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## A New Approach in Adolescent Alcohol Intoxication – Clinical Pediatric Experience and Research Combined

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### 1. Introduction

Misuse of alcohol has become a pediatric health care issue during the last decade. In clinical practice, patients are first treated in an acute care setting. After sobering up, follow-up treatment starts in an outpatient department. To cope with the increasing numbers of underage patients with alcohol intoxication, special programs have been developed to improve follow-up treatment of these patients. The focus has shifted towards underlying neuropsychological and social problems. The main goals of the program are behavioral changes and prevention of new events.

The physiology of alcohol metabolism is clear, however in children and adolescents definitions of binge-drinking, problematic alcohol use and alcohol abuse are overlapping. Research is being done on epidemiology, risk factors and consequences that should be cleared up further. In particular, concerns about brain damage in young adolescents are a topic of interest.

Besides medical attention being paid to this new patient group, policymakers should increase awareness of the dangers of alcohol use. National and international policies differ substantially in legal drinking age and location of purchase. Media attention and marketing also have a huge influence on the drinking behavior of adolescents.

This chapter deals with the following subjects:

- Physiology
- Epidemiology
- Risk factors
- Consequences
- Acute care
- Hospital admittance
- Intervention / follow up
- Screening tools
- Prevention
- Protocol

## 2. Physiology

Ethanol is absorbed in the stomach or small bowel. Approximately 25% is absorbed directly from the stomach into the bloodstream; the remainder is absorbed by the small bowel. Ethanol cannot be stored; 90% up to 98% of it is broken down in the liver by oxidation. The other 2% to 10% is removed directly via urine, breathed out through the lungs or excreted in sweat. Ethanol reaches its peak-blood-concentration within one hour, particularly when ingested on an empty stomach.

Oxidation of ethanol takes place in two ways. Most of it is done by enzymes known as alcohol dehydrogenase (ADH), which produces acetaldehyde, and aldehyde dehydrogenase (ALDH), which transforms acetaldehyde into acetate, a non-toxic metabolite. In this process, hydrogen is transferred from nicotinamide adenine dinucleotide ( $\text{NAD}^+$ ) to become NADH (figure 1). Acetate is further metabolized through the citric-acid cycle and leaves the body as carbon dioxide and water. A small amount is processed via an alternative pathway, known as the 'microsomal ethanol-oxidizing system', using cytochrome P-450. In young people, this system is hardly used, as it is mainly activated in regular drinkers or when the level of alcohol is very high (1).

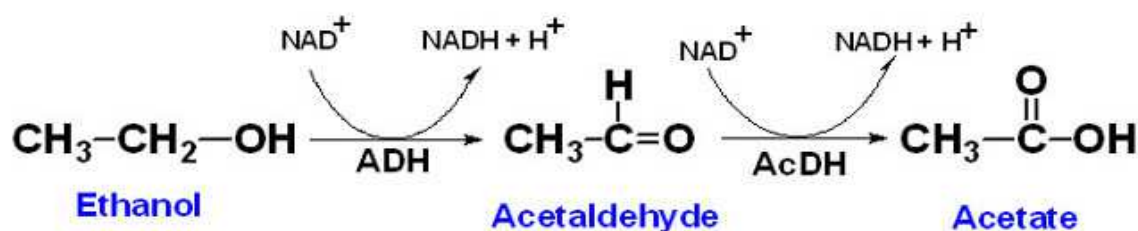


Fig. 1. Oxidation of Ethanol

Different subtypes of ALDH exist within the human body. Mitochondrial ALDH-2 has the biggest affinity with alcohol. About 50 per cent of East-Asian people have a genetic variation which causes their ALDH enzyme not to work very well, resulting in accumulation of toxic acetaldehyde.

The kinetics of alcohol has several metabolic consequences. Due to a changed  $\text{NAD}^+/\text{NADH}$  ratio, which inhibits gluconeogenesis, the glucose metabolism can be affected. If existing glycogen deposits have been used, this might lead to hypoglycaemia. Young persons with low glycogen levels are particularly at risk. In other situations alcohol may favor, rather than inhibit, gluconeogenesis and may therefore cause hyperglycaemia (2).

In oxidation, several acid metabolites are being formed, such as lactate and hydroxyacid, which causes metabolic acidosis. In metabolic acidosis, renal potassium loss can cause hypokalaemia, which could be increased by vomiting. These metabolic alterations also favor liver damage. In practice, hypoglycaemia rarely occurs and acidosis is often mild (2) (see also Acute Care chapter).

Symptoms of alcohol intoxication usually appear at a blood alcohol concentration of 20-50 mg/dl (0.2-0.5%) (Table 3). However, interpersonal variability can be observed. Children have a smaller extracellular volume and could therefore experience symptoms at a lower blood concentration. Symptoms of alcohol use will be further discussed below.

### 3. Epidemiology

Of all the substances, alcohol is –by far– the most popular product. Almost all secondary school students try out alcoholic beverages at least once before they leave school between the age of 16 and 18. The percentage of students who abstain in their secondary school period is constant at around 10% (ref). Between 50% and 60% of all students consume alcohol every month.

Over the past years, this percentage has been rather stable. Since 2003, the youngest students (12 – 14 years) show an increase in lifetime prevalence of alcohol use and previous month alcohol use, especially among girls. Girls also seem to become an increasing cause of concern on other scales. Since 2003, young girls (<15 years) engage in binge drinking more often and have the same frequency of drunkenness as young boys (3;4).

Monitoring alcohol related hospital admissions in the Netherlands is part of the Dutch Pediatric Surveillance System (NSCK). This unique and effective signaling system collects information on several predetermined diseases, disorders or symptoms in Dutch general and academic hospitals. Nearly all the Dutch pediatricians participate (92%). Adolescent alcohol use was included in 2007, and ever since it has been one of the leading topics of the system.

When a patient under the age of 18 is admitted because of alcohol related problems, the pediatrician in charge reports the case. Questionnaires are distributed to the pediatricians by mail or they can download them from the website. The questionnaire consists of four parts, exploring (1) previous alcohol use circumstances and hospital treatment, (2) patient characteristics, (3) alcohol use patterns, and (4) control variables.

### 4. Questionnaire content

#### 4.1 Intoxication and characteristics of hospital treatment

Time frame of intoxication (morning [6 a.m.–noon], afternoon [noon–6 p.m.], evening [6 p.m.–midnight], night [midnight–6 a.m.]), reason for hospitalization (traffic accident, other accident, aggression/violence, suicide attempt, reduced consciousness—if yes, period of unconsciousness in hours), blood alcohol concentration (BAC, grams of alcohol per liter blood), type of alcohol consumed (beer, wine, distilled spirits, premixed drinks, post mixed drinks [home-mixed or commercially mixed drinks], other), alcohol-obtaining practice (at home, from friends, supermarket, liquor store, hotel and catering industry, other), alcohol-consuming location (parents' home, adolescents' own home, friends' home, on the street, work place, at [a] school [party], public place [sports bar/canteen], commercial place [hotel and catering industry/bar/pub/discotheque], holiday, other), alcohol-consuming company (nobody, friends, parents, other relatives, strangers, other), and other (illicit) substances used (none, cannabis, cocaine, amphetamines / speed, magic mushrooms, Ecstasy, other). If respondents answered “yes” to the last question, method of confirmation was recorded

(adolescents’ own acknowledgment, other testimony, judgment of the pediatric doctor, laboratory values/urine, other), total time of hospitalization (days), hospital intensive care use (days), intravenous fluids (yes/no), and hospitalization aftercare (patient forwarded to any medical or aid agency).

**4.2 General and demographic information about the adolescent**

Patient code (control variable consisting of initials of the adolescent, confidential), date of birth (dd-mm-yy), gender, living area (first two numbers of postal code), daily occupation (educational level, work), school performance (normal, repeating of a class, dropout), family situation (traditional, foster parents, living alone), siblings (none, brother[s], sister[s], both), position to siblings (oldest, middle, youngest), cultural background (Dutch, Moroccan, Turkish, Surinamese, Antillean, other), religious background (none, Roman Catholic, Protestant Christian, Jewish, Muslim, Hindu, Buddhist, other), and adolescent registration to medical or aid agencies (none, pediatrician, psychologist, other professional, mental health care institution, The Netherlands Youth Institute, other).

**4.3 Patterns of alcohol use and other substance use**

Alcohol use in previous months (average number of units per week day [Monday-Thursday] and average number of units per weekend day [Friday-Sunday]), regular drinking places (parents’ home, adolescents’ own home, friends’ home, on the street, work place, at [a] school [party], public place [sports bar/canteen], commercial place [hotel and catering industry/bar/pub/discotheque], holiday, other), regular (illicit) substance use (none, cannabis, cocaine, amphetamines/speed, magic mushrooms, Ecstasy [3,4-methylenedioxymethamphetamine, or MDMA], other), regular tobacco use (no, yes; if possible, estimated number of cigarettes per week), prescribed medication use (no, yes; if yes, what type of medication/name], and parental knowledge of alcohol use (parents know exactly, parents know approximately, parents believe their adolescent child consumes more or less), age of first alcoholic drink.

**4.4 Control variables**

Date of the intoxication, the date of filling in the questionnaire, pediatrician code number, and the hospital involved.

**5. 2007 – 2010 Results**

Over the years, the number of adolescents treated with alcohol intoxication increased, as also depicted in Table 1.

	2007	2008	2009	2010
Adolescents treated	297	337	500	684
Increase previous year		13%	48%	37%
Usable questionnaires (response)	231	288	440	566

Table 1. Number of hospitalized adolescents due to alcohol intoxication in Dutch hospitals

The actual number of adolescents suffering from alcohol intoxication must be higher due to the following considerations:

- not all hospitals participated in the data collection procedure;
- not all underage adolescents in hospitals see a pediatrician (instead, they are treated by an emergency doctor or other specialist)
- not all alcohol-related incidents might be diagnosed as alcohol related; and
- not all the adolescents with an alcohol-related injury or intoxication visit a hospital.

5.1 Demographic information

Boys and girls are admitted with alcohol intoxication in about the same percentages (52% male vs. 48% female). However, boys generally have a higher level of blood alcohol concentration (1.87 vs. 1.69 g/L). Intoxicated girls are younger (15.3 vs. 15.7 years) and are hospitalized for shorter periods than boys. Ages range from 11 years up to 17 years, with an average of 15.7 years.

The educational levels of youngsters with alcohol misuse seem to be similar to national statistics. Repeating a study year is not seen more frequently in adolescents with alcohol intoxication. In the Dutch multicultural society, the family structures and cultural and religious backgrounds in this group of patients also correspond with national statistics. The youngest child in the family is more frequently admitted with alcohol abuse (44% youngest child vs. 32% oldest child), children without siblings are relatively uncommon (7% of hospitalized patients have no siblings). These numbers show that adolescent alcohol intoxication occurs in all levels of society, making this pediatric health care issue a difficult but most important subject to deal with.

5.2 Intoxication characteristics and alcohol use patterns

On average, the adolescents admitted to hospital had a blood alcohol concentration of around 1.80 g/L. Depending on age, body weight, gender, tolerance and drug use, this represents an alcohol consumption of about 15 units.

	2007	2008	2009	2010
Average BAC*	1.8	1.9	1.8	1.8
Average reduced consciousness (hours)	2.2	2.9	3.1	3.1
Maximum reduced consciousness (hours)	16	24	22	48

\* Blood Alcohol Concentration (grams of alcohol / liter blood)

Table 2. Intoxication characteristics

On average, reduced consciousness lasted for two to three hours (also known as alcohol coma). In 2010, one youngster stayed in a coma for 48 hours.

Questionnaires on the pattern of alcohol use demonstrate that more alcohol is consumed during weekends (0-15 units a day in the weekend, vs. 0-5 units on a week day). For 30% of the patients, the alcohol consumption is their first time; the other 70% do have experience in consuming alcoholic beverages. Most often they consumed beer (59%), followed by distilled spirits. Drinking locations mainly involve a friend’s (54%) or parent’s home (30%), but,



strikingly, 35% of the adolescents treated with alcohol intoxication have been served alcohol in the catering industry (as well). Adolescents report that their parents 'know to some extent' or even 'know exactly' how much alcohol they drink.

## 6. Risk factors

General risk factors for alcohol abuse are plenty. Individual, social, physiological and genetic factors influence alcohol use. Not all of these factors have the same level of importance, and some risk factors are still to be identified, as adolescents admitted with alcohol intoxication are a fairly new patient group. Also, risk seeking behavior overlaps with alcohol use. The different definitions of alcohol use, alcohol intoxication, problematic alcohol consumption etc., most likely lead to different outcomes in research and they should perhaps be looked at as different entities. However, known risk factors should be taken into account in individuals presenting with alcohol intoxication and are therefore discussed here.

A physiological process that could contribute to alcohol intoxication in adolescence is decreased sensitivity to most consequences of ethanol, which may lead to relatively high levels of alcohol consumption. For example, children do not have an explicitly stumbling walk when intoxicated. Possibly, sensitivity of cerebellar receptors is not yet fully developed. At the same time, adolescents seem to be more sensitive to other symptoms of alcohol use such as the social facilitation which occurs at low doses of alcohol (5;6).

Among adolescents admitted with alcohol intoxication, boys have a higher ethanol concentration than girls (7). Gender distribution is equal in the population, and duration of unconsciousness is equal between boys and girls. This shows that boys drink more, but it also suggests that girls become intoxicated at lower blood alcohol levels than boys (8). Girls probably are more sensitive to the toxic, suppressive effects of alcohol on the central nervous system.

The role of the socio-economic position in alcohol use is not completely clear. Negative health behavior is often confined to lower income families. More strikingly, it is one of the main factors by which socioeconomic health differences arise (9). Alcohol-related mortality is higher in lower socio-economic classes, mainly among middle-aged men (10). The educational level of the parent is associated with alcohol consumption. Highly educated mothers are correlated with less alcohol consumption (11). At the same time, unskilled occupational level of the father is positively correlated with the amount of alcohol consumed. Other reports conclude that children from families with higher incomes drink more frequently and they more often drink without supervision (12). Material factors such as financial worries and material scarcity can also reduce adolescent alcohol consumption (9). Lower intelligence scores, familial alcohol problems, peer influence and parental attachment can be possible confounders.

Students at pre-vocational secondary education or pre-university secondary education all drink from an early age. It appears that patients with alcohol intoxication on the pre-vocational level are younger and drink less. Higher educational level it is an independent risk factor for higher BAC at admittance.

Parental knowledge of alcohol use and parental rules influence alcohol use amongst adolescents (13). These aspects are striking in clinical practice, with examples of parents

offering alcohol to their underage children. Parents who set strict alcohol-specific rules early on delay the age of onset and reduce the frequency and quantity of adolescent alcohol consumption (14) (Koning). A strict attitude of parents towards alcohol diminishes adolescents' involvement in alcohol use. To positively influence problematic alcohol use in their children, parental attitude should be addressed in the treatment of these patients.

Parental attachment can be another factor of interest in parental involvement. It has been described that poor parental attachment is related to an earlier onset of drinking. The inverse explanation can be that the younger the adolescent starts using alcohol, the less strong the attachment with the parents is (13). The influence of the relation between parent and adolescent needs to be clarified further.

A family history of alcohol use is associated with more alcohol consumption in adolescents; and with even higher transmission between parents and adolescents of the same gender (15). Alcoholism of the parents is associated with heavy drinking and binge drinking patterns during adolescence (16). The explanation of these tendencies can be found in the direct exposure to alcohol, as well as in assimilating certain standards and beliefs on alcohol use. Adolescents tend to imitate role models. On the other hand, a positive family history has been found to lead to a relatively lower sensitivity to alcohol.

Students living with peers during their college years drink more alcohol (17). Peer influence is a risk factor in many risk-seeking attitudes, such as smoking, substance abuse and sexual risk behavior. Children are particularly prone to the influence of peers during adolescence. Also, underage drinkers can gain access to alcohol through peers by having older friends who work in a store.

Alcohol use is related to substance use. Cannabis in particular is common, but amphetamines are used as well, as are ecstasy, happy mushrooms and cocaine. Co-occurrence is common and therefore patients admitted with alcohol intoxication should always be screened for substance abuse (18).

Cultural influences are connected to local politics, either nationally- or statewide. Determining legal drinking age has a strong influence on the availability of alcohol for adolescents (19;20). However, this seems to be just one of several factors to be considered. A prosperous society and a change in the available types of drinks are likely to have an effect on alcohol consumption. An increase in drinking among youngsters has been observed in the past decade (21). For Dutch adolescents purchasing alcohol is one of the leading expenses (22-24).

The relationship between alcohol or substance abuse and psychiatric disorders such as ADHD is described as a consequence as well as a cause (25;26). Symptoms like physical aggression, conduct disorders and violence as well as hyperactivity and oppositional behaviors at a young age appear to be risk factors for alcohol use in later life (27). In particular, higher quantities of alcohol consumption have been associated with a lack of restraint (disinhibition) (28;29). The interpretation of these associations can be causal and consequential and are interesting subjects of research still to be carried out. Depression and anxiety disorders in relation to alcohol use are mainly studies in adult populations (and not in adolescents or children). However, depression occurs more frequently in patients with alcohol abuse (30).



The clustering of social problems and alcohol intoxication was a particular observation of interest in a project carried out at the Reinier de Graaf Hospital in Delft, The Netherlands (see Protocol chapter). The rate of self-reported social problems was high among the adolescents admitted for alcohol intoxication. Among them were family histories of addiction (35.3%), divorce or a deceased parent (19.1% and 11.3% respectively); parent-child interaction was aberrant in many cases (44.6%), as were school problems (34.3%) and sexual abuse (4.4%) or life-events (e.g. severe illness, emotional problems (41.2%). Also common were underlying psychiatric disorders (40%) (autism, attention deficit hyperactivity disorder, depression or eating disorders).

These percentages show that the clustering of personal and social issues during puberty makes this group vulnerable.

## 7. Consequences

It is important to realize on the long term, that alcohol and substance abuse tend to track on into early adulthood and that alcohol use at a young age is a predictor for future alcohol use (31).

Adolescent drinkers are more likely than their non-drinking or experimenting peers to have school problems, drugs or engage in criminal activities such as stealing. In a follow up study carried out 10 years later, adolescents who had consumed alcohol were still more often involved in problem behaviors including unreliable work attendance, substance use problems, violent behavior and illegal activities during early adulthood. Early experimenters were also at higher risk than non-drinkers to have problems with substance use and criminal and violent behavior (32).

Heavy drinking has been shown to affect neuropsychological performance and could impair the growth and integrity of the brain structures. During adolescence, the part of the brain that is developing in particular is the frontal lobe. Here, the higher cognitive functions such as cognitive processing and executive functions are located (33;34).

Research with functional magnetic resonance imaging (fMRI) demonstrates that memory, attention and visuospatial abilities are negatively affected by alcohol. Alcohol and drug abusers perform worse than their peers (35). Increased vulnerability for these neurologic effects is seen in women, patients with a family history of alcohol use disorders, heavy episodic drinkers and alcohol use combined with drug use. The co-occurrence of psychiatric disorders is an important factor to consider in the evaluation of neurocognitive functioning in patients with alcohol abuse. As was mentioned before causality is not clear. The role of time of abstinence and age of first drink seem to be less related to neurologic damage (36).

Importantly, as young adulthood is a period when most people make important educational, occupational and social decisions, an impaired cognitive function could significantly affect their futures.

Alcohol use increases the risk of high-risk sexual intercourse. Young adolescents report that alcohol has caused them to engage in unplanned sex (27). Girls in particular are prone to participate in sexual relationships more readily, and even against their will, during intoxication. Afterwards, they often regret the incident and it is not uncommon that they are traumatized.

Alcohol consumption is one of the leading preventable causes of death in the United States (37). The WHO recently identified alcohol use amongst young people (10-24 years) as the most important factor contributing to disability adjustable life years (DALY's) (38). In particular, consumption of alcohol is associated with injuries and accidents, which are major contributors to mortality of adolescents.

Apart from the psychiatric disorders discussed before, alcohol use is also associated with medical conditions such as hepatitis and liver cirrhosis, hypertension, pancreatitis, cardiomyopathy, pneumonia and tuberculosis. Also cancers of the mouth, esophagus, pharynx, larynx and breast are more common in patients with excessive alcohol consumption. Neurologic disease is not uncommon, and alcohol use is associated with peripheral neuropathy and myopathy, as well as with central nervous diseases such as dementia and stroke.

8. Acute care

The acute care of an adolescent presenting with alcohol intoxication is being done conform the Advanced Pediatric Life Support protocol (APLS). Most hospitalizations occur during the evening or night (93%), (see Epidemiology section). The announcement of an adolescent having become unwell at a party or an unconscious youngster smelling of ethanol usually gives away the diagnosis. However, as the presentation is often severe, especially the level of consciousness, ABCD-assessment should always be done. Reports of reduced consciousness vary from a couple of minutes up to 48 hours (!), with an average of 2 hours and 11 minutes. According to Dutch research, average time of unconsciousness has risen during the past years from 2,2 hours in 2007 to 3,1 hours in 2010 (7). Other presentations include traffic accidents, aggression and violence and even suicide attempts (1%). These type of symptoms of alcohol intoxication (Table 3) usually appear at a blood alcohol concentration of 20-50 mg/dl (0.2-0.5%).

Blood Alcohol Concentration		Symptoms
Mg/dl	‰	
20-50	0,2-0,5	Gross motor impairment, difficulty concentrating
50-100	0,5-0,10	Decreased coordination and reactivity
100-150	1,0-1,5	Disturbed balance and gait
150-250	1,5-2,5	Stupor
300	3,0	Unconsciousness
400	4,0	Respiratory failure

Table 3. Symptoms of alcohol intoxication

At admission of a patient with alcohol intoxication, the following assessments should be done:

- Amount and type of alcoholic consumptions
- Other substances (e.g. marihuana, cocaine, amphetamines)
- Other medications (e.g. contraception, benzodiazepines)
- Blood (blood alcohol concentration, arterial blood gas, glucose, electrolytes, electrocardiogram, liver function)
- Urine toxicology screen.

The amount of alcohol consumed can be estimated by using the formula, based on the Widmark equation, in figure 2 (39). This can be of use in conversations with parents and patients about alcohol consumption.

$$\text{Cethanol} = \frac{A \times p \times 0,01 \times 0.8}{V \times Lg} \rightarrow \frac{A = \text{Cethanol} \times V \times Lg}{p \times 0,01 \times 0.8}$$

Cethanol	= Ethanol concentration (in g/L or o/oo)
A	= Amount of alcohol containing product consumed (in ml)
P	= Alcohol concentration in product (in %)
0,08	= Relative density of ethanol
V	= Volume of distribution (in L/kg) for a child: 0,7 L/kg
Lg	= Body weight (in kg)

Fig. 2. Formula to calculate amount of alcohol consumed

In general, acute medical complications are serious but mild. The complications seen most frequently are reduced consciousness (45%) and hypothermia (43.1%). Electrolyte disturbances are most often hypercloremia (31.1%) and low bicarbonate (22%), but hypokalemia (11.9%) and hypernatremia (7.7%) are also seen. Hypoglycaemia is not often reported, however hyperglycaemia can be seen in some patients (13.6%). Mild acidosis, more often metabolic but also respiratory, was observed in 28.8% of patients (2).

After admittance patients are directly monitored. Treatment mostly consists of administering intravenous fluids to rehydrate. Metabolic acidosis, hypoglycaemia and hypothermia are corrected. Gastric lavage and activated charcoal are not recommended since they are ineffective due to the rapid resorption of ethanol and because they possibly enhance the risk of aspiration.

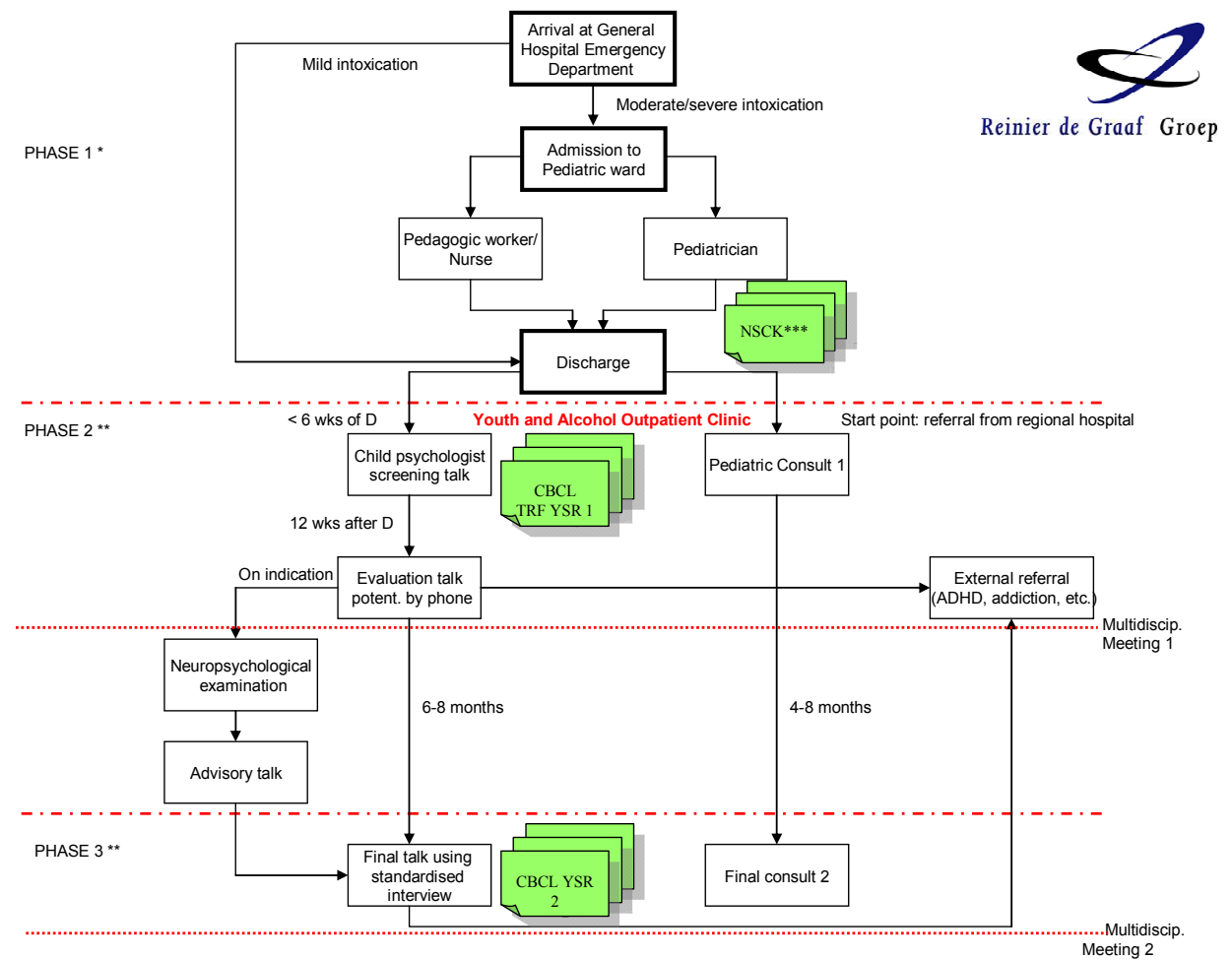
9. Protocol

To standardize the care given to an intoxicated adolescent, a program was developed in the Reinier de Graaf Hospital, Delft, The Netherlands to follow up on patients with alcohol intoxication. The objective of the program is to structurally intervene in the growing problem of adolescents with alcohol intoxication. Four main goals were identified:

- To prevent repetition of intoxication
- To change the behavior of the adolescent towards alcohol
- To change the behavior and guidance of the parents
- To detect psychological co-morbidity

Consecutively, more insight is obtained into the epidemiology, social environment and psychological and cognitive functioning of these patients.

Based on the short-term and long-term complications mentioned above, the protocol is divided into different stages.



NSCK: Dutch Pediatric Surveillance System  
CBCL: Child Behaviour Checklist  
TRF: Teacher Report Form  
YSR: Youth Self Report  
Fig. 3. Flowchart alcohol treatment policlinic alcohol and youth

10. Hospital admittance

After acute care, the focus shifts towards treatment and education. By informing the patients and their parents about the dangers of alcohol consumption, the effect of hospitalization is broadened towards prevention and intervention. This will be of use during follow up at the outpatient department.

Most patients are admitted in the evening or at night (40). The next morning, they are woken on time to start a short program before being discharged from hospital. First, the pediatrician speaks both to the patient and the parents, explaining the reason for admittance and emphasizing the seriousness of the event. The patient’s medical and social histories are checked and questions are asked about further alcohol use. The dangers of alcohol use are explained. This is seen as an important moment for intervention and education. Patient and parents pay more attention shortly after the incident occurred. Later on, a pedagogic

employee or nurse will help the adolescent to answer questions on alcohol use on a government-funded website. Parents are also referred to websites for further information.

Most of the patients leave the hospital in good clinical health within a day after admittance. After discharge, a program starts at the outpatient department of pediatrics and child psychology.

## 11. Intervention & follow up

After treatment of the acute problems and sobering up, the multiple alcohol-use related problems mentioned above should be attended to in an evaluation.

Many treatments for alcohol use disorders can be applied to decrease alcohol use. Among them are family treatment, (short) motivational enhancement therapy and behavioral therapy, which all seem to have a significant positive effect on alcohol and substance use (41).

After receiving information in the hospital setting, the patients visit a pediatrician and a pediatric psychologist at the outpatient clinic. The program consists of several appointments.

At the appointment with the pediatrician, the patient's general alcohol and drug use, school problems and social issues are addressed. By means of a presentation several alcohol related problems are addressed, such as epidemiology, metabolism, neurological and physical consequences, case reports, peer pressure (for example at sport facilities), media attention and marketing strategies of alcohol industries. The role of the parents is emphasized as well; alcohol-specific rules are pointed out, such as; rules on vacation are the same as those at home, parents are not supposed to drink in front of their children, not to mention invite them to try. To optimize the effect of the intervention, these issues can be individualized depending on the patient's interest.

The child psychologist performs a psychological interview to screen for underlying problems. The patient is also evaluated based on behavioral questionnaires (Youth Self Report (YSR), Child Behavior Checklist (CBCL) and Teacher Report Form (TRF), to be filled in by patient as well as parents and teachers), and earlier and recent educational performance. The interaction between parents and adolescent is taken into account, and life events and psychosocial history also are important issues for discussion. Once again the dangers of alcohol use are explained.

When indicated, psychological, social, medical or addiction-related treatment is offered. Some services can be offered within the setting of the outpatient clinic, for others, the patient can be referred elsewhere. Although treatment is not always necessary, follow-up is done at all times. After the first appointments the patient will be contacted within 6 months after the event to discuss alcohol use and general well-being. However, often the pediatrician or child psychologist finds it necessary to see the patient in the mean time because of related issues.

In conclusion, underlying social and neuropsychological problems can come to light during psychological and pediatric screening and can be treated when indicated. The dangers of alcohol are being explained extensively to patients as well as parents. Help can consist of psychological treatment or referral to detox clinics or other youth care institutions.



Preliminary results of the project are promising. At follow-up, 84-88 % of the patients had stopped binge drinking and 61% had stopped the consumption of alcohol. Awareness of the parents was another factor of interest; at follow up 82,5 % of the parents applied specific alcohol rules, including prohibition of alcohol under 16 years of age. Behavioral questionnaires were filled in by 89% of the study population. Neuropsychological screening was done in 72% of the patients for whom it was indicated.

## 12. Tools for screening

Screening for problematic alcohol use can be useful during follow up of the patients. It can be expected that questions about lifestyle are delicate, particularly during adolescence and in the direct vicinity of parents or adults. At the same time, detection of problematic alcohol use at a young age can reveal alcohol dependency and ensure a more effective intervention. So far, no standard screening method has been identified.

Various self-report questionnaires are available for rapid assessment of drinking behavior, such as the Alcohol Use Disorders Identification Test (AUDIT), TWEAK (Tolerance, Worried, Eye-opener, Amnesia, Cut Down), the Michigan Alcohol Screening Test, CAGE (Cut Down, Annoyed, Guilty, Eye Opener) and the Alcohol Dependence Scale. The AUDIT was developed by the World Health Organization (WHO) as a measure for alcohol consumption, dependence and alcohol-related problems. The TWEAK focuses more on tolerance. It was specifically developed for women and aims to identify possible hazardous drinking patterns. The CAGE places emphasis on behaviors consistent with alcohol dependence.

These various screening methods are rapid, non-invasive and inexpensive, but they have different outcome parameters and were developed for adults. Applicability for adolescents has been investigated and seems to support the AUDIT as the better screening method (42), due to its focus on frequency of use, quantity and frequency of binge drinking. This can be an advantage in adolescents, because here the early detection of drinking problems is the main goal. However, reliability is low because of self-report.

Biological screening methods can offer more objectivity. Amongst them is the extensively used blood alcohol concentration, which is generally determined during the first care. However, this test only gives information during a short period after consumption of alcohol. It has no role in screening for alcohol use at the outpatient clinic.

Other traditional and new markers can add to the suspicion of problematic alcohol use. The more established markers of alcohol use are mean corpuscular volume (MCV), gamma-glutamyltransferase (GGT), aspartate aminotransferase (AST) and alanine aminotransferase (ALT). Increased values can lead to the differential diagnose of alcohol dependency. Direct markers, which are all products of ethanol metabolism, are acetaldehyde, acetic acid, fatty acid ethyl ester (FAEE) and ethyl glucuronide (EtG).

Newer biomarkers include carbohydrate-deficient transferrin (CDT), total serum sialic acid (TSA) and 5-hydroxytryptophol (5-HTOL). Transferrin is a plasma protein that carries iron through the bloodstream to the bone marrow. Transferrin is a polypeptide with two N-linked polysaccharide chains. The chains are branched with sialic acid residues. Consuming



significant quantities of alcohol increases the proportion of transferrin with low saturation of sialic acid residues. They are referred to as carbohydrate-deficient transferrins (CDT). CDT testing is available in a regular hospital lab.

Sialic acid is a monosaccharide carbohydrate. As a consequence of excessive alcohol consumption, saturation of transferrin with sialic acid decreases and total serum sialic acid rises. Determination of TSA provides a means of detecting alcohol abuse. 5-hydroxytryptophol (5-HTOL) is a human metabolite of serotonin (5-hydroxytryptamine, 5-HT) and is excreted in the urine, where it mainly occurs conjugated with a glucuronic acid and, to a lesser extent, in free form or conjugated as a sulphate. After alcohol consumption, the 5-HTOL level in various body fluids will rise above normal values.

The value of these new biomarkers for screening purposes is still under discussion. Several factors are of importance; such as detection period after abstinence, patterns of alcohol use (episodic drinking, non-heavy chronic patterns, etc.), associated medical disorders, demographic differences and cost and availability. Sensitivity and specificity are of particular interest and are highly dependent on cut-off points, which have not yet been established (43;44)

The indirect marker CDT and direct marker EtG seem to have the most advantages for all-around utility. Combinations of different markers, especially CDT and GGT, have been studied, and application at multiple time points could significantly increase their usefulness.

Still, little research has been done among adolescents. Some studies among adults include a sub-analysis of patients under 20 years of age, and these show minimal association of alcohol consumption and markers (43;44).

In conclusion, biomarkers of alcohol use are of interest to pediatricians dealing with adolescents at the outpatient clinic for obtaining useful information on drinking patterns, which would otherwise be obtained by less reliable means like questionnaires. The exact role of biomarkers should be clarified further.

### 13. Prevention

Alcohol use in adolescents is influenced by internal and external factors. In the first place, health interventions such as government campaigns for mass media as well as smaller programs attempt to decrease youth alcohol use. Some studies show effects on knowledge, attitude and behavior. However, the effect is uncertain and these health effects can disappear over time (45).

Secondly, the alcohol industry has a major influence via alcohol commercials and brand visibility. Advertisements attempt to make the customer feel positive about a specific product or brand. Not only adults, but adolescents as well are persuaded to adopt a positive attitude towards alcohol and even drink more alcohol (46). Policies concerning alcohol advertisement focus on specific high-risk groups. Restricting outdoor alcohol advertisements near schools, banning alcohol commercials from television early in the evening or on youth-oriented channels and specific advertisement related rules are laid down in the law.

Another factor that influences alcohol use is media portrayals. The ambience that movies and television series create in relation to alcohol increases alcohol consumption, partly through the 'modeling theory'. In particular, the so-called 'product placements' which are hidden in television shows and movies are often located tactically. Direct relations have been described between alcohol use in movies and early-onset teen drinking, drinking without parental awareness and acute alcohol consumption (47).

External risk factors that should be considered when carrying out prevention measures are matters of social, economic, physical and legal availability, which are the most important predictors of adolescent alcohol consumption, drinking patterns and alcohol-related harm (48).

Social availability refers to the social context into which drinking is incorporated. As was mentioned before, teens and adolescents drink alcohol in the company of their peers. Another social factor related to higher alcohol use is parental alcohol consumption. Economic availability relates to, prices of alcohol and especially to special promotions which increase alcohol consumption. The most frequently used governmental tool to prevent alcohol use is increasing taxes on alcoholic beverages. Higher prices lead to lower consumption (49). A third factor that can be used in prevention is physical availability, which focuses on outlet density and opening hours. Higher outlet density is related to higher availability. Especially outlet density and location should be considered, for example by decreasing availability near educational institutions.

A very important factor is legal availability. Alcohol policies for various age groups differ around the world, but the increasing number of patients admitted with alcohol intoxication demonstrates the ineffectiveness of these laws. All legislation concerning the purchase, sale, consumption and possession of alcohol should be critically arranged for underage citizens. One of the prime governmental tools to influence alcohol consumption is setting age limits, because binge drinking, drinking at school and drinking and driving are related especially to the sale of alcohol to underage persons. Research has shown that higher legal age limits are related to a decrease of alcohol-related car crashes and other injuries. However, despite legal age limits it is still possible for many underage adolescents to obtain alcohol in commercial places. Strikingly, compliance with age legislation in commercial establishment is not guaranteed; and alcohol can easily be obtained and consumed (50). Falsification of identification cards is another way to obtain alcohol.

Prevention of alcohol use among adolescents should be aimed at patients, parents and politics. A conjunct of medical, political and sociological awareness of the dangers of alcohol use can decrease alcohol use within modern societies.

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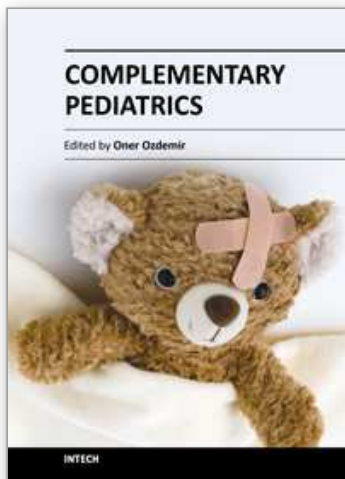
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