

Title: Traumatic Brain Injury and Alcohol Use Disorders

E. Lanier Summerall, MD, MPH

Department of Psychiatry

Dartmouth Medical School

Alcohol Medical Scholars Program **(Slide 1)**

I. Introduction (Slide 2)

A. Alcohol misuse common in the gen. pop.

1. 80% lifetime use ¹

2. 15% lifetime abuse

3. 10% lifetime dependence ²

4. Intoxication, abuse or dependence = alcohol use disorders
(AUD's)

B. Traumatic brain injury (TBI) each year in US common³ **(Slide 3)**

1. 1.4 million total

a. 50,000 die

b. 235,000 hospitalized

c. 1.1 million to emergency room

2. Mechanisms of TBI more common with alcohol³

a. Falls-28% (#1 cause death in old)

b. Motor vehicle accidents (MVA's)-20% (#1 cause hospitalization)

c. Struck by/against object-19%

d. Assaults/violence-11% (#1 cause death in young)

3. Location/type of TBI ⁴ **(Slide 4)**

a. Anywhere in brain

b. Visible-brain bruise, tissue deformity

i. Invisible-axon damage

c. Frontal lobe damage = "fingerprint" of TBI due to:

- i. Acceleration/deceleration of brain
- ii. Bony structure of skull

(Slide 5)

4. TBI can cause : ⁵ **(Slide 6)**

a. Frontal syndrome (Mnemonic=VALIUM)

- i. ↓ Vision/hearing
- ii. ↓ Attention/concentration
- iii. ↓ Language skills
- iv. ↓ Insight
- v. Unacceptable behaviors
- vi. ↓ Memory
 - i. Impulsivity
 - ii. Sexual disinhibition
 - iii. Violence

b. Physical/neurologic problems

- i. Seizures
- ii. Headaches
- iii. Unsteady gait
- iv. Spasticity
- v. Tremor

c. 40% develop depression ^{6, 7}

C. Relationship complex **(Slide 7)**

1. Alcohol misuse ↑ risk of TBI
2. TBI ↑ risk of alcohol misuse for some (↓ judgment)
3. AUD + TBI can ↓ recovery from either

D. This lecture covers: **(Slide 8)**

1. Definitions
2. Epidemiology/outcomes for AUDs before TBI
3. Epidemiology/outcomes for AUDs post-TBI
4. Prevention AUD + TBI
5. Treatment

II. Definitions

A. TBI

1. Defined by level of consciousness at time of TBI, using

Glasgow Coma Scale (GCS)⁸ **(Slide 9)**

- a. Standard neurologic assessment
- b. Best response in eye movement + verbal response + motor = total GCS
- c. Lowest score 3 = deep coma or death
- d. Highest score 15 = fully awake, responsive

2. Mild TBI (concussion) **(Slide 10)**

- a. If available, GCS: 13-15, or
- b. Loss of consciousness (LOC): ≤ 30 minutes, or
- c. Post-traumatic amnesia (PTA): ≤ 24 hours, or
- d. Dazed, confused, “seeing stars”
- e. Commonly called concussion
- f. 85-90% symptom free w/in days-weeks

3. Moderate TBI

- a. GCS: 9-12, or
- b. LOC: 30 minutes-24 hours, or
- c. PTA: > 24 hours < 7 days
- d. Recovery variable; not linearly related to severity

4. Severe TBI

- a. GCS: 3-8 or
- b. LOC: >24 hours or
- c. PTA: > 7 days
- d. Recovery variable; not linearly related to severity

B. DSM IV definitions of AUD's ⁹, etc. **(Slide 11)**

1. Legal intoxication usually ~0.8% blood alcohol level (BAL)

2. Std drink = 10-12 gm alcohol = ~ 0.2 gm/dl ¹⁰

- a. 12 oz. beer
- b. 5 oz. wine

- c. 1 oz spirits (gin, vodka, whiskey, et al.)

3. Acute intoxication: 1 +; **(Slide 12)**

- a. Slurred speech
- b. Incoordination
- c. Unsteady gait
- d. Nystagmus (rapid involuntary movement of eyes)
- e. ↓ Attention or memory
- f. Stupor or coma

4. Abuse: 1 + recurrent in same 12 mos.;

- a. ↓ Ability to fulfill role obligations
- b. Use in physically hazardous situations
- c. Legal problems
- d. Social or interpersonal probs.
- e. Never dependent

5. Alcohol dependence: 3 + recurrent in same 12 mos.;

- a. Tolerance (need more for effect)
- b. Withdrawal (rebound signs of intoxication)
- c. Use heavier or longer than intended
- d. Desire and inability to cut down
- e. Activities aborted
- f. Long time spent in alcohol-related activities
- g. Ongoing use despite consequences

(Slide 13)

III. Epidemiology/outcomes AUD before TBI **(Slide 14)**

A. Epidemiology of intoxication + TBI ^{11,12}

1. 45% of TBI hospitalized legally intoxicated

2. Intoxication < 19yo ↑ risky TBI-related behaviors; ^{13,14,15}

- a. 1.6 X ↑ Drinking + driving
- b. 2 X ↑ Driving after 5 or more drinks
- c. 1.8 X Riding w/ drunk driver
- d. 2.6 X ↑ injuries requiring medical attention

- e. 2.5 X ↑ violent behavior
- f. ↑ TBI 2° violence

B. Intoxication affects TBI outcome (Slide 15)

1. Can mask TBI (e.g. intracranial bleed) 2° sim. signs¹⁶
 - a. Unsteady gait, confusion, belligerence, unresponsiveness etc.
 - b. Missed diagnosis of TBI → inappropriate discharge, worse outcome, poss. death
2. ↑ Severity of TBI¹⁷
 - a. ↓ GCS
 - b. ↑ Damage on CT scan
3. ↑ Intensity of tx.¹⁸
 - a. 3X ↑ ICU days
 - b. 3X ↑ ventilator days
 - c. 2.5 X ↑ benzodiazepines
 - d. 2 X ↑ opioids
4. ↓ Scores on cognitive tests 1mo. + after injury^{19,20}
 - a. Verbal IQ ↓ 10%
 - b. Processing speed ↓ 10%
5. 2.5 X risk of repeat trauma next 2 years²¹

C. Epidemiology abuse/dependence before TBI (Slide 16)

1. Prior abuse/dependence: 37% TBI (w/o intoxication at TBI)²²
2. Abuse/dependence → risk of TBI in any 12 mos. ↑ 60%²³

D. Abuse/dependence before TBI affects TBI outcome

1. Post-injury unemployment 3X > TBI alone²⁴
2. Life satisfaction < TBI alone²⁵
3. ↑ Risk multiple TBI's²⁶

(Slide 17)

IV. Epidemiology/outcomes of AUD's post-TBI (Slide 18)

A. Epidemiology

1. 50% w/ AUD before TBI ↓ alcohol use after TBI²⁷

2. Abstinence rates after TBI ↑ 2X (15% to 30%)
3. ~ 30% of all in AUD tx. have unreported hx. of TBI²⁸
4. Sub-group develop/maintain AUD post-TBI (**Slide 19**)
 - a. ~ 25% (10% gen. pop.)
 - b. Risk factors: ²⁹
 - i. Pre-TBI AUD
 - ii. Major depressive disorder post-TBI
 - iii. Less physical disability-independent, can obtain/use alcohol
 - iv. Male
 - v. Younger age
 - vi. Uninsured or on Medicaid
 - vii. Unmarried

B. AUD post-TBI affects TBI outcome (Slide 20)

1. ↓ Neuron reorganization from alcohol ↓ natural healing process ³⁰
2. TBI + AUD may ↑ brain atrophy ³¹
3. TBI + AUD death by suicide 4X > TBI alone³²
4. TBI + AUD death by suicide 7X > gen. pub.
5. ↑ Involvement in criminal justice system³³
6. Alcohol use ↑ impact of TBI symptoms
 - a. Gait/balance problems
 - b. Poor judgment
 - c. Poor insight
 - d. Inappropriateness
 - e. Depression

(Slide 21) (Slide 22)

V. Prevention TBI/AUD combo

- A. ID/tx. of AUD ↓ risky behaviors → TBI's
- B. Successful US public health interventions re MVA (**Slide 23**)
 1. MVA's previously #1 cause of TBI, now #2 (falls #1)³⁴

2.MADD (Mothers Against Drunk Driving)

- a. Started 1980
- b. Advocates tougher drunk driving laws

3.Mandatory seat belt laws in US late 1980's ³⁵

- a. ↓ All fatalities 45%
- b. ↓ All injuries 50%
- c. ↓ TBI's 38%

4.Laws ↓ BAC to 0.08% ↓ alcohol related fatalities and related TBI's 36% ³⁶

C. Public Health Challenges (**Slide 24**)

- 1.Mandatory helmet law ↓ TBI 67% for motorcycle riders ³⁷
- 2.Highest rate of drunk driving=motorcycle riders ³⁸
- 3.2X TBI deaths in states w/o helmet law ³⁹
- 4.<50% of states w/ mandatory helmet law

(Slide 25)

VI. Treatment Approaches

A. As TBI have ↑ risk AUD, need search for acute withdrawal

- 1.Assessment of acute withdrawal (may be masked by TBI)

(Slide 26)

- a. Symptoms
 - i. Anxiety/Agitation
 - ii. Insomnia
 - iii. Irritability
- b. Signs
 - i. Tremor
 - ii. ↑ Reflexes
 - iii. Sweating
 - iv. Unstable blood pressure
 - v. ↑ Pulse
 - vi. Disorientation/confusion
- c. Interview for symptoms/amt. of use if possible

- i. Life problems re alcohol
 - ii. Usual and max. drinks past wk.
 - iii. Time since last drink
 - iv. Previous withdrawal episodes
 - d. Physical exam for signs of withdrawal/chronic use
 - i. Enlarged liver and spleen
 - ii. Cardiac arrhythmia (“holiday heart”)
 - e. Labs ⁴⁰
 - i. BAL
 - ii. Gamma glutamyl transpeptidase (GGT)
 - >35units
 - iii. Carbohydrate deficient transferrin (CDT) 20 u or 2.6%
 - iv. LFT’s, CBC, Utox, etc.

2. Treatment of acute withdrawal (**Slide 27**)

- a. Benzodiazepines (benzos) = gold standard ⁴¹
 - i. “Start low, go slow” ⁴²
 - 1'. After TBI, ↑ sensitivity to med effects
 - a'. Sedation
 - b'. Respiratory depression
 - 2'. Low initial doses – ½ reg. dose
 - 3'. ↑ cautiously, based on symptoms + signs
 - ii. Longer-acting benzos preferred ⁴³
 - 1'. Chlordiazepoxide (Librium)
 - a'. Start 25 mg. PO QID
 - b'. ↑ or ↓ Based on clin. assess
 - 2'. Diazepam (Valium)
 - a'. 5 mg PO QID
 - b'. ↑ or ↓ Based on clin. assess.
- b. Overmedication → respiratory depression or coma

c. Undermedication → agitation, delirium, seizure

B. Early-phase treatment/ prevention of AUD's (Slide 28)

2. Motivation to change alcohol behaviors ↑ after TBI ⁴⁴

- a. If dependent pre-TBI, ↑ motivation ⁴⁵
- b. ↑ # of drinks/week pre-TBI, ↑ motivation
- c. ↑ BAL at injury ≠ ↑ motivation
- d. Motivation highest 1st yr. post-TBI

3. Motivational interviewing (MI) effective at this stage ⁴⁶

- a. Non-directive interview
- b. Patient-centered, empathetic
- c. Elicits behavior change
- d. Explores/resolves ambivalence

4. MI + coping skills training > MI alone ⁴⁷

- a. Avoid situations/people likely to ↑ drinking
- b. Relaxation-exercise, breathing exercises
- c. Distraction-hobbies, “keeping busy”
- d. Identification/participation in meaningful activity

C. Treatment of chronic AUD +TBI (Slide 29)

2. No evidence-based algorithm for treatment⁴⁸

3. ↓ Effect of standard tx. ⁴⁹

- a. Cognitive barriers
 - i. ↓ Attention, judgment, insight, language skills
 - ii. ↓ Short-term memory, etc. ↓ behavior control
- b. Interpersonal barriers 2° ↓ cognition/↑ behavior problems
 - i. Frustrate caregivers
 - ii. Impair fxn. in self-help groups
- c. System barriers
 - i. High cost of AUD + TBI care
 - ii. Most inpt. AUD programs exclude TBI
 - iii. Outpatient tx. may not be enough

4. Modify std. assessment of AUD for TBI **(Slide 30)**

- a. Routine screen for all TBI patients ⁵⁰
 - i. AUDIT
 - 1'. Alcohol Use Disorders Identification Test
 - 2'. 10 questions, takes little time
 - ii. GGT; CDT
- b. Multiple assessments needed ⁵¹
 - i. Interview pt. alone re alcohol use
 - ii. Review records for evidence AUD, past TBI
 - iii. Interview pt.'s family ⁵²
- c. Accommodate deficits/behaviors in work up
 - i. ↑ Time
 - ii. Frequent breaks
 - iii. Maintain positive interaction

5. Modify std. tx. of AUD for TBI ⁵³ **(Slide 31)**

- a. External motivators ↑ effectiveness of tx.
 - i. Financial incentives, concrete tx. plans ⁵⁴
 - 1'. 50% ↑ in tx. retention
 - 2'. May ↑ perceived value of tx.
 - ii. Intensive case mgmt. ⁵⁵
 - 1'. ↑ access to tx. and rehab.
 - 2'. ↑ continuity of tx.
 - 3'. Ongoing support patient/family
 - iii. Peer support provides; ⁵⁶
 - 1'. Emotional support
 - 2'. Knowledge about TBI/resources
 - 3'. Advocacy skills
 - 4'. Shared experiences
- b. Modify treatment conditions
 - i. ↑ Time
 - ii. ↓ noise/visual distractions

- iii. Frequent breaks in individual +group settings
- c. ↑ Cognitive retention
 - i. Pt. takes notes
 - ii. Pt. tapes session and listens again later
 - iii. Patient/caregiver repeat main points
 - iv. Role-play (coping strategies, relapse triggers)
- d. Content simplification ⁵⁷ **(Slide 32)**
 - i. Concrete , not abstract, e.g
 - 1'. Pt. uses decision making form (pros v. cons, alternative choices)
 - 2'. Break complex tasks into steps
 - ii. Behavioral focus (not insight-oriented) e.g.
 - 1'. List specific activities to replace drinking
 - 2'. Pictorial daily schedule
 - 3'. Alarm/watch to initiate these activities

6.Pharmacology **(Slide 33)**

- a. Monitor for alcohol and TBI medication interactions ⁵⁸
 - i. If pt on benzos for spasticity/anxiety, alcohol →sedation, respiratory depression
 - ii. If pt on anti-seizure medications: alcohol→ ↓ cognitive processing speed , ↓effectiveness
 - 1'. Valproic acid (Depakote)
 - 2'. Gabapentin (Neurontin)
 - 3'. Carbamazepine (Tegretol)
 - iii. If pt on propranolol for tremor : alcohol → sedation, arrhythmia, heart failure
 - iv. If pt on Selective Serotonin Reuptake Inhibitors (SSRI's) for post-TBI depression (fluoxetine/ Prozac, sertraline/Zoloft, etc): alcohol → sedation, ↓ cog processing speed
 - v. Many other med/ alcohol interactions possible

- b. Medications to stop drinking⁵⁹ **(Slide 34)**
 - i. Disulfiram (Antabuse) contraindicated
 - ii. Naltrexone (Revia) 50-100 mg/d
 - 1'. Opioid receptor antagonist
 - 2'. Reduces cravings, ↑ abstinence once achieved
 - 3'. No studies for TBI
 - iii. Acamprosate (Campral) ~ 2g/d
 - 1'. ↑ GABA (inhibits), ↓ glutamate (excites)
 - 2'. Reduces cravings, ↑ abstinence once achieved
- c. “Start low, go slow” 2° ↑ medication sensitivity
- d. Monitor medication adherence closely

D. This talk has covered **(Slide 35)**

- 1. Definitions
- 2. Epidemiology/outcomes for AUDs before TBI
- 3. Epidemiology/outcomes for AUDs post-TBI
- 4. Prevention AUD+TBI
- 5. Treatment

VII. REFERENCES

1. Foster SE, Vaughan RD, Foster WH, Califano JA, Jr. Alcohol Consumption and expenditures for underage drinking and adult excessive drinking. *JAMA* 2003; 289:989-995.
2. Hasin, DS, Stinson FS, Ogburn E, Grant BF. Prevalence, correlates disability and comorbidity of DSM-IV alcohol abuse and dependence in the United States: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Archives of General Psychiatry* 2007; 64:830-842
3. Langlois JA, Rutland-Brown W, Thomas KE. Traumatic brain injury in the United States: emergency department visits, hospitalizations, and deaths. Atlanta (GA): Centers for Disease Control and Prevention, National Center for Injury Prevention and Control; 2004.
4. Corrigan JD, Cole TB. Substance use disorders and clinical management of traumatic brain injury and posttraumatic stress disorder. *JAMA* 2008; 300 (6):720-721.
5. Jones, G. A. (1989). Alcohol abuse and traumatic brain injury. *Alcohol Health & Research World*, 13(2), 104-109.
6. Kreuzer JS, Seel RT, Gourley E: The prevalence and symptom rates of depression after traumatic brain injury: a comprehensive examination. *Brain Injury* 2001; 15:563-576.
7. Jorge RE, Robinson RG, Moser D, et al: Major depression following traumatic brain injury. *Arch Gen Psychiatry* 2004; 61:42-50.
8. Teasdale G, Jennett B. Assessment of coma and impaired consciousness. A practical scale. *Lancet* 1974 13:2 (7872):81-84.
9. Diagnostic and statistical manual of mental disorders, 4th edition, text revision. Washington DC: American Psychiatric Press Inc; 2000.
10. [www.niaaa.nih.gov/NR/rdonlyres/102BE3DF-18D7-47EE-98C5-E907\(7611929\)/0/StandardDrink.pdf](http://www.niaaa.nih.gov/NR/rdonlyres/102BE3DF-18D7-47EE-98C5-E907(7611929)/0/StandardDrink.pdf) . Accessed 12/29/2009.
11. Parry-Jones BL, Vaughan FL, Cox WM. Traumatic brain injury and substance misuse: A systematic review of prevalence and outcomes research (1994-2004), *Neuropsychological Rehabilitation* 2006; 16: 537-560.
12. Corrigan JD. Substance use as a mediating factor in outcome from traumatic brain injury. *Archives of Physical Medicine and Rehabilitation*, 1995; 76 : 302-309.
13. Wingvist, Satu, Alcohol misuse in relation to traumatic brain injury. The Northern Finland 1966 birth cohort study. *Acta Univ. Oul.* D970, 2008.
14. Hingson R, Heren T, Zakocs R, Winter M, Wechsler H. Age of first intoxication, heavy drinking, driving after drinking and risk of unintentional injury among U. S College students. *J Stud Alcohol* 2003; 64.
15. HingsonR, Heeren T, Zakocs R. Age of drinking onset and involvement in physical fights after drinking. *Pediatrics* 2001;108:872-877.
16. Galbraith S; Misdiagnosis and delayed diagnosis in traumatic intracranial hematoma. *BMJ* 1: 1438-1439, 1976.

17. Cunningham RM, Maio RF, Hill EM, Zink BJ. The effects of alcohol on head injury in the motor vehicle crash victim. *Alcohol and Alcoholism* 2002; 37: 236-240.
18. Chatham-Showalter PE, Dubov WE, Barr MC, Rhodes M, Sun J-M, Wasser T. Alcohol level at head injury and subsequent psychotropic treatment during trauma critical care. *Psychosomatics* 1996; 37:285-288.
19. Bombardier CH, Thurber CA. Blood alcohol level and early cognitive status after traumatic brain injury. *Brain injury* 1998; 12;725-734.
20. Tate PS, Freed DM, Bombardier CH, Harter SL, et al. Traumatic brain injury; influence of blood alcohol level on post-acute cognitive function. *Brain Injury* 1999: 13; 767-784.
21. Rivera FP, Koepsell TD, Jurkovich GJ, Gurney JG, Soldberg R: The effects of alcohol on readmission for trauma. *JAMA* 1993;270:1962-4.
22. Bombardier CH, Tempkin NR, Machamer J, Dikmen SS. The natural history of drinking and alcohol related problems after traumatic brain injury. *Archives of Physical Medicine and Rehabilitation*, 2003, 84, 185-191.
23. Fann JR, Katon WJ, Uomoto JM, Esselman P, . Psychiatric disorders and functional disability in outpatients with traumatic brain injuries. *American Journal of Psychiatry*, 1995; 152 1493-1495.
24. MacMillan PJ, Hart RP. Martelli MM, Zasler ND. Pre-injury status and adaptation following traumatic brain injury. *Brain Injury*, 2002; 16 :41-49.
25. MacMillan PJ, Hart RP. Martelli MM, Zasler ND. Pre-injury status and adaptation following traumatic brain injury. *Brain Injury*, 2002; 16 41-49.
26. Wong PP, Dornan J, Schentag CT, Ip R, et al. Statistical profile of traumatic brain injury: A Canadian rehabilitation population. *Brain Injury* 1993; 7: 283-294.
27. Bombardier Ch, Temkin NR, Machamer J, et al. The natural history of drinking and alcohol related problems after traumatic brain injury. *Archives of Physical Medicine and Rehabilitation* 2003; 84:185-191.
28. Walker R, Cole JE, Logan TK, et al. 2007. Screening substance abuse treatment clients for traumatic brain injury: prevalence and characteristics. *J. Head Trauma Rehabil.* 22:360-367.
29. Horner MD, Ferguson PL, Selassie AW, La Babbate LA, et al. Patterns of alcohol use one year after traumatic brain injury: A population based, epidemiologic study. *Journal of the International Neuropsychological Society* 11:322-330, 2005.
30. Bach-y-Rita P. A conceptual approach to neural recovery. In Bach-y- Rita P, editor. *Traumatic brain injury*, New York: Demos Publications, 1989:81-85.
31. Bigler ED, Blatter DD, Johson SC, Anderson CV, et al. Traumatic Brain Injury, alcohol, and quantitative neuroimaging; preliminary findings. *Brain Injury*, 1996, 10, 197-206.
32. Teasdale TW, Engberg AW: Suicide after traumatic brain injury: A population study. *Journal of Neurology, Neurosurgery and Psychiatry* 2001; 71:436-440.

33. Kreutzer JS, Marwitz JH, Witol AD. Interrelationships between crime, substance abuse, and aggressive behaviors among persons with traumatic brain injury. *Brain injury* 1995; 9: 757-768.
34. CDC, 2008
35. US Department of Transportation: Final regulatory impact assessment on amendments to Federal Motor Vehicle Safety Standard 208, Front Seat Occupant protection (DOT publ no HS-8060573). Washington DC, U.S. Department of Transportation
36. Insurance Institute for Highway Safety, Highway Loss Data Institute, 2005a. http://www.iihs.org/research/fatality_facts/alcohol.html.
37. Insurance Institute for Highway Safety, Highway Loss Data Institute, , 2005C. http://www.iihs.org/research/fatality_facts/motorcycles.html
38. Peek-Asa C, Kraus JF: Alcohol use, driver and crash characteristics among injured motorcycle drivers. *J Trauma* 41 (6):989-993, 1996
39. Sosin DM, Sacks JJ, Smith SM. Head injury associated deaths in the US from 1979-1986. *JAMA* 262:2251-2255.
40. Allen JP, Sillanauke P, Strid N. National Institute of Health Publications. Biomarkers of heavy drinking.
41. McKeon A, Frye MA, Delanty N. The alcohol withdrawal syndrome. *Journal of Neurology, Neurosurgery and Psychiatry*. 2008;79; 854-862.
42. Silver JM, McAllister TW, Yudofsky SC. *Textbook of Traumatic Brain Injury*. 2005 American Psychiatric Publishing, Arlington VA, p.514.
43. Ashworth M, Gerada C. ABC of mental health. Addiction and dependence - II, alcohol. *British Medical Journal*, 1997; 315 (7104):358-360.
44. Bombardier CH, Ehde D, Kilner J: readiness to change alcohol drinking habits after traumatic brain injury. *Archives of Physical Medicine and Rehabilitation* 1997; 78:592-596.
45. Bombardier CH, Rimmele CT, Zintel H. The magnitude and correlates of alcohol and drug use before traumatic brain injury. *The Archives of Physical Medicine and Rehabilitation* 2002; 83:1765-1772.
46. Rollnick S, Miller WR. What is motivational interviewing? *Behavioral and Cognitive Psychotherapy* 1995; 23:325-334
47. Vungkhanching M, Heinemann AW, Langley MJ, et al. Feasibility of a skills-based substance abuse prevention program following traumatic brain injury. *Journal of Head Trauma Rehabilitation* 2007;17: 112-131.
48. Graham, DP, Cardon AL. An update on substance use and treatment following traumatic brain injury. *Ann N.Y. Acad Sci* 2008; 1141:148-162.
49. Corrigan JD, Lamb-Hart GL, Rust E. 1995. A program of intervention for substance abuse following traumatic brain injury. *Brain Injury*; 9:221-226.
50. Frye D. Screening for substance abuse as part of the neuropsychological assessment. *Brain Injury Source* 2001; 5(4):20-22.
51. Moore, D. (1998). Substance use disorder treatment for people with physical and cognitive disabilities. Treatment Improvement Protocol (TIP) Series 29. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Substance Abuse and Mental Health Services Administration. DHHS Publication Number (SMA) 98-3249.

52. Kreutzer JS, Witol AD, Sander AM, Cifu DX, Marwitz JH, Delmonico R. A prospective longitudinal multicenter analysis of alcohol use patterns among persons with traumatic brain injury. *Journal of Head Trauma Rehabilitation*, 11(5)58-69.
53. <http://pubs.niaaa.nih.gov/publications/social/module10Disabilities/module10I.html>. Disabilities and alcohol use disorders. Accessed 12/11/09.
54. Corrigan JD, Bogner J, Lamb-Hart G, Heinemann AW, et al. Increasing Substance Abuse Treatment Compliance for Persons with Traumatic Brain Injury. *Psychology of Addictive Behaviors* 2005; 19: 131-139.
55. Heinemann AW, Corrigan JD, Moore D. Case management for TBI survivors with alcohol problems. *Rehabilitation Psychology* 2004; 49:156-166.
56. Hibbard MR, Cantor J, Charatz H, et al. Peer support in the community: initial findings of a mentoring program for individuals with traumatic brain injury and their families. *Journal of Head Trauma Rehabilitation* 2002; 17:112-131.
57. Cash R., Philactides A. *Clinical Treatment Guidelines for Drug and Alcohol Clinicians. No 14: Co-occurring acquired brain injury/cognitive impairment and other drug use disorders.* Fitzroy, Victoria 2006 : Turning Point Alcohol and Drug Centre Inc.
58. Sparadeo, F. R. (2001). Treating substance abuse in individuals with TBI: The lessons of experience. *Brain Injury Source*, 5(4), 24-27, 42-45.
59. Corrigan JD, Cole TB. Substance abuse issues after traumatic brain injury. [www.biausa.org/elements/BIAM/2004/substanceabuse .pdf](http://www.biausa.org/elements/BIAM/2004/substanceabuse.pdf).