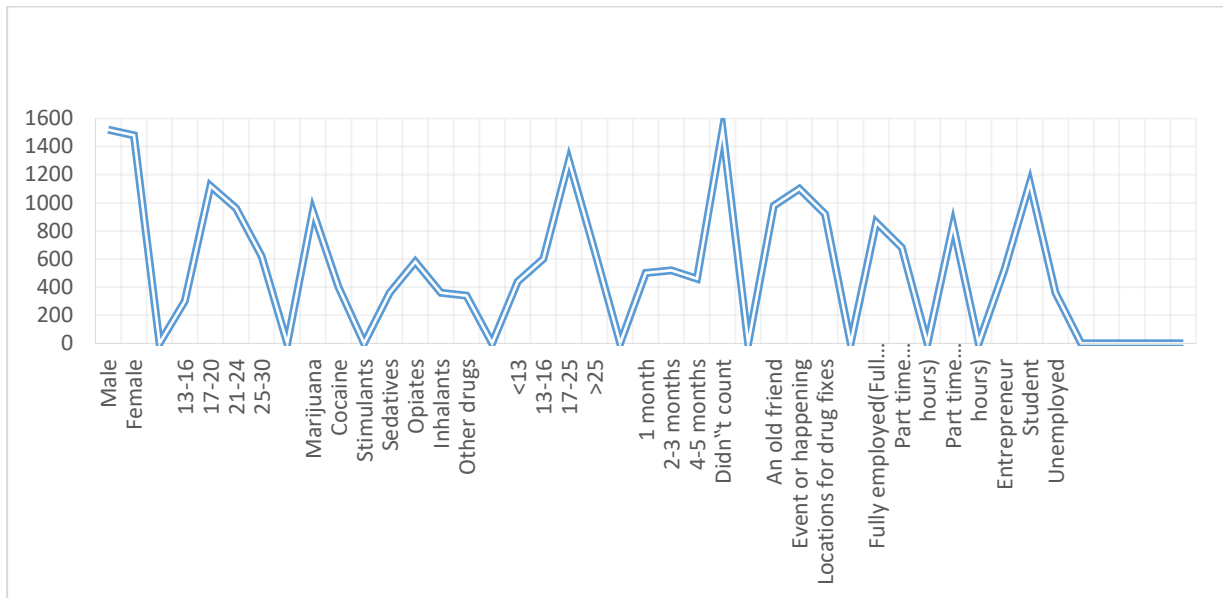
Figure 2. Drug Rehabilitation Clustered Dataset

From a close monitoring and evaluation of addicts for a period of 6 months, the following sobriety and relapses tracks were obtained and presented from the participants using the rehab wellbeing application. Figures 3, 4 and 5 shows the Sobriety and Relapse tracking based on Gender (male vs female), Drug Type and Age range respectively.
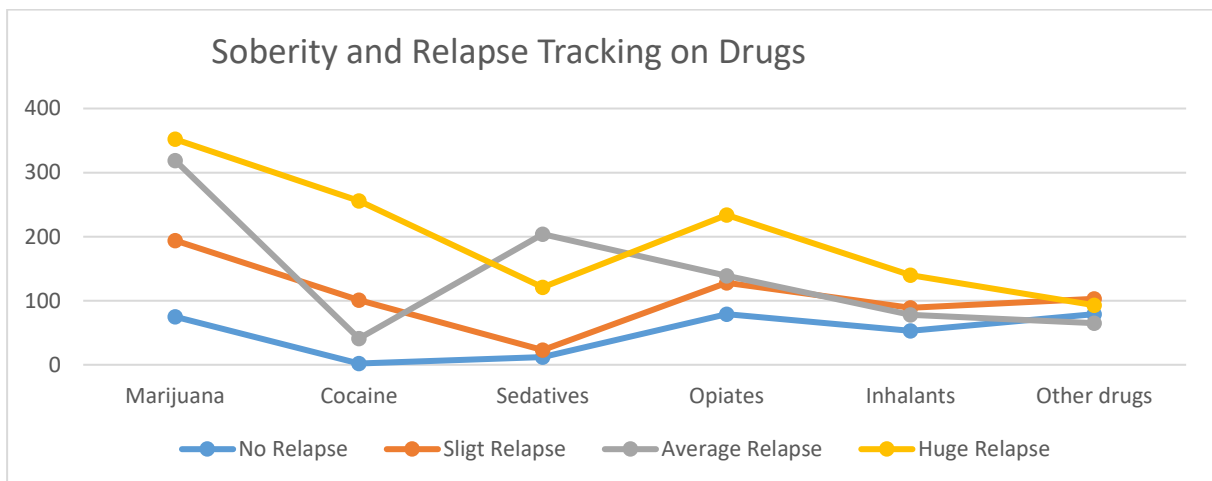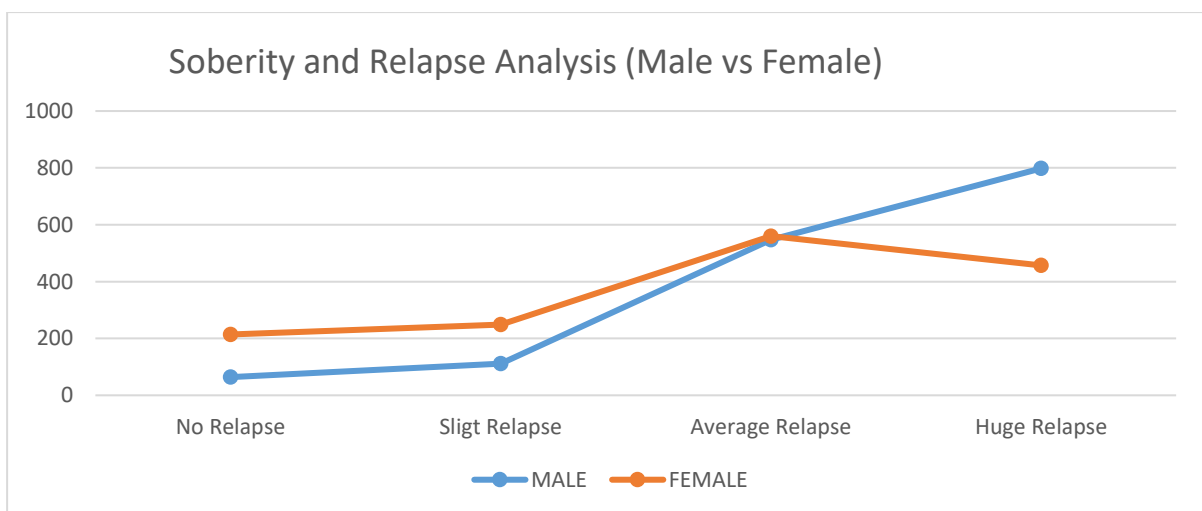

Figure 3. S&R Analysis (Male Vs Female)

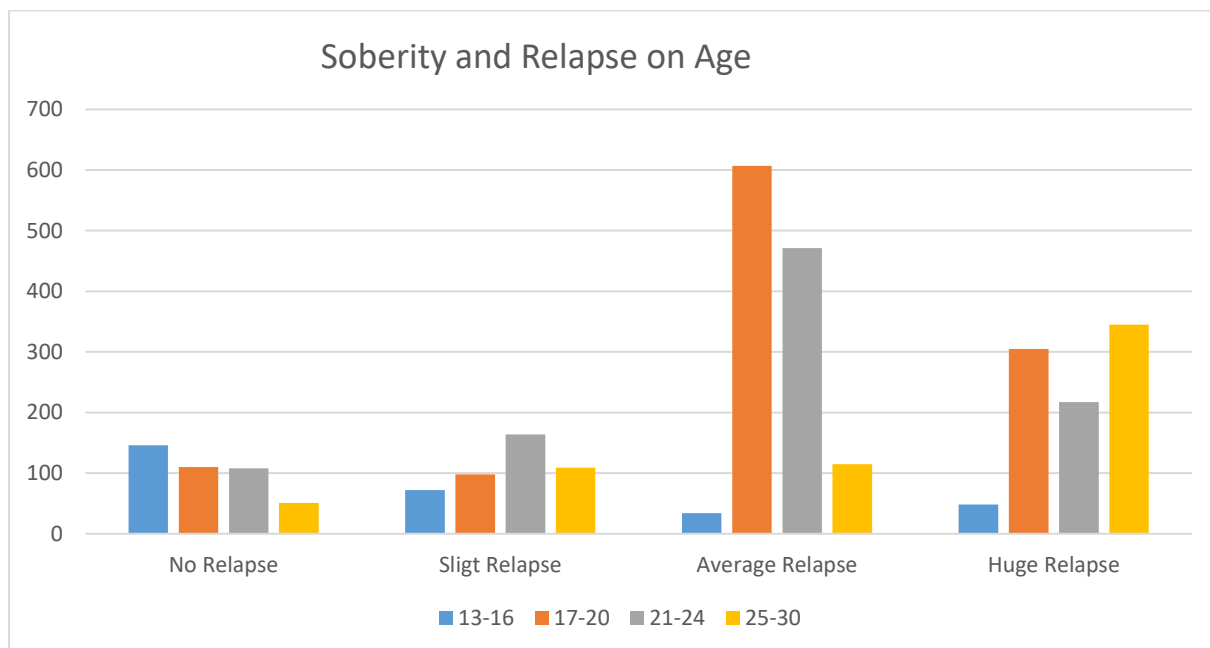

Figure 4. S&R Tracking on Drugs

Figure 5. Sobriety and Relapse Tracking on Age

5.0 CONCLUSION

As Relapse remains an inevitable occurrence on the path to rehabilitation, providing an optimal solution to monitor the process for effective rehabilitation becomes important. Thus, tracking behavioural patterns in quick succession towards effective decision support by care givers remains an important goal this research as addressed. The developed Relapse and Wellbeing applications is a machine learning powered solution that clustered distinct features from addict in order to predict sobriety and relapses status towards effective decision support on the part of the care givers.

REFERENCES

[1]   Miech R, Schulenberg J, Johnston L, Bachman J, O'Malley P, Patrick M. Monitoring the Future National Adolescent Drug Trends in 2017: Findings Released. Ann Arbor, MI: Institute for Social Research, The University of Michigan;2017.

[2]   Jones CM, Paulozzi LJ, Mack KA. Alcohol Involvement in Opioid Pain Reliever and Benzodiazepine Drug Abuse–Related Emergency Department Visits and Drug-Related Deaths United States, 2010. Accessed September 18, 2018.

[3]   Sharma AK, Upadhyaya SK, Bansal P, Nijhawan M, Sharma DK. A study of factors affecting relapse in substance abuse. Education. 2012;2(17.033):17.033.

[4]   K. D. Brownell, G. A. Marlatt, E. Lichtenstein, and G. T. Wilson, "Understanding and preventing relapse," 1986;41:765–82

[5]   https://qz.com/africa/1538843/nigeria-drug-abuse-14-million-adults-use-drugs/

[6]   Fadahunsi, Kayode Philip; Akinlua, James Tosin; O'Connor, Siobhan; Wark, Petra A; Gallagher, Joseph; Carroll, Christopher; Majeed, Azeem; O'Donoghue, John (March 2019). "Protocol for a systematic review and qualitative synthesis of information quality frameworks in eHealth". BMJ Open. 9 (3):e024722. doi:10.1136/bmjopen-2018-024722.

[7]   NIDA, "Overdose death rates," https://www.drugabuse.gov/ related-topics/trends-statistics/overdose-death-rates, September-2017, online, accessed 25-March-2018.

[8]   Y. Fan, Y. Zhang, Y. Ye, W. Zheng et al., "Social media for opioid addiction epidemiology: Automatic detection of opioid addicts from twitter and case studies," in Proceedings of the 2017 ACM CIKM. ACM, 2017, pp. 1259–1267

[9]   Breese GR, Chu K, Dayas CV, Funk D, Knapp DJ, Koob GF, Le DA, O'Dell LE, Overstreet DH, Roberts AJ, Sinha R, Valdez GR, Weiss F, 2005. Stress enhancement of craving during sobriety: A risk for relapse. Alcohol Clin. Exp. Res 29, 185–195.

[10] Acion L, Ramirez MR, Jorge RE, Arndt S. Increased risk of alcohol and drug use among children from deployed military families. Addiction. 2013;108(8):1418–25.

[11] Ming-Yuan Chih, M.H.A., M.S.,* Timothy Patton, B.S., Fiona M. McTavish, M.S., Andrew Isham, M.S., Chris L. Judkins-Fisher, B.S., Amy K. Atwood, Ph.D., and David H. Gustafson,

Predictive Modeling of Addiction Lapses in a Mobile Health Application Published online 2013 Sep 10. doi: 10.1016/j.jsat.2013.08.004

[12] Zhe Wang,1,† Shujuan Chen,1,† Junning Chen,2 Chunfeng Xu,2 Zhikang Chen,1 Wenxu Zhuang,1 Xu Li,1 Min Zhao,1,3 and Jiang Haifeng Theraleighhouse, "3 stages of drug addiction relapse: Emotional, mental & physical," https://www.theraleighhouse.com/addiction-blog/resources-myself/ 3-stages-addiction-relapse-emotional-mental-physical, 7-September2017, online, accessed 25-March-2018.

[13] Asghari A, Porshahbaz A, Farhodian A. Personality dimensions relevant to substance abuse relapse in the treatment of opioid dependence with methadone. J Res Addict. 2011;5(19):20-7.

[14] Zhe Wang,1,† Shujuan Chen,1,† Junning Chen,2 Chunfeng Xu,2 Zhikang Chen,1 Wenxu Zhuang,1 Xu Li,1 Min Zhao,1,3 and Jiang Haifeng1, A Community-Based Addiction Rehabilitation Electronic System to Improve Treatment Outcomes in Drug Abusers: Protocol for a Randomized Controlled Trial Published online 2018 Nov 6. doi: 10.3389/fpsyt.2018.00556

[15] Nastizayi N, Hezareh Moghadam M, Mollazehi A. The study of factors for recurred addiction from the view of self-introduced addicts to the addiction abandonment centers of zahedan. J Urmia Nurs Midwifery Faculty. 2010;8(3).