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Chapter

Quantitative Assessment Methods for the Severity of Drug Dependences and Corresponding Rehabilitation Programs

Mu Wang, Yu-Xiang Qian, Zeng-Hui Ding, Cun-Feng Yuan, Xian-Jun Yang, Yu Liu and Yi-Ning Sun

Abstract

Drug use is a worldwide issue, and how to treat it is even a greater challenge. It is important for drug dependences to receive interventions and treatments in time. Before receiving treatments, an effective screening or diagnosis assessment is necessary, and patients should have an assessment to understand the severity of drug use–related disorders. For more than 40 years, the instruments to assess the severity of drug dependence have been developed well, and different quantitative methods can cover almost every field of the symptoms in different periods and stages of drug addiction. This chapter reviews more than 20 drug dependence screening and diagnosis assessments and different types of treatments. These quantitative assessments can provide drug dependences a comprehensive diagnosis of their drug use–related disorders. The treatments should be designed for different level of drug dependence.

Core tip: We reviewed the screening, severity assessments, treatments for drug use–related disorders. The existing screening or severity assessments can provide us a comprehensive diagnosis of the disorders. However, after discussing the treatments, we found that conventional treatments focus more on symptoms amelioration and drug effects reduction. It is necessary to develop personalized and comprehensive treatment based on quantitative assessments.

Keywords: drug dependence, assessments, screening, treatments, exercise

1. Introduction

Drug dependence has become a worldwide issue, and 31 million individuals are suffering from its negative effect [1]. Even worse, according to National Center for Health Statistics, 70,630 people were killed by drug-involved overdose in 2019 [2]. Moreover, yearly economy effect from illicit drug use is around 193 billion dollars in the United States [3]. It is important for drug dependences to receive interventions and treatments in time. Before receiving treatments, an effective screening or
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diagnosis assessment is necessary [4]. This review covers quantitative assessment methods for drug dependences and the corresponding treatments. It concluded more than 20 quantitative instruments that are put into three main categories, screening, severity diagnosis assessments, and treatment outcomes assessments. In addition, three different types of treatments, conventional treatments, emergency treatments, and novel treatment, are discussed.

2. Assessments

2.1 Screening

Screening instruments usually are brief and easy to conduct. They are considered as “flagging,” because it’s the fundament of further assessments or treatments [5, 6]. The screening instruments tend to diagnose the presence of potential drug use–related disorders in specific fields, such as psychopathology, physiology, and social ability. The answers of screening questions are usually “yes” or “no.”

World Health Organization (WHO) developed The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) to screen and manage substance use and related issues. ASSIST has eight items to detect more than nine types of substance and scored 0.58–0.90 in test-retest reliability [7, 8]. Brown et al. proposed a two-phase assessment, A Two-item Conjoint Screen for Alcohol and Other Drug Problems (TICS) for screening alcohol and drug disorders [9]. TICS has nine questions in phase 1 and five questions in phase 2. One item’s answer is positive or negative, and the rest is never, rarely, sometimes, or often. TICS can screen around 80% drug dependences [9]. There is an approach, named Prenatal Substance Abuse Screen (5Ps), developed for prenatal females. The woman needs treatments if there is a “yes” in any of the five items. The overall accuracy of whether the woman needs treatments in 5Ps 0.776 [10]. Some screening techniques would contain more items to obtain more information. Skinner designed The Drug Abuse Screening Test (DAST), a screening and treatment evaluation instrument for drug dependences [11]. It has 28 items, including background, drug use history, social stability, and psychology. The answer for each item is “yes” or “no” and scored 1 point for “yes,” 0 for “no,” except for items 4, 5, and 7, for which a “no” response is given a score of “1.” The cutoff point is 6 and 12. If the score of a patient is larger than 5 or larger than 11, they will be considered to be “might” or “definitely” have drug use disorders, respectively. The reliability of DAST was 0.86–0.91 in Internal Consistency Reliability [11]. DAST-10 and DAST-20 are two shortened versions of DAST and drug use disorders can be screened faster in these two [12]. Another one is CAGE-adapted to Include Drugs (CAGE-AID) [13]. CAGE is derived from four sections: Cut down, Annoyed, Guilty, and Eye-opener. The result indicates clinical significance, if two or greater questions are “yes” [13]. CAGE-AID had general good to excellent performance in different subjects [14, 15].

2.2 Severity diagnosis assessments

Severity diagnosis assessments are to recognize the drug use–related disorders and estimate the level of the disorders. These assessments contain multiple items and have score for each item. Usually, the higher score represents the greater level of severity. Since 1970s, scientists have been studying on the assessments to diagnose
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The severity of drug dependence. After 40 years, a number of addiction severity assessments have been developed. Addiction severity index (ASI) is one of the most famous ones. ASI was proposed by A. Thomas McLellan and his colleagues (1980). It is a structured clinical interview, focusing on several areas, including medical status, employment status, alcohol use, drug use, legal status, family relationships, social relationships, and psychological functioning. Higher score in ASI means the higher level of severity and greater indication of accepting treatment [16]. This instrument has been used more than 30 years and is considered as gold standard in measuring the severity of drug addiction. The reliability of ASI has been tested by different studies. For example, both McLellan et al. and Hodgins et al. claim that ASI is generally reliable, and most parts are good to excellent, in addiction severity assessment [17, 18]. Now, ASI has developed into sixth version, ASI-6. There are also several adjusted versions of ASI, such as The Addiction Severity Index, Lite version (ASI-Lite) [19] and Addiction Severity Index self-report form (ASI-SR) [20].

Psychiatric disorders are the main concerned part in drug dependence severity assessments. Some psychological disorders assessments are directly utilized in drug dependence. Diagnostic and Statistical Manual of Mental Disorders (DSM) is an assessment for psychiatric disorders. The first version of DSM, DSM-1, was designed by American Psychiatric Association in 1952, and then it has been adjusted into several versions, DSM-II, DSM-III, DSM-III-R, DSM-IV, DSM-IV-TR, and DSM-5 [21]. Although DSM series were developed to measure mental disorders, they were widely used in drug disorders [22] and as a benchmark or to compare with other drug-dependent severity assessments [23, 24]. DSM series are reliable in drug dependence severity assessments. For example, DSM-5 performed good to excellent in alcohol, opioid, cocaine, and cannabis use disorders [25]. DSM-III-R and DSM-IV had good to excellent reliability in most items in opiates, cannabis, and cocaine [26]. Composite International Diagnostic Interview Substance Abuse Module (CIDI-SAM) is derived from another famous interview psychiatric instrument CICI. CIDI-SAM can be utilized to test alcohol, tobacco, and nine classes of psychoactive drug disorders. The performance of CIDI-SAM was excellent in most target substance in the reliability test [23].

Based on DSM series, some other drug dependence scales have been developed. Substance Dependence Severity Scale (SDSS) is to test drug dependences’ mental disorders, based on DSM-IV and ICD (mental health tests), as well as drug use history, such as frequency, recency, and amount of consumption in last 30 days [24]. It has 11 items to assess the severity and frequency, scored from 0 to 49, and higher score means higher severity level. SDSS had excellent performance in most items in alcohol, cocaine, heroin, and sedatives in test-retest. Semi-structured Assessment for Drug Dependence and Alcoholism (SSADDA) and The Chemical, Use, Abuse, and Dependence Scale (CUAD) are also DSM-based instruments. SSADDA has seven criteria to test a large range of indexes, including drug use history, social activities, and physical and psychological problems. SSADDA performed excellent in nicotine and opioid dependence, good in alcohol and cocaine, and fair in cannabis, sedatives, and stimulants [27]. CUAD relies heavily on the American Psychiatric Association’s (1987) Diagnostic and DSM-III-R for substance use disorders [28, 29]. CUAD has maximum 80 items and has Substance Severity Score for each substance they used and Total Severity Score for all substance they used. Different from assessments mentioned above, CUAD has different score weight for different items. For example, for items 16 and 17, each item scores 4 points, but 3 points for item 15, if they are true. In test-retest reliability, CUAD performed with excellence [29].

3
Evaluating the severity of withdrawal symptoms is as important as assessing the severity when patients are using drugs. There are a group of assessments focusing on the severity of opiate dependence in withdrawal. Severity of Opiate Dependence Questionnaire (SODQ) is a self-completion questionnaire that contains five sections for opiate dependence. It assesses opiate use, physical and affective symptoms in withdrawal, withdrawal-relief drug use, and rapidity of reinstatement of withdrawal symptoms after a period of abstinence. This assessment concerns more about the severity in withdrawal. The reliability was from 0.70 to 0.88 in Cronbach’s alpha [30]. The Clinical Opiate Withdrawal Scale (COWS) is an 11-item clinician-administered instrument to assess opioid withdrawal severity [31]. COWS also has different score weights on different items. The possible maximum score is 48. The score represents the level of severity, 5–12 points: “mild,” 13–24: “moderate,” 25–36: “moderately severe,” and more than 36: severe (more than 36, 33). The reliability of overall items in Cronbach’s alpha is 0.78 [31]. There are several similar withdrawal scales focusing on opiates, such as The Himmelsbach Scale, The Opiate Withdrawal Scale, Subjective Opiate Withdrawal Scale, Objective Opiate Withdrawal Scale, Short Opiate Withdrawal Scale, and The Subjective Opiate Withdrawal Questionnaire [32–36].

Clinical Drug Use Scale (DUS) can assess the drug dependence severity in different stages. It is a self-report instrument with excellent reliability to scale abstinence, consumption without impairment, abuse, dependence, and dependence with institutionalization [37, 38].

Some instruments tend to use a large number of questions to obtain detailed information from drug dependences and some tend to use a small number of items to diagnose patients’ severity as soon as possible. Similar to CUAD, 80 items, Substance Abuse Outcomes Module (SAOM) is a 113-item self-report scale. It covers patient characteristic, patient outcomes, and process of care. This assessment takes 20 minutes on average [39]. On the other hand, The Severity of Dependence Scale (SDS), Leeds Dependence Questionnaire (LDQ), SDSS, Drug use disorder (DUD), and COWS have much fewer items. SDS has five items to measure the level of drug dependence, mainly focusing on psychological components [40]. LDQ has 10 self-completion items, which are sensitive to severity change over time in opiate and alcohol dependences [41]. In both SDS and LDQ, each of the items can be scored from 0 to 3 and higher score represents higher level of drug dependence [40, 41]. DUD is a self-report measurement to assess drug use and dependence criteria for marijuana, cocaine, and painkiller. It tried to minimize the subjects’ bias while designing [42]. The number of items does not represent the reliability. No matter large number items assessments, CUAD and SAOM or small number items SDS, LDQ, DUD, and COWS, both had good to excellent performance in reliability test, details in Table 1.

2.3 Treatment outcomes assessments

Evaluating drug use–related disorders during treatment is crucial and treatments can be according to this. The assessments mentioned in severity diagnosis assessments can also be utilized during treatment. However, here are some methods that have been designed for it. SAOM, The Substance Abuse Treatment Scale (SATS), Australian Treatment Outcomes Profile (ATOP), Treatment Outcomes Profile (TOP) are focusing on the treatment outcomes in drug dependences. SATS measures the treatment progress for drug dependences. SATS and TOP monitor and assess patients with eight scales and 38 items, respectively [43, 44]. TOP covers more fields including substance use, health risk behavior, offending, and health and social functioning. In reliability
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<table>
<thead>
<tr>
<th>Assessments</th>
<th>Target substance</th>
<th>Number of items</th>
<th>Approach</th>
<th>Reliability*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Screening assessments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAGE-AID</td>
<td>Drugs</td>
<td>4 sections&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Self-report</td>
<td>Generally good to excellent</td>
</tr>
<tr>
<td>Prenatal substance abuse screen (5Ps)</td>
<td>alcohol and drugs</td>
<td>5 items</td>
<td>self-report</td>
<td>not tested</td>
</tr>
<tr>
<td>The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST)</td>
<td>alcohol, cigarettes and drugs</td>
<td>8 items</td>
<td>Self-report</td>
<td>0.58–0.90</td>
</tr>
<tr>
<td>The Drug Abuse Screening Test (DAST)</td>
<td>alcohol and drugs</td>
<td>28 items</td>
<td>Self-report</td>
<td>0.86–0.91 in Internal Consistency Reliability</td>
</tr>
<tr>
<td>Two-item conjoint screening (TICS)</td>
<td>alcohol and drugs, particularly sensitive to polysubstance</td>
<td>5 items</td>
<td>Semi-structured interview</td>
<td>Can screen nearly 80% drug dependences with disorders</td>
</tr>
<tr>
<td><strong>Severity diagnoses assessments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Addiction Severity Index (ASI)</td>
<td>Alcohol and drugs</td>
<td>Covering 7 problem areas</td>
<td>Semi-structured interview</td>
<td>Generally reliable, good to excellent</td>
</tr>
<tr>
<td>Clinical Drug Use Scale (DUS)</td>
<td>Drugs</td>
<td>5 sections</td>
<td>Self-report</td>
<td>Generally excellent</td>
</tr>
<tr>
<td>Composite International Diagnostic Interview Substance Abuse Module (CIDI-SAM)</td>
<td>Alcohol, tobacco and nine classes of psychoactive drugs</td>
<td></td>
<td>Fully-structured interview</td>
<td>Generally excellent</td>
</tr>
<tr>
<td>Drug Use Scale (DUS)</td>
<td>Drugs</td>
<td>5 items</td>
<td>Self-report</td>
<td>Generally excellent</td>
</tr>
<tr>
<td>DSM series</td>
<td>Drugs</td>
<td>—</td>
<td>Interviews</td>
<td>Most items were good to excellent in DSM-IV and 5</td>
</tr>
<tr>
<td>Leeds Dependence Questionnaire (LDQ)</td>
<td>Alcohol and opiates</td>
<td>10 items</td>
<td>Self-report</td>
<td>0.70–0.90</td>
</tr>
<tr>
<td>Semi-structured Assessment for Drug Dependence and Alcoholism (SSADDA)</td>
<td>Drugs, particular for cocaine and opioid</td>
<td>7 sections</td>
<td>Semi-structured interview</td>
<td>Excellent in cocaine and opioids, fair to good in other drugs, fair to good in psychiatric disorders</td>
</tr>
<tr>
<td>Severity of Opiate Dependence Questionnaire (SODQ)</td>
<td>Opiates</td>
<td>5 sections</td>
<td>Self-report</td>
<td>0.70–0.88 in Cronbach’s alpha test</td>
</tr>
<tr>
<td>Substance Dependence Severity Scale (SDSS)</td>
<td>Alcohol and drugs</td>
<td>11 items</td>
<td>Semi-structured interview</td>
<td>Most items were excellent in alcohol, cocaine, heroin, and sedatives</td>
</tr>
</tbody>
</table>
Zilm and Sellers (1978) proposed a quantitative technique to assess the level of physical dependence of narcotics, with administering naloxone. They gave an equation of objective severity scoring index (OSSI). However, this method has not been tested in reliability or validity, and Zilm and Sellers claim it relies on the experience of executors.

Table 1.
The list of screening and severity diagnosis assessments.

<table>
<thead>
<tr>
<th>Assessments</th>
<th>Target substance</th>
<th>Number of items</th>
<th>Approach</th>
<th>Reliability*</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Chemical, Use, Abuse, and Dependence Scale (CUAD)</td>
<td>Alcohol and drugs</td>
<td>Minimum 2 items, maximum 80 items</td>
<td>Semi-structured interview</td>
<td>Generally excellent</td>
</tr>
<tr>
<td>The Clinical Opiate Withdrawal Scale (COWS)</td>
<td>Buprenorphine, opiates and opioids</td>
<td>11 items</td>
<td>Self-report</td>
<td>0.78 in Cronbach’s alpha</td>
</tr>
<tr>
<td>The Severity of Dependence Scale (SDS)</td>
<td>Drugs</td>
<td>5 items</td>
<td>Self-report</td>
<td>0.8–0.9 in Cronbach’s alpha</td>
</tr>
<tr>
<td>The Substance Abuse Treatment Scale (SATS)</td>
<td>Drugs</td>
<td>8 scales</td>
<td>Semi-structured interview</td>
<td>Generally excellent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assessments</th>
<th>Target substance</th>
<th>Number of items</th>
<th>Approach</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian Treatment Outcomes Profile (ATOP)</td>
<td>Alcohol and drugs</td>
<td>22 items</td>
<td>Excellent in most items</td>
<td></td>
</tr>
<tr>
<td>Drug Use Disorder (DUD)</td>
<td>Marijuana, cocaine and painkillers</td>
<td>12 items</td>
<td>Self-report</td>
<td>0.88–0.95 in Cronbach’s a coefficient</td>
</tr>
<tr>
<td>Drug Use Disorder (DUD)</td>
<td>Marijuana, cocaine and painkillers</td>
<td>12 items</td>
<td>Self-report</td>
<td>0.88–0.95 in Cronbach’s a coefficient</td>
</tr>
<tr>
<td>Substance Abuse Outcomes Module (SACOM)</td>
<td>Alcohol and drugs</td>
<td>113 items</td>
<td>Self-report</td>
<td>Moderate to high</td>
</tr>
<tr>
<td>Treatment Outcomes Profile (TOP)</td>
<td>Drugs</td>
<td>38 items</td>
<td>Fully-structured interview</td>
<td>Eight items below 0.6 and eight more than 0.75</td>
</tr>
<tr>
<td>Objective severity scoring index (OSSI)</td>
<td>Narcotics</td>
<td>An equation</td>
<td>—</td>
<td>Not tested</td>
</tr>
</tbody>
</table>

*the reliability test is test-retest, if there is no indication; the coefficient is larger than 0.75, the reliability is excellent, 0.6–0.74 is good and 0.4–0.59 is fair.

*A section might contain more than one item.
2.4 Assessments selecting

All assessments are listed in Table 1. It concludes the target substance, number of questions, assessment approach, and reliability. The reliability is from test-retest, and the reliability coefficient below 0.40 is Poor; 0.40 to 0.59 is Fair, 0.60–0.74 is Good, and 0.75–1.00 is Excellent [48]. There are other assessments, such as Antisocial Personality Disorder, CIDI, General Health Questionnaire, Primary Care Posttraumatic Stress Disorder Screen, Health of the Nation Outcome Scales, and Michigan Alcoholism Screening Test, designed for psychological or alcoholic diagnosis and are not discussed in detail in this review.

Two main approaches of drug use disorder severity assessments are interview and self-report. In terms of reliability, there is no significant difference between interview and self-report. Several studies have proved that self-report assessments are as reliable as interview ones [49–51]. Compared with interview, self-report is more cost-effective and convenient, but the understanding of questions might affect the accuracy of self-report. Moreover, self-report instrument is more likely to collect honest answers and face-to-face interview might be unsuccessful to, because the questions would make the interviewees uncomfortable [52]. In interview assessments, there are two types, semi-structured and fully structured. Both of them have advantages and disadvantages. Fully structured interview does not need clinical judgment, and as a result, it does not need experienced clinicians. Semi-structured interview, in contrast, can obtain more detailed information of patients’ status, but more human cost and time cost [53].

Specific to each instrument, the reliability has been listed above, and all assessments are generally reliable. Some studies compared different assessments and found no significant difference in general, but disagreement in specific field [54, 55]. For example, the reliabilities of SDSS for alcohol, cocaine, heroin, and sedatives were excellent, but for cannabis, it was just fair [24]. SSADDA is more sensitive to cocaine and opioid [27]. In addition, the validity of assessments may not vary between different races. Taking DSM-IV as an example, Horton et al. reported that there is no significant difference between African-Americans and Caucasians, when using this assessment [55]. Taken together, when screening instruments or severity assessments were selected, factors, including genders, different stages of drug use or withdrawal, reliability in different drugs, time, human resource and economic cost, and the condition of patients, should be considered. It is important to choose one or more assessments, based on patients’ conditions to get accurate results.

3. Treatments

The treatments for drug dependence can be classified into three categories, conventional treatments (non-emergency), emergency (overdose) treatments, and novel treatments. Psychosocial interventions and medication managing are the most common techniques in conventional treatments. Patients need pharmacological intervention to reverse death when they are in overdose. In addition, physical activities, brain stimulation, virtual reality (VR), and mindfulness are considered as novel treatments for drug dependence. The drug dependences may need a combined treatment to make the therapeutic process more effective.
3.1 Conventional treatments

WHO and The United Nations Office on Drugs and Crime gave the standards of the treatments for drug use disorders (Standards). In order to screen out unqualified (ineffective, even harmful) treatments, Standards required the treatments of drug disorders to meet: (1) stopping or dropping drug use; (2) improving health, well-being, and social functioning of the affected individuals; (3) preventing future harms by reducing the risk of complications and relapse [4]. According to Standards, the traditional treatments can be categorized into psychosocial interventions, medication managing treatments and overdose or emergency treatments.

3.1.1 Psychosocial interventions

Psychosocial interventions are to address psychological and psychosocial issues related to drug use disorders. Cognitive-behavioral therapy (CBT) helps patients identify self-defeating thoughts and behaviors. It can contribute to address mental illnesses caused or related to drug use [4, 56]. Previous studies provided data-based evidence to support the effectiveness of CBT in drug dependence [57–59]. Contingency management (CM) is to reinforce patients’ positive behaviors, such as keeping abstinence, treatment attendance, and compliance with medication, by providing them rewards. Different from other treatments, the effect of CM may be not directly shown in drug use reduction, but shown in combined treatments [4, 60].

Moreover, building connection with other individuals and obtaining supports from others are crucial in psychological therapy. Family-orientated treatment approaches (FOTAs) are to realize the importance of family relationships and cultures. FOTA has been proved that it can be an effective and promising method for drug use disorders [61]. Mutual-help groups (MHP) are frequently used in drug rehabilitation centers, and there are famous drug-focused mutual-help groups, such as Narcotics Anonymous and Cocaine Anonymous. Twelve-step oriented MHP is a nonprofessional, mental support, emphasizing “sharing” and peer-led treatment [4, 62]. Evidence from different types of studies, meta-analysis, randomized controlled trials, and observational studies illustrated the effects of MHP, including reducing drug use, improving mental health, and decreasing relapse rate [63–65].

There are also some other psychosocial interventions, such as contingency management, the community reinforcement approach, and motivational interviewing and motivational enhancement therapy.

3.1.2 Medication managing treatments

Medication managing, also called substitution therapy, is useful and effective in managing and treating drug-related disorders. Pharmacological techniques treat drug disorders, usually through agonist approaches, antagonist approaches, targeting negative reinforcement of drugs, and targeting psychiatric and cognitive disorders [66]. Different drugs have different targeted medicines. For opioid dependence, WHO suggests two main pharmacological treatments: (1) opioid agonist maintenance treatment with long-acting opioids (extended-release opioids), methadone and buprenorphine, this method should be combined with psychosocial treatments; (2) detoxification, with naltrexone, an opioid antagonist [67]. Some other synthetic oral opioids such as L-alpha-acetyl-methadol and slow-release morphine are also considered as effective agents for opioids withdrawal [68]. Long-acting
benzodiazepine is a helpful medicine for sedative, hypnotic, or anxiolytic withdrawal. In addition, for methamphetamine and cocaine withdrawal, Provigil and immunotherapies would be the most useful agents, respectively [68–71]. These medicines will reduce withdrawal symptoms and reduce drug use, rather than being an alternative addiction for another [72].

3.1.3 Conventional treatments selecting

The conventional treatments do not have a specific program for patients in different levels of severity. Taking cocaine dependence as example, Hser et al. claim that different treatments, including outpatient methadone maintenance, outpatient drug-free, long-term residential and short-term inpatient, did not have significant difference on different severity of cocaine [73]. In general, a combined treatment is more effective. Drug-free treatments are more suitable for less severe drug dependence, and high level of drug dependence is challenge for any treatments.

Different groups may need different treatments. For pregnant women, almost all pharmacological treatments, except methadone, are unavailable, and stimulants and cannabis substitution drug is very limited, even nonexistent [74, 75]. Psychosocial intervention might be a better method [75]. Moreover, the treatments should be changed based on different ages. Treatment Improvement Protocol suggests that the elderly with drug addiction should accept age-specific treatments and combined pharmacological and psychosocial treatment is necessary. Building and rebuilding of self-esteem and social support network are important [76]. Adolescents with drug addiction may confront worse psychiatric comorbidity, and this issue is more common in family having alcohol and drug problems and mental health problems [77, 78]. Family dysfunction and mental health problems are more common and worse in girls, compared with boys [79, 80]. Therefore, the treatments for adolescents may focus more on psychiatric issues, and solving family issues would benefit the treatment outcomes, especially for female adolescents.

Treatments also need to consider about ethical issues. A large proportion of dependences are not willing to accept or seek treatments [45, 81]. Compulsory drug treatment is not legal in some nations, and how to convince drug dependences to receive treatments is a challenge. Johnson intervention, which is an organized and rehearsed meeting to let the drug dependence understand the treatment benefits and nontreatment risks, can be a choice [82]. In addition, patients should choose the treatments they prefer. For example, according to Drug Abuse Treatment Outcome Study, cocaine dependent did not like methadone maintenance. Patients who have used but are not dependent on heroin and cocaine like drug-free treatments more. Heroin dependence, or cocaine and heroin dependence, tends to be treated in methadone maintenance program [73].

3.2 Overdose or emergency treatments

Opioids and stimulants overdose can cause irreversible damage, even death. Opioid dependences are more likely to experience overdose, especially using it by injection [4]. WHO suggests that naloxone, a life-saving drug, can be timely administrated to reserve the opioid overdose [83]. For stimulants overdose, WHO recommends using benzodiazepines and sometimes antipsychotic medications to manage syndromes and ameliorate symptoms [4]. Gorelick claim that pharmacokinetic, which is to maintain the target drug under its minimum effective concentration at the site of
action, treatment can be effective for acute drug overdose [84]. The immunotherapies are antagonizing the effects of drug through pharmacokinetic mechanisms. This approach involves the use of nicotine-specific antibodies that bind nicotine in serum, resulting in a decrease in nicotine distribution to the brain and an increase in nicotine’s elimination half-life [85].

3.3 Novel treatments

Psychosocial and pharmacological interventions are treating drug disorders through reducing negative symptoms, decreasing craving, or managing the effect of target drugs. New treatment methods bring prospects for the cure of addiction, and it is helpful for developing personalized and comprehensive treatment.

Recent studies have highlighted the potential of brain stimulation as an innovative, safe, and cost-effective treatment for some SUDs. These include: (i) transcranial electrical stimulation; (ii) transcranial magnetic stimulation (TMS); (iii) transcranial direct current stimulation (tDCS); and (iv) deep brain stimulation (DBS). Stimulation therapies may achieve their effect through direct or indirect modulation of brain regions involved in addiction, either acutely or through plastic changes in neuronal transmission. Although these mechanisms are not well understood, further identification of the underlying neurobiology of addiction and rigorous evaluation of brain stimulation methods has the potential for unlocking an effective, long-term treatment of addiction.

Exercise may also provide a new treatment idea. In recent years, exercises are considered as a novel treatment for drug addiction. Lynch et al. concluded that exercises can reduce the reinforcing effects of drugs and may prevent the relapse [86]. Exercise can increase dopamine level in several parts of brain [87], bring happiness [88], and improve mental health and self-esteem [89]. More importantly, some studies found that exercises can affect dopamine in the reward pathway, even repair the decreased dopamine receptors [86, 90–92]. Furthermore, the side effects that resulted by drug use are not only psychiatric disorders and brain damage, but also the physical impairment, such as impaired respiratory system and bone loss [93, 94]. Exercise can benefit the physical health is well known. Drug dependences should accept the risk evaluation of exercise before having physical activities. The effects of exercises on drug use disorders still need more clinical studies, especially on the dopamine system. Besides, depending on the age, type of drug, age of onset, it is necessary to design appropriate exercise plans according to individual health characteristics [95]. It reported a significant increase in glutamate and GABA signaling in the visual cortex following exercise, as well as an increase in glutamate in the ACC after exercise in adult rats, and exercise-induced expansion of cortical pools can be seen for both glutamate and GABA neurons [96]. Additional, high-intensity interval training has been noted to possess benefits even greater than those of standard moderate exercise [97]. However, appropriate exercise intensity and exercise mode for patient with different age, gender, type of drug still need more in-depth research.

Besides, VR technology has emerged as a powerful tool for the research and intervention of addiction [98]. It’s a tool to study how proximal multi-sensorial cues, contextual environmental cues, as well as their interaction (complex cues), modulate addictive behaviors. Moreover, VR simulations can be personalized. They are currently refined for psychotherapeutic interventions. Embodiment, eye-tracking, and neurobiological factors represent novel future directions. The progress of VR
applications has bred auspicious ways to advance the understanding of treatment mechanisms underlying addictions.

Last but not least, mindfulness-based relapse prevention (MBRP) has been shown as effective in treating substance use disorders [99]. Study results suggest that mindfulness meditation practice may produce endogenous theta stimulation in the prefrontal cortex, thereby enhancing inhibitory control over opioid dose escalation behaviors [100]. However, it necessary to examine the following mediators of intervention outcome: mindfulness skills, emotion regulation skills, executive functioning skills, savoring, and positive and negative affect.

4. Conclusion and outlook

For more than 40 years, the instruments to assess the severity of drug dependence have been developed well, and different quantitative methods can cover almost every field of the symptoms in different periods and stages of drug addiction. Patients, medical workers, or researchers can choose suitable assessments, based on their conditions. The comprehensive and convenient techniques might leave one problem that is how to convince the dependences to do the screening or diagnosis tests. As mentioned in Treatments section, most drug dependences do not want to accept treatments. This needs efforts from drug dependences themselves, their family, the community, and whole society.

Drug addiction is a chronic disease [101], it needs chronic treatments. The interventions or treatments for drug dependence might be in a dilemma caused by medical development. Existing treatments are focusing on addressing the symptoms of drug use–related disorders, rather than the root of addiction. Drug addiction, also called drug use disorders, is defined as a complex, but treatable, disease that affects brain functions modulated by genetic, developmental, and environmental factors. People with addiction use drugs often tend to continue despite harmful consequences [101, 102]. The brain function damage caused by drug use has been proved. For example, chronic methamphetamine use can result in hippocampal volumes decrease and severe gray-matter deficits [103]. Moreover, dopamine receptors and transporters deficits are the consequence of drug use [104, 105]. Conventional treatments, psychosocial interventions, and medicines can only ameliorate withdrawal symptoms, reduce craving or improve psychological health, but not repair the brain or dopamine functions. Exercise or brain stimulation might be a supportive method to contribute to brain system recovering. So far, it is far more from the real rehabilitation. We need more novel treatments to contribute to the functional recovery. Furthermore, existing treatments do not subdivide patients of different level of severity or different groups of patients. Future work can design treatments based on the characteristics of the patients.

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