

Practitioner Review: Adolescent alcohol use disorders: assessment and treatment issues

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Background: Alcohol use disorders in adolescents are associated with significant morbidity and mortality. Over the past decade, there has been a burgeoning of research on adolescent alcohol use disorders. **Methods:** A summary of the alcohol assessment tools is provided, and randomized studies reviewed and synthesized to provide an overview of state of the art knowledge of treatment of adolescent alcohol use disorders. Animal models of addiction are also briefly reviewed, and the value of translational research approaches, using findings from basic studies to guide the design of clinical investigations, is also highlighted. **Results:** Comorbidity is the rule, not the exception in adolescent alcohol use disorders. Comprehensive assessment of psychiatric and other substance use disorders, trauma experiences, and suicidality is indicated in this population to optimize selection of appropriate clinical interventions. In terms of available investigated treatments for adolescents with alcohol use disorders, Multidimensional Family Therapy and group administered Cognitive Behavioral Therapies have received the most empirical support to date. There is a paucity of research on pharmacological interventions in this patient population, and no firm treatment recommendations can be made in this area. **Conclusions:** Given the high rate of relapse after treatment, evaluation of combined psychosocial and pharmacological interventions, and the development of novel intervention strategies are indicated. **Keywords:** Adolescents, alcohol abuse, alcohol dependence, assessment, treatment.

Alcohol misuse in adolescents is associated with significant morbidity and mortality. Adolescents who use alcohol are at increased risk for smoking, other drug use, and impairment across multiple domains of functioning (Clark, 2004). In addition, alcohol use is associated with the three leading causes of death among adolescents: motor vehicle accidents, homicide, and suicide (Brent et al., 1993; Irons, 2006; McLaughlin, Daniel, & Joost, 2000). It is estimated that approximately one in three older adolescents in the United States (US) have five or more drinks at a time on a monthly or more frequent basis (Eaton et al., 2006; Faden, 2006; Grunbaum et al., 2004), and about 20% of adolescents report drinking this much at least once a week (NIDA, 2003). A recent examination of the prevalence of alcohol use in the US, United Kingdom (UK) and European countries indicates that rates of binge drinking, as well as average weekly alcohol consumption, are 2 to 3 times greater in the UK and Europe than in the United States (Case, 2007).

Despite the high prevalence of excessive drinking, only 4–6% of adolescents meet diagnostic criteria for an alcohol use disorder (Kandel et al., 1999; Kilpatrick et al., 2000; Lewinsohn, Rohde, & Seeley, 1996). The greatest risk for problem drinking is associated with the start of alcohol use prior to the age of 14 (Grant & Dawson, 1997;

Hingson, Heeren, Zakocs, Winter, & Wechsler, 2003). The prognostic value of early alcohol use in predicting later alcohol use disorders holds not only in the US, but in other countries with more permissive attitudes toward drinking as well (Schmid, 2007). Extant research suggests that adolescent onset of alcohol use disorders is also associated with a more rapid transition from first use to dependence, and shorter time from first to second substance dependence (Clark, Kirisci, & Tarter, 1998). While there is much that has been learned in the area of adolescent alcohol use over the past decade, there is much left to discover.

The goals of this review include: (a) summarize the assessment instruments of alcohol use and associated problems; (b) review randomized studies on therapies for adolescent alcohol use disorders; and (c) discuss translational research approaches for identifying novel intervention strategies in this area. There are multiple prior reviews on treatment outcome research for general substance use in adolescents (e.g., Deas & Thomas, 2001; Ozechowski & Liddle, 2000; Waldron, 1997; Williams et al., 2000). Yet, employing interventions that are designed to address general substance misuse may be questionable for alcohol use as treatments effective for reducing use of illicit substances may fail to treat alcohol problems (e.g., Azrin et al., 2001; Peterson, Baer, Wells, Ginzler, & Garrett, 2006; Santisteban et al., 2003).

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Assessment

Diagnostic criteria

The symptoms required for the diagnoses of Alcohol Abuse and Dependence outlined in the *Diagnostic and Statistical Manual*, fourth edition (DSM-IV; American Psychiatric Association, 1994) and the International Classification of Diseases, tenth edition (ICD-10; World Health Organization., 1992) are presented in Table 1. DSM-IV criteria for substance dependence are similar to those in ICD-10. Despite some differences in specific language used to describe symptoms, studies demonstrate high concordance between DSM-IV and ICD-10 criteria for alcohol dependence, indicating that both systems tap into the same underlying constructs (for review see Hasin, Hatzenbuehler, Keyes, & Ogburn, 2006).

However, agreement is poor for alcohol abuse, with the DSM criteria being impairment based, and the ICD-10 criteria reliant instead on physical (e.g., hepatitis) and psychological (e.g., depression) consequences of alcohol misuse for the diagnosis. These differences in the diagnostic systems are further complicated by the culture-specific patterns of alcohol use. Comparative cross-national data on drinking practices are necessary for standardizing the criteria across DSM-IV and ICD-10, and for establishing norms for community and clinical samples.

Extant data suggests that there are developmental differences in the behavioral and physiological characteristics of alcohol use disorders (Kaminer, 1991). For example, withdrawal is rare in adolescence (Chung, Martin, & Winters, 2005). In contrast,

Table 1 Diagnostic criteria for alcohol use disorders

DSM-IV criteria (description)	ICD-10 criteria (description)
<p>Alcohol abuse</p> <p><i>One or more of the following symptoms during a 12-month period</i></p> <ol style="list-style-type: none"> 1. Recurrent use resulting in failure to fulfill major role obligations at work, school, or home (repeated absences from school or work because hung over, skipping classes, suspensions or expulsions, or school failure secondary to alcohol use, drunk while at school or work) 2. Recurrent use in situations which are physically hazardous (driving or speeding, or engaging in other dangerous behavior while intoxicated, such as jump off roof, play dare) 3. Recurrent use related legal problems (vandalism, theft, or assault while under the influence – whether or not it resulted in arrest) 4. Continued use despite persistent or recurrent social or interpersonal problems (fights with girlfriend/boyfriend, other peers, or parents about intoxication, loss of friends due to alcohol use) 	<p>Harmful use</p> <p>Recurrent substance use that is causing harm to health (physical damage, such as hepatitis acquired from injections of drugs and/or mental damage, such as depressive symptoms secondary to alcohol misuse)</p> <p><i>Caveat:</i></p> <p>Harmful use is not necessarily evidenced by negative consequences, such as marital discord or legal problems, and/or cultural censure of specific substances</p>
<p>Alcohol dependence</p> <p><i>Three or more of the following symptoms during a 12-month period</i></p> <ol style="list-style-type: none"> 1. Tolerance (progressively larger amounts are needed to achieve effect) 2. Withdrawal (2 or more symptoms: after reduction/cessation of alcohol use after heavy and prolonged use experience sweats, increased pulse, hand tremor, insomnia, nausea, psychomotor agitation, anxiety, transient hallucinations or illusions, seizures; use of substance to relieve/avoid withdrawal) 3. Drank more than intended (drink to point of getting sick or passing out, drunk when planned casual drinking) 4. Time consuming (considerable amount of time spent obtaining alcohol, using alcohol, or recovering from excess use) 5. Important social, occupational, or recreational activities given up or reduced due to use (quit extracurricular activities due to use, drop out of school, stop spending time with friends) 6. Continued use despite knowledge of persistent or recurrent physical or psychological problems that are likely caused or exacerbated by use (recurrent episodes of getting sick, passing out, or injuring self when intoxicated and/or despite bouts of anger or depression related to use) 7. Unsuccessful efforts to cut down or control use (repeated expression of desire to cut down without behavioral change) 	<p>Dependence syndrome</p> <p><i>Three or more of the following symptoms during a 12-month period</i></p> <ol style="list-style-type: none"> 1. Tolerance (progressively larger amounts are needed to achieve effect) 2. Withdrawal (physical symptoms, use of substance to relieve/avoid withdrawal symptoms) 3. Difficulty in controlling onset, termination and level of substance use 4. Time consuming (increased amount of time needed to obtain and consume substance and/or recover from its effects) 5. Progressive neglect of other pleasurable activities due to substance use 6. Continues use despite clear evidence of harmful consequences (harm to liver, depressive mood, cognitive impairments) 7. A strong desire or compulsion to consume substance

Note: Adapted from DSM IV (APA, 1994) and ICD-10 (WHO, 1992, 1996).

the symptoms of tolerance and drinking more than intended are frequently endorsed by adolescents who do not meet criteria for any abuse symptoms (Chung et al., 2005). As some degree of tolerance is a normative physiological process with the onset of use, the alcohol dependence symptom of tolerance should only be considered met if the amount required to achieve intoxication increases after a period of regular use. In addition, in adolescents excessive drinking is most often attributable to inexperience with alcohol and responding to peer pressures, and not compulsions, as is frequently reported in adult subjects (Chung et al., 2005).

Presently, most of the diagnostic inventories for substance use disorders are DSM-based. There are two diagnostic interviews that provide dimensional measure of adolescent substance use based on DSM-IV and ICD-10, namely, the Substance Abuse Module (SAM) of the Composite International Diagnostic Interview (CIDI; WHO, 1990), and the Substance Dependence Severity Scale (Hasin et al., 1996). However, only SAM is validated for use with adolescents. There is a dearth of validated cross-cultural diagnostic instruments for adolescent alcohol and substance use disorders. A greater concordance between DSM-IV and ICD-10 criteria may serve advances in the fields of epidemiology, health service management, and morbidity and mortality analyses (Saunders, 2006). Yet, the relevance of the DSM-IV and ICD-10 distinctions among categories of alcohol use disorders is unclear for the current state of the treatment outcome research. Our database on the randomized studies of interventions for adolescent alcohol misuse indicates that little attention is frequently paid to differentiating alcohol abuse from dependence in the description of targeted populations and in reporting results. Most studies rely on frequency of substance use (e.g., number of days of use or abstinence) as a measure of outcome and evaluate reduction in the associated negative consequences (e.g., social, family, school, peer, legal and behavioral problems).

Multiple informants/confidentiality

Assessment of substance use disorders and related problems rely primarily on the adolescent self-report. While studies have shown that parents are critical informants when assessing child and adolescent psychopathology, especially externalizing disorders, parents' reports of adolescent substance use are less valuable. In a recent study of approximately 600 adolescents assessed for alcohol use disorders using the parent- and child-version of the Semi-Structured Assessment for the Genetics of Alcoholism, 63% of the cases of alcohol abuse or dependence would have been missed if adolescent data were not collected and only parent report were obtained. In contrast, adolescent data alone would

have resulted in only 8% of the alcohol use diagnoses being missed (Fisher et al., 2006).

The assessment of alcohol use behaviors is facilitated by the general discussion of peer preferences, favorite drinks, and the types of alcohol typically served at parties prior to inquiring about specific symptoms (Kaufman et al., 1997). In order to facilitate disclosure, it is important to assure confidentiality (Bukstein & Winters, 2004). One survey found that less than 20% of adolescents would seek care related to alcohol or drug use if parental knowledge were mandatory (Marks, Malizio, Hoch, Brody, & Fisher, 1983). While parents are aware of the alcohol use of most adolescents entering care for treatment targeting this problem, alcohol and drug abuse disorders also are highly prevalent in general adolescent psychiatric settings (Lipschitz, Grilo, Fehon, McGlashan, & Southwick, 2000), and need to be carefully and sensitively assessed in all patients. There is tremendous variation in laws across regions, but most jurisdictions permit adolescents to consent for alcohol and/or drug abuse treatment (Weddle & Kokotailo, 2002), and clinicians should be familiar with their jurisdiction's legislation on this issue.

Alcohol and substance use assessment tools

Delineating patterns of alcohol and substance use requires careful assessment of the content of the problematic behaviors, and multiple factors that contribute to their onset, maintenance and desistance. Many instruments are available for the assessment of substance use and related domains of functioning. In this section we build upon and extend prior reviews of the measures of substance use in adolescents (e.g., Allen & Columbus, 2003; Center for Substance Abuse Treatment, 1999; Farrow, Smith & Hurst, 1993; Leccess & Waldron, 1994; Winters, Latimer, & Stinchfield, 2001). To identify alcohol use assessment instruments, we have consulted prior reviews and searched PsycInfo and Medline using keywords such as *adolescent, alcohol, drug, substance, assessment, measure, instrument*. We have also consulted substance use assessment websites such as Alcohol and Drug Abuse Institute Instrument Database, and NCADI and SAMHSA Alcohol and Drug Information. Of the identified measures, we have selected instruments that met the following criteria: 1) instrument assesses substance use in adolescents; 2) assessment includes alcohol use; 3) instrument evidences good psychometric properties (reliability and validity); and 4) psychometric properties have been examined with adolescent populations (see Table 2).

We have identified 32 assessment instruments that fall into three major categories: screening tools; comprehensive measures; and expectancy, motivation and self-efficacy instruments. *Screening tools*, most frequently self-report questionnaires, are used

Table 2 Assessment instruments of alcohol use disorders and associated factors

Assessment Instrument	# of items	Administration	Brief description
Screening instruments			
Adolescent Alcohol Involvement Scale (Mayer & Filstead, 1979)	14	5	Assesses the type and frequency of alcohol use, including reasons for drinking, drinking context, consequences, last drinking episode, adolescent's/other perceptions about drinking.
Adolescent Drinking Index (Harrell & Wirtz, 1989)	24	5	Assesses alcohol use-related symptoms, including psychological, physical and social problems, and loss of control. Subscales: self-medicating drinking & rebellious drinking.
Adolescent Obsessive Compulsive Drinking Scale (Deas et al., 2001)	14	5–10	Inquires about the adolescent's level of effort to resist thoughts about drinking (irresistibility scale) and the distress associated with these thoughts (interference scale).
Alcohol and Drug Problem Acknowledgement Scale (Weed et al, 1994)	13	5	Scale from Minnesota Multiphasic Personality Inventory for Adolescents. Assesses open acknowledgment of substance use.
Alcohol and Drug Problem Proneness Scale (Weed et al, 1994)	36	10	Scale from Minnesota Multiphasic Personality Inventory for Adolescents. Assesses potential for developing substance use problems.
Alcohol Use Disorders Identification Test (Babor et al., 1992)	10	2	Identifies hazardous and harmful alcohol consumption before established dependence, and major physical and psychosocial consequences.
Drug Use Screening Inventory – Revised (Kirisici et al., 1995)	159	20	Assesses severity of substance use, behavior patterns, health status, mental illness, school and work adjustment, social skills, family systems, peer relationships, and recreation.
CRAFFT (Knight et al., 1999)	6	2	Measures of substance use and related problems. CRAFFT is an acronym derived from the first letters of the key words in items of the questionnaire.
Leeds Dependence Questionnaire (Raistrick et al., 1994)	10	5	Assesses pathophysiological elements of dependence syndrome, tolerance and withdrawal.
Personal Experience Screening Questionnaire (Winters, 1991)	40	10	Assesses substance use severity and history, associated psychosocial problems and response distortion tendencies (faking good and faking bad).
Problem Oriented Screening Instrument for Teenagers (Rahdert, 1991)	139	20–25	Assesses substance use, physical and mental health status, family relations, peer relations, school and employment status, social skills, recreation, aggressive behavior and delinquency.
Rutgers Alcohol Problem Index (White & Labouvie, 1989)	23	10	Addresses negative consequences of alcohol use, including family and social relations, delinquency, and psychological, physical and neuropsychological functioning.
Substance Abuse Proclivity Scale (MacAndrew, 1986)	36	10	MMPI derived scale developed to assess substance use in adolescent and young adult males. Taps into the substance abuse potential delinquency-relevant and reward-seeking behaviors.
Substance Abuse Subtle Screening Inventory-Adolescents (Miller, 1985)	100	10–15	Assesses substance use, includes four subtle scales designed to identify abusers who are attempting to minimize their substance use.
Diagnostic interviews			
Adolescent Diagnostic Interview (Winters & Henly, 1993)	213	45	Assesses symptoms associated with substance use as per DSM-IV criteria, including substance use history, psychosocial functioning, mental health, and sociodemographic information.
Customary Drinking and Drug Use Record (Brown et al., 1998)	varies	10–30	Assesses substance dependence symptoms and negative consequences of substance use. Assesses current and lifetime use as per DSM-IV criteria.
Diagnostic Interview Schedule for Children (Costello et al., 1985)	varies	30–120	Separate forms for child and parent. DSM-IV version available (Shaffer, Fisher, & Dulcan, 1996).
Structured Clinical Interview for the DSM – Adolescent Version (Martin et al., 1995)	varies	10–15	Assesses substance use in adolescents using DSM-IV criteria.
Substance Abuse Module (Cottler, 2000)	38	30–45	Substance use section of the Composite International Diagnostic Interview (World Health Organization, 1990). Evaluates onset and recency of substance use symptoms, withdrawal symptoms, and physical, social and psychological consequences; interview questions serve the diagnostic criteria of DMS-IV and ICD-10.

Table 2 Continued

Assessment Instrument	# of items	Administration	Brief description
Problem-focused inventories			
Adolescent Drug Abuse Diagnosis (Friedman & Utada, 1989)	150	45–55	Measures substance use and levels of functioning in multiple domains, including psychological and legal status, employment, and school, peer and family involvement/problems.
Adolescent Problem Severity Index (Metzger et al., 1991)	85	45	Assesses substance use, psychological and legal status, employment, and school, peer and family involvement, reasons for assessment, referral source and adolescent understanding for referral reasons.
Comprehensive Adolescent Severity Inventory (Meyers et al., 1995)	varies	45–90	Measures multiple domains of functioning, including family, health, school and legal status, stressful events, sexual behaviors, substance use, mental health, peer relationships, and leisure.
Global Appraisal of Individual Needs (Dennis et al., 2002)	1,606	60–120	Measures recency, breadth, and frequency of problems, services utilization, physical and mental health, risk and protective factors, environment, and vocational situation.
Teen Addiction Severity Index (Kaminer et al., 1991)	154	20–45	Assesses substance use and levels of functioning in multiple domains, including psychological and legal status, employment, and school, peer and family involvement/problems.
Multiscale inventories			
Adolescent Self-Assessment Profile (Wanberg, 1992)	225	25–50	Assesses frequency, benefits and consequences of substance use, and risk factors.
Hilson Adolescent Profile (Inwald et al., 1986)	310	45	Assesses substance use and other characteristics that correspond to psychiatric diagnoses and psychosocial problems.
Personal Experience Inventory (Winters & Henly, 1989)	276	45–60	Assesses substance use severity, risks, protective factors and response distortion tendencies. Supplemental measures address suicidality, trauma history, and parental substance use.
Retrospective systematic assessments of drinking behaviors			
Alcohol Time-Line Follow-Back (Sobell & Sobell, 1992)	varies	10–30	Estimates daily drinking up to 12-month from the interview day.
Form 90 (Tonigan et al., 1997)	58	40–60	Semi-structured interview to reconstruct alcohol and illicit drug use for the past 90 days.
Expectancies, motivation, self-efficacy			
Alcohol Expectancy Questionnaire – Adolescents (Brown et al. 1987)	90	20–30	Assesses individual's anticipated effects of alcohol use. Measures positive and negative expectancies.
Circumstances, Motivation, Readiness and Suitability (DeLeon et al., 1994)	42	5–10	Assesses external and internal motivation, readiness for treatment and perceived appropriateness of the treatment modality. Designed to predict treatment retention.
Drug Avoidance Self-Efficacy Scale (Martin et al., 1995)	16	5	Assesses adolescent's ability to resist use of substances in different high risk situations.
Perceived Benefit of Drinking Scale (Pitchers & Singer, 1987)	5	2	A nonthreatening problems severity screen to assess specific reinforcements received from drinking; the higher the perceived benefit, the higher the likelihood of alcohol use.
Problem Recognition Questionnaire (Cady et al., 1996)	25	5	Assesses adolescent motivation for substance use change and readiness for treatment.

to evaluate presence of a substance use problem (e.g., Alcohol Use Disorders Identification Test; AUDIT) and the level of functioning in related domains, including physical and mental health, family and peer relations, education and vocational status, legal involvement, and leisure activities (e.g., Drug Use Screen Inventory and Problem Oriented Screening Instrument for Teenager). Scales that help characterize problematic substance use in teenagers who are known to have substance misuse history include the Adolescent Drinking Index, the Adolescent

Obsessive-Compulsive Drinking Scale, and the Personal Experience Screening Questionnaire. Scales that are useful in identifying negative consequences of substance use are the Adolescent Alcohol Involvement Scale, AUDIT, and the Rutgers Alcohol problem Index. CRAFFT is a brief screening scale that is particularly suitable in cases when substance use history is not known. The Substance Abuse Subtle Screening Inventory for Adolescents is mostly relevant for teenagers who are suspect for minimizing their alcohol and drug use problems.

If the initial screen suggests the presence of a problem that requires further assessment, more comprehensive instruments are used. Comprehensive measures include diagnostic interviews, problem-focused interviews, multiscale questionnaires and retrospective systematic reviews of drinking behaviors. *Diagnostic interviews* provide general psychiatric assessment and substance use evaluation (e.g., Adolescent Diagnostic Interview). *Problem-focused interviews* typically measure history of substance use and related problems, including functional difficulties and social, legal, academic, and vocational consequences (e.g., Adolescent Drug Abuse Diagnosis). *Multiscale questionnaires* tap into similar domains; however, they are self-administered, usually include scales for detecting response distortion tendencies, and have normative data in community and clinical samples (e.g., Adolescent Self-Assessment Profile). *Retrospective assessments* of drinking behaviors provide a systematic review of alcohol consumption that can be used for treatment planning, evaluation of treatment effects and follow-up assessments (e.g., Alcohol Time-Line Follow-Back). Further, multiple measures have been developed to evaluate *motivation for change*, *expectancies* or anticipated effects of substance use and *self-efficacy* (e.g., Alcohol Expectancy Questionnaire – Adolescent Version). These measures are particularly useful for assisting adolescents in gaining insight into their substance use problem, understanding reasons for using, psychosocial and physical consequences, and factors that promote and maintain their substance use.

Biomarkers

Clinically significant changes in liver enzymes are rare in adolescents with alcohol use disorders, including those who meet criteria for alcohol dependence (Clark, Lynch, Donovan, & Block, 2001). Urinalysis is recommended in monitoring treatment in adolescents with alcohol use disorders, given the high comorbidity with marijuana and other drug use problems in this population (Bukstein & Winters, 2004; Casavant, 2002). Carbohydrate-deficient transferrin (CDT) is a relatively expensive biomarker recently approved by the Food and Drug Administration (FDA) for detecting and monitoring alcohol use disorders (Irons, 2006). More cost effective serum markers of alcohol hepatotoxicity such as gamma-glutamyltransferase (GGT) reliably discriminates users from non-users (Taracha et al., 2006), the early detection of alcohol consumption (EDAC) test uses routine chemistry and haematology analytes to identify alcohol misuse (Harasymiw, Seaberg, & Bean, 2004), and results from breath alcohol tests correlate well with blood alcohol content to verify recent use and current intoxication (Bendtsen, Hultberg, Carlsson, & Jones, 1999). The validity of these approaches to monitor use in adolescents, however, has not been examined.

Comorbidity, suicidality and trauma history

Comorbidity is the rule, not the exception for adolescents with alcohol use disorders. High rates of behavioral, mood, anxiety, and other substance use disorders have been reported in adolescents with alcohol use disorders (Clark et al., 1997); therefore, complete psychiatric and substance abuse assessments are indicated in working with this population. Further, alcohol use in adolescents is associated with elevated rates of suicidality (Cornelius, Clark, Salloum, Bukstein, & Kelly, 2004). The presence of a loaded gun is associated with 32-fold increased risk of suicide completion and adolescent suicide victims who use firearms are 4.9 times more likely to have been drinking than those who used other methods of suicide (Brent, Perper, & Allman, 1987). Thus, careful assessment of suicidal ideation, history of prior attempts, and availability of firearms and other means of harm is indicated in working with this population.

Adolescents with alcohol use disorders are also 6 to 12 times more likely to have a history of physical abuse and 18 to 20 times more likely to have a history of sexual abuse than community controls (Clark, Lesnick, & Hegedus, 1997). Trauma histories in adolescents with alcohol use disorders are associated with earlier onset of substance use diagnoses, higher rates of comorbid major depression and posttraumatic stress disorder (PTSD), greater disability, and higher rates of relapse (Clark, De Bellis, Lynch, Cornelius, & Martin, 2003; Grella & Joshi, 2003).

While alcohol dependence is one of the more common diagnoses associated with child abuse (Kendler et al., 2000; Moran, Vuchinich, & Hall, 2004), not all maltreated children develop alcohol use disorders. Emerging data suggests the likelihood of a given abused individual developing alcohol use disorders is influenced by genetic factors. Gene by environment interactions have now been reported in three independent samples (Covault et al., 2007; Kaufman et al., 2007; Nilsson et al., 2005), with the risk for the development of alcohol problems following maltreatment and/or severe stress greatest in individuals with the short allele of the serotonin transporter gene (locus SLC6A4). It has been suggested that integrated PTSD- and alcohol-focused cognitive-behavioral and family treatment for adolescents with comorbid abuse-related PTSD and substance use disorders may optimize outcomes for this population (Cohen, Mannarino, Zhitova, & Capone, 2003), although empirical data is currently lacking regarding the efficacy of combined treatment for these patients, or the optimal sequencing of these interventions.

Comprehensive assessment of trauma histories should include multiple informants and data sources (Grasso et al., in press). One of the reliable and efficient self-report measure that has been

frequently used is the Child Trauma Questionnaire (CTQ; Bernstein, Ahluvalia, Pogge, & Handelsman, 1997). The CTQ is a 28-item self-report scale that assesses experiences of neglect, physical, sexual, and emotional abuse.

Assessment summary

The abundance of available psychometrically sound alcohol use measures affords users a choice, but, on the other hand, presents a selection challenge. The general guidelines for the selection of assessment instruments include conceptual and pragmatic considerations, such as the purpose of the assessment, psychometric properties of an instrument, and availability of resources to administer and score a measure. That is, in clinical settings with a new client, brief screening instruments are of major utility, while in research settings, the need to define clinical characteristics of the sample may necessitate comprehensive measures and full assessment batteries.

We have provided a summary of the alcohol use measures that have been tested with adolescent populations. Many of these measures, particularly problem-focused inventories, include assessment of issues related to alcohol use, such as family, peer and school functioning, legal status, risk and protective factors, and involvement in leisure activities. Assessment of these domains may provide valuable information about factors that contributed to the onset and maintenance of alcohol use and may assist in treatment planning. Assessment of comorbidity, trauma history, and self-harm risk are particularly salient factors to evaluate in alcohol using adolescents, as they frequently complicate treatment, and may necessitate adjunctive monitoring and therapeutic interventions.

Treatment

Multiple interventions have been employed for treating adolescents with alcohol use disorders (Center for Substance Abuse Treatment, 1999; Mack & Frances, 2003). These approaches include family therapies, cognitive-behavioral interventions, motivational interviewing, pharmacological treatments, and Alcoholics Anonymous (AA).

This review focuses on randomized studies of psychosocial and pharmacological interventions that target alcohol use disorders. Literature search procedure included consulting prior reviews and conducting keyword search of the PsycInfo and Medline databases. We used keywords identified in the reviews and treatment articles, including *adolescent, alcohol, drug, substance, randomized, control, empirical, trial, efficacy, research, treatment, therapy, and intervention*. Further, we have searched for articles on the websites of the substance abuse

research and services organization, such as Substance Abuse and Mental Health Services Administration, the National Institute on Drug Abuse, and Center for Substance Abuse Treatment. We used the following inclusion criteria: 1) study was published in a peer-reviewed journal; 2) study focused on adolescents/young adults with a maximum age of 22 years; 3) subjects were randomly assigned to experimental conditions; 4) measures of outcome included alcohol use; and 5) active interventions were detailed.

Using previously mentioned criteria, we identified 21 studies. The characteristics of these studies are presented in Table 3. Of the identified studies, 8 studies evaluated family interventions, 5 studies tested the efficacy of cognitive-behavioral approaches, 3 studies examined motivational enhancement/interviewing, 1 study evaluated the three above approaches, and 4 studies focused on pharmacological interventions. Given the prevalence of AA interventions with adolescent populations, however, AA programs are briefly discussed before reviewing the randomized studies detailed in Table 3.

Alcoholics Anonymous

AA is an international organization of recovering alcoholics that offers emotional support through self-help groups and a model of abstinence for people recovering from alcohol dependence, using a 12-step approach. One large-scale study reported outcomes of adults randomized to AA 12-step like treatment comparable to adults randomized to more traditional cognitive behavioral interventions (Project MATCH Research Group, 1998). Although AA groups are among most frequently recommended interventions for adolescents with alcohol misuse disorders, there has been little systematic investigation of the efficacy of AA approaches in adolescent populations to date.

AA principles provide the theoretical framework for most residential treatment programs, including the Minnesota Model Treatment Program for Adolescents (Winters, Stinchfield, Opland, Weller, & Latimer, 2000). This program focuses on the first five steps: 1) admitting to the power of substances to make one's life unmanageable; 2) believing there is hope for change if you let yourself be helped; 3) learning from the advice of others as you explore making different decisions about your life; 4) taking an in-depth moral inventory of one's life; and 5) discussing your past wrongs with a peer, counselor, or significant other.

Preliminary work supports the efficacy of the Minnesota Model (Winters et al., 2000), with treatment completers relapsing approximately one-third less frequently than individuals assigned to a waitlist control group (47% vs. 73%). Attendance at 12-step meetings after discharge has also been associated with longer periods of abstinence, but only 10% of the variance in adolescent outcomes is explained by

Table 3 Summary of treatment outcome studies for alcohol and other drug use

Study	Nature of substance use	N (age range) gender/ethnicity	Treatments	Outcome measures for substance use	Main findings
Family treatments Liddle et al. (2001)	Alcohol Marijuana	N = 182 (13–18) 80% male 51% Caucasian 18% African American 15% Hispanic 6% Asian 10% other	<ol style="list-style-type: none"> 1. Multidimensional Family Therapy (MDFT; 14–16 sessions;) 2. Adolescent Group Therapy (AGT; 14–16 sessions; focuses on psychosocial development; self-efficacy, social skills training, self-control) 3. Multifamily Educational Intervention (MEI; 14–16 sessions; skill-building, psychoeducational, problem-solving, addresses family communication/organization, works with multiple families) 	Urine toxicology Adolescent Drug Use Scale Multiple measures on behavioral problems, school performance and family functioning	At post-treatment, ↓ alcohol/marijuana use MDFT > AGT = MEI At 6- and 12-month follow-up, ↓ alcohol/marijuana use MDFT > AGT > MEI (at 12-months)
Liddle et al. (2004)	Alcohol Marijuana	N = 80 (11–15) 72.5% male 42% Hispanic 38% African American 11% Haitian or Jamaican 3% Caucasian 4% other	<ol style="list-style-type: none"> 1. Multidimensional Family Therapy (MDFT; 24–32 sessions) 2. Peer Group Treatment-As-usual Condition (24–32 sessions; based on social learning principles and behavior therapy, focuses on self-esteem, school failure and social skills) 	Timeline Follow-Back Method Multiple measures to assess risk factors for substance-use	↓ alcohol/marijuana use MDFT > control
Henggeler et al. (1991)	Alcohol Marijuana Cocaine Hallucinogens Amphetamines Barbiturates Heroin	N = 47 (Mage = 15.1) 72% male 74% African American 26% Caucasian	<ol style="list-style-type: none"> 1. Multisystemic Therapy (MST) 2. Usual Care (individual counseling, eclectic) 	Self-report on substance abuse	↓ alcohol/marijuana use MST > control
Henggeler et al. (1999)	Alcohol Marijuana Cocaine Heroin Tranquilizers Quaaludes LSD other	N = 118 (12–17) 79% male 50% African American 47% Caucasian 1% Asian 1% Hispanics 1% Native American	<ol style="list-style-type: none"> 1. Multisystemic Therapy (MST; 130 hours of services with 40 direct contact hours) 2. Usual Care (e.g., 12-step programs) 	Urine toxicology Personal Experience Inventory (PEI) Adolescent Self Report	At post-treatment assessment, ↓ alcohol/marijuana use MST > control on PEI ∅ substance use on urine toxicology At 6-month follow-up, ∅ alcohol/substance use
Santisteban et al. (2003)	Alcohol Marijuana	N = 126 (12–18) 75% male 100% Hispanic	<ol style="list-style-type: none"> 1. Brief Strategic Family Therapy (BSFT; 4–20 sessions) 2. Group Therapy control condition (6–16 sessions; non-directive, encourages discussion and problem-solving among participants) 	Urine toxicology Severity index Multiple measures to assess behavior problems and family functioning	∅ alcohol use ↓ marijuana use BSFT > control

Table 3 Continued

Study	Nature of substance use	N (age range) gender/ethnicity	Treatments	Outcome measures for substance use	Main findings
Lewis et al (1990)	Alcohol Marijuana Heroin Cocaine	N = 84 (12–22) 81.0% male	1. Purdue Brief Family Therapy (PBFT; 12 sessions) 2. Training in Parenting Skills program (TIPS; 12 sessions; cognitive-based; psychoeducation)	Urine toxicology Poly-Drug Use History Questionnaire Multiple measures on family functioning	↓ alcohol/substance use PBFT > TIPS
Friedman (1989)	Alcohol Marijuana Amphetamines Cocaine, PCP Hallucinogens Tranquilizers Hashish	N = 135 (14–21) 60% male 90% Caucasian	1. Functional Family Therapy (FFT; 24 sessions) 2. Parent Training Group (PT; 24 sessions; parents learn negotiation of power, active listening, nonblaming skills, constructive confrontation) + youth individual counseling	Drug Severity Index Multiple measures to assess subjects' behavior, attitudes, relationships, self-esteem, parent-child relationship, and family environment	At 15-month follow-up, ↓ alcohol/substance use FFT = PT
Smith et al. (2006)	Alcohol Marijuana other	N = 98 (12–18) 71% male 24% minority	1. Strength Oriented Family Therapy (SOFT; 30 treatment hours) 2. The Seven Challenges (7C; 25 treatment hours; individual, decision-making, skills training, inter-active journaling, motivational interviewing)	Urine toxicology Global Appraisal of Individual Needs (Substance Frequency Scale and Substance Problem Scale)	At 3- and 6-month follow-up, ↓ alcohol/substance use SOFT = 7C
Cognitive-behavioral treatments Conrod et al. (2006)	Alcohol	N = 297 (14–17) 44% male	1. Cognitive-Behavioral Treatment for Personality Risk Factors (CBT-P; 2 sessions; group format) 2. No-treatment control condition	Rutgers Alcohol Problems Index Interview to assess self-reported frequency of substance use	At 4-month follow-up, ↓ drinking rates, drinking quantity and problem drinking symptoms CBT-P > control
Kaminer et al. (1998)	Alcohol other	N = 32 (13–18) 34.4% male 50.0% Caucasian	1. Cognitive-Behavioral Treatment (CBT; 12 sessions; group format) 2. Interactional Treatment (IT; 12 sessions; goals were to explore interpersonal relationships, regulate self-care, and foster self-esteem and insight)	Urine toxicology (treatment only, not for follow-up) Teen Addiction Severity Index (T-ASI) Time-Line Follow-Back	At 3-month follow-up, ↓ alcohol/substance use CBT > IT on T-ASI At 15-month follow-up (Kaminer & Burleson, 1999) ↓ alcohol/substance use CBT = IT on T-ASI
Kaminer et al. (2002)	Alcohol and Marijuana Cocaine Opiates	N = 88 (13–18) 70.5% male 89.8% Caucasian	1. Cognitive Behavioral Therapy (CBT; 8 sessions; group format) 2. Psychoeducational Substance Abuse Treatment as control condition (8 sessions; didactic or videotapes presentation about immediate and delayed problems associated with substance use)	Urine toxicology Teen Addiction Severity Index (T-ASI)	At 3- and 9-month follow-up, ↓ alcohol/substance use CBT = control At 3-month follow-up, ↓ other illicit substances CBT > control for older male subjects on urine toxicology At 9-month follow-up, ↓ other illicit substances CBT = PET

Table 3 Continued

Study	Nature of substance use	N (age range) gender/ethnicity	Treatments	Outcome measures for substance use	Main findings
Latimer et al. (2003)	Alcohol Marijuana Cocaine Heroin other	N = 43 (14-18) 76.7% male 86.0% Caucasian 7.0% Native American 4.6% Hispanic 2.3% Asian	1. Integrated Family and Cognitive-Behavioral Therapy (IFCBT; 16 sessions; individual family + peer group CBT; foster cognitive skills to manage drug abuse risks, self-regulation skills, parent skills training) 2. Drugs Harm Psychoeducation control condition (PET; 16 sessions) 1. Individual-Cognitive Therapy; (ICT; 15 sessions; problem solving, self-control) 2. Family-Behavioral Therapy (FBT; 15 sessions; addresses cognitive, verbal, social, and familial factors via behavioral contracting, stimulus control, urge control and communication training)	Urine toxicology Personal Experience Inventory Weekly drug use logs Multiple measures to assess drug-related beliefs, parent-child communication, problem solving skills, and motivation for change Urine Toxicology Time-Line Follow-Back Interview Multiple measures to assess conduct problems, problem-solving skills, mood, personal and family satisfaction	From 1- to 6-months follow-up, ↓ alcohol/marijuana use IFCBT > control ↓ other illicit substances IFCBT = control
Azrin et al. (2001)	Alcohol Marijuana Cocaine Amphetamines Barbiturates Benzodiazepines Opiates, PCP Methaqualone	N = 56 (12-17) 82% male 78.6% Caucasian 16.1% Hispanic 1.6% African American 3.6% other	1. Motivational Interviewing + Cognitive-Behavioral Alcohol Intervention Group Program (AIG; 4 sessions) 2. No-treatment control condition	Alcohol Use Disorder Test Readiness to change Questionnaire Alcohol Knowledge Questionnaire Drug and Alcohol Problem Quick Screen Adolescent Drinking Index Young Adult Drinking and Driving Adolescent Injury Checklist Health Behavior Questionnaire Adolescent Drinking Questionnaire Stages of Change Algorithm Urine toxicology Time-Line Follow-Back Rutgers Alcohol Problem Index Interview to assess self-reported frequency of substance use	∅ alcohol use ↓ other illicit substances ↓ conduct problems ICT = FBT
Motivational enhancement/interviewing Bailey et al. (2004)	Alcohol	N = 34 (12-19) 50% male	1. Motivational Interviewing + Cognitive-Behavioral Alcohol Intervention Group Program (AIG; 4 sessions) 2. No-treatment control condition	Alcohol Use Disorder Test Readiness to change Questionnaire Alcohol Knowledge Questionnaire Drug and Alcohol Problem Quick Screen Adolescent Drinking Index Young Adult Drinking and Driving Adolescent Injury Checklist Health Behavior Questionnaire Adolescent Drinking Questionnaire Stages of Change Algorithm Urine toxicology Time-Line Follow-Back Rutgers Alcohol Problem Index Interview to assess self-reported frequency of substance use	At post-treatment and at 1- and 2-months follow-ups, ↓ alcohol use ↑ readiness to reduce drinking, alcohol knowledge AIG > control
Monti et al. (1999)	Alcohol	N = 94 (18-19) 64% male 80% Caucasian 13% African American 5% Asian/East Indian 2% Hispanic	1. Motivational Interviewing (MI; 1 sessions) 2. Standard care	Alcohol Use Disorder Test Readiness to change Questionnaire Alcohol Knowledge Questionnaire Drug and Alcohol Problem Quick Screen Adolescent Drinking Index Young Adult Drinking and Driving Adolescent Injury Checklist Health Behavior Questionnaire Adolescent Drinking Questionnaire Stages of Change Algorithm Urine toxicology Time-Line Follow-Back Rutgers Alcohol Problem Index Interview to assess self-reported frequency of substance use	At 6-month follow-up, ↓ alcohol use MI = control ↓ driving after drinking, alcohol involved injury or alcohol-related problems MI > control
Peterson et al. (2006)	Alcohol Marijuana Cocaine Amphetamines Hallucinogens Heroin Tranquilizers Inhalants	N = 285 (14-19) 54.7% male 72.3% Caucasian 15.9% mixed 3.2% African American 3.2% Native American 3.2% Hispanic/ 1% Asian/Pacific	1. Brief motivational enhancement (ME; 1 sessions) 2. Assessment only control group (AO) 3. Assessment at follow-up only control group	Alcohol Use Disorder Test Readiness to change Questionnaire Alcohol Knowledge Questionnaire Drug and Alcohol Problem Quick Screen Adolescent Drinking Index Young Adult Drinking and Driving Adolescent Injury Checklist Health Behavior Questionnaire Adolescent Drinking Questionnaire Stages of Change Algorithm Urine toxicology Time-Line Follow-Back Rutgers Alcohol Problem Index Interview to assess self-reported frequency of substance use	∅ alcohol/marijuana use At 1-month follow-up, ↓ other substance use ME > control At 3-month follow-up, ME = control

Table 3 Continued

Study	Nature of substance use	N (age range) gender/ethnicity	Treatments	Outcome measures for substance use	Main findings
Cannabis Youth Treatment Study Dennis et al. (2004)	Alcohol Marijuana Cocaine Heroin Opiates	N = 600 (12–18) 83% male 61% Caucasian 30% African American 4% Hispanic 6% other	1. A 5-week Motivational Enhancement + CBT (MET/CBT5) 2. 12-week MET/CBT (MET/CBT12) 3. Family Support Network (FSN; 22 sessions; added parent/family based approach to MET/CBT) 4. Adolescent Community Reinforcement Approach (ACRA; 14 sessions; behavioral therapy to rearrange environmental contingencies) 5. Multidimensional Family Therapy (MDFT; 12–15 sessions)	Urine toxicology Participant interviews Collateral interviews Global Appraisal of Individual Needs	↓ alcohol/substance use No differential treatment effects
Pharmacological interventions Niederhofer & Staffen (2003b)	Alcohol	N = 26 (16–19) 65.4% male	1. Disulfiram (200 mg daily for 90 days) 2. Placebo	Biological markers Self-reported substance use	↓ alcohol use Disulfiram > placebo
Niederhofer, Staffen & Mair (2003a)	Alcohol	N = 30 (15–19)	1. Naltrexone (50 mg daily for 90 days) 2. Placebo	Self-reported substance use	↓ alcohol use Naltrexone > placebo
Niederhofer & Staffen (2003a)	Alcohol	N = 26 (16–19) 65.4% male	1. Acamprosate (1332 mg daily for 90 days) 2. Placebo	Biological markers CAGE Michigan Alcoholism Screen Time-Line Follow-Back	↓ alcohol use Acamprosate > placebo
Deas et al. (2000)	Alcohol	N = 10 (M _{age} = 16.6) 80% male 80% Caucasian	1. Sertraline (25 mg per day, increase weekly by 25 mg, max dose 100 mg) + Cognitive-Behavioral Therapy (CBT; 12 sessions) 2. Placebo + CBT (12 sessions)		↓ alcohol use and depression Sertraline + CBT = placebo + CBT

Notes: ∅ – no effect; ↓ – decrease; ↑ – increase; = there were no differential improvements as a function of treatment type; > significantly more effective.

attendance in these programs (Kelly, Myers, & Brown, 2002). Jaffe (1990) developed a workbook addressing the 12 steps which have been modified for use with adolescents. The book is designed for adolescents to write answers to specific questions that can be reviewed with counselors and/or presented and discussed in a group format. Given their frequent use, further systematic evaluation of AA approaches with adolescents with alcohol use problems is sorely needed.

Family treatments

Family treatments have been extensively studied in the treatment of adolescent substance use disorders (Deas & Thomas, 2001; Kaminer & Slesnick, 2005). In the present review, the five family therapy approaches that were tested for treating alcohol use disorders in adolescents include: Multidimensional Family Therapy (MDFT; Dennis et al., 2004; Liddle et al., 2001; Liddle et al., 2004); Multisystemic Therapy (MST; Henggeler et al., 1991; Henggeler, Pickrel, & Brondino, 1999); Brief Family Therapy (Lewis, Piercy, Spunkle, & Trepper, 1990; Santisteban et al., 2003); Functional Family Therapy (FFT; Friedman, 1989); and Strength-Oriented Family Treatment (SOFT; Smith, Hall, Williams, An, & Gotman, 2006).

MDFT incorporates structural and strategic family therapy approaches, as well as systems approaches (Liddle, 1992). The key assumption of MDFT is that the adolescent is involved in multiple domains such as family, school, peer, legal and welfare systems. These distinct domains are associated with different risk factors that are best managed within a multiple systems approach. Treatment focuses on four areas: 1) individual characteristics of the adolescent (e.g., perceptions about alcohol/drug use, using behavior, including coping with urges to use, and emotional regulation processes); 2) the parent(s) (e.g., parenting practices, personal issues); 3) family interaction patterns; and 4) extra-familial sources of influence and development (e.g., school, juvenile justice, medical and legal systems). The overarching goal of treatment is to re-establish normal developmental processes. Goals and foci areas with the adolescent include building competencies in school, sports, or other domains, reducing involvement with deviant peers, increasing involvement in prosocial activities, and problem-solving and affect regulation skills building. For the parent, goals include reducing psychiatric distress, improving social support and parenting skills, and addressing necessary economic issues. At the family level, interventions focus on attachment, communication, and increasing family organization.

In a randomized trial of 182 adolescents with marijuana and alcohol use disorders (Liddle et al., 2001), MDFT was found to be more effective than a multifamily psychoeducation group and adolescent

group therapy in reducing substance use. At termination, 42% of adolescents in MDFT reported significant reduction in substance use and 45% of adolescents indicated reduction in substance use at the 1-year follow-up. The positive effects on substance use reduction were replicated in a second trial of 80 adolescents, where MDFT was tested against peer support group (Liddle et al., 2004). The efficacy of MDFT is further supported by the results of the multi-site Cannabis Youth Treatment (CYT) Study (Dennis et al., 2004), discussed later in the paper.

In theory and foci, MDFT is similar to MST, another family intervention based on social ecological and family systems theories. However, MDFT is most often office-based, and is less time intensive, with once a week sessions the norm, while MST is home- and community-based. In addition, in MDFT a subset of sessions is conducted with the adolescent individually, and the parent individually, to focus on issues separate from his or her role as parent. Further, MDFT puts greater emphasis on emotional processes within the family, while MST focuses more on behavioral conceptualization of problems and their solutions.

In MST, intervention strategies are adapted from existing evidence-based techniques, including cognitive-behavioral treatments, pragmatic, problem-solving models, parent training, and pharmacological treatments (Henggeler, Schoenwald, Borduin, Rowland, & Conningham, 1998). The goals of MST encompass: 1) enhancing caregiver's capacity to effectively monitor adolescent behavior; 2) increasing family structure; 3) identifying barriers to parent's effective reinforcement of appropriate behaviors and contingency management; 4) decreasing adolescent involvement with delinquent peer group and encouraging association with prosocial peers; and 5) promoting school performance and/or vocational functioning. MST has been extensively validated for youth with violent behavior (Elliot, 1998) and as a promising substance abuse treatment (e.g., Liddle & Dakof, 1995; Stanton & Shadish, 1997). In two studies, Henggeler and colleagues evaluated the effectiveness of MST versus usual care for alcohol, marijuana and other illicit substance use in adolescents (Henggeler et al., 1991, 1999). MST was found to be superior to control condition in decreasing self-reported substance use in both studies. However, utilization of urine toxicology screens and follow-up assessment resulted in more sobering outcomes, as there was no treatment effect on substance use on urine toxicology and at 6-month follow-up (Henggeler et al., 1999). MST remains a promising intervention, requiring further evaluation and efficacy testing by different investigative teams.

Just as MDFT and MST, Brief Strategic Family Therapy incorporates theories and techniques from structural and strategic family therapies. However, while MDFT and MST embrace social ecological processes, BSFT focuses specifically on 'within-family'

interventions (Szapocznik, Hervis, & Schwartz, 2003). The main goals of this approach include: 1) engagement of treatment resistant family members; 2) joining with the family; 3) assessment of family communication patterns; and 4) restructuring family interactions to improve limit-setting, monitoring of adolescent behavior, and other parenting practices linked to substance use and behavior problems. Evaluation on BSFT for adolescent alcohol use has produced mixed results. In a study with 126 substance-using adolescents, Santisteban et al. (2003) found support for BSFT efficacy for reducing marijuana use but not alcohol use. There is preliminary support for several other family treatment models, but to date none of the results have been replicated (Friedman et al., 1989; Lewis et al., 1990; Smith et al., 2006).

Cognitive Behavioral Therapy

Cognitive Behavior Therapy (CBT) interventions for adolescent alcohol and substance use involve (Kaminer & Slesnick, 2005): 1) self-monitoring; 2) identifying cognitive, social, and emotional triggers of use; 3) developing a repertoire of skills to manage cravings; and 4) identifying alternative reinforcement contingencies. Communication, problem-solving, and alcohol refusal skills are taught, together with relaxation training and anger management. Distorted cognitions are also addressed, and therapy sessions characteristically include modeling, behavior rehearsal, and feedback. Adolescents are frequently resistant to 'homework', and often require in-vivo processing of distorted cognitions and problem solving deficits during therapy sessions.

In the evaluated studies, CBT has been applied to adolescents with alcohol and substance use in group format (Conrod, Stewart, Comeau, Maclean, 2006; Kaminer, Burleson, Blitz, Sussman, & Rounsaville, 1998; Kaminer, Burleson, & Goldberger, 2002) and in combined individual, family, and group therapy formats (Latimer, Winters, D'Zurilla & Nichols, 2003), with the strongest empirical support to date for group administration in combination with brief individual motivational enhancement (Dennis et al., 2004). Conrod et al. (2006) tested CBT intervention targeting personality factors that place adolescents at higher risk for alcohol misuse (e.g., anxiety sensitivity, hopelessness, sensation seeking). Two hundred and ninety-seven adolescents participated in the study; subjects in CBT condition demonstrated significantly greater reduction in drinking rates, drinking quantity and problem drinking symptoms as compared to those in control group.

Further, Kaminer et al. (1998) provided preliminary evidence for the efficacy of group CBT in reducing substance use in a pilot study with 32 subjects. CBT was shown to be superior to interactional treatment that includes exploration of interpersonal relationships, regulating self-care and

fostering self-esteem and insight. The positive effects on substance use reduction were replicated in a second trial of 88 adolescents, comparing group CBT to psychoeducational treatment (Kaminer et al., 2002). There were no differential treatment effects for alcohol use. However, at 3-month follow-up, relapse rates for other substances were significantly lower for subjects in CBT condition than for those in comparison condition for older adolescents and for male subjects. At 9-month follow-up relapse rates at both conditions were similar. This pattern of short-term but not long-term efficacy of CBT has been demonstrated in other studies of adolescent substance use as well as in depression (e.g., Brent et al., 1997; Waldron, Slesnick, Brody, Turner, & Peterson, 2001).

Latimer et al. (2003) evaluated integrated family and group CBT intervention and found it to be superior to psychoeducation in reducing alcohol and marijuana use, as well as improving problem-solving, school learning skills, and familial structure and interactional processes. The improvements were sustained within the 6-month follow-up period. The addition of a family component to CBT, which included improvement in parental monitoring, resolution of family conflicts and attending to parental and sibling substance use, may have contributed to the long-term effectiveness of the intervention.

Azrin et al. (2001) looked at the efficacy of cognitive and behavioral interventions on reducing substance use in 56 substance using adolescents with co-morbid conduct disorders. The study compared Individual Cognitive Therapy and Family-Behavioral Therapy. Although no reduction in alcohol use was observed, adolescents in both conditions significantly reduced use of other illicit substances and demonstrated improvement in conduct problems.

Motivational Enhancement Therapy

The goal of Motivational Enhancement Therapy (MET) is to resolve adolescents' ambivalence concerning whether or not they have a problem with alcohol and other drugs, and to increase their motivation to change. Miller and colleagues (Miller, Rollnick, & Conforti, 2002) published a book which describes motivational interviewing and how it can be applied to enhance change, with the second edition of this book specifically addressing issues involved in utilizing this technique with adolescents. There are five main strategies to MET (Irons, 2006; Levy et al., 2002): 1) express empathy; 2) develop discrepancies; 3) avoid arguments; 4) roll with resistance; and 5) support self-efficacy.

Although there is a strong empirical base to support the use of MET in adults (Carroll & Onken, 2005), findings are mixed in adolescents (Grenard, Ames, Pentz, & Sussman, 2006). There is a growing body of literature which supports its efficacy in adolescents when combined with cognitive behavioral

therapeutic approaches (Bailey, Baker, Webster, & Lewin, 2004; Dennis et al., 2004). A pilot examination of the brief motivational and cognitive-behavioral-based alcohol treatment on 34 adolescents indicated that subjects in the treatment condition had a significantly higher reduction in the frequency of drinking, increase in alcohol knowledge and readiness to reduce alcohol use than those in no-treatment control condition (Bailey et al., 2004).

Nevertheless, results on MET are equivocal when it is used alone to address alcohol use disorders. Monti et al. (1999) examined motivational interviewing approach versus standard care in a study of 94 adolescents with alcohol use disorders. Results indicated that both interventions significantly reduced alcohol consumption; there were no differential treatment effects as a function of treatment type. However, motivational interviewing had a stronger harm-reduction effect, including lower incidence of drinking and driving, alcohol-related injuries and social problems, and traffic violations. Peterson et al. (2006), on the other hand, failed to find intervention effect for MET on alcohol and marijuana use in the study of 285 homeless adolescents. MET was significantly more effective than control condition in reducing use of other illicit substances at 1-month follow-up; however, the effect was not maintained at 3-month follow-up. The characteristics of the targeted population should be taken into account when interpreting the outcomes. MET was tested with homeless adolescents with multiple comorbid psychological and psychosocial problems, and numerous stressors that require more comprehensive and sustained interventions to address substance use than a single session of motivational enhancement. Further research is needed to test efficacy of MET for adolescent alcohol and substance use problems.

Cannabis Youth Treatment Study

The Cannabis Youth Treatment (CYT) study is the largest psychosocial treatment trial to date completed in adolescents with substance use disorders (Dennis et al., 2004; Diamond et al., 2002). Six hundred adolescents with a cannabis use disorder, of whom approximately 40% also met criteria for an alcohol use disorders, were randomized to one of five treatments: Multidimensional Family Therapy, 5 sessions of Motivational Enhancement and Cognitive Behavioral Therapy (MET/CBT-5), 12 sessions of MET/CBT (MET/CBT-12), Family Support Network (FSN), and the Adolescent Community Reinforcement Approach (ACRA). MDFT was delivered as described above over a 12-week time period. The MET/CBT-5 condition included two individual MET and three group CBT sessions, with the primary goal of the group sessions being to provide skills for coping with situations that would normally elicit marijuana use. The MET/CBT-12 arm involved two individual MET and 10 group CBT sessions, with the first three

also addressing coping skills as in the MET/CBT-5 program, and the remainder of the sessions focusing on problem-solving skills. FSN was designed as an adjunct to the MET/CBT-12 program. In addition to the 2 individual MET and 10 group CBT sessions, it included six 60-minute didactic sessions for parents about adolescent development and dependency, four 90-minute home visits, and case management services designed to maintain treatment participation. ACRA is a behavioral therapy treatment that focuses on rearranging environmental contingencies so that non-using is more rewarding than using. ACRA is an adaptation of the Community Reinforcement Approach originally developed for adult alcoholics (Miller et al., 1999), and uses many of the behavioral therapy elements described previously. The treatment was administered in 10 sessions with adolescents alone, and 4 sessions with caregivers (2 with the caregivers alone, and 2 with the caregivers and the adolescent together).

All five treatments were associated with approximately comparable reductions in substance use, behavior problems, violence, participation in illegal activities, family conflict, and school absences. Across conditions, at 1-year follow-up, approximately 25% of adolescents were in recovery and percent days drinking were down approximately 30% from baseline. Given the similarity in outcomes, and the large differences in costs for the interventions, cost-effectiveness also was examined. The greatest cost effectiveness was associated with MET/CBT-5, MET/CBT-12, and the ACRA program. The cost per day of abstinence over the 12-month follow-up period was greatest for adolescents assigned the FSN and MDFT interventions. The low rate of sustained recovery, however, highlights the need for more potent interventions.

Pharmacological interventions

The study of the efficacy of pharmacological interventions in adolescent alcohol use disorders is in its infancy. The largest randomized placebo-controlled pharmacological treatment trial in adolescent alcohol use disorders included a total of 26 subjects, and there are no replicated reports of medication efficacy (Niederhofer, Staffen, & Mair, 2003a). Given the paucity of research in this area, available investigations conducted with adolescents will be reviewed together with a summary of the primary findings in studies conducted in adults with alcohol use disorders.

Disulfiram

Disulfiram is the first medication approved by the FDA for treatment of alcohol dependence and is most commonly used of the pharmacological agents for prevention of alcohol consumption (Buonopane &

Petrakis, 2005). Disulfiram alters the metabolism of alcohol and produces a mildly toxic acetaldehyde which causes anxiety, headache, nausea, and vomiting. The symptoms are noxious enough that most individuals, who are compliant with medication, remain abstinent. Clinical studies with adults, however, do not support the efficacy of disulfiram in alcohol dependence treatment, as most individuals prescribed disulfiram are non-compliant. The largest clinical trial with disulfiram included 600 adults, and approximately 80% discontinued medication use (Garbutt, West, Carey, Lohr, & Crews, 1999). Compliance in adults, however, can be increased by the use of behavioral contingencies and involvement of significant others in assuring treatment adherence.

Only one case report (Myers, Donahue, & Goldstein, 1994) and one placebo-controlled study (Niederhofer & Staffen, 2003a) have examined the efficacy of disulfiram in alcohol-dependent adolescents. Compliance was not a significant problem in the controlled study of 26 adolescent, and this study provides preliminary support for the use of disulfiram in adolescents with alcohol misuse in inpatient settings with adjunctive psychosocial treatment. Further investigation is warranted.

Naltrexone

The opioid antagonist naltrexone has been FDA approved for the treatment of alcohol dependence since 1994 (Buonopane & Petrakis, 2005). Large multicenter studies suggest that in relatively unselected populations of alcohol-dependent patients, naltrexone has a small effect in promoting abstinence or reducing intensity of drinking. The largest pharmacotherapy study of alcohol dependence conducted to date, Project COMBINE, reported a small (effect size = .2) but significant effect of naltrexone in nearly 1400 alcohol dependent patients (Krystal, Cramer, Krol, Kirk, & Rosenhack, 2001). However, a very similar effect size was found to be not statistically significant in a study of 627 alcohol dependent veterans. The modest efficacy of naltrexone in these studies may be related to greater medication efficacy in subgroups of patients, such as those patients who drink consistently or, perhaps, patients with the Asp40 allele of the μ opiate receptor gene (Gelernter et al., 2007; Oslin et al., 2003).

In a small open treatment trial of 5 adolescent outpatients with alcohol dependence, augmentation of CBT treatments with naltrexone was associated with reduced number of days drinking and lowered reports of craving alcohol (Deas, May, Randall, Johnson, & Anton, 2005). A larger placebo-controlled treatment trials of 26 adolescents demonstrated similar effects (Niederhofer, Staffen, & Mair, 2003a). Results suggested that naltrexone is an effective and well-tolerated pharmacological adjunct to psychosocial interventions with alcohol-dependent adolescents. Long-acting injectable forms of

naltrexone may have greater efficacy than oral naltrexone in adult patients or, alternatively, may select for more highly motivated patients (Garbutt et al., 2005; Kranzler, Wesson, & Billot, 2004). To our knowledge, long-acting naltrexone has not been tested yet in adolescents.

Acamprosate

Acamprosate has been registered for the treatment of alcohol dependence in adults since 1996 (Buonopane & Petrakis, 2005). Its mechanism of action has yet to be established, and mixed results have been reported on the efficacy of acamprosate in reducing alcohol consumption and craving (Anton et al., 2006). Most recently in the COMBINE study referenced above, acamprosate showed no significant effect on drinking when compared to placebo, and was significantly less effective than the other interventions examined. One small placebo-controlled trial of acamprosate in inpatient alcohol-dependent adolescents had promising results, but further investigation is warranted (Niederhofer & Staffen, 2003b).

Serotonergic agents

Preclinical (e.g., animal) and clinical studies suggest a link between serotonergic dysfunction and alcohol use disorders (Buonopane & Petrakis, 2005). In adults there is evidence that selective serotonergic reuptake inhibitors (SSRIs) are effective in treating adult patients with alcohol dependence and comorbid depression and/or anxiety disorders. The efficacy of SSRIs in the treatment of adolescents with alcohol use disorders and comorbid depressive diagnoses has been examined in one open label trial of 13 patients (Cornelius et al., 2001; Cornelius et al., 2005), and one placebo-controlled trial with 10 adolescents who met criteria for an alcohol use and depressive disorder (Deas, Randall, Roberts, & Anton, 2000). Both studies provided adjunctive psychosocial treatments, and both reported improvements in depression and alcohol symptoms. In the placebo-controlled trial, however, there was no difference in the outcomes of the adolescents receiving the SSRI and those receiving placebo. Preliminary support for the efficacy of tianeptine (Niederhofer, Staffen, & Mair, 2003b), which facilitates the re-uptake of serotonin, and ondansetron (Dawes et al., 2005a, 2005b), a 5HT3 antagonist, have also been reported in adolescents with alcohol use disorders. The relatively modest sizes of these trials, however, prohibit the drawing of definitive conclusions regarding the efficacy of any of these serotonergic medications in adolescents with alcohol use disorders.

Treatment summary

In the past decade, much progress has been made in the area of psychosocial interventions for adolescents

with alcohol use disorders. The strongest empirical support has been provided for Multidimensional Family Therapy (MDFT) and group administered Cognitive Behavioral Therapy (CBT). While MDFT and Multisystemic Therapy (MST) have similar treatment foci and theoretical underpinnings, MDFT has stronger empirical support, with replicated sustained results. It also requires fewer service hours than MST and, as an office-based intervention, is less costly and labor intensive than MST. CBT interventions tend to produce rapid short-term effects that are enhanced with the addition of brief Motivational Enhancement Therapy (MET), with the addition of MET most helpful in reducing the negative consequences of drinking. Combination of CBT with family-based interventions may be a promising strategy for longer-term efficacy. There is currently no empirical data to support the matching of certain psychosocial treatments to particular patients in adolescent or adult cohorts (Cutler & Fishbain, 2005).

Data on pharmacological and combined treatment strategies in adolescents are too preliminary to suggest definitive guidelines in the medication management of adolescents with alcohol use disorders. As we have learned in the area of child depression, it is not appropriate to generate guidelines for the treatment of children or adolescents based on data derived from adult samples (Kaufman, Martin, King, & Charney, 2001). Many medications that are extremely efficacious in adults with depression (e.g., tricyclic antidepressants) work no better than placebo in juvenile populations. As many of the neuroanatomical sites and neurochemical systems implicated in the reward and addiction properties of ethanol are undergoing rapid development during adolescence, this may also prove to be the case in the pharmacological management of adolescent alcohol use disorders as well. While the past decade has seen a marked advance in the data base supporting different treatments for adolescent alcohol use disorders, about 25% of adolescent outpatients, and approximately 50% of adolescent inpatients, have poor treatment outcomes (Dennis et al., 2004; Winters et al., 2000). More work is needed in this area and translational research may inform further advances.

Key practitioner messages

While parents are generally critical informants when assessing child and adolescent psychopathology, especially externalizing disorders, parents' reports of adolescent substance use are notably less valuable, and most adolescent alcohol use diagnoses would be missed if only parents are surveyed about their adolescent's alcohol use. Assuring confidentiality, however, is vital for obtaining reliable information about adolescent's alcohol use, and clinicians should be familiar with

the laws of their jurisdiction regarding limits of confidentiality and adolescents' rights to consent for treatment.

Given the high co-occurrence of other problems with alcohol use diagnoses in adolescents, comprehensive assessment of psychiatric and other substance use disorders, trauma experiences, and suicidality is indicated in this population to optimize selection of appropriate clinical interventions.

There are important developmental differences in the clinical characteristics of alcohol use disorders in adolescents and adults. For example, withdrawal is rare in adolescence, and the symptoms of tolerance and drinking more than intended are frequently endorsed by adolescents who do not meet criteria for any abuse symptoms. As some degree of tolerance is a normative physiological process with the onset of use, the alcohol dependence symptom of tolerance should only be considered met if the amount required to achieve intoxication increases after a period of regular use. In addition, in adolescents excessive drinking is often attributable to inexperience with alcohol or a response to peer pressure, and may not be a reliable indicator of dependence.

Although Alcoholic Anonymous (AA) groups are among most frequently recommended interventions for adolescents with alcohol misuse disorders, there have been few investigations examining the efficacy of AA approaches in adolescent populations. There is rudimentary support of AA approaches with adolescents, and there is a published workbook addressing the 12-steps which has been modified for use with adolescents that can facilitate implementation of 12-step approaches with teens.

Multidimensional Family Therapy (MDFT) and group administered Cognitive Behavioral Therapies (CBT) in combination with brief individual Motivational Enhancement Therapy (MET) have received the most empirical support in the treatment of adolescent alcohol use disorders. Manuals are available to facilitate the implementation of each of these interventions, and other treatments showing preliminary efficacy.

Adolescent-onset alcohol use disorders are associated with a more rapid transition from first use to dependence, and shorter time from first to second substance dependence. In addition, alcohol use is associated with the three leading causes of death among adolescents: motor vehicle accidents, homicide, and suicide; and relapse rates are high among adolescents completing treatment. Psychoeducation, safety planning, and aftercare are important components of all interventions with adolescents with alcohol use disorders, and further innovation and research is needed to optimize clinical interventions for this high risk population.

Translational research approaches in the study of addiction

A central tenet of translational research approaches is that knowledge learned through basic (e.g., animal) research can be used to guide research on the pathophysiology and treatment of various disease states. Animal models have been invaluable in delineating the neuroanatomical structures and cellular and molecular mechanisms involved in addiction (Hyman, 2005; Hyman, Malenka, & Nestler, 2006). In fact, the examination of naltrexone in humans was stimulated by studies showing opiate receptors modulate alcohol intake in animals (Oswald & Wand, 2004). Ultimately, the goal of translational research is to use findings from basic studies to identify novel therapeutic approaches to treat addiction (Krystal et al., 2006; Lovinger & Crabbe, 2005).

Preclinical studies have shown that alcohol uniquely affects gamma-amino butyric acid (GABA) A and N-methyl-D-aspartate (NMDA) receptors in the brain. There are, however, multiple common short- and long-term effects of administration of alcohol and other drugs of addiction. For example, intake of alcohol and other addictive drugs is associated with increased dopamine release in the nucleus accumbens, and secondary changes in multiple cellular and molecular processes involved in reward-related learning. This work has led to the identification of multiple potential foci for intervention efforts in the treatment of alcohol and substance use disorders in adults.

The application of this preclinical work in the development of new treatment approaches for adolescents, however, may be somewhat limited. Most of the basic work to date has been completed in adult animals. Emerging findings from studies conducted in adolescent and mature animals suggest there may be important developmental differences in the processes involved in addiction, and further examination of the neurochemical, molecular, and cellular mechanisms involved in reward-related learning in juvenile animals will likely be invaluable in understanding some of the unique clinical features of adolescent-onset alcohol use disorders. For example, while GABA_A receptors are present early in life, the number and composition of these receptors change with development, and when compared to adult animals, adolescents exhibit enhanced alcohol-induced sedation following GABA_A receptor stimulation (Silveri & Spear, 2002). NMDA receptors also undergo a marked change in composition and number, achieving greater than adult levels during adolescence, which affects the tolerability of NMDA receptor antagonists such as alcohol at this stage of development (Green & Sherwin, 2005; Krystal et al., 2003). When compared to adult animals, adolescents also exhibit increased extracellular basal dopamine in the nucleus accumbens, greater dopamine re-uptake after cocaine

administration, and enhanced behavioral response to low-dose cocaine (Badanich, Adler, & Kirstein, 2006). Adolescents have also been found to have enhanced drug-induced upregulation of the transcription factor Δ FosB when compared to adult animals (Ehrlich, Sommer, Canas, & Unterwald, 2002). In addition, while naltrexone reduces craving in adolescent and adult rats, lower doses have been found to be more effective in immature animals (Sable, Bell, Rodd, & McBride, 2006).

Future research

Adolescence is a vulnerable period for the development of alcohol use disorders, and further investigation of developmental changes in the neurocircuitry and secondary cellular and molecular processes associated with reward-related learning offers significant promise in understanding adolescent onset addictive disorders and identifying new foci for intervention efforts (Chambers, Taylor, & Potenza, 2003). Recent neuroimaging studies further highlight the need for incorporating a developmental perspective in studies aiming to delineate the neuroanatomical correlates of addictive disorders. When completing reward tasks during imaging, adolescents were found to have enhanced nucleus accumbens and reduced prefrontal activation compared to adults completing the same task (Ernst et al., 2005; Galvan et al., 2006). Developmentally informed translational research approaches can help better understand adolescents' enhanced susceptibility to addiction, delineate the causes of the frequently observed rapid succession from first to second dependence, and identify novel foci of intervention efforts.

Efficacy of psychopharmacological agents in the treatment of adolescent alcohol use disorders requires further investigation. Available research on medications for adolescent alcohol use disorders provides only preliminary evidence due to small sample sizes, lack of replication efforts, and limited number of studies on adolescent population. Incorporation of molecular genetic approaches will also help to guide improved patient-intervention matching. Validation of pharmacological treatments has to include evaluation of risks. Usually evaluation of drug safety lags behind efficacy trials (Ionnidis & Lau, 2001). Obviously, this shortcoming is particularly concerning in pediatric and adolescent populations. The physiological maturation and neurodevelopmental factors in adolescence warrant special consideration of the long-term effects of a treatment. Safety of medication use in children and adolescents cannot be inferred from data on the adult population. On the other hand, potential risks of pharmacological treatment have to be weighted against the negative consequences of chronic alcohol use on the developing organism. Such risk-benefit

analysis is critical to ensure proper care. Unfortunately, many medications prescribed 'off-label' to children and adolescents are only tested for safety during their use in the community (Vitiello et al., 2003).

Psychosocial interventions also require further evaluation. Clinical experience suggests that in 'real world' settings, young people with alcohol and related psychiatric and psychosocial problems require sustained, multimodal interventions. The available data indicate that the brief therapies evaluated in trials and described here are associated with high rates of relapse. Further data on the combined effects of psychotherapy and medications for treatment of alcohol use disorders in adolescents is required, and development and evaluation of integrated treatments for comorbid conditions also warrants further investigation. Comorbidity is high in adolescents with alcohol use problems. Alcohol is frequently used to self-medicate other Axis I disorders (e.g., depression, anxiety) or may precede and precipitate their development. Differences in clinical presentations of comorbid internalizing versus externalizing disorders point to a need for different treatment emphases (Mack & Frances, 2003). How treatments should be altered to address these differences and conditions requires further investigation.

Areas of future research

Efficacy of psychopharmacological agents in the treatment of adolescent alcohol use disorders requires further investigation. There is a paucity of research in this area.

Research examining the combined effects of psychotherapy and medications for treatment of alcohol use disorders in adolescents is also warranted.

Integrated treatment approaches targeting alcohol use disorders and common comorbid diagnoses need to be developed and evaluated.

Given the high rate of relapse among adolescents completing treatment, examination of the efficacy of 'booster' and longer-term multi-modal treatments also appears warranted.

Incorporation of molecular genetic research strategies into treatment studies may help guide improved patient-intervention matching.

Translational research approaches, including preclinical (e.g., animal) and clinical investigations studying developmental changes in the neurocircuitry and secondary cellular and molecular processes associated with reward-related learning, also offer promise in understanding adolescent-onset addictive disorders and identifying new foci for intervention efforts.

Concluding remarks

The past decade has seen a marked advance in the database supporting different treatments for adolescent alcohol use disorders. Relapse rates, however, are high among adolescents treated for alcohol use disorders, and issues of comorbidity have been poorly integrated into treatment approaches. Multidisciplinary translational research strategies offer significant promise toward the identification of new foci for future prevention and intervention efforts. There is much left to learn to optimize outcomes of adolescents with alcohol use disorders.

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