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1

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**Abuse Of Volatile Solvents
And Inhalants:
Papers Presented At W.H.O.
Advisory Meeting**

Pusat Penyelidikan Dadah dan Ubat-Ubatan
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11800 Penang,
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**WORLD
HEALTH
ORGANIZATION**

**ABUSE OF VOLATILE SOLVENTS AND INHALANTS:
PAPERS PRESENTED AT A W.H.O
ADVISORY MEETING**

M. GRANT

Division of Mental Health
World Health Organization
Geneva, Switzerland

A.E. ARIF

Formerly Division of Mental Health
World Health Organization
Geneva, Switzerland

V. NAVARATNAM

W.H.O. Collaborating Centre for
Research and Training
in Drug Dependence
Centre for Drug Research
University of Science
Minden, Pulau Pinang
Malaysia

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W.H.O. Collaborating Centre
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(CENTRE FOR DRUG RESEARCH)
UNIVERSITI SAINS MALAYSIA
MINDEN, PULAU PINANG
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Most regions of the world have shown concern about solvent substance inhalation as a form of drug abuse. This concern has been expressed in the past at various international meetings, including the Executive Board of the World Health Organization and the World Health Assembly and the United Nations Commission on Narcotic Drugs.

The World Health Organization, in response to this increased abuse of volatile substance inhalation, convened a meeting of an advisory group to discuss the adverse health consequences of volatile solvent inhalation. The meeting was held from 21 to 25 April 1986 at a WHO collaborating centre, the Mexican Institute of Psychiatry in Mexico City, Mexico. The problems associated with the inhalation of cocaine were excluded from this study as WHO had already completed a study on the adverse health consequences of cocaine and coca-based smoking (Arif, 1987).

It was recognized that there is a need for more information and knowledge about the extent of solvent abuse, clinical aspects, adverse health consequences and treatment and prevention, particularly among teenage populations.

The objectives of this study were to review the extent and magnitude of the problem of volatile substance abuse at a global level, its epidemiological, pharmacological and neurobehavioural aspects, suspected adverse health consequences and other medical complications, treatment strategies and approaches for prevention.

Background

The inhalation of volatile substances for mind-altering and recreational purposes is one of the oldest and simplest forms of intoxication. Inhalation of substances to produce euphoria and intoxication has its roots in history. Long before the dawn of modern civilization, tribes were known to burn incense and spices to produce mild intoxicating effects during religious rituals. The Oracle of Delphi, for example, was the result of inhaling gases emanating from the fissures in the rocks. These gases caused a state of intoxication.

During the past 50 years there has been considerable expansion in the petrochemical and other related industries,

which are producing an increasing number of volatile organic substances. Today the volatile substances reported to be abused involve a large range of substances which are widely used at home and in the industries. These substances have the potential to induce a wide range of toxic effects; several reports have appeared in recent years on the increased mortality arising from the inhalation of volatile substances, e.g. sudden death due to induced cardiac fibrillation and arrest, accidents occurring while under the influence of volatile substances, etc. There are also numerous reports on morbidity concerning mainly the liver, the kidney, the lungs and the central nervous system, particularly after prolonged use of those volatile substances.

Commonly abused volatile substances

The volatile substances reported to be currently abused include many which are widely used at home and in the industries. These substances have a wide range of potential toxic effects.

The following are the most commonly abused volatile solvents:

Aromatic and aliphatic hydrocarbons: The most common substances in the group of aromatic hydrocarbons are benzene, toluene, xylene and naphthalene. Among the aliphatic hydrocarbons hexane and heptane are the most common. These substances are commonly found in gasoline, paint thinners, adhesives and rubber cements, glue and aerosol sprays.

Alcohols: These are mainly methanol, ethanol and isopropanol. They are commonly found in many products including paint thinners and sprays, glue, stair polish and aerosol sprays.

Anaesthetics: These are mainly methylene chloride, trichloro-ethylene and nitrous oxide. They are used in oil and grease dissolvers.

Ketones: Among the common substances in this group are acetone and methyl butyl ketone. These are commonly found in paint thinners.

Esters: Two common substances of this group are ethyl acetate and propyl acetate which occur mainly in paint thinners.

Nitrites: These include amyl nitrite and isobutyl nitrite. The former is mainly found in aerosol sprays and the latter in room spray deodorants.

The aerosol spray deserves special mention because it is so commonly used in almost every home and because it is very popular in many countries. It contains several intoxicating substances including solvents. The aerosol is used in various domestic items such as sanitizer fresheners, glass cleaners, furniture polish and cleaners, insecticides, disinfectants, deodorants, hair sprays and antiperspirants.

Methods of use

Five common methods of abusing volatile substances have been identified:

- (a) Sniffing/inhaling directly from containers. The abuser may inhale from a wide variety of containers such as gasoline tanks, cans, bottles, etc.
- (b) Sniffing/inhaling from plastic bags. Here the volatile substance is placed in a plastic bag and the abuser inhales the vapour that is emitted. He does this by putting just his nose or his whole head into the bag. The latter method is especially dangerous because the abuser may become asphyxiated.
- (c) Sniffing/inhaling from cloth/clothing. The volatile substance is placed on a piece of cloth or clothing. The abuser then inhales the vapours which are emitted.
- (d) Aerosol inhalation. The volatile substance in an aerosol container is squirted directly into the nasal or oral cavity.
- (e) Inhalation of vapours emitted by heating volatile substances. Here the volatile substance is heated and the emitted vapour is then inhaled.

Table 1 contains a comprehensive classification of abused solvents.

TABLE 1
A classification of abused solvents*

1. <u>Aliphatic and aromatic hydrocarbons</u>	4. <u>Ketones</u>
Hexane	Acetone
Naptha	Cyclohexanone
Petroleum distillates	Methyl ethyl ketone
Benzene	Methyl butyl ketone
Xylene	Methyl amyl ketone
Toluene	
2. <u>Halogenated hydrocarbons</u>	5. <u>Esters</u>
Trichloroethylene	Ethyl acetate
1, 1, 1-trichloroethane (methylchloroform)	Amyl acetate
Carbon tetrachloride	Butyl acetate
Ethylene dichloride	6. <u>Alcohols</u>
Methylene dichloride	Methyl alcohol
Chloroform	Isopropyl alcohol
Halothane	
Freons and fluorocarbons	7. <u>Glycols</u>
Trichlorofluoromethane (FC11)	Methyl cellulose
Dichlorodifluoromethane (FC114)	acetate
Cryoflurane	Ethylene glycol
Dichlorotetrafluoromethane (FC12)	
3. <u>Aliphatic nitrites</u>	8. <u>Ethers</u>
Amyl nitrite	
Isobutyl nitrite	9. <u>Gases</u>
	Nitrous oxide

Description of volatile substance-related syndromes

These substances can induce mental state alterations and mood elevations. Their effects are rapid but of short duration. Thus one has the advantage of getting "high" several times over a short period. Under certain conditions of heavy dosage and/or chronic use, volatile substances can cause symptoms that meet the criteria for a diagnosable psychiatric disorder.

* Table 1 contains a comprehensive list of abused solvents (taken from NIDA Research Monograph Series No. 15, 1977, US Department of Health, Education and Welfare, Washington, D.C.),

An intoxication syndrome may occur with heavy doses of inhalants and the symptoms are mainly independent of the type of inhalant used. The duration of the syndrome varies according to the amount of substance inhaled. As regards symptomatology, the syndrome resembles that of alcohol or barbiturate intoxication but with a comparatively quicker onset (within five minutes) and a shorter duration of effect. The intoxication disorders may eventually include emotional excitation and loss of motor control, hallucinations and/or delusional or confusional states of mind. High doses may induce characteristic psychomotor retardation as well as neurological symptoms such as general muscle weakness, coma or epileptic seizures.

Chronic use of inhalants may lead to a dependence syndrome. Again, this syndrome is not specific to the type of volatile substance abused. Dependence is typically psychological in nature, but physical dependence may occasionally occur in severe cases.

Psychological dependence may be characterized by a number of criteria such as a repeated effort or persistent desire to stop or reduce inhalant use, intoxication or impairment to the extent of not fulfilling school and work obligations, preoccupation with seeking or taking inhalants for a longer period than intended, continuation of inhalant use despite significant mental or physical disorder, giving up social, familial and occupational obligations in order to seek or to inhale volatile substances.

Etiology of volatile substance abuse

Inhalant abuse typically begins in late childhood and early adolescence. In most cases, use is experimental and short lived, but heavy patterns of abuse can develop.

Among the etiological factors of volatile substance abuse is the easy availability and accessibility of various volatile substances. Young people have many choices as to the substance to abuse.

Whereas experimental use is mainly due to availability and peer influence, there appears to be a common set of psychological and social characteristics that mark those young people who eventually go on to use these substances in chronic and potentially harmful ways. These can be labelled as factors associated with inhalant abuse.

The first set of factors is cultural and familial. Many young people come from culturally marginal environments. Transition from traditional values to new values induces stress, especially if it is rapid. This stress is felt not only by the individual but also by the family. The family resources become

attenuated. Parental separation and other disruptions are common. Such parents are unable to exercise the necessary care and control in the upbringing of their children. In particular, these parents cannot effectively transmit to their children those values and beliefs that can overcome drug abuse.

Another consequence of weakened family influence is the lack of integration of children into the usual social institutions such as primary schools and places of work. The child then becomes further alienated from these normal sources of support. An unfortunate consequence of this is low self esteem and other psychological stresses.

The young person, bereft of psychological and social support looks for other alternatives. These are very often found by seeking out and associating with other young people in similar circumstances. These groups may turn to drugs as a form of expression and to alleviate stress. Over a period of time a circular pattern develops in which the physical and psychological effects of drugs further reduce social competence. After a time, a strong dependence on the chemicals may manifest itself from which escape, even with intensive ameliorative efforts, is difficult.

But why are inhalants chosen? Marginal youths often grow up in poor socioeconomic environments. They have limited access to most psychoactive drugs. Thus they turn to those that are cheap and readily available. Inhalants are found everywhere, even in the bleakest economies and remotest areas. While other drugs may be preferred as a way of blunting psychological pain. Inhalants are ubiquitous and apparently provide an adequate "solution".

While cultural marginality provides an example of the etiological factors involved in solvent abuse, it should be recognized that inhalant abuse can occur in a variety of cultural, social, and economic conditions. Any circumstance in which there is considerable cultural and familial disruption, leading to personal and psychological inadequacies may provide the basis for inhalant abuse.

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CHAPTER 2: EPIDEMIOLOGY - A GLOBAL OVERVIEW

Extent and Magnitude of the Problem

Most regions of the world have shown concern about solvent inhalation as a form of drug use.

When available information from different regions was brought together it became evident that comparability was limited due to the variations in sources of information. Another limitation is related to the method used and the different ways in which questions were constructed.

Furthermore prevalence rates were not available for most countries. In spite of these differences some common features, as well as regional variations, can be inferred from the available information. Before reviewing this information it is worthwhile to pinpoint some issues in relation to the sources of information.

Sources of Data

Clinical Settings

Inhalant users do not readily seek treatment. Thus, probably only the most severe cases will be detected in these settings.

Justice System

In some countries, especially those where the use of intoxicating inhalation is considered as an offence, the justice system is the major source of information. However, the association of inhalant abuse with criminal offences may be overemphasized in these data.

School Surveys

Only when anonymity is assured can school surveys provide the best approach to learning about drug abuse among students. One must be careful when using data from this group. In the United States, Canada and other countries, students constitute the majority of the young population. However, this is not the case in developing countries such as Latin America where a large segment of the population does not attend school.

General Population Surveys

The information provides an overall picture of patterns

of drug abuse. It covers populations in and out of school. Unfortunately general population surveys do not include populations without a fixed place of residence and other marginal groups which are also highly likely to abuse volatile solvents.

High Risk Groups

Most of the individuals heavily using volatile solvents or having serious health problems will be classified in the high risk groups.

Observational Studies

Some abusing groups can be observed by employing the participant observation technique and other observational methods.

Reporting Systems

Some countries use morbidity, mortality and/or drug abuse reporting systems. In these cases inhalant abuse can be monitored provided the system has been in existence for some time. When a new drug is used, the extent of its abuse can be overemphasized. Care must be exercised in interpreting this information.

Global Assessment and Regional Variations

South-East Asia/Western Pacific Region

The use of volatile solvents for the purpose of intoxication, whilst not a new phenomenon in the global context, is of very recent origin in the South-East Asian and Pacific Regions. One possible reason for this is the ready availability of other substances of abuse, such as heroin, at relatively low prices. The Philippines and Japan were among the first countries in the region to report the emergence of problems related to the use of volatile substances (Navaratnam, 1986).

In Japan, the main substances being abused by adolescents are organic solvents. In Malaysia, the abuse of these substances is just emerging while in Vietnam, South Korea and Hong Kong the problem has not arisen (Navaratnam, 1986).

Rates of drug use among students in Australia (Australian Royal Commission of Inquiry into Drugs Report, 1980) and New Zealand (Edmondson, 1986) varied between 6.5%

and 15% for 'ever use' and 7% to 3.4% for 'current use'. In general, more males than females report ever use (Australian Royal Commission of Inquiry into Drugs Report, 1980) but in some areas this difference is not observed (Home1 et al., 1984). Use is most common among children and adolescents (from 7 to 18 years). Heavy use is more prevalent among natives and among teenagers from high density areas and poor living conditions.

Europe

The problem of inhalant abuse is present in most countries of the region. It was first noted in Northern Europe in the 1950's (Watson, 1980; National Swedish Board of Health and Welfare, 1978) where it had its peak in the 1960s and 1970s. It has now levelled off or declined in those countries. In Central and Southern Europe inhalant abuse is more a sporadic phenomenon which has caused increased concern (Facy and Angel, 1984; Ministerio dell'Interno, 1983). Drug use emerged in the Iberian Peninsula relatively late compared to other European countries, and rates of use among students in this country are lower than the ones observed in other regions. The rate of 'ever use' in one study was 2.3% and 'actual use', 0.6% (Fonseca, 1985), whereas in England prevalence varies between 9.8% and 8.1% (Ramsay, 1982; Faber, 1985). In Sweden rates of ever-use reported in several regions of the country varied between 2% and 27% (National Swedish Board of Health and Welfare, 1978). In Germany 8% of young people aged 12 to 24 years have used volatile solvents (Bundesminister fur Jugend, Familie und Gesundheit, 1983). Meanwhile, among the 15 to 24 year old students in Switzerland have used drugs, are 8.1% were males and 3.6% were females (Schweiz. Fachstelle fur Alkoholprobleme, 1985/6).

In Europe, inhalant abuse is more common among males but gender differences are diminishing. It is also more common among young people from large towns. Rates of use of other drugs such as alcohol, cannabis, heroin and stimulants are higher than those for inhalants (Uchtenhagen, 1986).

North America

In North America representative surveys of students typically show that many have used inhalants recently. Inhalants are far less popular than drugs such as alcohol, cannabis or hallucinogens (Smart, 1986). Rates of 'ever use' are about three times as high as 'use' in recent months; rates of inhalant use are much higher among dropouts

(Annis et al., 1975) than students in school. Most student surveys show no signs of an increase in use; use rates are usually stable (Johnston, 1983) or declining (Smart, 1983). It is not clear whether rates of use are increasing among non-students; most student users use inhalants infrequently, only a small minority use as often as once a week; inhalant users are predominantly 12-15 year-old males (Smart, 1986).

Inhalant users often use other drugs and engage in considerable delinquency, especially theft and burglary (Stybel et al., 1976; Swerhun et al., 1983; Smart, 1983). They are often early school dropouts and have low expectations of post secondary education; inhalant use among adults is not often studied. Although it appears to be infrequent, some emergency room studies have found adult abusers requiring treatment (Hershey et al., 1982), and the major problem with abuse occurs in certain impoverished or ghetto situations (Smart, 1986). Very heavy use has been found in a large number of Indian communities both in Canada and the United States (Barnes, 1980). Other heavy users include poor Hispanics and lower class blacks in some southern areas of the United States (Press and Done, 1967).

Latin-America

In general it may be said that inhalation of psychotropic substances has been observed in almost all the countries of the region (Medina-Mora, 1986).

In Mexico inhalants are widely used and is the drug of choice among secondary students between 12 and 15 years of age (Castro and Maya, 1982). Among older students (16 years and over) marihuana is the drug of choice (Castro, Maya, 1982). The highest incidence of inhalant use among students was reported in Paraguay 21% (Velez, 1982), and the lowest in Venezuela 0.03% (Gruson, 1978).

In most countries, except Brazil (Murad, J.E., 1983) where perfume and other types of sprays are very frequently used, glue and thinner are substances reported to be commonly abused. Inhalation is practised by all social classes. It appears that gasoline is preferred in low socioeconomic groups. In general, inhalant users are under 18 years of age. However, in Costa Rica it seems to be more common among populations between 19 and 24 years of age (this practice is more frequent among males under 18 years of age, from deprived areas (Miquez, L.H., 1984).

In some countries of South America, such as Uruguay (Bachini, 1982); Honduras (Zavala, 1984) and Argentina

(CENARESO, 1979), as well as in some countries of Central America, such as El Salvador (Angel, 1972) and Panama (Ferrara Castro, 1976), figures of prevalence of inhalants are not available. However through case studies or statistics of patients in treatment it is evident that the problem does exist.

General Trends

Inhalation of substances with psychotropic effects is observed in most regions of the world. Use in some regions such as Northern Europe (Uchtenhagen, 1986) has been prevailing for over three decades whilst in South East Asia (Navaratnam, 1986) this practice is of recent origin.

In countries with a longer history of use the trend is towards maintenance as in Mexico (Castro, 1986) or a decrease as in some countries in Northern Europe (Uchtenhagen, 1986).

In those countries with a more recent history of abuse a tendency towards an increase is observed (Navaratnam, 1986) whereas in Canada (Smart, 1983) there is no evidence of an increase. Nevertheless, these trends can change because use of solvent/inhalants is a shifting phenomenon, with a probability of epidemic peaks. Depending on the type of substance available, frequent shifts are observed.

When other drugs are available, inhalants are not the drugs of choice. In fact, they are usually quite low down on the list of preference. Only among minors and in countries where the use of illegal drugs is not a common practice, would inhalants be among the most commonly abused drugs.

In many countries more males use inhalants compared to females, but in some countries the ratio is about equal. However, males generally predominate among very heavy users and those admitted for treatment.

In some countries inhalant use is combined with use of other drugs. In some native groups of Canada and the United States (Smart, 1986) users of inhalants who are also consumers of alcohol have been reported. However, in other countries, particularly Mexico (Medina Mora, 1982) and Costa Rica (Miguez, 1983), some groups are users of inhalants only.

It has been recognized that available epidemiological data do not give an accurate picture of the global extent of inhalant abuse. International treaties do not cover these substances, hence there was a lacuna of information, substance control and law enforcement. In view of the potential adverse health

consequences of inhalant abuse, the fact that very young people are involved, and the obvious spread of the practice, steps to improve information about inhalant abuse are important.

Trends in Morbidity and Mortality

A considerable gap of knowledge has to be reported here.

The medical sequelae following volatile substance abuse are not well documented in different regions, i.e. Latin America, North America, Europe, South-East Asia and the Western Pacific, and the extent of morbidity and its changes over time are hardly known.

Volatile substance abuse-related mortality includes sudden death due to cardiac arrest, and also accidental death through suffocation (in persons inhaling by pulling plastic bags put over their heads), drowning during intoxication or suicide. Mortality rates as well as trends in these rates have not been appropriately documented.

Populations at Risk

Various populations at risk have been described:

- children and adolescents, especially urban males from socioeconomically marginal sectors of the population that have dropped out from school (Uchtenhagen, 1986)
- children and adolescents from some minority groups (e.g. natives) (Smart, 1986)
- adults in occupations where contact with volatile substances occurs (e.g. painters (Westermeyer, 1986)
- medical workers (e.g. anaesthesiologists and dentists) (Perez de Francisco, 1975)
- prisoners (Westermeyer, 1986)
- homosexuals who use nitrites (amyl nitrite and butyl nitrite) to enhance pleasure (Westermeyer, 1986)
- users of other drugs who change to inhalants when their drug of choice is not available. This is more common along alcohol and heroin users who have a previous history of solvent abuse.

Natural Course

The natural course of solvent abuse ranges from experimental use for most users to chronic use in a comparatively small proportion of users.

Some researches indicate that most users stop use without treatment or intervention, mostly in the post-adolescent phase. Several factors in the users' environment have been identified which are related to the onset and termination of use (Ortiz, A. et al., 1986; Uchtenhagen, 1986).

Inhalants abusers are not a homogenous population. At least three groups can be distinguished:

- those who start with volatile substances and become polydrug users.
- those who stay with volatile substances for a while and then shift to other drugs.
- those who remain exclusively on volatile substances.

A distinction has to be made between onset of abuse in children and adults. In the latter, the volatile substance abuse may be related to the lack of availability of other drugs (e.g. in the case of imprisoned populations), to being exposed to volatile substances for occupational reasons (e.g. painters) or to medical practice (e.g. anaesthetists and dentists).

Patterns of Use

General

Various patterns of use have been observed (from experimental and occasional use to long-term continuous use). A continuous shift from one kind of solvent/inhalant to another is a common practice.

Experimental Use

This pattern is observed among children who experiment with these substances but do not continue with their use. A variation of this pattern is observed among minors who sniff as a group activity but who do not continue with the practice; inhaling is usually limited to the group setting.

Long-term Sporadic Use

Some experimenters continue abuse after curiosity is

satisfied. However, no daily chronic use is observed. In some cases users may inhale for a few days and then abstain for several months.

Long-term Heavy Use

This pattern is usually observed in specific population subgroups, usually from those of low socioeconomic status or in other marginal groups. Inhalation forms part of the everyday lifestyle, and several exposures per day are commonly observed.

Availability

The availability of volatile substances is limited in some countries. In Japan, for instance, this has resulted in illegal distribution.

In other countries certain substances are not readily available and are sold and passed from person to person through various channels of distribution (e.g. pure toluene in Mexico (Leal, 1977)).

THE PROBLEM OF INHALANT ABUSE
IN THE SOUTH-EAST ASIAN/WESTERN PACIFIC REGION -
A REGIONAL ANALYSIS

Dr. V. Navaratnam

Introduction

The use of volatile inhalant for the purpose of intoxication, whilst not being a new phenomenon in the global context, is of very recent origin in the South East Asian/Pacific region. One could speculate on the reasons for the late emergence of the problem of the abuse of inhalants. One important factor was the ready availability of other substances of abuse, such as heroin, at relatively low prices.

Philippines and Japan were among the first countries, in the region, to report the emergence of problems related to the use of volatile inhalants. Even then the number of persons associated/reported were minimal within the context of the national drug abuse problem.

However, since the early 1980's, the problem of volatile substance abuse has slowly but steadily begun to emerge as a major concern in this region. In this paper an attempt has been made to review the extent of the problem of volatile substance abuse in the region. However, the "newness" of the problem, together with the difficulties associated with the identification of persons abusing them, made it difficult for several countries to describe their real situations.

Of the countries in the region, the majority were not able to provide any information, though about 12 indicated that they were concerned about the problems of volatile solvent abuse. Of these twelve, only three could provide epidemiological data and a further three gave some information about the respective problems. It was very apparent from this regional analysis that there was an urgent need for definitive studies to define the extent and nature of the problem of inhalant abuse.

Regional Analysis

Vietnam, South Korea and Hong Kong reported that they were unaware of problems related to a volatile solvent abuse, but were concerned about the possibility of its emergence.

Australia acknowledged that there were reports of volatile solvent abuse. However, no epidemiological data were available on the extent and nature of the problem. It was stated that the problem was mainly experienced among the aboriginal/ tribal groups in remote areas of the country. However, some reports indicated abuse by adolescents in smaller urban areas.

Japan reported that the main substance abused by adolescents were the organic solvents. These organic solvents included paint thinners, toluene, adhesive paints, etc. For the period 1972 - 1984, 581,822 persons/abusers were detected by enforcement agencies for abusing organic solvents (Table 1). Of this group 85.4% or 496,405 were adolescents (i.e. below 20 years of age). In 1984 alone, 52,669 were detected abusing organic solvents and of this population 46,636 were adolescents (88.6%). Of these identified adolescent abusers 37.3% were students/pupils, 32.4% were unemployed and 30.3% were employed.

There was also some evidence in Japan that these organic solvent abusers have been associated with criminal activities.

It was also reported that some of these abusers had proceeded to abuse other drugs such as amphetamine or similar stimulants. Accidents and aggravation of other illnesses as a consequence to organic solvents was reported. In 1984 alone, 32 abusers were reported to have died as a consequence of organic solvent inhalation.

In Malaysia the abuse of organic volatile solvents is of very recent origin. Less than 1,000 cases have been reported over the last 24 months. These cases were predominantly in East Malaysia (i.e. Sabah and Sarawak) and also in Johore (i.e. the Southern part of West Malaysia bordering Singapore). The types of substances include paint thinners, nail varnish removers, air fix glues etc. Currently, attempts are made to launch prevention programmes in the affected areas, as well as to improve diagnostic detection procedures.

In New Zealand solvent abuse (glue sniffing) continues as a highly visible yet unmeasured problem. In estimated quantitative terms, solvent abuse appears to involve about 5% drug abusers, who are below the age of 20 years. Since 1980 about 1 - 4 children per year have died of secondary problems due to solvent abuse. Individuals involved are predominantly in the 9 - 18 years age group with the majority being between 11 - 15 years. As with the solvent abusers in Australia, the users in New Zealand are invariably from minority and lower socio-economic groups with a high percentage from unemployed or single parent families. The items involved are usually glue, nail polish, felt pens, aerosols, and fire extinguishers. Attempts are currently being made to quantify the problem more satisfactorily.

JAPAN

TABLE I
NUMBER OF ARRESTEES OF INHALANT ABUSE
1972 - 1984

YEAR	TOTAL NO.	ADOLESCENT NO.
1972	38,159	36,054
1973	20,166	16,220
1974	26,291	21,137
1975	44,422	36,968
1976	45,820	37,046
1977	39,837	32,578
1978	47,301	39,615
1979	47,293	40,433
1980	53,182	45,161
1981	50,651	43,536
1982	57,280	49,638
1983	53,251	51,383
1984	52,669	46,636

In the Philippines the problem of abuse of organic solvents has been reported since the late 70's. However, whilst during the last five years the drug scene in Philippines has not changed dramatically, there have been increases in inhalant abuse. In 1981, only 42 cases were detected but this figure had increased to 133 in the first 11 months of 1985. (See Table II).

The profiles of the abusers show that they are adolescents, between the ages of seventeen and twenty-one with the mean age of eighteen years. More males are involved, with the majority being in junior high school. A significant percentage have been in conflict with the law. This group tends to drop out of school and are usually jobless.

Inhalant abuse in Singapore has become a serious problem. It was first identified in late 1979. In 1980, Singapore began to monitor the number of inhalant abusers. In 1980 only 24 abusers of inhalants were detected, but the figure rose sharply to 763 in 1984. During the first six months of 1985, a total of 664 inhalant abusers were detected. (See Table III).

The type of inhalants abused ranged from adhesives through to petroleum products. More than 95% of inhalant abusers abused glue and the "Earth Brand Rubber Solution". The price of the rubber solution ranges from US\$1.00 to US\$1.25 per can. Other inhalants abused include paint thinners and plastic cement.

Three common methods of inhaling are used in Singapore. These are:

- (a) Inhaling from containers: The abusers inhale the volatile material directly from the container.
- (b) Inhaling from plastic bag: The volatile material is placed in a plastic bag and the abusers inhale the vapour that is emitted.
- (c) Inhaling from cloth: The volatile material is placed on a piece of cloth and spread evenly. The abusers then inhales the vapours emitted.

An analysis of the abusers showed that a large percentage were young persons. Of the total number of 1967 inhalant abusers detected between 1980 to June 1985, 383 or 19.5% were below 15 years of age, while 1337 or 67.7% were between 15-19 years which was the predominant group. Of growing concern was the increasing number of school-children becoming involved. In the first half of 1985, 115 or 17.3% of the 664 inhalant abusers detected were school-children. In spite of management efforts, 11.3% of those detected in 1985, were redetected at least five times for using inhalants.

PHILIPPINES

TABLE II
NUMBER OF INHALANT ABUSERS DETECTED
DURING 1981 - 1985

YEAR	NUMBER IDENTIFIED
1981	42
1982	89
1983	176
1984	120
1985	133

(Jan. - Nov.)

SINGAPORE
TABLE III:
BREAKDOWN OF INHALANT ABUSERS BY DRUG RECORDS
1980 - 1985 (JUNE)

Year	Drug Record		Total	
	Traced	Untraced		
1980	3	21	24	
1981	12	61	73	
1982	31	472	503	
	%	6.2	93.8	100.0
1983	25	717	742	
	%	3.4	96.6	100.0
1984	35	728	763	
	%	4.6	95.4	100.0
1985				
Jan	0	87	87	
	%	0	100.0	100.0
Feb	2	90	92	
	%	2.2	97.8	100.0
Mar	3	124	127	
	%	2.4	97.6	100.0
Apr	5	97	102	
	%	5.0	95.0	100.0
May	6	114	120	
	%	5.0	95.0	100.0

Year	Drug Record		Total
	Traced	Untraced	
1985			
Jun			
%	11	125	136
	8.1	91.9	100.0
Sub-total	27	637	664
CUMULATIVE TOTAL	133 (4.8%)	2636 (95.2%)	2769 (100.0%)

Pathological damage due to volatile solvents is wellknown. Death due to intoxication is one of the unwanted effects. In the first six months of 1985, 3 inhalant-related deaths were reported in Singapore.

The problems related to inhalant abuse is of major concern to this region. Recently a workshop on "Dangers of Inhalants" was organised during an ASEAN DRUG EXPERTS MEETING. The discussions centred around the problems related to the control of inhalants and ways to reduce the demand for such inhalants.

It was reported that Philippines and Thailand have legislation relating to the control for such inhalants. However, in Thailand it is only in relation to industrial use of inhalants and is related to labelling requirements and maintenance of records regarding use.

Conclusion

The regional analysis confirmed that the abuse of inhalants is becoming contagious. Whilst only a few countries have been affected to date, the potential for it to spread is there.

REVIEW OF THE EXTENT OF VOLATILE SOLVENT ABUSE IN AUSTRALIA

Dr. K. Edmondson

History

Inhalation of volatile substances, whether fumes, smokes, gases or various kinds of vapours is an act which has attracted the attention of humans throughout recorded history. There is no doubt that inhalation of various substances to produce a physiological or psychoactive effect, discovered by chance, has had an attraction.

Cultures as widespread as those in ancient Greece, Israel, Africa, North and South America inhaled substances such as hemp, cold gases, and burning spices to alter consciousness as part of worship practices and rituals. While the practice of inhalation has remained, the substances involved have altered over the centuries. (Wood, 1978) In the early modern period, sniff was a popular inhaled substance, its place being taken rapidly by inhaled tobacco smoke.

Nitrous oxide, anaesthetic gas used alone or as an adjunct to more potent anaesthetics, was abused as early as 1799 and is used even today as a social intoxicant. Chloroform was first produced in 1831 and abused soon after (DiMaio and Garriott, 1978). Since deaths from overdose were not uncommon, chloroform has never gained wide popularity as an intoxicant. The volatile nitrates, including amyl nitrate which has been used medically since 1867 to relieve angina pectoris, are abused by young people today. (Roger, 1982) The use of volatile nitrates in some parts of Australia appears to be extensive, especially amongst homosexual groups. In the 18th century, Hoffman introduced ether to the medical world. It was inhaled by medical students in the USA long before it was used as a general anaesthetic. (Sigell, 1978) Ether drinking and sniffing was popular in the 19th century as it was regarded as a cheap and harmless substitute for alcohol. After World War I ether inhalation became fashionable at socialite parties. During the depression following that period the first reports of inhalation of petrol, a commodity becoming more readily available, occurred. During the early part of the 20th century the deliberate misuse of solvent agents, while never disappearing completely as a problem, had occurred sporadically. (Watson, 1980)

The intoxicating properties of volatile substances have been well known since the early part of this century and the abuse of

such substances reported in the scientific literature since 1934. However, it was not until the mid 1950s and 1960s that the practice attracted a more serious concern. (Mahmood, 1983)

In 1959 in the USA a number of children were arrested by police for inhaling petrol vapours and within seven years the practice was reported to have spread to all states in the USA. (O'Connor, 1979)

Deliberate 'sniffing' of glue from model airplane sets is believed to have begun in the USA as early as the 1940s and some commentators state that the intoxicating properties of these glues were discovered accidentally by a number of young people while working with model airplane kits. The cellulose "dopes" used for painting model aircraft were also inhaled. (Rogers, 1982)

By 1963, 2000 cases of inhalation of volatile solvents since the fifties had been reported in New York City. In 1960, there were 30 arrests in Denver, Colorado while in 1964, 184 arrests were recorded for solvent inhalation. In 1961, 41 Los Angeles children were arrested and by 1962 the number had risen to 136. By 1967 it was estimated that 50 per cent of males aged between 10 - 17 years in Denver had experimented with solvents on at least one occasion. By the end of the 1960s the practice of glue inhalation had spread to Europe, Canada, Australia, New Zealand and the United Kingdom. (Watson, 1980)

Notwithstanding this long history, and perhaps overlooking the particularly lasting habit of tobacco smoke inhalation, sniffing of volatile substances has come to be regarded generally as a new phenomenon. In part this is because of the ever widening range and the easy accessibility of many household products containing solvents which probably played a serious part in the spread of solvent misuse. Many children could have been initiated into the practice by friends, while others experimented out of curiosity, bravado or peer pressure. (Wood, 1978)

Although the initial substances misused were glues, the list of volatile solvents abused soon expanded to include contact cements and adhesives, paints, lacquers and thinners, dry cleaning fluids and spot removers, degreasers, refrigerants and other volatile solvents. (Rogers, 1982) Not long after aerosols became popular items on the market, they were also found to be intoxicating and their use for this purpose spread. Initially aerosol preparations of glass chillers and vegetable non-stick frying sprays were inhaled but since then virtually every type of aerosol spray has been used. The list of aerosols currently abused would include air sanitisers, deodorants, hair

sprays, disinfectants, spray medication, window cleaners, insecticides and breath fresheners. (Cohen, 1977)

Availability

Many thousands of consumer products or substances commercially available contain volatile substances which may be abused. To list all these substances would, under these circumstances, be almost meaningless. Some contain mixtures of solvents likely to increase their toxicity.

The following summary of substances which might be contained in abused products is not exhaustive but demonstrates their wide availability.

(a) Aliphatic alcohols

Methanol, an industrial solvent and ingredients in many widely used products, such as paints, adhesives, cleaners.

Ethanol, in alcoholic beverages and many "spirit" based products.

Isopropanol, in some medications, drugs and a variety of cleaners and car care products.

(b) Aliphatic Esters

Methyl acetate, a common solvent.

Ethyl acetate, a solvent for nitrocellulose used industrially and in such products as nail polishes and removers.

n. - Propyl Acetate used in laquers and perfumes.

n. - Butyl Acetate in adhesives and laquers.

(c) Formates

Methyl or Ethyl Formate used as solvents and fumigants in various organic chemical processes.

(d) Aliphatic Ketones

A wide variety of substances the most commonly known being acetone (dimethyl ketone) which are used in the printing and rubber industries and for various crafts.

(e) Aliphatic nitrites

Amyl nitrite has been used medically since 1867 to relieve attacks of angina pectoris, however it has largely been replaced by other preparations for this purpose.

A variety of volatile nitrites has been used to enhance sexual pleasure. Preparations containing them have been sold, often illegally, (because in many countries they are scheduled poisons requiring prescription) in the so-called sex shops.

(f) Aromatic hydrocarbons

Benzene has been used as a substrate in the manufacture of many organic compounds and as an industrial solvent. Many countries have legislation regarding permissible levels of benzene vapour in the working environment.

Toluene is contained in a wide range of solvents and cleaners on the consumer market such as paints, varnishes, paint removers, dry cleaning solvents and so on.

(g) Xylenes

A group of substances also used in adhesives.

(h) Styrene

A liquid with a pungent, penetrating odour used as a solvent for plastic products and in various model cements.

(i) Anaesthetic agents

Nitrous oxide, chloroform, diethyl ether, halothane, ethyl chloride, trichlorethylene which are, or have been, used as anaesthetic agents and liable to abuse where there is access. The last two named have also been used in industrial manufacturing processes and may be contained in certain industrial products such as degreasers and solvents.

(j) Halogenated hydrocarbons

Substances such as 1, 1, 1 - Trichloroethane, carbon tetrachloride, ethylene dichloride, methylene chloride are contained in various industrial types of cleaners, degreasers and solvents.

They are severely toxic to the heart, liver and kidneys and restrictions have been placed on their use in many countries.

- (k) Chlorofluorocarbons are a group of compounds also known as "freons" or "halons" which are used as refrigerants or aerosol propellants and as such are contained in a large variety of consumer products or in such devices as fire extinguishers. Most are gases at normal temperature and pressure. Although chemically inert they are rapidly absorbed into the bloodstream and appear to have a narcotic effect although this is not entirely the explanation for their toxicity.

Sample Survey on Commercial Availability of Volatile Substances

Reports from some organisations have claimed that a very large range of products, with the potential for misuse through 'sniffing', were on open display and available for sale to young people. In order to estimate the extent of availability of these potentially usable products. The Drugs of Dependence Branch of the Department of Health undertook surveys of three major outlets - a supermarket, a hardware store and a stationery supplier. The surveys showed the number of brands and the number of types of products on sale.

For the purposes of these surveys "product type" is defined as a saleable item distinguished by its manufacturer's name or trademark and/or by variations in contents or application (excluding such minor variations as colour, size and fragrance). The results of the surveys indicate that there were a total of 234 product types with the potential for abuse by 'sniffing' on sale at the three outlets surveyed. Of these, 201 brands or trademarks were represented.

Survey of a Stationery Store

A stationery store in a large Canberra shopping complex was surveyed on 26 July 1984. The following 27 potentially abusable substances were readily available to consumers:

	Brand/ Trademarks	Number of Product Types
<u>Aerosols</u>		
- General purpose adhesives	2	2
- Foam and fabric adhesive	1	1
- Photomount adhesive	1	1
- Adhesive cleaner and solvent	1	1
- Varnishes	2	6
- Artist's fixative	1	1
- Aerosol can adaptor (for spray painting)	1	1
- Aerosol spray paint propellants	3	3
<u>Non-Aerosol Glues</u>		
- Plastic model cements (eg. "Tarzan's Grip")	3	3
- Photopaper glue	1	1
- Rubber cements	2	2
<u>Thinner and Cleaners (Non-Aerosol)</u>	1	1
<u>Metallic Calligraphy Inks</u>	1	1
<u>Correction Fluids</u>	2	2
<u>Stamp Pad Inks</u>	1	1
Totals	23	27

Survey of a Hardware Store

The following product survey was conducted at a Canberra hardware store on 25 July 1984.

Of the product types offered for sale, 155 appeared to be chemicals which are potentially abusable (volatile hydrocarbons, fluorocarbons, etc.). These included:

Paint primers and woodstains	51
Adhesives and cements	18
Solvent cleaners and degreasers	17
Reducers, paint thinners and strippers	10
Fillers and sealants	9
Varnishes and lacquers	10

Approximately 24 types of products were sold as sprays containing fluorocarbons or hydrocarbons as propellants.

About half the potentially abusable products carried warnings regarding adequate ventilation.

While the sale of all potentially abusable products appeared to be open and unrestricted, about 1/3 of these products contained poisonous or otherwise unpleasant chemicals which probably made them unattractive to sniffers. (For example, liquid insecticides).

The following categories were observed:

	Brands/ Trademarks	No. of Product Types
--	-----------------------	-------------------------

Adhesives, Glues, Cements

- Wall panel adhesives	1	2
- Contact adhesives	3	8
- Glues	3	3
- Adhesive sealants	2	4
- Pressure sensitive glue	1	1
Total	10	18

	Brands/ Trademarks	No. of Product Types
--	-----------------------	-------------------------

Solvent Cleaners, Degreasers

- Acetone solvent	1	1
- Tar and spot remover	2	2
- Degreaser cleaner	3	4
- Kerosene	3	3
- Kitchen cleaning foam spray	2	2
- General solvents	2	2
- Car degreaser	2	2
- Drycleaning fluid	1	1
Total	16	17

Fillers, Sealants

- Grout seal	2	2
- Fibreglass filler	2	2
- Waterproofing	3	3
- Wood putty	1	2
Total	8	9

Paint Thinners, Reducers, Strippers

- Paint stripper	3	3
- Woodstain reducer	2	2
- Paint thinners, roll and brush cleaners	5	5
Total	10	10

	Brands/ Trademarks	No. of Product Types
<u>Paint Primers and Woodstains</u>		
- Fish oilene spray	1	1
- Rust inhibitor	2	4
- Spray chrome	1	2
- Spray paint	3	4
- Woodstains (3 brands, various applications)	3	40
<hr/>		
Total	10	51
<hr/>		

Varnish, Lacquers

- Copper and metal lacquer	2	3
- Furniture finish	1	5
- Leather lacquer	1	1
- Clear paint	1	1
<hr/>		
Total	5	10
<hr/>		

Garden Products

- Pruning/grafting spray	2	3
- Liquid insecticides	3	6
- Spray insecticides	2	4
- Powder insecticides	1	1
<hr/>		
Total	8	14
<hr/>		

Household Products

	Brands/ Trademarks	No. of Product Types
- Pre-wash spray	1	1
- Cookhelp spray	1	1
- Fly spray	2	5
- Floor polish	1	2
- Fabric protector spray	1	3
- Spray shoe polish	2	1
- Window cleaner	2	2
- Spray carpet cleaner	1	3
<hr/>		
Total	11	18
<hr/>		

Other

- Mortar glaze	1	1
- Leather softener	1	1
- Hi-Temp spray protector	1	1
- Engine starter spray	2	2
- Butane cartridges	1	1
- Mothballs, naphthalene	2	2
<hr/>		
Total	8	8
<hr/>		

Grand Total 86 115

Survey of a Supermarket

This survey was conducted at a Canberra supermarket on 18 July 1984.

There were 96 product types displayed and offered for sale which contained chemicals making them liable to abuse by 'sniffing'. Most of these products were aerosol spray packs with fluorocarbons or other hydrocarbons as the propellants. The six non-aerosol product types displayed which may be abused included nail polish remover, lighter fluid and adhesives.

	Brands/ Trademarks	No. of Product Types
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Aerosol Products

- Cooking sprays	3	3
- Breath fresheners	2	2
- Deodorants/body sprays colognes	14	14
- Hair sprays, "mousses" etc	9	9
- Pre-wash sprays	3	3
- Ironing aids	3	3
- Insect sprays	6	6
- Insect repellants	3	3
- Room fresheners	6	6
- Furniture polishes	3	3
- Carpet cleaners	2	2
- Oven cleaners	4	4
- Lens cleaner	1	1
- Glass cleaner	1	1
- Tile cleaner	2	2
- Shave creams	7	7
- Men's deodorants	4	4
- Spray talcs	2	2
- Men's hair dressing	1	1
- Lighter fluids	2	2
- Garden sprays	6	6
- Cream whips	2	2

Non-Aerosols

- Nail polish remover	1	1
- Lighter fluid	1	1
- Glues - "Kwik Grip", "Tarzan's Grip", "Selleys"	3	3
- Shoe repair glue	1	1

Total	92	92
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Effects of inhalation

There is a variety of toxic effects of these various chemical substances which are beyond the purpose of this paper. These substances are inhaled to induce euphoria or a "high". Inhalation provides rapid transfer to the brain via the lungs and bloodstream so that effects are experienced rapidly. Initially the effect may be somewhat similar to mild alcohol intoxication but, at a deeper level of intoxication auditory and visual hallucinations can occur. These may be frightening and it has been suggested that they occur only in susceptible individuals. There may also be cerebral depressant effects at a yet deeper level of intoxication which include disorientation, blurred vision, slurred speech, ataxia and eventually coma.

Elimination is usually rapid and depending on the amount inhaled and the depth of intoxication recovery is not prolonged.

For most young abusers the effects are therefore short lived but with chronic abuse a variety of symptoms may occur which can be traced to the various substances which have been abused. The majority of subjects do not appear to develop serious organ damage as a consequence of sniffing, and some of the toxic effects which occur may be reversible.

However chronic solvent abuse may lead to liver or kidney damage, effects on bone marrow causing haematological abnormalities, effects on the nervous system such as encephalopathy, cerebellar ataxia, peripheral neuropathy. Cases of sudden death which have been recorded can probably be put down to the fact that in the acute stage, certain volatile substances can sensitize cardiac muscle to the action of adrenaline, resulting in severe cardiac arrhythmias which may be fatal. This has been found to occur more commonly in association with certain aerosol products and the possibility of cardiac arrhythmias occurring is increased by the presence of stress or vigorous activity.

Other possible acute toxic effects are severe respiratory depression caused by a central action on the brain, and laryngeal spasm with asphyxiation when an aerosol product is sprayed directly into the mouth. Asphyxia may also be caused by inhaling, from closed plastic bags containing the abused substance.

Fatal accidents such as drowning may also occur during intoxication.

It appears that for the majority volatile substance sniffing is a transient problem not continuing into adulthood. However, there are recorded instances (Davies, 1985) of chronic use continuing into adulthood and others who have progressed to the use of heroin and other illicit drugs.

Methods of inhalation

Various methods of inhaling these substances have been recorded including

- (a) direct inhalation from spray cans.
- (b) inhalation from small and large hand held containers.
- (c) inhalation from soaked rags.
- (d) inhalation from plastic bags in which the material to be inhaled has been placed, sometimes by pulling the face inside the bag.

Cases have been recorded of some substances being heated in a container to increase the vaporisation, often resulting in severe burns to the subject.

Characteristics of users

As with most examples of substance abuse, it is not possible to be precise about the subject's characteristics since those who came to attention are through health or welfare agencies and are unlikely to fully represent the true subject population.

However there is sufficient information recorded to suggest that they can be divided broadly into two groups. One, possibly the larger, is motivated by peer influence and cultural expectation, while the other became solvent abusers as a result of various personal, social and environmental difficulties. One should not overlook the fact that the majority of young people who inhaled solvents have only been experimenters and do not continue the practice. It has been noted in New Zealand that some continue infrequently as a group social habit and become adept in minimising harm. It is suggested that only a few young persons put themselves seriously at risk by becoming chronic solvent abusers and that while the habit seems mostly a group activity, those who sniff alone tend to become chronic abusers.

The age group most involved, as recorded in the majority of the countries, seems to be between 9 and 18 years of age. The New Zealand experience suggests that the majority of abusers are of lower socio-economic background and that a large proportion of the Maoris are involved.

Experience in the Philippines suggests a similar age range and socioeconomic status. In addition it has been noted that these children have often been abandoned by their families and support themselves by scavenging, begging or work in jobs such as news boys or shoe shine boys. They are often involved in other delinquent activities.

In the Australia experience, chronic abusers have tended to have some characteristics such as low economic status, unstable family life, school failure or personality disturbance. High use of alcohol by parents has also been recorded. It should be recognised however that this is not always the case, and occasional experimenters may not fit into these groups.

A serious problem in some Aboriginal communities in Australia has been petrol sniffing. The communities have become more concerned because of the possible effects of leaded petrol. While the hallucinatory effect of sniffing has been noted some observers have suggested that the effect is like alcohol, erroneously comparing its use by children to the use of alcohol by their elders. An important paper shows that alcohol problems and petrol sniffing problems do not necessarily occur in the same community. (Cohen, 1977) The social and environmental influences are recorded as being very complex, and may include factors such as the size and traditional influence of the community, the socialisation and maturation of children as well as community ideas and perceptions. Examples were given of a group sub-culture where children identified with petrol sniffing carried cans around their necks or wore similar clothing.

Studies in other countries have also suggested that there are associations between solvent sniffing and low academic performance (Watson, 1980), parental relationships (Merrill), social problems in ethnic minorities (Press, 1967), immaturity, anxiety and coping skills. However, at the same time one might question the interpretation of data on characteristics of users since these may well be simply those characteristics which bring them to the attention of social and legal agencies. Study populations, then, tend to be preselected. (Press, 1967)

Use patterns and mortality from solvent abuse

Australia

A number of Australian surveys have sought to measure the drug use patterns of school students. Of these surveys, three have included questions on the abuse of volatile solvents. These surveys were undertaken in Queensland in 1974, Victoria in 1979 and New South Wales in 1983.

The 1974 Queensland study surveyed both primary and secondary school students. It indicated that 6.5 per cent of school children had used inhalants and that 3.4 per cent were current users. The survey also indicated that primary school students had a higher incidence of 'sniffing' than secondary school students. With regard to the ratio of male

to female users, the survey showed that male users were significantly greater than female users; the distribution being 8.1 per cent to 4.9 per cent respectively.
(Australian Royal Commission of Inquiry into Drugs Report)

A more recent and comprehensive survey carried out in 1983 studied drug use by secondary school students in New South Wales which provides a detailed picture of the extent of adolescent solvent abuse. The study surveyed 4165 secondary school students aged 7 - 11 and found that after analgesics and alcohols, solvents and aerosols were the next most commonly abused substances. The following table illustrates the comparison between the usage of drugs.
(Home1, 1984)

TABLE 1
ESTIMATED WEEKLY USE OF CERTAIN DRUGS
BY AGE AND SEX (Home1 et al., 1984)

		12 yrs	13 yrs	14 yrs	15 yrs	16 yrs	17 yrs
<u>Alcohol</u>	male	14.3	20.9	31.8	44.8	58.6	57.4
	female	11.8	18.0	35.0	41.5	53.4	59.2
<u>Analgesics</u>	male	19.1	23.4	22.8	23.4	26.4	20.9
	female	27.8	34.4	38.1	38.8	41.7	41.9
<u>Marihuana</u>	male	0.4	2.2	6.0	10.9	14.9	15.4
	female	1.4	1.4	5.4	9.4	11.1	8.0
<u>Solvents/</u>	male	5.6	6.4	7.5	6.8	3.3	5.2
	female	9.7	13.4	9.8	5.5	6.1	2.3

Approximately half of all the students surveyed reported having 'sniffed' at one time or another. The 'sniffing' of solvents and aerosols was found to be more common amongst early adolescents and in particular, amongst 13 year old girls where 13 per cent were found to be 'sniffing' on a regular basis. Regular use was defined as three times or more in the past month. However, while the incidence of solvent abuse was very high, only one per cent of the various age groups reported levels of abuse which could be considered chronic - that is, 'sniffing' every day. The following table indicates the degree of popularity of certain volatile substances.

TABLE 2
PREFERENCE FOR CERTAIN VOLATILE SUBSTANCES (Home1, 1984)

RANK	PRODUCT	PER CENT OF RESPONSE
1	Glue	23.8
2	Petrol	19.4
3	Corrective fluid/thinner	17.5
4	Other thinner	11.7
5	Household Aerosols	8.2
6	Lighter fluids	5.4
7	"Skefron"	0.7

Similar surveys were conducted in the USA: NSW school students indicated a significant preference for the abuse of glues and aerosols in comparison to other drugs which are traditionally misused (e.g. alcohol, tobacco etc.). In NSW 46 per cent of those surveyed reported having at one time 'sniffed'. In the USA studies, on the other hand the extent was 18 per cent. Also, in the month preceding the survey 11 per cent of the 16 - 17 year old NSW students reported incidences of 'sniffing' compared to 2.5 per cent of the same age group in the USA survey. The authors note that the figure of 46 per cent needs to be treated with some caution as some respondents may have misinterpreted the meaning of the question and reported the superficial inhalation of solvents.

In estimating the general features of solvent abusers, the survey found that they were more likely to be in the 13 - 14 year-old age group and that suprisingly, in the light of other surveys, girls were more likely to be 'sniffers' than boys. No common characteristic of usage, social class or area was found although the report notes that children who go out at night, who are inclined to play truant, and who obtain large amounts of pocket money are more likely to abuse solvents.

The report notes that generally the most important factor in regard to substance abuse is the child's perception of the danger inherent in solvent or aerosol 'sniffing': It also notes that students unaware or sceptical of the risks of injury from 'sniffing' are more inclined to be volatile solvent abusers.

The report also notes that the survey results indicate that the practice of 'sniffing' is usually transitional - tried once and then discontinued. Any school can have a relatively high rate of 'sniffing' regardless of its area or

socio-economic status. Results also indicate that the practice of solvent abuse is more likely to be independent of other drug abuse as 'sniffers' tend to be no more involved in the use of other drugs than 'non-sniffers'.

Australian Mortality Statistics

Detailed statistics on Australian fatalities from the inhalation of volatile solvents and aerosols is limited. Some Australia wide data is available from a survey conducted by the Aerosol Association of Australia. Table 3 summarises the results of this survey.

TABLE 3
DEATHS FROM AEROSOL INHALATION AUSTRALIAWIDE
MAY 1974 TO FEBRUARY 1983

Age Group	<u>Year</u>									
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
12-14	1									
14-16		1	1		2		2	1	2	
16-18		1			1		2	1	1	1
18-20		1	2	2	1			1		
20-22			1			1				
22-24			1		1					
Age Unknown		1	2	1	1	2				
Sub-Totals	1	3	6	4	6	3	4	3	3	1

Total all years - 34 deaths from aerosol inhalation

Thirty four deaths were reported in this survey over the eight year period. The ages of the victims ranged from 12 to 24 years with a median age of 16.4 years. The most commonly abused substance involved in these fatalities was reported to be "Pure and Simple" cooking spray which was cited 15 times out of the 29 products mentioned. "Pure and Simple" contains the propellant F11 and a hydrocarbon. Other products abused included "Skefron" and antiperspirants. Plastic bags were implicated in 13 out of the 29 incidents where details of the death were reported in the press.

In New South Wales deaths from volatile substance abuse have accounted for four to five deaths per year with a record ten in 1981. While the number of deaths occurring in 1983 from solvent abuse is still unknown, it is expected that the figure will exceed that for 1981.

Results from New South Wales from January 1975 to May 1980 on the type or substances which caused fatalities are as follows. (Merrill, 1978)

TABLE 4
VOLATILE SUBSTANCES CAUSING FATALITIES
IN NSW, 1975 - 1980

<u>Volatile Solvent</u>	<u>Number of Fatalities</u>
Freons	11
Petrol	3
Toluene	2
BCF (Bromochlorodifluoromethane-portable fire extinguisher)	1
	<hr/>
	17
	<hr/>

In Victoria, a report dated September 1983 from the State Chemistry Laboratory indicated that there were 18 solvent glue type deaths handled by the Medicolegal Laboratory in Victoria between 1977 and 1983. A summary of this report is outlined in Tables 4 and 5.

TABLE 5
DEATHS FROM VOLATILE SUBSTANCE ABUSE
IN VICTORIA, 1977 - 23 SEPT 1983, BY AGE AND YEAR

<u>YEAR</u>	1977	1978	1979	1980	1981	1982	1983	Total
CASES								
Male	2	2	3	3	1	3	1	15
Female	1	1	-	1	-	-	-	3
Total	3	3	3	4	1	3	1	18
PREDOMINANT AGE GROUP (years)	14-16	16-18	18-19	15-24	19	14-17	15	

TABLE 6
DEATHS FROM VOLATILE SUBSTANCE ABUSE
IN VICTORIA, 1977 - 23 SEPT 1983, BY PRODUCT

YEAR PRODUCT	1977	1978	1979	1980	1981	1982	1983	Total
"Pure and Simple"	3	-	-	2	-	-	-	5
"Kwik-Grip"	-	2	1	-	1	-	-	4
"Ikon"	-	1	-	-	-	-	-	1
"Shellite"	-	-	-	-	-	-	-	-
Other Solvents	-	-	1	-	-	1	1	2
Contact Cleaner	-	-	-	-	-	1	-	2
Gases	-	-	1	-	-	-	-	1
	-	-	-	2	-	1	-	3

New Zealand

The problem of sniffing appears to be growing in seriousness but its distribution is uneven. While absolute figures are, understandably, not available, the information from drug treatment centres suggests that about 3.4% of new admissions were using solvents. A 1982 survey of 483 young people carried out by the Christchurch Hospital indicated that seven per cent of respondents said they were currently 'sniffing' solvents while 8.5 per cent said they had done so previously. Overall 15 per cent of the young people surveyed were found to have definitely 'sniffed' solvents at one time. The survey showed no significant difference in the proportion of male and female users. However, it did find that people belonging to an ethnic group of Polynesian origin had double the rate of incidence compared to those of European origin. There have been sixteen deaths from solvent abuse since 1977, but it is important to note that none of these have been due to glue sniffing which is the commonest form of abuse. An important recent development is that bromochlorofluoromethane, used in fire extinguishers, had been the cause of death in four young men during the past two years.

Philippines

No cases of death have been reported in the Philippines where the major substance abused is glue. There have been recent changes in the pattern of volatile substance abuse with a fall from 7.1% in 1977 amongst males who came to attention for drug abuse, to 4.4% in 1978 and 1.3% in 1983. Comparable figures for females were 1.3%, 0.7% and 0.02%.

TABLE 7
DEATHS FROM SOLVENT ABUSE IN NEW ZEALAND
(Deliberate not accidental)

	Age	Sex	Race	Region	Solvent
1977	4	M	Maori	Rotorua	Petrol
1978	16	F	Non Maori	Gisborne	Freon
	17	M	"	Auckland	Trichloroethylene
	18	M	"	Greymouth	Trichoroethane
	14	M	"	Auckland	Trichloroethane (in shoe polish)
1979	14	M	Non Maori	Auckland	Petrol
	21	M	"	"	Paint thinners
1980	17	M	Non Maori	Auckland	Chloroform
	23	M	"	Wanganui	Butane (lighter)
1981	16	M	Maori	Nelson	Fire extinguisher (B.C.F.)
	17	M	Non Maori	"	Butane
1982			Nil		
1983	21	M		Auckland	Bromochlorodifluoromethane
1984	?	M	?	Christchurch	Bromochlorodifluoromethane
	?	M	?	Auckland	"
	18	M	?	Upper Hutt	"
	17	M	?	Upper Hutt	Unknown as yet

Note : Further details of 1984 deaths will become available next year.

TABLE 8
SOLVENT ABUSE TREATMENT

Based on numbers of new patients admitted for treatment at major clinics in New Zealand

	<u>Total Admissions</u>	<u>Ever used Solvents</u>		<u>Current use of Solvents</u>			
		No.	%	No.	%		
Dec. 82 - March 83 (i.e. 4 months)	462	14	3.0	Not asked			
April - June 83	326	13	3.0	7		2.1	
July - Sept. 83	369	31	8.4	20		5.4	
Oct. - Dec. 83	330	54	16.4	8		2.4	
	<u>1,487</u>	<u>112</u>	<u>7.5</u>	<u>35</u>		<u>3.4</u> (of 1,025)	
<u>Age first used</u>	<u>October - December 1983</u>						
		<u>Admissions</u>					
Unstated	Under 10 years	10 - 14	15 - 19	20 - 24	25 - 29	30+	Total
3	-	29	20	1	-	1	54

Fiji

Health authorities are aware of the abuse of volatile substances to produce an intoxicated state. The substance most commonly abused is petrol. While no deaths have been recorded and the prevalence of the habit has not been surveyed, it is known that it occurs, from time to time as a group activity amongst male teenagers from high density, poorer living conditions and whose standard of living is lower.

It is suggested that many male teenagers were referred for psychiatric help because of conduct disorders. Some who have been imprisoned for criminal conduct involving aggressive behaviour have indulged in petrol sniffing for 'kicks' at some time or other. It cannot be suggested, however, that the abuse may have led to behavioural disorders or to antisocial acts leading to imprisonment.

It is considered that there is little understanding of the possible dangers of volatile substance abuse and that there is a need to include teaching about these dangers in education programmes.

No legislative controls are at present being contemplated.

Hong Kong

There is little evidence at present of solvent and aerosol abuse. There have been reports of thefts of thinners and glue by teenage boys but the motives behind such thefts are not apparent. A recent detailed study of over 2000 drug addicts revealed that only one had tried inhaling fumes from volatile thinners.

The present policy is not to include any warnings about substance abuse in preventive programmes. There is concern that this might be counter-productive in a situation where there is so little evidence of abuse. Nevertheless, the situation is being carefully monitored.

Forensic Data

Forensic data is a most useful method of gauging the effects and general characteristics of solvent abuse. In the United Kingdom in particular, deaths attributed to solvent abuse are increasingly being reported. While this may be partially due to an increased awareness on the part of responsible authorities, it is still also very likely that volatile substance abuse itself is increasing. Other drug use surveys in the United States and Canada also confirm the belief of health authorities that the incidence of adolescent solvent abuse is increasing.

In Australia, forensic data on solvent-type deaths is sketchy and limited. Surveys on drug use patterns undertaken in this country provide a more accurate picture of the extent of solvent abuse. A recent 1983 survey of NSW school students has shown that approximately half of those surveyed reported having 'sniffed' at one time. Importantly only one per cent of the various age groups reported levels of abuse which would be considered chronic. This survey, along with other overseas research, has indicated that the practice is by and large transitional, with the vast majority of adolescents growing out of the practice.

Further results from this survey indicate that glues were the most popular substance abused while petrol and corrective fluids ranked second and third respectively. Surprisingly, the NSW survey also indicated that young adolescent girls aged between 13 and 14 were more likely to be 'sniffers'.

While the majority of adolescents appear to mature out of the practice of solvent abuse largely unaffected, the practice is still dangerous. Australian forensic data highlights the significant dangers of butane or aerosol abuse. In particular, aerosols containing freons account for a very high proportion of solvent related deaths in comparison to other volatile solvents.

Legislative Approaches to Control

A number of countries have attempted to use legislative control measures to address the problem of solvent misuse. Measures have ranged from the introduction of controls on products, their sale, constituency or labelling, to prohibition of the practice of sniffing itself. In some cases, legislation has provided penalties for shopkeepers who sell products for the sole purpose of 'sniffing'.

The first recorded legislative approach to the problem of glue sniffing was in the USA in the City of Anaheim, California. In June 1962 Ordinance No. 1722 was passed making it illegal for any person to:

"inhale, breathe or drink any compound, liquid, chemical or any substance known as glue, adhesive, cement, mucilage, cope or other material or substance, or combination thereof, with the intention of becoming intoxicated, elated, dazed, paralysed, irrational or in any manner changing, distorting or disturbing the eyesight, thinking process, balance or co-ordination of such person".

A Maryland law enacted in the 1960s was not quite so broad. This statute made it:

"unlawful for any person under twenty-one years of age to deliberately smell or inhale such excessive quantities of any narcotic drugs or any other noxious substances or chemicals containing any ketones, aldehydes, organic acetates, ether, chlorinated hydrocarbons or any other substances containing solvents which release toxic vapours and cause conditions of intoxication, inebriation, excitement, stupefaction or dulling of the brain and nervous system".

By 1968 some 13 US States and 29 countries and municipalities had 'glue sniffing' laws and several other states planned to legislate.

Certain products in the USA were also in the late 1960s removed from the market. These included a spray-on product used for chill cocktail glasses. At that time it was estimated that over 300 aerosol products which were available on the US market were capable of causing the same effects because of the use of similar propellants.

Laws were proposed in the late 1960s that all aerosols be labelled to provide warnings. However, most jurisdictions had rejected this approach at that time.

In the 1970s the USA banned a range of aerosol products containing chlorofluorocarbons. However, this action had nothing to do with anti-glue-sniffing campaigns. Rather, it was undertaken for environmental reasons to ostensibly protect the ozone layer of the atmosphere.

Attempts in the USA and in Canada and recently in the UK can, according to Joanne Birdling from the NZ Police, broadly be summarised as those which:

"make it illegal to sell solvents to adolescents under a certain age or without parental permission, or without proof that the solvent is going to be used for a legitimate reason"; and

"aim at the abuser of solvents making it illegal to inhale or abuse solvents for the purposes of intoxication".

Such approaches are intended to restrict the numbers of products available to experimenters and act as a deterrent to 'sniffing' as well as foster treatment strategies for offenders who are caught.

In the USA critics have claimed that legislative approaches to this problem have been singularly unsuccessful because of the sheer number of products available and because labelling certain products as dangerous has highlighted the 'best' products for 'sniffers' to try.

In July 1983 the provisions of the Solvent Abuse (Scotland) Act 1983 came into effect. It provides that children caught 'glue sniffing' can be referred to the children's panel which has wide ranging powers to deal with problem children. Between its introduction and February 1984, 300 children in Scotland had been referred to the panel due to 'glue sniffing'. In December 1983, two shopkeepers in Glasgow were charged and convicted for three years under Scottish common law for selling kits to children specifically for 'glue sniffing'.

Another approach has been to require a denaturant or noxious substance such as oil of mustard to be added to the contents of products. Objections to this approach have been related to the dangers which such additives may present to the legitimate user.

In England at present, there is no legislation which relate specifically to the abuse of volatile substances. While in Scotland, prosecutions are possible under Scottish common law, it is not possible to seek prosecution in England for similar offences under English common law. The only Act which is being used increasingly against solvent abusers in Section 5 of the Road Traffic Act which relates to a person who, when in charge of a motor vehicle which is on a road or other public place, is unfit to drive due to drink or drugs.

The solvent abuse issue has been discussed from time to time in the House of Commons since July 1980. At that time it was considered that the problem was best tackled through community based multidisciplinary initiatives involving parents, teachers, social workers, doctors, health workers, police and others. The matter was subsequently debated again in 1981 with a view to introducing restrictive legislation. At that time the Under Secretary of State for Health and Social Security, when speaking on the possibility of restrictive legislation, stated during debate in the House of Commons:

"The Advisory Council on the Misuse of Drugs which advises Ministers on all matters to do with the control of drug misuse has looked at this and has concluded that the model of strict control under the Misuse of Drugs Act which penalises such activities as unlawful manufacture as well as supply and possession of drugs that are misused could not be applied to a whole range of common household products and would in any case be doomed to failure because of the impossibility of enforcement".

Nevertheless, the question of restrictive legislation has continued to be an issue in England. In response to the call for the introduction of restrictive legislation the British Government in December 1983 decided to introduce restrictions on the sale of solvents. While these restrictions do not have the force of law, they do require shopkeepers to display signs saying that they reserve the right not to sell certain products to young people. These restrictions also require solvents and solvent-containing products to be kept behind counters instead of being on display.

Restrictive legislation on solvent abuse has however been recently introduced in the House of Commons by means of Private Members Bills. On 2 May 1984, Mr Harry Greenway introduced a Bill entitled Glue Abuse (prevention) Bill 1984. The Bill requires manufacturer of glue for sale to the public to include in them an agent which will render them repellant. A second Private Members Bill entitled Limitation of Sales of Solvents Bill 1984, was introduced by Mr Greenway later this year. This Bill seeks to make it an offence for a shopkeeper to sell substances to young people under 16 if he has reasonable grounds for believing that those substances are likely to be inhaled to achieve intoxication.

The British Government has indicated its willingness to support this legislation - following the lead taken by France in 1983 on banning the sale of trichloroethylene to young people under 18.

A further response in Britain to solvent abuse, has been the setting up, as a crime prevention measure by police, of centres to help cure 'glue sniffing' and the abuse of other solvents by teenage children in three London areas.

Legislation by Australian States and Territories

Some States have adopted legislative measures as one approach to the control of abuse of volatile solvents.

In Queensland the poisons regulations have been amended since 1983 to require that glues containing volatile solvents be stored out of reach of public. Proposed amendments to the Queensland welfare services legislation also provide that where a police officer or responsible adult considers a child is in danger, they may confiscate volatile substances and take the child to a place of safety.

In Western Australia, although there is no law against selling, buying or processing these substances, if there are signs that a substance is being used for an improper purpose,

the user may be charged under Section 65(5) of the WA Police Act with being in possession without lawful excuse of a deleterious drug. There is little evidence, however, that this law is used to address the problem.

In New South Wales the Minister for Health has announced that warning labels will be required under the NSW Poisons legislation. Under this legislation warning labels will be required on products specified in the regulations of the Poisons Act. The NSW Drug and Alcohol Authority's surveys into which products are frequently being used for sniffing purposes are of assistance in identifying substances causing concern.

In South Australia a Bill entitled Controlled Substances Bill 1983 was introduced in 1983. Under the provisions of the Bill a person who sells or supplies a volatile solvent to another, where there is reason to suspect that the other person intends to inhale it, or intends to sell or supply it to a further person for purposes of inhalation, is liable to a penalty of \$2000 or two years imprisonment.

Other control measures which have been proposed have been largely regulatory. In this regard a certain muscle relaxant spray, "Skefron", has been rescheduled by the Poisons (Schedule) Standing Committee to Schedule 3 which means that it may only be sold in pharmacies. In addition, the PS(S)C has recommended that all products containing 1,1,1-trichloroethane carry warning labels. The NH & MRC in June 1984 subsequently agreed to this recommendation.

A further proposal which has been made from time to time is the use of additives which make the vapours obnoxious to the sniffer. This is not as easy as it sounds. Past experience with such drugs as paraldehyde or unpleasant flavoured medicines demonstrating that habituation can lessen these effects in so far as the taker is concerned. An early attempt at rendering glues unpleasant by adding oil of mustard (allylisocyanate) was unsuccessful because of the toxic effects of the additive.

In some Aboriginal communities in Australia ethylmercaptan which has a highly penetrating foul odour has been added to petrol. While this has undoubtedly stopped the practice, while it could be maintained, it has been difficult to ensure that all supplies were treated. In these situations the decisions to use the additive have been made by the community itself after factual information was discussed.

Unfortunately, it is said, due to concern about the offensive smell and its possible effect upon the elderly, people with chest conditions and pregnant women, as well as the sight

of children vomiting after inhaling the treated petrol, such treatments have been discontinued. There is no doubt, however, that the additive curbed sniffing for a time.

The concern about additives is really that it is an easy way out and that it may encourage communities to avoid taking other more effective action to curb sniffing.

Social and Community Approaches

As with drug abuse generally, there seems to be some evidence that inhalation of volatile substances is associated with various kinds of social difficulty and deprivation. It occurs in lower age groups, on the whole, and tends to cease as a problem with the onset of adulthood. It is, however, sometimes found in young adults in communities which are very poor and have little access to drugs. In some cases the corresponding adult problem is alcoholism.

Like the rehabilitation of drug abusers it may be far more important to understand the problems which the volatile substance abuser sees as most pressing. This is not necessarily the abuse itself. Uncovering social problems, giving appropriate counselling and help and endeavouring to improve the life-style in some way may be essential particularly in relation to meaningful employment and recreation. The social problem of alcoholism in the adult community must be seen as part of the problem.

Community leaders, police, teachers, priests, youth leaders, parents should be encouraged to bring young people whose abuse has been discovered for counselling. Counselling of the community itself is equally important particularly where a death has created serious anxieties.

Groups may be persuaded to involve themselves in a support programme.

Suitable educational support will be required to supplement counselling, and needs usually to be included in a total health educational package. It may be as important to relieve anxieties as to emphasise the dangerous toxic effects. Design of programmes must meet the particular community's needs.

Special educational interventions dealing only with volatile substance abuse are usually regarded as inappropriate and there is some evidence that they can stimulate interest. There is also some evidence that emotive press reporting has heightened interest too. The media may be helpful in certain aspects of educational campaigns but care must be taken, and good liaison is essential.

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THE EPIDEMIOLOGY OF VOLATILE SOLVENT/ INHALANT USE IN NORTH AMERICA

Dr. R.G. Smart

Introduction

Epidemiological interest in solvent and inhalant abuse began in the 1960's, although some isolated cases were reported in the 1940's and 1950's (Fernandez, 1978; Faucett and Jensen, 1952). By the early 1960's solvent use was common in some American schools. In New York some 2,003 glue sniffers had been reported in 1963 (Allen, 1966). About 50% of young males in Denver (Cohen, 1973) had tried solvents in 1967.

The first Canadian solvent use cases were reported by Gellman (1968) as occurring in 1964. At that time a Winnipeg pharmacist noted a sudden increase in sales of nail polish to teenagers who later admitted using it for "kicks" and euphoria. During the mid-1960's many instances of solvent use were reported in some Canadian schools but others seemed unaffected. Consistent patterns of use were difficult to find on a national basis. For example, between 1968 and 1970 solvent use decreased in Toronto but increased in Halifax according to survey results (Fejer, Smart and Whitehead, 1972). Solvent use has retained some popularity throughout the 1970's and 1980's among young people but it did not gain the wide acceptance that many other drugs had.

The use of solvents did not develop sub-cultural values as did LSD, or cannabis. It never seemed to become the "smart" or stylish drug to use nor did it attract articulate devotees extolling its virtues. People never seemed to argue (as for hallucinogens) that it created mind expansion, enhanced sensuality, improved perceptions or contributed to a better life. Hence, solvent use has always been rather sporadic and infrequent compared to the more popular drugs such as alcohol and cannabis. Also, it has been associated with economic impoverishment and is very common on certain Indian reservations, and in some ghetto situations.

Our knowledge of current solvent use in North America is derived from student surveys, some studies of special populations especially Indians and other impoverished groups and a few studies of adults. Reviews of solvent abuse studies have been made by many investigators starting with the early review by Press and Done (1967) and proceeding through many others (e.g., Barnes, 1979, 1981; Watson, 1980; May, 1982; O'Connor, 1984).

Current Solvent Use in Student Populations

Because solvents have not been as popular as many other drugs there are relatively fewer studies of their use in large populations. Some large scale investigations particularly of adult drug use in Canada and the United States do not enquire about them. However, six large representative sample studies, three in Canada and three in the United States do give trend data on the extent of solvent use. Table 1 shows the results of these studies. It should be noted that the way the questions were asked and the sampling methods vary from one study to another. Therefore, easy comparisons of the percentage of users are difficult to make.

Current use of solvents varies somewhat from one study to another. For example Hollander and Davis (1983) found that in the past six months 6.2% of the students in Vancouver 'used' compared to 3.3% in Prince Edward Island (Killorn, 1983). In Ontario, 3.2% reported use of glue while 4.1% used other solvents in the past 12 months (Smart et al., 1983). Among high school seniors in the United States 4.5% reported use in the past 12 months (Johnston et al., 1982). The range of variation in use rates (except for P.E.I.) is not very great for solvents. It should be noted that solvents are much less often used than alcohol, cannabis or hallucinogens.

Rates of "ever use" are about three times as high as use in recent months. For example, 12.8% of high school seniors used solvents "ever" compared to 4.5% in the past year. Use in the past 30 days is infrequent in the three studies which have enquired about it - half or less of the rate of use for recent months. Rates of use among students are lower than among dropouts and hence the school studies underreport use. For example, Annis and Watson (1975) found that 17% of early dropouts used glue or other solvents compared to only 7% of those remaining in school.

Frequency of Solvent Use

Usually, solvent and glue users in student populations take these substances infrequently unless they are in a specially selected heavy using group, such as those in treatment. In the Ontario school study 81.2% of glue users and 72.8% of solvent users reported using the substance only once or twice in the previous 12 months. Only 1.2% of glue users and 1.5% of solvent users reported using 40 or more times. In fact, glue and solvents were the least frequently used drugs. For example, 6.4% of cannabis users, 20% of drinkers, 16.9% of heroin users and 7.2% of LSD users reported using about 40 or more times per year.

TABLE 1
TRENDS IN SOLVENT USE REPORTED
IN REPRESENTATIVE SAMPLES

COUNTRY	REFERENCE	YEARS	TYPE OF SAMPLE	EVER USE %	PREVALENCE		
					PAST 12 MONTHS %	PAST 6 MONTHS %	PAST 30 DAYS %
Canada	Hollander, M.J. and Davis, B.L. (1983)	1970	Students in grades 8 - 12 n = 2,496	8.8			
		1974	n = 1,732	9.3			
		1978	n = 1,806	10.7	3.9	4.4	2.8
		1982	n = 1,701	19.2	6.2	6.2	3.7
Canada	Killorn, J. (1983)	1972	Students in grades 7 - 12 n = Not Stated				
		1982	n = Not Stated n = 1,559		2.3	4.2	3.3
Canada	Smart, R.G. et al. (1983)	1977	Students in grades 7, 9, 11 and 13 n = 4,678				
		1979	n = 4,794	1. 3.9			
		1981	n = 3,270	2. 6.6			
		1983	n = 4,737	1. 4.3			
				2. 6.2			
				1. 2.5			
				2. 3.2			
				1. 3.2			
				2. 4.1			
United States	Fishburne, P.M. et al. (1979)	1972	National Household Survey (12 yrs. and over) n = 3,265	3. 6.4			1.0
		1974	n = 4,022	4. *			*
		1976	n = 3,576	5. 8.5			.7
		1977	n = 4,594	3. 9.2			<.5
		1979	n = 7,224	4. 1.2			<.5
				5. 8.1			.9
				3. 9.0			.5
				4. 1.9			<.5
				5. 9.0			.7
				4. 11.2			<.5
				5. 1.8			<.5
				3. 9.8			2.0
				4. 16.5			1.2
				5. 3.9			.5

COUNTRY	REFERENCE	YEARS	TYPE OF SAMPLE	EVER USED %	PREVALENCE		
					PAST 12 MONTHS %	PAST 6 MONTHS %	PAST 30 DAYS %
United States	Johnston, L et al. (1982)	1976	High School Seniors n = 15,400	10.3	3.0	.9	
		1977		11.1	3.7	1.3	
		1978		12.0	4.1	1.5	
		1979		12.7	12.7	1.7	
		1980		11.9	4.6	1.4	
		1981		12.3	4.1	1.5	
		1982		12.8	4.5	1.5	
		1983		13.6	4.3	1.7	
United States	New York State Division of Substance Abuse Services (1981)	1975	Household (12 yrs and over) n = 3,500	2.0	<.5	<.5	
		1981		2.0	<.5	<.5	

1. Glue
2. Other Solvents
3. Youth age 12 - 17

4. Young adults: age 18 - 25
5. Older adults: age 26+
* Not Tabulated

Also, the study by Abelson et al. (1977) showed that nearly half of adults and youth who had ever used inhalants took them only once. It appeared that glue and solvents attract many users who try them once or twice and stop and a few who maintain a heavy use pattern.

Trends in Solvent Use

Only two of the surveys reported in Table 1 show an upward trend in solvent use over the past few years. Solvent use increased considerably in Vancouver between 1974 and 1982 (3.9% used in the past 6 months vs. 6.2%). The study in P.E.I. shows a peak in 1976 and a decline by 1982. The Ontario study shows a peak in 1977 for solvents and a general decline by 1983 (6.6% vs. 4.1%) which is statistically significant but there was essentially no change in glue use (3.9% vs. 3.2%) in the same time period.

In general, there is no clear evidence that solvent use is increasing in most parts of North America, but suggestive evidence that it is decreasing. The household study in New York, for example, showed no difference in rates of use between 1975 and 1981. Johnston's study of high school seniors in the United States shows signs of stability in the past few years. Solvent use among Ontario students has been relatively stable, with a slight decline in recent years. On the other hand, the survey by Fishburne et al. (1979) shows an increasing trend throughout the 1970's. However, data for the past half a dozen years are not available, and it is in this period that we have seen some decline, or at least stability in other studies.

Characteristics of Solvent Users

Relatively little attention has been paid to the characteristics of solvent users, beyond age and sex in most surveys. Some of these characteristics are shown in Table 2 for various studies.

Age and Sex

It is clear that solvent users are typically very young. The study in Vancouver found that solvent use was most common among those 14 years of age and under. Johnston et al. (1984) found that the first use of solvents tended to occur prior to grade 10. A study of students in New York State also showed that current use was more likely among younger students, although "ever" use showed no difference by age.

TABLE 2

CHARACTERISTICS ASSOCIATED WITH
INHALANT USE: SELECTED STUDIES

COUNTRY	REFERENCE	YEAR	TYPE OF SAMPLE	EXTENT OF USE	CHARACTERISTICS
Canada	Barnes (1981)	Fall and Winter 1977 - 78	Students in grades 4 - 10 from 6 Northern Canadian communities n = 623, including 334 Indians, 92 Metis and 197 non-Indians	3.1% past 6 mths	<ul style="list-style-type: none"> - use was significantly related to peer and sibling use - tended to be young males from broken homes - use was more likely among those with the least financial resources - use was most common among those 14 yrs of age and under (21.6%) - use was slightly more common among females (19.5%) than males (18.9%)
Canada	Hollander and Davis (1983)	1982	Vancouver students in grades 8 - 12 n = 1,701	19.2% ever used	<ul style="list-style-type: none"> - 6.2% used in past 6 mths - 3.7% used in past 30 days - 100%
Canada	Swerhun and LeBreton (1983)	1982	Chronic solvent abusers in a treatment program at ARF in Toronto n = 10	100%	<ul style="list-style-type: none"> - 70% male - range of 12 - 17 yrs for age of first use - range of 5 - 11 for level of education - range of 5 - 12 for years of use - all had a family history of alcohol or drug use - all reported legal problems

CHARACTERISTICS

EXTENT OF USE

TYPE OF SAMPLE

YEAR

REFERENCE

COUNTRY

United States	Johnston et al., (1984)	1983	High school seniors n = 17,000	13.6% ever used 4.3% past year 1.7% past month	<ul style="list-style-type: none"> - use was more common among males (8.6% in past year) than females (4.5% in past year) - use was more common among those who did not plan to go on to complete college - first use tended to occur prior to the 10th grade
United States	Stephens et al., (1978)	Winter of 1974 - 75	New York State students in grades 7 - 12 n = 8,553	5.3% ever used 1.9% past 6 mths	<ul style="list-style-type: none"> - although current use (last 6 mths) is more likely among younger students, there is no difference in ever use by age - 76% used other drugs - strong and consistent inverse relationship between use and grade point average - males were slightly more likely to use than females (2.2% vs. 1.6% respectively, in past 6 mths)
United States	Stybel et al., (1976)	1973	Low socioeconomic students in a Neighbourhood Youth Corps Program in Dallas, Texas n = 600	28% ever used	<ul style="list-style-type: none"> - males (37%) were more likely to have used than females (20%) - 37% of sniffers vs. 14% of non-sniffers had ever been arrested

Most studies show that males predominate among solvent users. Johnston et al. (1984) found that use among males was nearly twice as high as among females. Also, 70% of solvent users in treatment (Swerhun and LeBreton, 1983) in Toronto were males. Use was also more common among males in a study of Canadian Indian communities and students in a low socioeconomic "Youth Corps" in Texas (Stybel et al., 1976). Only Hollander and Davis (1983) in Vancouver found solvent use rates to be about the same among males and females.

Other Social Characteristics of Users

Several social characteristics of solvent users seem to be important. For example, Johnston et al. (1984) found use greatest among students not planning to go to university. In several studies (Stybel et al., 1976; Swerhun and LeBreton, 1983) solvent users have been shown to have legal problems and a history of frequent arrests. Solvent use among family members was also a factor for many Indian users (Barnes, 1981). An early review by Press and Done (1967) claimed evidence for sniffing being mainly a male behaviour engaged in far more often by lower class and Hispanic people. In the study of Canadian Indians by Barnes (1981) solvent use (gasoline) was most common among those from broken homes and those with the fewest financial resources. These studies have led to studies among several economically impoverished groups (see page 8). However there are few studies of the characteristics of solvent users in large representative samples.

Characteristics of High School Solvent Users: A Special Study

Because so few representative studies examine the characteristics of solvent users a special analysis was made of users in the 1983 Ontario Student Survey of Drug Use. This survey involves a large (n=4,737) representative sample of students in grades 7, 9, 11 and 13.

Table 3 shows some demographic and social characteristics of solvent users in the 1983 Ontario study. As expected, use of solvents was more frequent among males than females (6.4% used in the past year vs. 4.8%). Almost all solvent users were in grades 7 or 9. There were very few users in grade 13. Solvent use was more common among students with low grade averages and uncommon among those with A standing. Use was more frequent among those who never attended church.

Solvent users tend to be users of many other drugs (Table 4). Users of alcohol, cannabis and medical tranquillizers are twice as likely to use solvents as non-users of these drugs.

TABLE 3
SOLVENT USE BY DEMOGRAPHIC CHARACTERISTICS
AMONG ONTARIO STUDENTS: 1983

DEMOGRAPHIC CHARACTERISTICS	SOLVENT USE IN THE PAST 12 MONTHS		TOTAL (N)
	%	(IN)	
GENDER			
Male	6.4	(84)	(1320)
Female	4.8	(64)	(1339)
GRADE			
7	8.7	(79)	(908)
9	6.0	(49)	(816)
11	2.7	(17)	(622)
13	1.1	(3)	(323)
MARKS			
A	2.9	(18)	(623)
B	5.7	(69)	(1200)
C	5.8	(36)	(623)
D	12.4	(15)	(119)
F	29.5	(7)	(25)
CHURCH ATTENDANCE			
Very Frequent	4.9	(22)	(451)
Frequent	4.9	(18)	(372)
Occasional	5.5	(31)	(567)
Infrequent	5.0	(9)	(188)
Very Infrequent	5.4	(28)	(511)
Never	7.0	(40)	(566)

TABLE 4

SOLVENT USE BY OTHER DRUG USE
AMONG ONTARIO STUDENTS: 1983

DRUG USE	SOLVENT USE IN THE PAST 12 MONTHS		TOTAL (N)
	%	(N)	
TOBACCO			
No use	3.0	(45)	(1487)
Use	8.7	(101)	(1162)
ALCOHOL			
No use	3.3	(19)	(567)
Use	6.1	(128)	(2084)
CANNABIS			
No use	4.6	(93)	(2031)
Use	8.5	(53)	(627)
NON-MEDICAL BARBITURATES			
No Use	4.7	(118)	(2503)
Use	19.1	(30)	(158)
MEDICAL BARBITURATES			
No Use	4.8	(112)	(2347)
Use	12.3	(36)	(293)
HEROIN			
No Use	5.1	(113)	(2602)
Use	31.2	(14)	(44)
SPEED			
No Use	5.0	(126)	(2550)
Use	20.3	(21)	(104)
NON-MEDICAL STIMULANTS			
No Use	4.3	(98)	(2248)
Use	12.2	(49)	(406)
MEDICAL STIMULANTS			
No Use	5.1	(129)	(2500)
Use	13.7	(19)	(138)
NON-MEDICAL TRANQUILIZERS			
No Use	4.9	(124)	(2513)
Use	17.2	(23)	(133)
MEDICAL TRANQUILIZERS			
No Use	5.2	(128)	(2455)
Use	10.7	(18)	(172)
LSD			
No Use	4.7	(113)	(2418)
Use	14.3	(32)	(222)
PCP			
No Use	5.1	(133)	(2609)
Use	28.1	(15)	(52)

DRUG USE	SOLVENT USE IN THE PAST 12 MONTHS		TOTAL (N)
	%	(N)	
HALLUCINOGENS			
No Use	5.1	(127)	(2503)
Use	13.0	(20)	(156)
COCAINE			
No Use	4.8	(122)	(2544)
Use	23.8	(26)	(109)

Users of drugs such as barbiturates, heroin, speed, stimulants, LSD and other hallucinogens, and cocaine are three to six times as likely to have used solvents in the past year. However of the 148 solvent users a minority used any drug except alcohol and tobacco.

Since solvent use is often thought to be associated with delinquency a number of illegal behaviours were examined. Property crime, violent crime and selling drugs were much more common among solvent users than non-users. About twice as many solvent users as non-users reported violent crime and property crime, but more than three times as many reported selling drugs (Table 5).

Problems among solvent users have not been much investigated except for legal ones. The Ontario school study enquired about five problems and the results are shown in Table 6. Only 4.8% of solvent users had been arrested or warned by police because of their drug use. About the same proportions had medical treatment (3.1%) and had discussed their drug problems with school counsellors, nurses or teachers (3.4%). Few (4.0%) reported that their parents thought they used drugs too often. However, far more (18.3%) said that they wish to use drugs less than they did at the time of the survey. In the aggregate only 50 of 148 solvent users reported any problem. Of course some users reported more than one and hence the total number reporting one or more problems would be less than 50. It is clear that problems do not necessarily arise from solvent use, probably because use is often infrequent.

Solvents/Inhalants and Psychological Characteristics

Few studies have examined psychological characteristics among solvent users. Fejer and Smart (1972) found that glue users had much higher scores than non-users on a clinical test of anxiety. In fact, they had the highest anxiety scores of all types of drug users, with 51.9% falling into the highest quartile on anxiety and they were also frequently treated for psychological problems. Adlaf and Smart (1983) found no differences between glue or solvent users and non-users on a risk-taking scale. Not unexpectedly Annis et al. (1971) found that glue sniffers were lower than non-sniffers in self-acceptance and acceptance of others.

Case histories of inhalant abusers frequently mention depression (Faucett and Jensen, 1952; Lawton and Malmquist, 1961) and anxiety (Clinger and Johnson, 1951). However, Edwards (1960) reported a case marked by hyperactivity and mania. Clinger and Johnson (1951) reported inhalant abuse in a 16 year old schizophrenic, apparently the only case of that type.

TABLE 5

DELINQUENT BEHAVIOUR BY SOLVENT USE AMONG ONTARIO STUDENTS*: 1983

SOLVENT USE	DELINQUENT BEHAVIOUR		
	PROPERTY CRIME %	VIOLENT CRIME %	DRUG SELLING %
No	23.6	18.3	10.6
Yes	57.8	41.4	37.8

* Questions about delinquent activities were only administered to students in grades 11 and 13. Thus, this table is based on the responses of a subsample of Ontario students in those grades.

TABLE 6
 REPORTED PROBLEMS AMONG SOLVENT USERS
 IN THE ONTARIO STUDENT STUDY: 1983

DRUG-RELATED PROBLEM	PERCENT REPORTING		TOTAL (N)
	%	(N)	
Arrested/warned by police	4.8	(7)	148
Sought/required medical attention	3.1	(5)	148
Discussed problem with school counsellor, school nurse or teacher	3.4	(5)	147
Parents think student uses drugs too often	4.0	(6)	147
Wish to use drugs less than they do now	18.3	(27)	146

The average I.Q. reported for solvent abusers is relatively low at about 94 but the range is very great (see review by Barnes, 1981). Academic performance is poor, early dropout is common and inhalant abusers have many problems with school.

Solvent Use Among Adults

Solvent/inhalant abuse is recognized as predominantly an adolescent problem. However, a few studies have indicated that adults are included. Only one recent study (New York State, 1981) with a representative sample asked about solvent use among adults. A sample of 3,500 people aged 12 and over was used. Only 2.0% reported ever having used solvents and less than .5% reported recent use. Further evidence that adult solvent users do exist comes from two hospital studies. Smart (1983) found that 4% of cases of solvent abuse seen at Poison Control Centres in Canada were aged 25 and over. Also, a study in a large Cleveland hospital (Hershey and Miller, 1982) found that most inhalant abuse cases seen in emergency were adults (average age = 26). Unfortunately, the number of cases was quite small (only six) and hence extrapolations from this study should be made cautiously. Several studies of Indian groups mention use among adults as well as children.

Solvent Use Among Impoverished Groups

Special studies of solvent users in general populations seem to be rare. Most involve very poor or even impoverished groups living in ghetto situations such as Hispanics or Indians. For example, a number of studies have been made in a variety of Canadian and American Indian communities. Since gasoline sniffing is a problem among aboriginal people of the Ecuto Islands in Australia (Nucombe et al., 1970) there may be something about aboriginal life which predisposes them to inhalant use.

In Northern Canadian towns and Indian reservations gasoline is usually stored in unlocked drums outside houses and stores. There are also large petrol dumps with dozens of barrels accessible year round to both younger and older people. This makes such people especially vulnerable to trying gasoline sniffing. The series of studies of gasoline sniffing by Canadian Indians began with the observations of Boeckx et al. (1976). They reported three cases of acute lead poisoning in an isolated town in Northern Manitoba. They suggested that more than 50% of children in the town of Shamattawa were sniffers of gasoline and that other Manitoba towns also had many sniffers.

A more detailed study of gasoline sniffing in Shamattawa and five other communities also in Manitoba has been reported in an unpublished study by Barnes (1981). The total sample was 623 students, most of whom were in school. As expected Shamattawa had the highest proportion of sniffers (50% of students). In two communities no gasoline or solvent sniffers were found. In the remainder of the communities the rate varied from 1 to 22% for students. In general, Barnes concluded that these rates were lower than expected and that some comfort should be taken in that finding.

Barnes (1981) also found a number of characteristics to be related to gasoline and solvent sniffing. Gasoline sniffers were predominantly young males, frequently from broken homes. Often they were from the poorest families in very poor communities; often they came from homes with no radios or running water and their families had no money for clothes. Sniffers tended to be low in "acculturation" e.g., they used a native language at home and their mothers had a low educational level. Also, sniffers more frequently had friends who were sniffers and more family members who sniffed.

A "school self acceptance" measure indicating the extent to which students felt accepted and accepted their own performance at school was also used by Barnes. As would be expected from their low acculturation level, gasoline sniffers had lower levels of school self-acceptance than non-sniffers.

Lynn (1973) has studied a small Indian village in Northwestern Ontario called Poplar Hill. This village is a very poor one with no real employment; most income came from welfare or Mother's Allowance cheques. Typically, sniffers in Poplar Hill take gasoline from boat tanks. Most sniffers were aged 8 to 14 however many adults also sniffed. Of 49 people interviewed only seven were non-sniffers; 23 were occasional sniffers and 11 were frequent sniffers (the remaining eight were unclassified). In general, there was little concern about gasoline sniffing or lead poisoning in the village - even among parents some of whom sniffed themselves. However, high lead levels in the blood were observed among both occasional and frequent sniffers.

A similar study was made by Angle and Eade (1975) of two native communities in Northern Quebec. They interviewed 564 Indian (Cree) and Inuit residents and tested them for evidence of lead poisoning. Gasoline sniffing had disappeared from one village after a well published lead poisoning death. However, sniffing was epidemic in the other village. The authors estimated that 63% of those aged 6-18 had sniffed gasoline or naphtha (a cooking fluid). Most adults under 30 admitted

sniffing in the past. Some of the reasons given for sniffing were the high availability of gasoline, the cultural disintegration of old ways of life, community support for intoxication as a pastime and a lack of recreational and cultural facilities for young people.

Gasoline sniffing has also been found to be common among students in a Pueblo Indian village in New Mexico (Kaufman, 1973). Kaufman studied 72 elementary school children 62% of whom reported gasoline sniffing on at least one occasion. Almost all (93%) sniffers reported sniffing with others in "social sniffing" sessions. Although there was much heavy drinking in the village alcoholism was not more common in the families of sniffers compared to non-sniffers.

May (1982) reviewed a variety of published and unpublished studies of solvent/inhalant use among American Indians. Rates varied from a high of 62% in Kaufman's study to 4% for Indians in college. Overall, about 22% of Indians seem to have used solvents.

Several studies have found inhalant use among Hispanics living in the United States. For example, national studies (Cohen, 1979; Richards, 1980) estimate that 8 - 11% of all youth aged 12 - 19 have used inhalants but 13 - 22% of all Hispanic children used them. Also, Hispanics represented 82.5% of all 40% of the population (Reed and May, 1984).

Recently, Reed and May (1984) studied three groups of juvenile offenders. One group included 100 delinquents who had been in an inhalant abuse program. A second group of 100 untreated delinquents was matched to the first and a third was a random sample of delinquents from files. About 91% of the inhalant group were Hispanics and 84% were males. Most lived in single parent homes and many were from very poor families. The inhalant group also had problems with school and with the law at an early age. Despite their average age of 15.2 only 53% were enrolled in school. The inhalant abusers were arrested much more often than the other two groups, especially for burglary, shoplifting and solvent abuse. Typically, they came from impoverished disrupted families with low educational attainment and few prospects.

Another study of adolescents at a low socioeconomic level was made in the Dallas area in 1972. Stybel et al. (1976) administered a survey to 599 young people in a neighbourhood youth corps. Sniffers were typically young males who were Black or Hispanic; almost none were White or Indian. Most had been sniffing for less than a year and used a wide variety of solvents (paint, glue, lacquer, gasoline, nail polish, etc.).

Chronic users reported that it would be very hard to stop using solvents but most "social" users thought they could stop easily.

Summary and Conclusions

In general, the following conclusions can be made about solvent/inhalant abuse in North America:

- (a) representative surveys of student use typically show that 3.3% to 6.2% of students have used solvents in the past six months or past year. Solvents are far less popular than drugs such as alcohol, cannabis or hallucinogens. Rates of "ever" use are about three times as high as use in recent months; rates of solvent/inhalant use are much higher among dropouts than students in school;
- (b) most student surveys show no signs of an increase in solvent use; use rates are usually stable or declining; it is not clear whether rates of use are increasing among non-students;
- (c) most student users use solvents infrequently. Only a small minority use as often as once a week;
- (d) solvent users are predominantly males and very young with an average age of 12 - 15;
- (e) solvent users are often users of other drugs and engage in considerable delinquency, especially theft and burglary. They are often early school dropouts and have low expectations of post secondary education;
- (f) psychological characteristics of users include depression, anxiety and mania as well as lower than average intelligence;
- (g) solvent use among adults is not often studied. Although it appears to be infrequent some emergency room studies have found adult abusers requiring treatment; and
- (h) the major problem with solvent abuse occurs in certain impoverished or ghetto situations. Very heavy use has been found in a large number of Indian communities both in Canada and the United States. Other heavy users include poor Hispanics and lower class Blacks in some southern areas of the United States.

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INHALANT USE IN LATIN AMERICA:
A REVIEW OF LITERATURE

Mrs. E. Medina-Mora

Introduction

The use of substances with psychotropic effects has been a common practice in most societies, solvent use not being the exception. Reference to inhalation of steams is made since the oracle of Delphos¹. In our days the patterns of use have changed and the number of substances has widen. The new form of drug abuse became evident through the increase of mortality and morbidity events related to states of intoxication, due to inhalation of solvents. At the beginning this practice was mainly observed among children and adolescents from low socio-economic levels and from developing countries. Now days the adverse effects associated with this practice are observed in almost all countries of the world, among them the United States², Canada³ and India⁶. Concern with this practice, is not only related with the extension of its use. It is also related to the group of the population affected, (i.e. mainly children and adolescents at a stage of development²³), and to the association of this practice with physical and psychosocial adverse effects³⁵, poor school performance²⁶, and delinquent behavior²⁰. The impossibility of restriction of the availability represents a challenge to develop adequate preventive measures, a challenge that can be met only if there is adequate knowledge on the manifestation of the problem in each cultural context.

It is the purpose of this paper to identify gaps of knowledge in the region and to describe the rates of inhalant use and its effects. The use of this drug will be compared with the use of other substances. The groups affected and the context in which the use takes place will also be described.

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1. Head of the Division of Epidemiology and Psychosocial Research. Instituto Mexicano de Psiquiatria (IMP).

2. Research Associate, IMP.

Sources

Apart from reviewing the published literature, personal correspondence was established with persons working in the field, from the different countries in the region. Their kind assistance in the collection of the material has been of invaluable. In the paper there is no pretence of making an in-depth analysis of the situation of each country. The sources and type of studies are shown in Table 1. As can be observed, there is an inevitable bias as regards the availability of the related literature from Mexico. The sources consulted do not necessarily represent the existing literature in Latin America.

CENTRAL AMERICA

Costa Rica

Research conducted in this country is important in relation to its population size. Two household surveys were conducted in 1983 of population living in slums; one included population from 7 to 18 years⁵, and the other one 15 years and over⁴. The data obtained through these two studies is complemented with other three reports of drug use among minors accused of delinquency^{1, 2, 3}.

Through these reports it may be seen that among children and young adolescents (under 17 years of age), generally inhalants are the drugs of choice and as age increases, the use of other substances is also observed. These other substances are marihuana, natural hallucinogens, drugs of medical use and alcohol. There is no report of use of narcotics and cocaine; and apparently the use of this type of drugs is an urban phenomenon². In this country it was observed that though age of first use for inhalants may be lower than the one observed in the case of marihuana⁵, inhalant use is not the province of the younger population. Through the household survey it became evident that regular use was more prevalent among the age group 19 - 24 years (56% of users) followed by the group of 25 years and over (33%). In comparison, only 11% of adolescents between 16 and 18 years of age are involved.

Marihuana, grown in a small part of the country⁴ is the drug of first choice. The rate of ever use was 4.5%; of inhalants, 3.1% and of drugs of medical use, 2.5%. The average age group of users was 25 years and the average age of first use was 20 years⁵.

TABLE 1
INFORMATION SOURCES

Country	School Studies	Studies of infractor minors and	Case Studies	General Population studies (household surveys)	Population in treatment	Special Groups	Total
Mexico	12	9	6	7	3	7	44
Costa Rica		2		2			4
Honduras		1					1
El Salvador			1				1
Panama		1					1
Argentina	1				1		2
Bolivia	1		1				2
Brasil	1	1			2	1	5
Chile	3	2					5

Country	School Studies	Studies of infractor minors and	Case Studies	General Population studies (household surveys)	Population in treatment	Special Groups	Total
Colombia	8	2	2	1	1	1	15
Ecuador	3						3
Peru	5		1	2	1	2	11
Paraguay	1						1
Uruguay						1	1
Venezuela	1					1	2

TABLE 2
STUDIES ON DRUG USE IN CENTRAL AMERICA

COUNTRY	AUTHORS	POPULATION	DRUG USE
Costa Rica	Miguez HA, Instituto Nacional sobre Alcoholismo. 1983. (4).	House hold survey population 15 years and over. San Jose. N = 469.	Inhalant use Experimental 1.1% Regular 2%
			Marihuana use Experimental 7.4% Regular 7.1%
			<u>Drugs of medical use</u> Experimental 1.3% Regular 1.2%
			Experimental Regular Marihuana 10.3% Inhalants 19% 45.4% 23.3%
	Miguez HA. Instituto Nacional sobre Alcoholismo. 1983 (3).	Minors infractors 10 to 17 years. N = 77	Experimental Regular
	Miguez HA. Instituto Nacional sobre Alcoholismo. 1984. (5).	Minors from a urban area from 7 to 18 years N = 98	12.2% regular users on inhalants.
	Anonimos. 1984. (1)	Group of Adolescents inhalant users in a Tutelar Council n = 100	3.4% used drugs: solvents, hallucinogens mushrooms, drugs of medical use and alcohol.

COUNTRY	AUTHORS	POPULATION	DRUG USE
Honduras	Zavala CR. 1984 (6)	Minor infractors and street-trotters.	Tobacco 39.8% Alcohol 27.2% Inhalants 20.9% Marihuana 9.0% Drugs of medical use 2.7% Others 2.0%
Salvador	Angel Panameno CA. 1972 (7)	Young people, arrested for use or acquisition of drugs. Study conducted in two states 1st. Stage N = 163 2nd. Stage N = 146	Type of drug consumed 1st. Stage 2nd. Stage Marihuana 98% 68% LSD 14% Stimulants 5% Hypnotics 2% Thinner 2% 6% Codeine and heroin 1% N 163 146

More than one half of inhalant users use "glue" alone. The rest also use tranquilizers, alcohol or marihuana. The amount of glue used the first time is approximately 65 grs. in a 2 to 4 hour period. Inhalation takes place alone or in a group⁴. Inhalation among the younger group (between 11 to 14 years) is more hidden practice while in the older age groups (15 to 18 years) inhalation is more open⁵.

Inhalers use strategies in order to avoid being observed. Those include the use of juice or mild containers, or coloring the glue so that it looks like "gelatine"⁵.

Honduras

A recent study (1984) was conducted by Zavala among children either accused of delinquency or who are street-trotters. Tobacco was the drug of choice in this group (40%), followed by alcohol (27%) and inhalants - glue, gasoline or thinner (21%). The rates of use of other drugs were lower (9% for marihuana, 3% for drugs of medical use and 2% for other substances), 55% of the users consumed at least once a week. Around four-fifths (79%) were males, 21% did not know how to read or write, 71% had not completed studies, while only 15% completed elementary school. The average age of first use was 11.7 years with a range of 5 to 16 years. Tobacco and alcohol were the first drugs ever used⁶.

Salvador

One study was carried out in 1972 in El Salvador. Panameno reports rates of drug use among young people between 13 and 31 years of age. These people were arrested due to the usage or acquisition of drugs over a period of 12 months (August 1970 - 1971). The results are reported in two stages, of 6 months each.

Among those in this group, marihuana (74%) was the drug of choice followed by hallucinogens (LSD) (11%). Inhalants (7%) occupied the third place and only 1% reported use of opiates. 91% were males and 8% females.

The fact that inhalants are not the drug of choice among those in this group as was observed in Mexico and in Honduras is probably due to the wide range of the age group reported (13 to 31 years of age). Unfortunately, in this report drug use had been analyzed by age groups.

It is also interesting to note that the use of LSD is reported while in the other Central American countries only the use of natural plants with this type of effect was observed.

The author mentions that from the 103 subjects studied in the first state, 11 were foreigners and a further 50% were Salvadorians who had been out of the country in the United States, Chile, Mexico, Spain and other Central American countries. Some of them had started using drugs while out of El Salvador.

Panama

Very little information is available from this country. In a case study conducted in 1973⁸ Ferrara reported an increase in the use of thinner by the population of minors of the country who have been sent to the tutelar council for minor offenders due to this practice. The 27 males from 11 to 17 years of age ($x = 15.1$) that were studied come from low socioeconomic backgrounds and disintegrated families. They showed poor school performance and some actually dropped out.

SOUTHERN AMERICA

Argentina

Unfortunately, only two reports are available from this country i.e. a school survey conducted in 1974 among adolescents from Buenos Aires⁹ and statistics of patients having treatment at the National Centre of Social Re-education (CENARESO)¹⁰, from 1974 to the first trimester of 1979¹¹.

The first study reports that 69% of males and 59% of females reported drug use. This rate includes the use of tobacco, alcoholic beverages and other drugs. Unfortunately the information is not presented by drugs.

From the statistics of patients having treatment, it is evident that, as in other Latin American countries, males are over-represented i.e. 72% of the total patients seen at this facility from 1974 to the first trimester of 1979 (N = 2,867). With regards to age, 57% were between 16 to 20 years, 26% between 21 and 25 years and 17% over 25 years of age. Among the patients, 37% had used drugs with stimulant effect, 34% hallucinogens and 29% depressant drugs. The rate of multiple drug use was 35%. No reference was made in relation to specific drugs though it is mentioned that in 46% of the cases of drug use, the route of administration was oral, in another 25% it was 2.81% of the cases inhaled cocaine powder and 1.99% inhaled volatile solvents. In 25% of the cases, more than one routes of administration was reported. Most of the users who attended this centre lived in the capital city.

There is no information intravenous available with regards to the trends of inhalation in this country. Bertoni in a

TABLE 3
STUDIES ON DRUG USE IN SOUTHERN AMERICA

COUNTRY	AUTHORS	POPULATION	DRUG USE
ARGENTINA	Bonillacqua de Regge & cols. 1974. (9) CAMARESO 1974 - 1979 (10)	School Survey Adolescents in Buenos Aires, 12 - 18 years. n = 576. Statistics of patients in treatment. N = 2 867	70% males and 60% females reportes drug use. 97% of users were experimenters and 12% moderate or heavy users. 46% of usage is made to the type of drug-route of administration: 46% oral 25% endovenous, 3% cocaine inhaled, 2% solvents. In 25% of the cases, more than one route of administration was reported.
BOLIVIA	Noyes, TN. 1976 (15) Castellanos and cols. 1978. (14)	Drug users, Case study. Students 14 to 19 years School status: 7 to 9 years completed. N = 7 277	Distribution of drug use age-groups: 8 - 15 years: Inhalants: 16 - 25 years: marijuana and cocaine: Adults: morphine, methadone, cocaine. Ever use: 11% Habitual use: 0.87% Marihuana: 57% Inhalants: 17% Stimulants and depressors: 10% Cocaine: 6% LSD: 2% Heroin: 1% Regular use was of 1% among population 15 years of age and of 3% in the 19 years old group.

COUNTRY	AUTHORS	POPULATION	DRUG USE
BRAZIL	Murad, JE. 1983 (19) Murad, JE. 1983 (21) Morgado, AF, et al. 1983 (17) Lowenkron, TS. 1984(a)	Patients in treatment for the use of drugs. 1980 - 1982 n = 370 20% minors 80% under 25 years of age Minors with no fixed place of residence. 8 - 10 years Census of patients in treatment from 187 institutions from the nation. 1962 - 1965. n = 9 992 Not specified	Marihuana: 66% Optalidon: 22% (analgesic) Pembenyl: 15% (codeine and pseudoefrina) Solvents: 8% Cha de Cogumelo 7% (Natural Hall). Apetite modifiers: 5% Cocaine: 3% Frequent inhalation of perfume and other sprays. Inhalant users belong to the lowest SES and showed malnutrition, anemia and "depression osea" (busear traduccion). Barbiturates: 2% Tranquilizers: 2% Marihuana: 1% Stimulants: 0.9% Others (morphine, "elixir palegorico", ether, cocaine, opium): 0.2% Inhalation of perfume spray ("tricloraetilen") increases during summer time. Adolescents from high SES present higher rates of inhalation with the exception of gasoline.

COUNTRY	AUTHORS	POPULATION	DRUG USE
COLOMBIA	Duque, CJ, et al. 1980 (25) Vallejo, 1974 Quoted by Marin (30) Marin, 1974 (30) Vazquez de Pabon, E. (38)	Minors from institutions of protection and reeducation. (ages 7 - 12) n = 525 Male imprisoned population from 15 to 19 years n = 78 High-School students, attended school at night and worked during the day. n = 186 Industrial Population	20% of the group consumes inhalants. 24% males, 10% females. <u>Ever use:</u> Marihuana: 76% LSD: 6% Mezcaline and fungi: 13% Cocaine: 13% Tranquilizers: 45% Barbiturates: 6% Gasoline: 28% <u>Ever use:</u> Marihuana: 15% LSD: 2% Mezcaline and fungi: 1% Cocaine: 3% Tranquilizers: 33% Gasoline: 13% Amphetamines: 4% Barbiturates: 4% Tranquilizers: 7% Marihuana: 3% Inhalants: 2% Barbiturates: .5% Other drugs: .5% Two or more drugs: 7%

COUNTRY	AUTHORS	POPULATION	DRUG USE
CHILE	Morales, Remolina y Espinosa, 1975 (37) Valazques de Pavone Medellin, 1983 (39)	High-School students in Medellin n = 4 345 University students N = 48 308 n = 2 000	<u>Ever used</u> Trang. 15 Marigh. 17 Stim. 5 Inhalants 2 Hall. fungi 3 Barbit. 10 RATE 1/1000 <u>Incidence</u> Marihuana 5.8 Stimulants 0.4 Cocaine 9.3 Basuco 12.4 Trang. 2.6 Barbit. Opiates Inhalants 27.0 Hall. fungi.... <u>Frequent use (weekly)</u> 3 5 0.7 0.1 0.1 0.6 <u>Prevalence</u> 62.0 3.88 41.9 50.4 39.0 1.55 10.4 34.9 7.3
	Abarca, R, 1982 (52)	Minor offenders	Drug use between 5 - 12 years: "Neopren" (benzen). Between 12 - 15 years: Marihuana, older groups, LSD and tranquilizers.

COUNTRY	AUTHORS	POPULATION	DRUG USE
PERU	Sotomayor Urquiza, 1977 (65)	Males from 11 to 21 years in basic labor education N = 1 534	33% ever use. Higher prevalence rate among the 16 age group. <u>Ever use:</u> Marihuana 24% Amphetamines 21% Mandrax 11% Cocaine 15% Inhalants 6% Coca paste 5% LSD 1%
	Jeri, FR. 1980(b)	General population in the city of Lima 1979 - 1980 3 500 000 inhabitants between 10 and 45 years	1.4% of the population reported use of inhalants (49 000 subjects). <u>Age groups:</u> 10 - 19 years 2% 20 - 29 years 1% 30 - 39 years 2% 40 - 45 years 1%
URUGUAY	Bachini, O. 1982 (52)	People arrested and sent to the psychiatric state hospital for forensic expertise. n = 584	Marihuana 433 Inhalants 27 Cocaine 11 Hall. Fungi 24 LSD 12

COUNTRY	AUTHORS	POPULATION	DRUG USE
VENEZUELA	Davia, A y cols. 1976 (69)	Youth population of Caracas. 18 to 22 years. N = 200	Marihuana 32% LSD 20% Cocaine 16% Barbiturates 10% Metacualone 9% Amphetamines 8% Morphine 6% Heroin 5% Hashish 2% Mezcaline 1% Banana peel 1% Optalidon .4% Ecuamil .4% Gasoline .4%
	Gruson, A. 1978 (71)	Students from secondary in the 24 metropolitan areas N = 14 306	Marihuana 1.7% Barbiturates and depressors 0.15% Morphine 0.02% Inhalants 0.03% Hallucinogens 0.05% Two more drugs 0.05%

report of the Inter-American Institute of the Child, in a quotation from the final document of the Fourth Conference of the States of the South-American Agreement of Psychotropic and Narcotic Drugs in 1982 stated that in Argentina, solvent abuse has grown in the last years specially among the preadolescents¹².

Bolivia

Castellanos, Valda and Villegas in 1978¹⁴ made an analysis of drug use in the country. They reported that from 1930 to 1945, the use of drugs was limited to morphine and other derivatives associated with clinical practice. In the fifties, the first notice appeared of cocaine use, among adults, but it was a practice only in isolated cases. After 1960, there was widespread use of drugs which include amphetamines, barbiturates and hallucinogens. However, the rates of use were very low. Since 1970, drug use has increased considerably.

These authors reported a study made on students; 14 to 19 years of age with a school status between 7 to 9 years of completion. The rate of ever use was similar to the one observed in Mexico, 15%, only. 87% were habitual users and 6% were experimenters. Drug use increases with age. Among this group, marihuana was the drug of choice, (57% of users), followed by inhalants, (e.g. thinner, glue, gasoline, e.t.c.) (17%), then stimulants and depressors (10%). Cocaine was preferred by 6% of the users while LSD by 2% and heroin by 1%.

In a case study¹⁵, conducted also in 1976, it became evident that children between 8 and 15 years of age were using solvents especially gasoline. Inhalant use was related to age and socioeconomic status. They were used mainly by children and by people from low socioeconomic status. Among those in this last group mezcaine was also consumed. Among the youth population (15 to 25 years) of the upper classes, marihuana and cocaine were preferred. Morphine, methadone and cocaine were common among the male adult population while females preferred drugs of medical use (amphetamines, barbiturates and tranquilizers).

Brazil

The available information from this country includes studies conducted among minors accused of delinquency, students, patients in treatment and minors with no fixed place of residence. The percentage of arrests among minors (due to the use of drugs) was 12% in the first six months of 1974, considerably higher than the one reported in 1964, (7%) and with a peak in 1971, (15.3%). Inhalation was not observed¹⁶.

Use of drugs was reported by approximately 17% of the secondary students from 17 cities of the state of Minas Gerais and by 24% of the university students of Belo Horizonte. Amphetamines, tranquilizers and marihuana are the drugs of choice. The use of morphine and cocaine was rare and inhalants and heroin were not reported by the studies.

Since 1983 the first reports on the use of substances with psychotropic effects were found. Patients in treatment reported their use (see table 31). It is also in this year that a new pattern of use was reported: inhalation of perfume and other type of sprays^{21a}. Lowenkron (a) reports that the inhalation of perfume spray increases during summer time, and that high class adolescents showed higher rates of inhalation with the exception of gasoline. Murad²¹ reports that inhalation of perfume and other type of sprays is a common practice among minors (8 - 10 years of age) of low SES with no fixed place of residence. The solvents more commonly reported by patients in treatment were cola, i.e. a type of glue used for shoe making, perfume spray, benzine and "cheirinho de Lolo" that is made from either chloroform and benzine or hexano²¹. Street-trotters used more hexano, benzine, toluene, perfume (Lanca perfume) and other sprays (Murad 1983a) more frequently. Drug use is associated with low school and job performance and drop out rates¹⁹.

Colombia

Colombia is the country from which the highest number of studies were available. However, only one of them was conducted among the general population³⁹. Studies among students are over represented. Through these studies it became evident that students in Colombia reported the highest rates of drug use in Latin-America. In this country, the lowest prevalence was observed among secondary students in Antioquia (10%) and the highest among students from Bogota (55%).

Tranquilizers and marihuana are the drugs of choice, followed by hallucinogens, barbiturates and inhalants at considerably lower rates. Percentages of ever use of this last drug varied between 3% and 2% while that of frequent use between 0.2% and 0.1%^{23, 35, 37}. This drug was not reported by university students of Bogota³². (Table 4)

A report from the Division of Mental Health of the Ministry of Public Health²³ of a comparison of prevalences and characteristics of drug use among students from Bogota, Barranquilla and Bucaramanga, states that "incidence of consumption of all substances was considerably higher among students originating from urban areas than among those

TABLE 4
PERCENTAGES OF DRUG USE AMONG SECONDARY SCHOOL STUDENTS

	BOGOTA			BARRANQUILLA			BUÇARAMANGA			MEDELLIN		
	I	II	III	I	II	III	I	II	III	I	II	III
STIMULANTS	4.5	2.9	3.0	6.0	5.1	4.5	1.9	2.6	3.7	7.2	5.1	4.7
BARBITURATES	2.3	1.2	1.0	2.2	2.7	3.1	1.1	1.4	1.8	5.7	5.6	5.8
MARIHUANA	10.2	7.6	5.2	11.9	13.7	10.7	3.8	6.2	4.2	23.8	18.6	15.8
LSD	1.1	0.6	0.5	1.4	1.9	2.4	0.3	0.6	0.1	3.0	1.8	2.2
HALLUCINOGENIC FUNGI	1.2	1.5	0.7	2.2	3.4	3.6	0.3	1.0	0.6	6.8	4.2	1.6
TRANQUILIZERS	21.0	20.4	16.6	26.2	24.3	19.6	29.6	28.3	28.7	29.1	29.7	21.6
MARCOTICS	1.2	0.6	0.7	0.7	0.7	1.6	0.8	0.6	0.8	1.8	1.4	1.5
INHALANTS	2.6	1.7	2.6	1.0	1.6	3.9	2.2	4.0	3.2	1.6	3.0	2.7
OTHER SUBSTANCES	7.3	4.4	2.3	11.7	5.7	5.4	40.7	17.4	15.7	7.0	8.4	11.3
GLOBAL	51.4	41.2	32.8	44.3	40.1	33.7	80.7	62.3	58.9	49.0	46.0	39.0

I High SES
II Medium SES
III Low SES

Source: Mental Health Division. Ministry of public health of Colombia.²³

originating from rural areas and among students from families which are higher in the social scale." "The incidence of high consumption were lower among students living with both parents". "The incidence was found to be highest among students who stated that they did not practice any kind of religion, followed in descending order, by Jewish, Protestant and Catholic students".

In a school survey conducted in Barranquilla, by Morales in 1976³⁵ (n = 2934), inhalation was reported by 2% of the students. When the use was analyzed by socioeconomical level it was found that 1% of the high SES students reported their use as well while 2% from the medium SES and 4% of the low SES reported. This practice was more prevalent among the group from 10 to 19 years (4%).

Among institutionalized children²⁵ inhalant use is quite common. The rate of use in 1980 was 20%, being higher among males (24%) than among females (10%). Among males inhalation increases with age while among females the use was more prevalent between 7 and 8 years. The substances most commonly used were gasoline (29%) and "sacol" (27%). 25% of the users inhaled on a daily basis and 46% inhaled alone.

Gasoline was frequently reported by the imprisoned population and students with an evening schedule who are probably related with socioeconomic factors that limit the possibility of buying other drugs. A group of university students reportedly did not know its use as a drug³⁰.

Cocaine was not commonly reported in school surveys conducted before 1976. Since that time a shift on the problem of drug use in this country has occurred, with a proliferation in the use of "basuco", a derivate of the coca leaf, added to a tobacco cigarette and smoked³⁹.

Chile

Very few reports were available from this country. Through the available data, it seems to be that drug use is not very high, the prevalence rates among students vary between 5% and 11%⁵³. Only 1% of a group of minor offenders from 11 to 25 years reported solvent use compared to 43% for marihuana and 3% of cocaine. As in Mexico, the drug of choice is dependent upon age, children preferring inhalants⁵³ adolescents, marihuana, and older groups hallucinogens and drugs of medical use⁵³. This practice, is also more prevalent among males⁵².

Ecuador

Percentages of drug use in this country among students are very similar to the ones reported in Mexico, Chile and Brazil.

Inhalants was the drug of choice among students in Guayaquil⁴⁸. In Guayas⁴⁷ and Quito⁴⁶, marihuana was the drug most commonly reported. Cocaine is also frequently used in this country⁴⁸.

The solvents more commonly used were glues and thinner. In Guayas⁴⁷, solvent use were more commonly reported by students from elementary school ("ciclo basico") 9.6% in comparison with students in the next level ("ciclo diversificado"), 8.3%. Hallucinogenic fungi were reported by approximately the same proportion of students in both levels, 1.1% and 0.7% respectively. All other drugs were more commonly used in the "diversified circle".

Perception of problems in relation with parents were significantly higher among users. This last group also had a significantly greater amount of money to spend⁴⁷.

Paraguay

Only one report was available from this country⁵¹. Inhalation among university students is a frequent practice. The percentage of ever use of this drug was higher than the one observed for any other drug.

Peru

Like other countries in the region of the Andes, producers of cocaine, Peru has a problem in the use of this substance. Two different manifestations are observed: "coca chewing in the Andes, and coca paste smoking in the cities"⁶².

In relation to other drugs, school surveys conducted in this country report rates of drug use among student population varying between 20% among males from 11 to 22 years of age⁶³ to 33% in a sample of males from 11 to 21 years of age in basic labour education⁶⁵.

Among the general population (12 to 45 years of age) of Lima⁵⁵, tranquilizers is the drug of choice (15% ever used), followed by coca leaf (5.49%), amphetamines (4%) and marihuana (3.18%). Heroin and morphine were reported by only a small proportion (.13%). Inhalants were reported by 1.4% of the population.

Rates of use of tranquilizers increased with age until 34 years of age. Users are more frequently females from high socioeconomic classes, they are mainly married (8.21%) and have studied in a university (25%)⁵⁵.

Most coca chewers are between 35 and 39 years of age, mainly males, and with low school status. Most users had not completed elementary school (7.97%)⁵⁵.

Marihuana is also consumed by more males (5.32%) than females (1.16%), of the age group 20 - 24 years (7%), bachelors (4.13%), from high and medium socio-economic status (6.97% and 6.07% respectively) and with university studies (8.33%)⁵⁵.

The practice of smoking coca paste was reported by 1.34% of this sample, mainly males (2.47%) between 20 and 29 years of age. No case was found of those under 15 years or over 34 years. Most smokers came from low schools status, between 6 and 9 years of school. Cocaine was more commonly observed among unmarried males of high socioeconomic status. All users were between 15 and 34 years of age with most cases between 20 and 24 years of age⁵⁵. Inhalants were reported by all age groups included in the survey with similar proportions (b).

Uruguay

Only one report is available from this country. It refers to statistics of people sent to forensic experts and to a psychiatric hospital in 1982. Inhalants was the drug of second choice among this group⁵².

Venezuela

Prevalence of drug use among Venezuelan students seem to be considerably lower than the one reported in other Latin-American countries. Gruson, A., in 1970⁷¹ conducted a survey among students from secondary schools in the 24 metropolitan areas of the country. The rate of drug use was of 2.2%, marihuana being the drug of choice with a rate of ever use of 1.7%, followed by barbiturates and depressors, 0.15%. Inhalant use were reported by only 0.03% of the students.

Mexico

By the end of the 1960's and the beginning of the 70's it had become apparent through different indicators that drug use was no longer restricted to minority groups (i.e. cannabis use among soldiers) and that it was spreading to other groups especially youngsters. It was during this period that the first Mexican drug use studies were carried out. The first surveys were conducted among school population. The results from these surveys are difficult to interpret because the questionnaires employed varied; they either included only small sectors or were not conducted among representative samples. In spite of these, the rates of ever use reported did not show strong variations (13% to 20%)^{9, 17, 19}. Marihuana was the drug more frequently reported.

In 1972 the Centro Mexicano de Estudios en Farmacodependencia CEMEF (Mexican Center for Studies in Drug Dependence) was created (actually Instituto Mexicano de Psiquiatria, IMP). The scope of research was widened, the methods and techniques have been tested and standardized. Household surveys among population 14 years and over were conducted in six cities of the Mexican Republic^{24, 27, 31, 36, 37, 47}. (Tables 5 to 8). Studies among student population included a National survey of students between 14 to 18 years of age (1976)⁴, the study was replicated in the Federal District (Tables 9 and 10), in 1978⁸, and in 1980⁹, in 1980 a survey was conducted among university students⁶. In 1981, the "Centros de Integracion Juvenil", an organization for the treatment and prevention of drug use conducted a school survey in 15 cities of the Mexican Republic. The same instrument used in the studies previously mentioned was answered by students who had completed 7 to 16 years of education and who were 12 years of age and over and of both sexes¹².

Also Cabildo conducted a trend study among 5 samples of school population from 16 to 18 years of age in the northern sector of Mexico City from 1972 to 1980³, and other small studies were conducted after this year (table 11).

Finally adult imprisoned population^{13, 29, 39, 42, 43, 46}, (table 12) and minor offenders^{23, 35, 38, 41} were also studied (table 13).

Unfortunately these studies except the school surveys mentioned above, have been conducted only in one point of time, thus trends are difficult to estimate.

The epidemiological studies with an anthropological emphasis that have been conducted in Mexico include studies among solvent users in target areas^{12, 18, 20, 28, 33}, naturalistic and case-finding studies among polydrugusers^{1, 16, 25} and case studies^{35, 36, 45} (tables 14, 15, 16). Most of them have been oriented toward the detection and study of drug users, only two included a non-user comparison group^{16, 28} and only one study provided estimations of prevalence²⁸. Also most of them have been conducted only one period of time, two have studied the same area in different periods 1974¹⁶ and 1978²⁵, and another is a two year study of the same area and group of users²⁰. Thus trends can only be derived from these last studies.

Another major source of information from the country are the statistics from the specialized treatment facilities: "Centros de Integracion Juvenil", since 1970, 32 centres in 28 cities of the Republic have been founded. Information is available from 1970 onwards, when the first centre was opened. Between 1973 and 1974, 4 facilities were created; 8 between 1974 and 1975; 14 between 1975 - 76 and 5 more since 1977.

MEXICO

TABLE 5
PERCENTAGES OF DRUG USE AMONG GENERAL POPULATION

Number of users in the population 14 years old and over estimated through house-hold surveys in representative samples in six cities of the Mexican Republic:

	Distrito Federal ¹ N = 4 982 000 n = 2 733 1974	San Luis Potosi ² N = 215 000 n = 624 1975	Puebla ² N = 390 000 n = 666 1976	La Paz ¹ n = 444 1974	Mexicali ³ N = 263 000 n = 684 1978	Monterrey ⁴ N = 965 000 n = 800 1975
Marihuana	1.3%	2.1%	0.3%	4.9%	6.7%	0.2%
Solvents	.4%	0.5%	0.01%	0.7%	0.7%	0.2%
Hallucinogens	.3%	0.9%	-	1.1%	0.2%	-
Heroin	.1%	-	-	0.4%	0.02%	0.2%
Cocaine	-	-	0.2%	0.7%	1.6%	-
Barbiturates*	4.2%	0.8%	0.8%	4.7%	2.2%	0.8%
Amphetamines*	2.1%	1.0%	2.2%	2.0%	4.1%	0.3%

Percentages of ever use.

* Use out of prescription.

- Source: 1. Medina-Mora y cols. (24, 27)
2. De la Parra y cols. (36, 37)
3. Terroba y cols. (32)
4. Natera y cols.

TABLE 6
PATTERNS OF DRUG USE IN DIFFERENT CITIES OF THE MEXICAN REPUBLIC

HOUSEHOLD SURVEYS 14 YEARS AND OVER

SCHOOL SURVEY
(14 - 18 YEARS OLD)

	DISTRITO FOCGRAL ¹ 1974		LA PAZ ¹ 1974		SAN LUIS POTOSI 1975		PUSALA ² 1976		MEXICALI ³ 1978		DISTRITO FSOEPAL ⁴ 1978	
	Ever use	Last 30 days	Ever use	Last 30 days	Ever use	Last 30 days	Ever use	Last 30 days	Ever use	Last 30 days	Ever use	Last 30 days
MARIHUANA	1.3%	0.3%	4.9%	2.9%	2.1%	2. %	0.3%	0.3%	6.6%	3.8%	4.0%	1.1%
SOLVENT	0.4%	.12%	0.7%	0.7%	0.5%	-	0.01%	0.01%	0.7%	0.06%	5.0%	1.5%
TRANQUILIZERS*	0.5%	0.8%	5.0%	5.0%	6.7%	3.4%	2.2%	1.0%	0.7%	0.3%	3.1%	0.83%
BARBITURATES*	1.4%	1.4%	1.1%	1.1%	0.7%	0.5%	0.5%	0.5%	0.5%	0.02%	1.3%	0.48%
AMPHETAMINES*	2.3%	0.8% ¹	0.7%	0.7%	0.2%	0.2%	0.03%	0.03%	1.2%	0.8%	2.7%	0.6%

* use without prescription

Sources:

1 Includes the use of amphetamines and other stimulants.

1. Medina-Mora, et al.^{24, 27}
2. De la Parra, et al.^{36, 37}
3. Terreso, et al.⁴¹
4. Castro, et al.³²

TABLE 7
USE OF DRUGS BY SEX IN DIFFERENT CITIES OF THE MEXICAN REPUBLIC (HOUSEHOLD SURVEY) POPULATION 14 YEARS AND OVER

	O.F. ¹ 1974		La Paz ¹ 1974		San Luis Porca ² 1975		Putola ² 1976		Mexican ³ 1978		Monterrey ⁴ 1976	
	M	F	M	F	M	F	M	F	M	F	M	F
Marihuana*	0.4%	0.3%	9%	0.9%	3.3%	1.3%	0.7%	0.7%	-	11.4%	1.5%	0.4%**
Solvents*	0.7%	0.1%	1.4%	-	1.4%	-	0.0%	0.0%	-	1.4%	-	0.25%**
Barbiturates*	0.6%	2.4%	1.8%	0.9%	5.3%	1.5%	0.4%	0.4%	0.8%	0.8%	0.8%	0.42
Tranquilizers*	3.0%	5.2%	6.3%	9.9%	6.4%	0.5%	3.0%	3.0%	4.1%	3.2%	3.5%	2.8
Narcotic** Analgesics	4.1%	5.6%	9.8%	8.1%	5.7%	1.2%	2.0%	2.0%	5.0%	0.05%	1.8%	0.26%
Amphetamines**	0.2%	0.4%	0.5%	1.8%	0.8%	-	0.1%	0.1%	1.5%	0.02%	2.4%	.10
												0.50

1. Medina-Mora, et al (24, 27)
2. De la Parra, et al (36, 37)
3. Terroba, et al (47)
4. Natera, et al (32)

* Percentages of ever use

** Percentages of use in the last month or at least daily during one week in the last six months with or without prescription

TABLE 8
USE OF DRUGS BY AGE GROUPS IN DIFFERENT CITIES OF THE MEXICAN REPUBLICA (HOUSEHOLD SURVEYS) POPULATION
14 YEARS AND OVER.

	DISTRICT FEDERAL ¹			LA PAZ ¹			SAN LUIS POTOSI			PUSOLA			MEXICALTE		
	14-17	18-24	25-	14-17	18-24	25-	14-17	18-24	25-	14-17	18-24	25-	14-17	18-24	25-
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
MARIJUANA*	0.6	3.8	0.5	3.6	7.0	-	6.3	2.5	0.3	-	0.8	0.1	3.0	12.4	5.2
SOLVENTS*	1.0	0.8	0.3	-	2.1	-	-	2.1	-	0.1	-	-	0.06	2.8	-
BARBITURATES**	2.1	0.6	1.9	1.1	2.0	.9	0.9	0.6	.1	1.5	.1	.7	-	0.09	1.0
TRANQUILIZERS**	0.3	2.7	5.9	4.7	0.7	8.3	0.4	3.3	14.3	4.7	0.3	5.1	1.7	3.2	4.0
NARCOTIC ANALGESICS**	5.6	5.0	4.7	1.2	10.5	11.1	0.4	4.2	3.3	7.1	4.1	2.8	1.4	1.5	0.5
AMPHETAMINES**	0.4	0.7	.7	1.1	0.7	1.4	-	-	-	-	1.2	1.1	-	2.8	0.4

* Percentage of ever use

** Percentage of use in the last month or at least only during one week in the last six months with or without prescription.

Source:

Medina-Mora, et al 1974, 1974. (24, 27)
De la Parra, et al 1973, 1976. (36, 37)
Terroba, et al 1978 (47)

MEXICO

TABLE 9
PERCENTAGES OF DRUG USE AMONG SCHOOL POPULATION

AUTHOR	TYPE OF SCHOOL AND AREA	AGE GROUP	SAMPLE SIZE	RATE OF DRUG USE
Limon, et al (1982) (21)	State University, Mexico city	17 - 30	104	15% illegal drugs (marihuana more frequently)
Mata (1983) (22)	Secondary and preparatory school in one area to the south of Mexico city (6 to 12 years completed)	12 - 18	627	2.1% use of hallucinogens. higher than the average observed in Mexico city.
Cabildo (1980) (3)	One area to the north of Mexico city (9 to 12 years of school completed)	n = 494	n 1970 = 455 1971 = 422 1974 = 497 1976 = 625 1980 = 494	1970 1971 1974 1978 1980 Experimenters 11.8 12.4 17.5 20.8 12.3 Frequent users 1.9 2.7 2.4 3.0 1.8 Marihuana first drug of used, followed by inhalants, sedatives and amphetamines.

TABLE 10
TRENDS IN EVER USE (1978 - 1980) STUDENT POPULATION
MEXICO, CITY

Drug	1978 % of total of students	1978 Confidence limits		1980 % of total of students	Difference
		1978 Confidence limits	1978 Confidence limits		
Alcohol	59.0	68.0	60.0	57.5	-1.5
Tobacco	68.2	61.6	64.7	46.9	-6.8*
Inhalants	5.4	4.7	6.09	4.4	-1.0
Cannabis	3.8	3.2	4.3	3.5	-0.3
Tranquillizers	2.1	2.5	3.6	2.2	-0.9
Amphetamines	2.7	1.99	3.4	3.8	+1.1
Sedatives	1.8	.96	2.2	1.5	+0.2
Opium	0.91	0.66	1.25	1.8	+0.39
LSD	0.54	.032	.075	0.6	+0.04
Cocaine	0.52	0.20	0.83	0.7	+0.18
Heroin	0.29	0.13	0.44	0.3	+0.01

* Significant difference (out of confidence limits).

Castro, et al. (5)

TABLE 11
USE OF DRUG IN SCHOOL POPULATION BY DEMOGRAPHIC CHARACTERISTICS
MEXICO CITY, 1978 (ra4 059) (PERCENTAGES OF EVER USE)

EXO	MEXICO CITY, 1978 (ra4 059) (PERCENTAGES OF EVER USE)										Total
	Tobacco	Alcohol	Solvents	Marihuana	Tranquillizers	Amphetamines	Sedatives				
Male	69.4	62.7	7.3	6.1	2.6	2.4	1.4			2 009	
Female	40.8	55.4	3.5	1.5	3.5	3.0	1.1			2 013	
AGE											
14	61.1	56.1	9.8	0	4.9	4.9	0			41	
14	45.1	53.8	6.1	1.2	3.1	2.5	0.6			1 172	
15	51.5	53.1	6.2	2.9	2.8	2.5	1.4			1 237	
15	56.6	56.7	3.6	3.5	3.4	2.5	1.4			714	
17	61.7	63.8	4.7	6.3	2.9	3.1	1.6			447	
18	56.5	81.7	3.4	13.2	3.8	3.4	2.6			265	
18	10.8	80.2	3.2	14.2	4.3	4.3	2.1			94	
SCHOOL STATUS											
7 years	61.9	55.8	2.0	1.9	0	1.9	0			104	
8 "	49.9	52.7	6.1	2.4	2.9	2.4	0.8			1 103	
9 "	49.7	51.1	5.8	2.7	2.7	2.5	1.2			1 067	
10 "	61.4	69.9	6.6	5.7	4.4	4.4	2.2			45	
11 "	64.2	66.5	2.3	4.7	6.2	3.1	0.3			257	
12 "	59.5	69.1	1.9	10.4	1.0	2.7	1.9			250	
13 "	69.0	76.6	0	11.1	0	0	2.2			45	
14 "	30.5	94.7	10.5	21.1	0	0	0			19	

	Tobacco	Alcohol	Solvents	Marihuana	Tranquillizers	Amphetamines	Sedatives	Total
ACTIVITY (Outing the previous year)								
Did not study	50.0	80.8	3.0	8.0	2.4	2.4	2.4	212
Full time students	50.4	57.5	4.9	3.1	3.0	2.6	0.9	2 363
Part time students	57.0	81.1	4.5	4.2	3.4	3.2	1.6	1.423
WORK (During the previous year)								
Did not work	12.9	59.2	5.0	3.3	2.8	2.6	1.1	2 006
Fulltime worker	40.2	50.3	8.3	4.2	3.2	0.5	1.8	180
Part time worker		60.6	6.6	4.3	4.1	2.0		

* Percentages obtained from the total population in each group.

Non answers: Sex: n = 30, Age: n = 92; School status: n = 148; Activity: n = 6; Work: n = 405. Castro et al, 1980. (8)

MEXICO

TABLE 12
PERCENTAGES OF DRUG USE AMONG IMPRISONED POPULATION

Author	Type of study	Population	Drug use																					
Mier y Teran et al 1974 (29)	Case study of drug users	Females over 18 years n = 24	<table border="0"> <tr> <td></td> <td>Ever use</td> <td>Daily use</td> </tr> <tr> <td>Marihuana</td> <td>88%</td> <td>50%</td> </tr> <tr> <td>Inhalants</td> <td>25%</td> <td>8%</td> </tr> <tr> <td>Hallucinogens</td> <td>17%</td> <td>13%</td> </tr> <tr> <td>Opiate derivatos</td> <td>20%</td> <td>13%</td> </tr> <tr> <td>Cocaine</td> <td>33%</td> <td>4%</td> </tr> </table>		Ever use	Daily use	Marihuana	88%	50%	Inhalants	25%	8%	Hallucinogens	17%	13%	Opiate derivatos	20%	13%	Cocaine	33%	4%			
	Ever use	Daily use																						
Marihuana	88%	50%																						
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Hallucinogens	17%	13%																						
Opiate derivatos	20%	13%																						
Cocaine	33%	4%																						
Ruiz Harrel 1974 (39)	Case study comparison between users and non users	Male population over 18 years	<table border="0"> <tr> <td colspan="3">Use at least once in the last 3 months</td> </tr> <tr> <td>Marihuana</td> <td>96.42%</td> <td></td> </tr> <tr> <td>Barbiturates</td> <td>35.71%</td> <td></td> </tr> <tr> <td>Heroin</td> <td>17.85%</td> <td></td> </tr> <tr> <td>Hallucinogens</td> <td>16.65%</td> <td></td> </tr> <tr> <td>Inhalants</td> <td>8.33%</td> <td></td> </tr> <tr> <td>Cocaine</td> <td>8.33%</td> <td></td> </tr> </table>	Use at least once in the last 3 months			Marihuana	96.42%		Barbiturates	35.71%		Heroin	17.85%		Hallucinogens	16.65%		Inhalants	8.33%		Cocaine	8.33%	
Use at least once in the last 3 months																								
Marihuana	96.42%																							
Barbiturates	35.71%																							
Heroin	17.85%																							
Hallucinogens	16.65%																							
Inhalants	8.33%																							
Cocaine	8.33%																							
Straasi et al 1976 (43)	Case study of drug users	Males over 18 years n = 24	<table border="0"> <tr> <td></td> <td>Ever use</td> <td>Daily use</td> </tr> <tr> <td>Marihuana</td> <td>93%</td> <td>60%</td> </tr> <tr> <td>Inhalants</td> <td>50%</td> <td>15%</td> </tr> <tr> <td>Hallucinogens</td> <td>48%</td> <td>15%</td> </tr> <tr> <td>Opiate derivatives</td> <td>55%</td> <td>57%</td> </tr> <tr> <td>Cocaine</td> <td>14%</td> <td>-</td> </tr> </table>		Ever use	Daily use	Marihuana	93%	60%	Inhalants	50%	15%	Hallucinogens	48%	15%	Opiate derivatives	55%	57%	Cocaine	14%	-			
	Ever use	Daily use																						
Marihuana	93%	60%																						
Inhalants	50%	15%																						
Hallucinogens	48%	15%																						
Opiate derivatives	55%	57%																						
Cocaine	14%	-																						

Author	Type of study	Population	Drug use
Sara-Barrass (42), 1973	Epidemiological study - Sample of population of 4 rehabilitation centers with in the Federal District	Males over 18 years N = 4974 n = 390	Ever use Marihuana 19% Solvents 3% Hallucinogens 4% Opiate derivatives 5%
Suarez v c 1979 (46)	Epidemiological study Sample of population of a State Prison	Males over 18 years N = 454 n = 100	Ever use Marihuana .16% Inhalants 1% Marihuana and Inhalants 3% Marihuana Inhalants 5% Hallucinogens 5% Marihuana Hallucinogens 1%

MEXICO

TABLE 13
PERCENTAGES OF DRUG USE AMONG INSTITUTIONALIZED MINOR OFFENDERS

AUTHOR	TYPE OF STUDY	POPULATION	DRUG USE
Medina-Mora y cols. (1977) (23)	Analysis of files of minors institutionalized between 1971 - 1972 D.F.	Minors under 18 years of age	1971 1972 Marihuana 5.4% 8.8% Inhalants 9.2% 12.4%
Ruiz de Chavez L (1978) (38)	Analysis of files of minors institutionalized in 1974 D.F.	1 066 males 161 females Under 18 years of age	8% males and 4% females were institutionalized due to intoxication of the users 78% and 89% respectively were inhalant users, only 16% and 11% used marihuana and 1% of the male population reported use of LSD.
Secretaria de Gobernacion (1979) (41)	Analysis of files of minors institutionalized between 1974 - 1978. D.F.	23 568 minors from 7 to 17 years of age	10.11% males and 4.57% females were institutionalized due to intoxication.

TABLE 14
STUDIES WITH AN ANTHROPOLOGICAL EMPHASIS

AUTHOR	AREA	TYPE OF STUDY	POPULATION	DRUG USE
Chavez, et al (1974) (6)	Sub-urban community Low S.E. Level	Comparison between matched groups of users and non users	18 - 23 years n = 17 users	Drugs more frequently used: Marihuana 59% Inhalants 69% Barbiturates 12% Amphetamines 12%
Clarac, et al (1975) (15)	Metropolitan area of Mexico city	Case-study	16 - 20 years n = 70 users	Marihuana 96% Inhalants 57% LSD 31% Barbiturates 19% Amphetamines 19%
Leal, H. et al (1977) (20)	Target area within Mexico city	Follow-up study of drug users	Minors under 13* n = 24 (follow up) Adolescents 13 - 16* Young adults 17 - 23 (n = 144, N = 310)*	Inhalation at least four days per week. Daily use of solvents. Combination of alcohol and solvents and in some cases use of marihuana.
De La Garza, et al (1978) (8)	Two sub-urban communities within Monterrey, N.L.	Naturalistic study	28 families 32 users between 10 to over 62% under 15	Inhalation at least once a week

AUTHOR	AREA	TYPE OF STUDY	POPULATION	DRUG USE
Medina Mora, et al (1980) (25)	Sub-urban community Low S.E. Level	Intensive Case Finding	123 users de- tected 62 cases studied 14 - 35 years of age N = 320 n = 66	Marihuana 95% Inhalants 31% Amphetamines 18% Hallucinogens 13%
Medina-Mora, et al (1982) (26)	Target area within Mexico city	Sample of minors that make their		ever use daily use Solvents 27%

TABLE 15
RESULTS FROM CASE-FINDING OR EPIDEMIOLOGICAL STUDIES WITH AN
ANTHROPOLOGICAL EMPHASIS

AUTHOR	AREA	TYPE OF STUDY	POPULATION	DRUG USE
Solorzano A (1979) (45)	Mexico city	Case study	1 000 working non salaried children from 6 to 14 years of age 77% attended school 98% lived with family	6.4% experimenters on occasional users 1.9% frequent use Drug or choice marijuana followed by inhalants
Barrera CE y cols. (1982) (1)	City of Coatzacoalcos within the state of Veracruz	Combination of house-hold and intensive case finding among workers	Not specified	Percentages of ever used: 6% marijuana 4% tranquilizers 1% inhalants

TABLE 16
PERCENTAGES OF DRUG USE AMONG INSTITUTIONALIZED CHILDREN
AND ADOLESCENTS

AUTHOR	TYPE OF STUDY	POPULATION	DRUG USE
Caudillo C, et al (1984) (10)	Comparison of users and non users	Minors recluded in protection houses with no antecedents of institutionalization* 4 - 16 years N = 484 n = 84	Ever use Daily use Inhalants 37% 12%
Caudillo C, et al (1984) (10)	Comparison of users and non users	Minors recluded in protection houses with antecedents of institutionalization 4 - 17 years N = 329 n = 69	Ever use Daily use Inhalants 75% 55%

* It refers to antecedents of institutionalization in the Tutelar Council due to delinquent behavior including intoxication or in this type of houses due to lack of family or for working or sleeping in the street.

The number of patients attending treatment increased over the first 5 years. Due to the creation of new centres from 1978 to 1980 the number of patients remained stable. In 1981 an important decrease was observed, due to a modification of the admission policy of this Institution. Since 1981 only the most severe cases were accepted, experimenters, social users or ex-addicts were channelled to other institutions. Unfortunately no data are available for this last group. In 1982 an increase in multiple drug use was observed probably due to a modification of the registration system.

Prevalence Of Drug Use And Trends

From the sources consulted it became apparent that the substance most commonly abused in the country is marihuana followed by inhalants and amphetamines. Since 1970 the drug more commonly used by the patients in the specialized treatment facilities in the Mexican Republic were marihuana followed by solvents.

The proportion of patients that report the use of the different drugs vary according to the region of the country. Figure 1 shows the proportion of users of each drug obtained from the total number of patients attended to in 1983. Inhalant used varied between 27% in the central area of the country to 13% in the nonoccidental area¹¹.

Intoxication due to inhalation of volatile solvents is the second cause of intoxication reported in the toxicology reporting system of the Federal District. 3.4% of the cases were due to this substance; 1.6% due to the ingestion of barbiturates .27% due to mescaline and the same rate due to cannabis.

Inhalant use occupies between the third and fifth place of preference of the imprisoned population, (see table 6). In 1981, 2.8% of 8,431 persons studied in institutions of social readaptation, reported its use, occupying the third place of preference. Important variations were observed in the regional studies; the rates varied between 0.4% to 18%. The northern region was the less affected while higher rates were reported in the central region¹³.

Trends in the use of drugs in student population can be determined through the comparison of figures obtained in surveys of representative samples conducted in the Federal District in 1976, 1978 and 1980. From 1976 to 1978, it was found that the experimental use of cannabis and inhalants increased significantly. Unimportant differences were observed in regular or heavy use groups⁸. The rate of ever use in 1978 was 13% and in 1980, 12.3%.

Inhalants in 1978 occupied the first place of preference whereas in 1976 cannabis was the drug more commonly used. From 1978 to 1980 the use of drugs did not increase or decrease significant. In 1978 inhalants were more frequently used by students who attended schools located in low socioeconomic areas whereas in 1980 students attending schools from all the socioeconomic zones reported the same prevalence rates, with an average of 4%⁵.

Trends of drug use can also be inferred through the results from the national survey conducted in 1976, that reported figures for 13 regions of the Republic⁴, and the study conducted in 15 cities in 1981¹⁴.

The rate of ever use has increased to the same extent as the one observed in the Federal District between 1976 and 1978; unfortunately we do not have a global figure of drug use for 1976, in 1981 it was 15% slightly higher than the one observed in the capital city in 1978 and 1980 (13% and 12.3% respectively).

Inhalants use increased significantly in all regions, specially in the centre of the country.

Groups Of Population Affected

Solvent use is more frequently observed among minors who work on the streets. This group has been the focus of five surveys undertaken in Mexico, four of them in the Federal District and one in the city of Monterrey, Nuevo Leon. These studies varied in their results.

Leal in 1977²⁰ reported a high frequency of regular drug use among minors between 7 and 12 years of age, who lived in the centre of the capital city. Solorzano in 1980, in a case study of 1 000 minors from 6 to 14 years of age, who earn money through different types of activities such as carwashing or helping in supermarkets, reported a low prevalence rate, 6.4% for ever use and 1.9% for frequent use⁴⁵.

Both groups differed in many aspects, among them the place of residence: the first study was conducted in a high risk zone, the second study included minors from all the areas of the capital city.

Another important difference was in the school attendance and the contact with the family of origin. The minors from the first study had dropped out from school or had never started formal studies, and contact with family was nonexistent, whereas 77% of the minors from the second study were studying and 96% lived with the family.

In 1981 a case study was undertaken in two social welfare institutions, one of them houses minors that have recently started to work on the streets and with no antecedents of institutionalization. The second houses minors with antecedents of having been institutionalized in one of the houses of protection.

Both groups differed in school assistance: 83% of the minors studied in the first institution, were attending school, this was observed in only 1.4% of the second group. Contact with the family also differed, 56% and 20% respectively lived with their families. The age range of the minors from the first institution varied between 8 and 14 years, ($X = 11.6$) and the second one from 8 to 16 years ($X = 12.1$ years). The average number of years of formal education were 2.8 and 1.5 years respectively. Only males were studied.

Prevalence of drug use was also different; 37% of the minors without antecedents of institutionalization and 75% with antecedents reported use of drugs at least once in their lives; 12% and 55% respectively, reported frequent use¹⁰. In 1982, a study was undertaken with minors that work on the streets²⁸. The study was undertaken with the aim of: a) developing a methodology for selecting probabilistic samples and obtaining reliable information, and b) to estimate prevalence of use among a group of minors that work on the streets. In order to conduct this study, an area of great activity was chosen, the different types of businesses as well as parks buses and underground terminals provided jobs and shelter for the minors. All minors, children and adolescents, that worked in the area were included; minors who only used the area as access to other places were excluded from the study. The sample design was stratified, the variable for stratification was the different characteristics of the zones within the target area.

In order to determine the size of the universe, and to evaluate the possibility of elaborating a reliable sampling frame, two observers undertook an independent register of the cases observed in each zone. One of the observers selected at random the subjects for interviewing. The register of both observers varied by 4% (12 persons). The estimated size of the universe was of 329 minors, the non-response rate was 9%. The confidence limits of the estimation of prevalence was of $\pm 7\%$.

95% of the subjects were males, with an age range of 6 to 18 years and with an average of 12.8 years, 67% were not attending school at the time of the study, the average of years of school

completed was of 4.2 years, when an average of 6 was expected according to their age. 47% slept on the street. Excluding alcohol and tobacco, the drugs most commonly used were solvents, 27% reported ever use and 22% daily use, 9% reported inhalation 4 or more times a day. The second drug of choice was marihuana, 10.3% reported ever use and 1.5% daily use. One subject reported use of drugs of medical use, and use of other drugs was not reported.

The rate of ever use of alcohol was very similar to the one reported for inhalants, 28%, but daily use was 10 times lower, 2%. The average age for first use was 8.4 years. The time of drug use varied between 0 and 6 years, with an average of 4.5 years.

Seven variables correlated significantly with drug use ($R^2 = .42$). These variables were: not attending school, for starting to work on the streets at an early age ($X = 8.7$ and $X = 10.2$ respectively), a small income and little personal use of the money earned in comparison to family use. A bigger proportion of the users were born outside the capital city. Often, their brothers and friends used drugs.

This study was later replicated in the city of Monterrey, among minors that worked on the streets¹. In this study it was found that drug use was not a problem among this group, as opposed to what was observed in the capital city, inhalant users were found in the marginal communities.

Patterns Of Use

Inhalation is a practice usually performed in groups.

The type of substances and the patterns of use are related with the type of population and circumstances.

Among students and non-students who live with the family, inhalant use is an experimental practice. Among minors that work or live on the streets, inhalation is part of their everyday lives. Among this last group the patterns of use also vary. In places where police seldom patrols, the minors use plastic bags where an inhalant, usually glue, has been introduced. The plastic bag is then put to the nose and mouth. This pattern of use usually leaves spots of glue on the mouth and hands. When the police is around, the minors develop skills for inhaling without being noticed; for instance, wetting a cloth with thinner, or wetting the sleeve of the sweater with a bottle containing a solvent, usually kept at the waist²⁰. Other groups prefer to wet a cloth with paint and cover it with paper, called flutes¹⁸. University students report the use of sprays, ink and every alcohol⁶.

Discussion And Conclusions

In this section we will make a country-by-country comparison in terms of the availability of information; the rates of drug use, the type of substances more commonly abused, the sub-groups affected and when possible the sociocultural variables related with the type of drug problem.

Availability Of Information

While some countries in Latin America, among them Chile and Costa Rica, have a strong research tradition in the field of alcohol, this is not the case for drug use. No country has a complete picture of the drug problem.

General population surveys have only been conducted in Mexico, Costa Rica, Colombia and Peru, but none of them have a national nature. These studies have commonly been conducted on student populations. The results from these studies, though important in most Latin American countries, can not be generalized to the youth population as a whole as only a small fraction of this category are actually in schools.

Though it is obvious that more research needs to be conducted it is not easy to recommend the type of research design that should be chosen, while most researchers would agree that the high risk population needs to be given priority. They do not agree as to the type of survey that should be recommended.

Across the continent school surveys are comparable. However, they cover only a small sector of the youth population and the one that presents less risk for the abuse of drugs. Household surveys cover a wider sector of the population, though again they do not give results for drug subcultures with no stable place of residence and are very costly. A combination of different strategies is probably the best approach and must be specified for each country.

Type Of Substances Most Commonly Used And Subgroups Affected

In this region the use of heroin and other opiate derivatives is not very common. Derivatives from coca are widely used in the Andean region. Marihuana is the drug of choice in all the region and the inhalation of psychotropic substances is observed in almost all the countries. Colombia presents the highest rate of drug use. Alcohol and tobacco are, by far, the drugs more commonly used.

Youth population is most affected. Marihuana is the drug of choice among students while inhalants are more widely used among minor infractors in Central America and in Mexico.

Unfortunately such statistics of all the countries are not available.

The Problem Of Inhalation Of Substances With Psychotropic Effects

Use of these substances was observed in all countries, with interesting variations. For instance this practice was reported in Mexico since the first epidemiological surveys conducted in 1972 but no mention on the use of this drug was made before 1983 in Brazil. After this year there was a report of a small proportion of patients in treatment using it. This same year an apparent epidemic peak was observed in the use of sprays especially perfume. From the scarce information available from Argentina it seems to be that inhalation is not a common practice in this country, though it could be that it is not frequent in the population included in the report: students and patients in treatment.

The higher percentages of drug use among students were reported in Mexico.

In most countries, except Brazil, glue and thinner are the substances more commonly reported and though it seems that inhalation is observed in all social classes, it seems to be that gasoline is preferred in low socioeconomic groups.

In general inhalant users tend to be younger in age. However in Costa Rica it seems to be more common among the population between 19 and 24 years.

It is evident that many questions need to be answered. Research must be conducted not only in order to get a picture of prevalence of drug use and its trends, but to identify high risk groups such as polydrug users, and cultural variables associated with use and abstinence of drugs. Cross cultural comparisons could be specially enriching.

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Historical Aspects and Present Situation

The inhaling of volatile substances has been practised in European medicine and in paramedical practices for many centuries. Inhalation served various purposes such as stimulation and anaesthesia, sedation and analgesia, spasmolysis in the respiratory tract etc. Some of these old practices have been rediscovered in a recent effort to reestablish traditional and folk-medicine.

Historical forms of abuse are especially known with respect to narcotic and analgesic agents such as chloroform and ether which were introduced for anaesthesia in surgery and obstetrics at the end of the last century. Abuse and dependence of these substances became well known in contemporary psychiatry, with increased risks for medical and paramedical professions.

Abuse of other volatile substances became obvious after the Second World War, especially in Northern Europe, where the highest incidence and prevalence of inhalant use and abuse was recorded during the Sixties and Seventies. Most other European countries reported minimal or no abuse and cases of dependence. The only global review on the extent of drug abuse including inhalants, published by Hughes et al. in 1983, reported abuse of volatile solvents in three (from 35) European countries only (Tab. 1).

Sources of Information

Apart from the abovementioned review, no coordinated information system has been set up and no coordinated epidemiological study on the abuse of inhalants has been effected throughout Europe. Projects for coordination in drug epidemiology have been discussed and prepared but none realised so far.

The following information therefore is derived from heterogeneous sources, which differ from country to country, and which are no basis for a comparative evaluation over time or interregionally.

Some data stem from national surveys interviewing representative population samples. Others are based on school surveys. Again others are utilising data from therapeutic services. Another source of information are death statistics.

TABLE 1
NUMBER OF COUNTRIES AND TERRITORIES REPORTING ABUSE
BY REGION AND DRUG TYPE^{a, b}

Region (No. of countries in region)	Amphet- amines		Barbiturates sedatives tranquilizers		Coca type		Cannabis		Halluci- nogens		Heroin		Opium		Other opiates		Volatile solvents	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Africa (45)	12	27	10	22	2	4	24	53	3	7	1	2	1	2	3	7	1	2
Americas (40)	18	45	20	50	21	52	35	88	14	35	7	18	1	2	12	30	4	10
Eastern Mediterranean (24)	8	33	11	46	4	17	18	75	2	8	5	21	13	54	10	42	-	-
Europe (35)	22	63	27	77	16	46	30	86	18	51	18	51	7	20	28	80	3	9
South-East Asia (11)	3	27	5	45	3	27	6	55	2	18	6	45	6	55	7	64	-	-
Western Pacific (25)	8	35	9	39	5	22	17	74	5	22	12	52	10	43	8	35	1	4
Total (178)	71	40	83	47	51	29	120	68	44	25	48	27	38	21	68	38	9	5

^a Availability of drug data including verbal estimates for years 1975 - 1980

^b From Hughes et al., 1983

A general handicap of epidemiological studies in this field is the relatively young age of inhalers. Early teenagers, their parents and their schools are less accessible for interviewing than late teenagers, in many places. One method repeatedly used was therefore an interview of drug abusers about their early inhaling practices. It is understood that this kind of information is biased in many ways. On the other hand, one may expect an underestimation of the problem from the survey data.

Substances Used as Inhalants

The range of substances which are used occasionally or regularly for intoxication is large. The following list is not complete, but it contains the mainly substances used:

- (a) toluene (plastic cement, airplane glue, lacquer thinner).
- (b) xylene and acetone (fingernail-polish remover, model cement).
- (c) gasoline; benzene (rubber cement, cleaning fluid, tube repair kits).
- (d) naphta (lighter fluid).
- (e) hexane (plastic cement).
- (f) carbon tetrachloride (spot remover, dry cleaner).
- (g) dichloroethylene and trichloroethylene (degreaser, dry cleaner, refrigerant, liquid paper).
- (h) trichloromonofluoromethane and dichlordifluoromethane (aerosols and refrigerants).
- (i) trichloromethane (chloroform).

Legislation concerning the availability of these substances is variable from country to country. Some countries have introduced regulations on the declaration of toxicity, some others have restricted the availability of certain substances for minors. Nevertheless, the overall availability of inhalants is mostly unrestricted and regarded as nonrestrictable.

Epidemiology Data from Individual Countries

England

Sporadic cases of solvent abuse have been reported since the late 1950ies, especially in young teenage males

living in highly industrialised urban areas. A marked increase in the number of children and young people involved was found to have occurred between 1970 and 1975 (Watson, 1980). Over 200 papers on clinical and laboratory studies have been published recently (see bibliography on solvent misuse, London, 1985). Also a number of publications on treatment and prevention are available. On the other hand, it was not possible to find national statistics on the incidence or prevalence of inhalant abuse (Actions Against Sniffing, Stockholm, 1976).

The first sporadic reports on sniffing by children was in 1948. In 1956, an inquiry into thinner abuse was initiated by the Education Authority and the National Board of Health and Welfare. The occurrence of thinner abuse was noted in 12 countries and in Stockholm. This involved a total of about 130 cases. In the year 1957/58, the Education Authority reported some 50 cases. The school medical officer in Stockholm reported 103 cases in 1958/59, 20 in 1959/60 and 20 in 1961/62. The report on thinner resulted in a royal ordinance in 1969 prohibiting the sale of thinner to young people under 18 years of age.

Questionnaire surveys at various schools indicate that sniffing varies in extent. Between 2% and 27% of the pupils replied that they had sniffed. The majority were age 16, a smaller number between age 12 and 16. Sniffing is more common in large towns than in rural districts. The Education Authority's questionnaire survey to pupils in a selection of the headmaster divisions in the country produced the following figures (Actions Against Sniffing, 1976).

TABLE 2

Year	School-year 6		School-year 9	
	Boys	Girls	Boys	Girls
1971	9%	5%	27%	12%
1972	5%	3%	18%	13%

Another important questionnaire survey has been conducted since 1969/70 by the Institute of Military Psychology to all young people eligible for conscription (age 18). The results of this survey are as follows: (Actions Against Sniffing, 1976):

TABLE 3

Frequency	1969/70	70/71	71/72	72/73	Autumn 1973
Never sniffed	87%	80%	79%	76%	74%
Sniffed once	8%	10%	10%	10%	10%
Sniffed 2-10 times	4%	6%	7%	8%	8%
Sniffed 10 times	2%	4%	5%	6%	7%
Total percentage of sniffers	14%	20%	22%	24%	25%

Several investigations demonstrate that sniffing by individuals is often accompanied by other forms of abuse. Many of those who drink a lot also sniff and vice versa. In the same way, the combinations of sniffing/narcotics and narcotics/ alcohol are very usual. Sniffing is more usual among girls, but the differences are diminishing.

The overall consumption patterns seem to vary and there are local "epidemics" of sniffing behaviour in groups of young people. Just a few individuals in every generation seem to have become chronic abusers of solvents. Most users seem to discontinue at the end of adolescence. Many future drug addicts started their substance abuse with solvents and alcohol.

Table 4 summarises the findings on sniffing experience in Swedish school children over a decade 1971-1981. It shows a consistent decline of sniffing experience in boys and girls (Hibell & Jonsson, 1982).

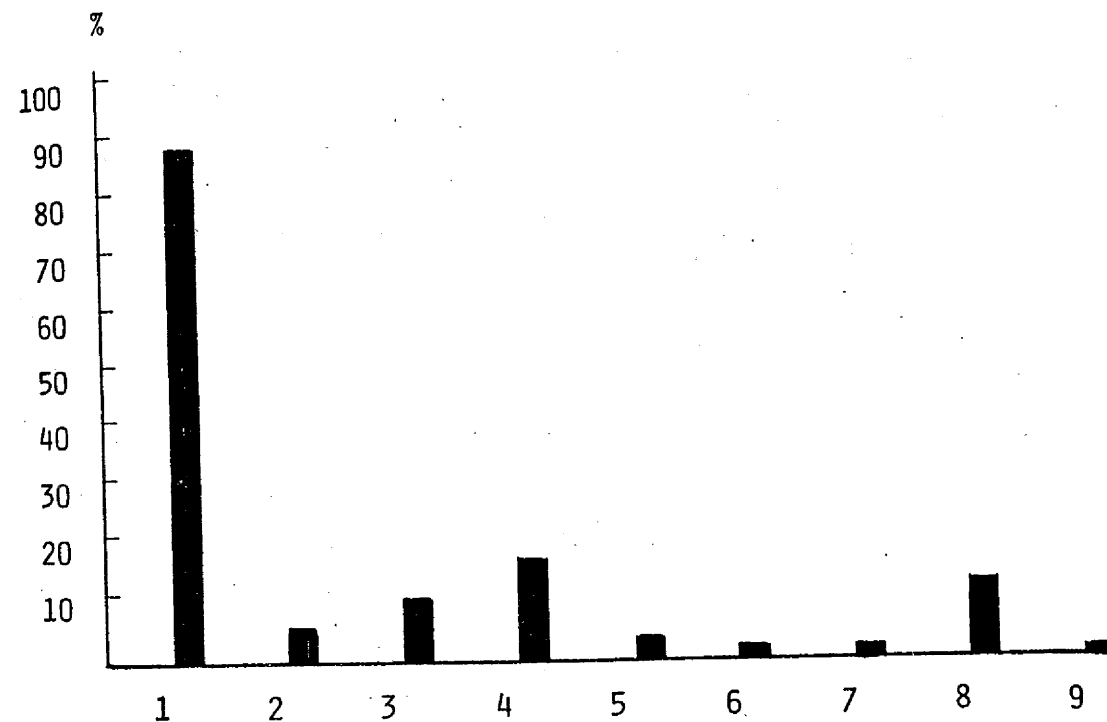
Results of a representative survey on Swedish adolescents and young adults, carried out in 1979/80, were published in 1981. It shows the relative prevalence of ever use of inhalants in comparison to other drugs. According to this survey, alcohol, cannabis and hypnotics are more frequently used than inhalants. Figures 5a and 5b

TABLE 4
SNIFFING EXPERIENCE IN SWEDISH SCHOOL CHILDREN

	Boys										Girls									
	71	74	77	79	80	81	71	74	77	79	80	81	71	74	77	79	80	81		
<u>Age 12</u>																				
Never sniffed	91	95	97	98	97	98	95	90	99	99	99	99	95	90	99	99	99	99		
Stopped sniffing	9	3	1	1	1	0	1	1	1	1	1	1	5	1	1	1	1	1		
Sniffing ongoing		2	1	1	1	1							0	1	1	0	1	0		
No answer	0	1	1	1	0	1							0	0	0	1	0	0		
<u>Age 15</u>																				
Never sniffed	73	87	93	95	95	95	88	89	94	96	96	96	88	89	94	96	95	96		
Stopped sniffing	27	10	4	3	3	3	12	2	2	3	3	3	12	2	2	1	3	3		
Sniffing ongoing		3	2	2	2	1		0	0	0	0	0	0	0	0	0	2	1		
No answer	0	1	1	1	1	1							0	0	0	0	0	0		

(Hibel e.a. Stockholm 1982)

DRUG USE IN A SWEDISH POPULATION AGE 12-24 (ever use)

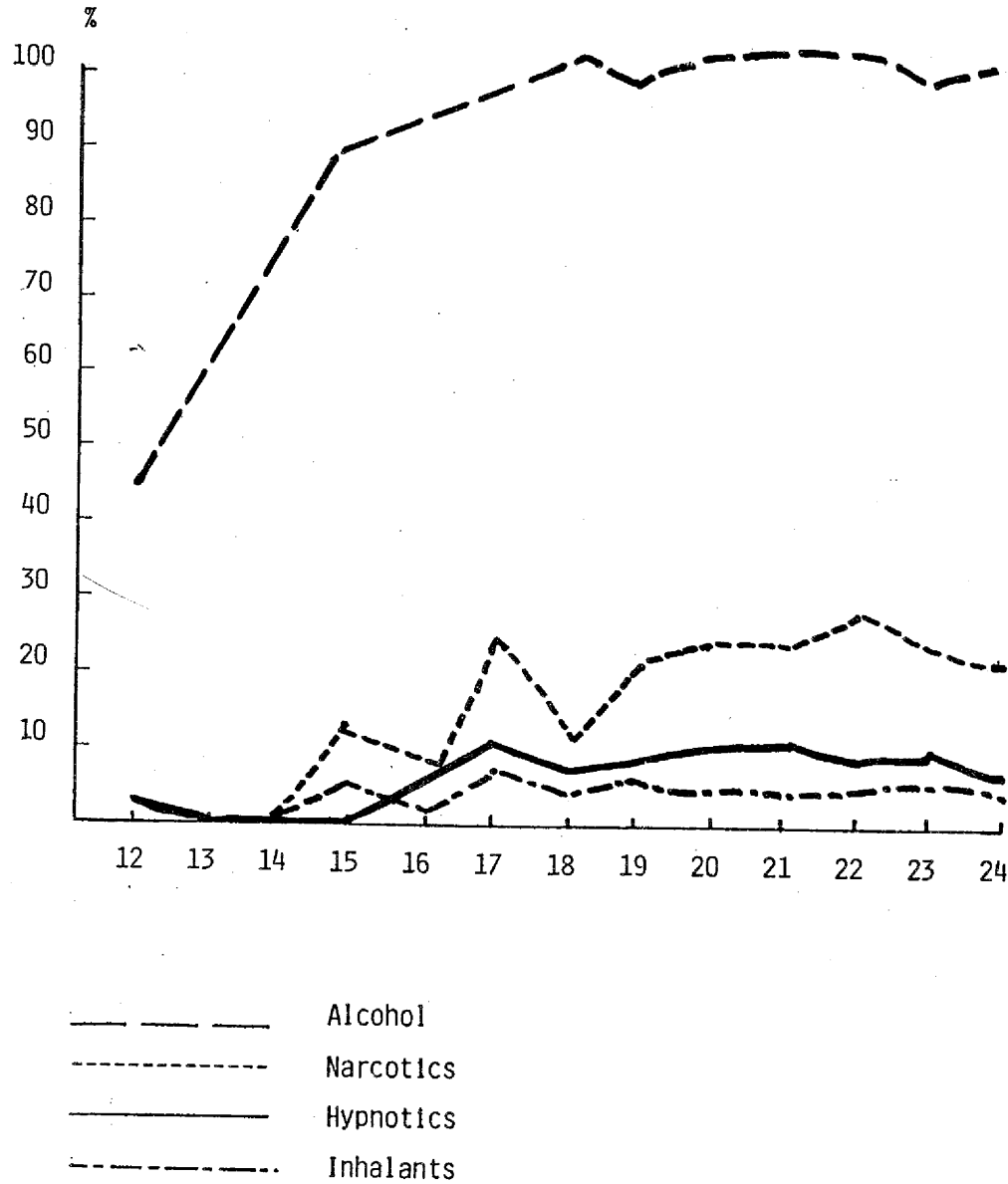


- 1 Alcohol
- 2 Inhalants
- 3 Hypnotics
- 4 Cannabis
- 5 Stimulants
- 6 Opiates
- 7 Hallucinogenes
- 8 No drug use
- 9 No answer

(Karlsson e.a. Stockholm 1981)

FIGURE 5b

DRUG USE IN A SWEDISH POPULATION AGE 12-24 (ever use)



(Karlsson e.a. Stockholm 1981)

demonstrates that this is the case for all ages except age 15, when sniffing is more frequently found than the use of hypnotics (Karlsson et al., 1981). Less information is available from other Scandinavian countries. In 1976, Norway reported about 5% ever use of solvents in young people. Sniffing in Denmark was apparently on a very small scale and problems were reported at one place in the country only. No figures were available on Finnish schools; it was merely established that sniffing occurs (Actions Against Sniffing, 1976). In 1980, a report of 20 sniffing-associated death cases in Denmark was published, covering the period from 1959-1968 (Kringholm, 1980).

Federal Republic of Germany

In 1982, the Deutsche Hauptstelle gegen die Suchtgefahren published a comprehensive report on inhalant abuse in the Federal Republic and in Berlin West, giving prevalence data, data on abuser characteristics and on treatment and legislation (DHS Informationsdienst 35, 3/4, 1982).

The first reports on glue sniffing were in 1968, especially in Berlin. In various places of the Federal Republic a "inhalant scene" developed in the following years. Users and abusers are mostly teenagers. According to an official statement by the National Government in 1983, the extent of inhalant abuse was considered important in Nordrhein-Westfalen and in Rheinland-Pfalz, whereas in the other countries abuse was considered to be unimportant (Deutscher Bundestag, Drucksache 10/848, 29.12.1983). The Federal Ministry of Youth, Family and Health published in 1983 an extensive report on use and abuse of drugs by young people. Table 6 summarizes the figures for actual use, experimental use, infrequent, frequent and extremely frequent use of all types of drugs. It may be noted that 8% of all interviewed persons age 12-24 reported ever use of inhalants (mostly glue and solvent sniffing). A similar percentage was found in those with actual drug use, with experimental use and infrequent use. Among those with frequent use and especially with extremely frequent use, the percentage of inhalant abuse is higher, 16% and 25% respectively (Konsum und Missbrauch von Alkohol, illegalen Drogen etc., Bonn, 1983). In Rheinland-Pfalz the figures given for ever use are 17%, in Bayern 4%, in Baden-Wurttemberg 3% (Tab. 7).

Extensive studies in West Berlin indicated a peak of inhalant abuse in 1971-1974. Numbers have been reduced since (DHS Informationsdienst, 1982).

TABLE 6
DRUG USERS IN WESTERN GERMANY (excl. Berlin, Hessen, Bremen)

Types of Drug Used	Pattern of use					
	Total Use 1137 %	Actual Use 423 %	Experimental Use 644 %	Unfrequent Use 335 %	Frequent Use 117 %	Extremely frequent Use 47 %
Hallucinogenes	89	92	88	95	98	98
Hashish	80	86	74	92	97	94
Marihuana	40	58	25	58	86	78
LSD	11	18	3	15	49	57
Mescaline	2	5	.	4	13	25
Stimulants	17	26	10	20	47	72
Captagon	8	12	2	10	30	47
Ephedrine	7	11	4	9	24	43
Percoffedrinol	3	6	1	3	17	29
Mirapront N	2	2	2	1	3	9
Opiates	8	12	3	7	34	100
Codeine	4	6	2	3	17	58
Opium	3	6	.	2	19	49
Heroin	2	4	.	3	13	35
Inhalants	8	9	5	10	16	25
Glue/Solvents	6	8	4	8	11	23
Hypnotics	6	9	2	8	26	45
Mandrax	6	9	1	6	23	38
Cocaine	4	8	1	4	22	33

TABLE 7

DRUG USERS CONSUMING INHALANTS/SOLVENTS

Year	Drug users n	Inhalants/ solvents n	Inhalants/ solvents %	Tendency	No Information n	Dependence?		Tendency
						no n	yes n	
1976	159	17	10,7		7	5	5	50
1977-79	161	22	13,7		12	6	4	40
1982	205	30	14,6		1	22	7	24
1983	199	33	16,6		1	29	3	9
	724	102	14,1		21	62	19	23,5

(Jahrbuch 1985 zur Frage der Suchtsgefahren)

On the other hand, experimentation with inhalants has become more frequent among those who later on became involved in other types of drug dependence. The corresponding figures are 11% in 1976 and 17% in 1983. In the same time, drug users reported less dependence from inhalants (Tab. 8, Jahrbuch, 1985; zur Frage der Suchtgefahren). An early warning system reported for 1976-1983 an incidence of ever use in drug dependent persons of 14%, in alcoholics of 1.6% (Jahrbuch, 1985; zur Frage der Suchtgefahren).

Another extensive study on heroin-dependent persons in Berlin demonstrated an initial abuse of inhalants in 3%, an ever use rate of 10% and a relatively late start with inhalants within the drug sequence (Tudrop, 1984).

From all countries of the Federal Republic, the rate of death due to inhalant abuse was registered; in 1979, 8 out of 623 death cases were due to inhalants, in 1981 it was 8 out of 360, which means a relative increase of 3% (Deutscher Bundestag, 29.12.83).

Switzerland

A representative survey in 1981 on the population aged 15-24 indicated ever use rates in men of 8.1%, and in women of 3.6% (Tab. 9, SFA 1985/86).

Available data indicate an important increase of consumption rates. A representative survey on young conscripts (aged 18) in 1972/3 resulted in an ever use rate of 1.4%. A regional survey in Lausanne 1983 among young people aged 15/16 resulted in an ever use rate of 8.8%.

Most of the users are experimental users without continued use or abuse.

The Institute of Legal Medicine, Zurich University, published a report on 11 death cases 1968-1978 (Pasi et al., 1985). A national centre for toxicological emergencies reported 17 intoxications with inhalants in 1984, where 15 had only minimal symptoms. The substances involved were: toluene, isobutyl nitrite, petrol, chloroform, amyl nitrite, trichloroethylene and some not precisely identified solvents and sprays.

France

Surveys on the extent of inhalant abuse are recent. For the time being there are only unpublished papers

TABLE 8
PERCENTAGE OF DRUG USERS AGED 12 - 49 BY TYPES OF DRUG USED
(Baden-Wurttemberg)

Types of Drug used	Age 12-24 97	Age 25-49 88
Hallucinogens	81%	85%
Stimulants	13%	13%
Opiates (without Heroin)	9%	6%
Sedatives	9%	6%
Narcotics	12%	2%
Analgesics	5%	3%
Substitute/Sniffs	3%	2%
Heroin	3%	2%
Cocaine	0%	-

Source:

(Ministerium für Arbeit, Gesundheit und Sozialordnung, Baden-Wurttemberg 1980)

TABLE 9
 DRUG CONSUMPTION (representative population samples)
 Switzerland age 15-24

Ever use of:	Male %		Female %		Actual use of:	Male %		Female %	
	Male %	Female %	Male %	Female %		Male %	Female %		
Cannabis	24.9	24.9	24.9	24.9	Analgesics	0.7	4.0	0.7	4.0
Opiates	3.0	4.0	4.0	4.0	Hypnotics	-	-	-	-
Hallucinogenics	3.8	5.3	5.3	5.3	Sedatives	-	2.1	-	2.1
Stimulants	2.0	2.2	2.2	2.2	Stimulants	2.2	1.5	2.2	1.5
Cocaine	1.5	5.7	5.7	5.7	Alcohol	15.6	7.1	15.6	7.1
Inhalants	8.1	3.6	3.6	3.6	Cigarettes	36.4	41.4	36.4	41.4

Source:

Research Department SFA 1981

available. A pilot study was carried out by the Institut Nationale de la Sante et de la Recherche Medicale in 1984. In this pilot study, 122 cases of heavy inhalant abuse are compared to nonusers of the same age group. The index cases were identified in various treatment settings throughout the country. Glue sniffing was the most frequent consumption pattern. About half of the patients inhaled in groups. Also about half of the patients were classified as polydrug users. Although many had important health and social consequences, only one third declared their willingness to discontinue. Half of those who had tried to discontinue relapsed (Facy & Angel, 1985). No national figures on incidence and prevalence were available at that time.

Italy

The Ministry of Interior published the results of a nationwide study on the abuse of drugs. This study collected data from various treatment facilities and was not based on representative population samples. According to this study, only 13 cases of inhalant abuse could be identified which corresponds to 2.9% of the treated population (Ministero dell'Interno, 1983). Informations from epidemiologists confirm that only sporadic cases are known and that no nation-wide representative figures are available at that time (Table 10).

Spain

Drug abuse emerged in the Iberian Peninsula relatively late in comparison to other European countries. Publications on drug abuse appeared only after 1980.

Surveys on representative samples of school students in the age-group 15-17 years were made mainly in the region of Asturias. Ever use of inhalants was found in 2.3%, actual use in 0.6% (Hinojal Fonseca et al., 1985). Male students were more frequent users of inhalants than females. Inhalants were the fourth group of drugs frequently of use, after cannabis, amphetamines and tranquilizers. Some differences of incidence were due to geographical distribution, socio-cultural characteristics and age of respondents.

No national figures are available for the time being.

Other Countries

From several countries, there is only inconclusive information about the use of inhalants, for instance in Poland, Austria, Netherlands. Abuse however, seems to be sporadic and no epidemiological data are available at the time.

TABLE 10
MAIN DRUGS USED IN TERRITORIAL SERVICES (Italy)

Types of Drug Used	Public services		Therapeutic communities		Private services		Total	
	n	%	n	%	n	%	n	%
Heroin	290	92.9	97	91.5	28	82.3	415	91.8
Cocaine	73	23.4	23	21.7	9	26.5	105	23.2
LSD	4	1.3	13	12.3	2	5.9	19	4.2
Psychopharmacological	247	79.2	82	77.4	20	58.8	349	77.2
Amphetamine	39	12.5	20	18.9	8	23.5	67	14.8
Cannabis	204	65.4	54	50.9	15	44.1	273	60.4
Alcohol	166	53.2	45	42.4	15	44.1	226	50.0
Inhalants	7	2.2	3	2.8	3	8.8	13	2.9
Other	20	6.4	5	4.7	1	2.9	26	5.7

Source:

Ministero Dell' Interno, 1983

Health and Social Consequences

An important number of publications on clinical observations, pathological findings, death cases etc. have been published, mainly in England and Sweden, and some in Western Germany.

Medical sequelae concern sudden sniffing death, mostly in conjunction with abuse of trichloroethylene, due to cardiac fibrillation. Also respiratory depression during or following sniffing is reported, especially in conjunction of inhalants with alcohol or other agents with a potential for respiratory depression. Continued inhalation leads to liver damage, kidney damage and damage in the bone marrow, especially in conjunction with abuse of trichloroethylene and benzol.

Other sequelae concern accidents during intoxication (traffic accidents, drowning etc.), accidents through ignition of inhaled gas, and suicide with or without acute intoxication.

Extensive analysis of death cases have been published by Sjoberg, 1978; Edh et al., 1973; Pasi et al., 1985; Watson I.M., 1979; Anderson et al., 1982.

As regards psychiatric morbidity after inhalant abuse, the following conditions have been described: cognitive effects of longtermuse (Allison and Jerrom, 1984), neurological symptoms (Cooper et al., 1985; Hollstedt and Wyrren, 1985; Altenkirch, 1982). Also, toxi-psychosis were found in cases of inhalant abuse (Tarsh, 1979; Channer et. al., 1983; Kind, e.t., 1981).

A most common consequence of continued inhalant abuse is lack of concentration, deterioration in work performance, eventual apathy and lack of initiative, with ensuing social consequences.

Populations at Risk

Most at risk is in all countries is the age group of 10-20 years, male more than female, but with diminishing differences.

Certain geographical areas show higher incidence rates, especially industrialised urban areas, inner-city areas with low economic status population, and also certain more or less isolated rural areas.

An increased risk for continued inhalant abuse are teenagers from broken homes, with comparatively less educated parents, and a comparatively higher incidence of parental pathology. In part it is the same risk group as those who engage in early minor delinquency, in truancy and early school dropout. Such data are available from Sweden, Federal Republic of Germany and France (Hibell e.a., 1982; Deutscher Bundestag, 29.12.83; Facy & Angel, 1985).

Prevention and Treatment

Preventive Drug Education is in most European countries not specified according to certain substances. It focuses more on general issues such as health education, conflict management, structuring leisure time, etc. Nevertheless, specific information and education programmes have been developed and realised in high risk areas in Sweden, England and Western Germany. It has not been evaluated, however, as to what extent the leveling off or decline of consumption rates in these areas is due to these preventive activities.

Preventive Legislation concerns mainly decreased availability of volatile substances for teenagers under the age 18 and in general regulations for storing and selling toxic substances. It is considered but not analysed that decreased availability for young teenagers has contributed to a decline of consumption rates.

Emergency Treatment is provided in general emergency services in general hospitals. Symptomatic treatment is given with oxygen supply, reanimation etc.

Psychiatric Treatment is provided in existing psychiatric facilities, inpatient as well as outpatient. These provide treatment especially for acute and chronic psychiatric conditions in conjunction with inhalant abuse.

Psychological Guidance, Family Guidance and Psychotherapy are also mostly provided in corresponding services for adolescents and young adults. In only a few places (e.g. Glasgow), specialised services for sniffing teenagers have been established. Due to the comparatively early age of inhalant abuse there is considerable effort made to involve not only the teenagers themselves, but parents and families as well.

Follow-up data are rarely available. They seem to indicate a general tendency to discontinue inhalant abuse in late adolescence and early adulthood. The longterm outcome of severely damaged abusers is not well documented.

Summary

Inhalant abuse in its present form and with highest risks for underprivileged urban youth started in Northern Europe in the 1950ies, and peaked in the 1960ies and 1970ies. Since it seems to have levelled off or declined in those countries. In Central and Southern Europe inhalant abuse is more a sporadic phenomenon which has provoked some increased concern but so far there have been no decisive legislative or other preventive and therapeutic measures. Somatic, psychological and psychiatric consequences of inhalant abuse are well documented; however longterm follow-ups are not available yet

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Acute Pharmacology of Toluene

Toluene is similar to many other central nervous system (CNS) depressants, causing stimulation at low doses and depression, leading eventually to unconsciousness and death, as the concentration and duration of exposure increase. Exposure of rats and mice to various concentrations of toluene interferes with ongoing behaviour and causes a characteristic abnormal motor syndrome which includes head tremor and aimless hind limb scratching movements (Hinman, 1984; Pryor et al., 1984b).

Gause et al (1985) found initial increases in locomotor activity followed by decreases after rats regained consciousness after exposures to concentrations of 10,000 to 30,000 ppm of toluene.

Schedule-controlled operant behaviour has been used to assess the acute effects of toluene. In pigeons exposure to as little as 400 ppm toluene for four hours increased the rate of pecking in the "counting" key, whereas exposure to 3,200 ppm caused the bird to become grossly ataxic.

In mice responding to the Fixed-Ratio Interval schedule (FI-60), 1,000 ppm toluene increased responding whereas 2,000 ppm decreased responding. These effects remained essentially the same during five daily consecutive exposure test sessions. A similar lack of tolerance effect to the Differential Reinforcement of Low Rate (BRL) component was reported.

The interesting hypothesis that people might inhale toluene for its tranquilising effects has been studied with methods used to identify minor tranquilisers. Geller et al. (1983b) reported that toluene, like diazepam, reinstated lever pressing which had been suppressed by punishment in rats. Woods et al. (1984) reported that toluene antagonised pentylenetetrazol seizures and attenuated the reduction in operant response rate caused by punishment with electric shock.

Toluene has also been reported to (i) reduce the response rate of baboons performing a match-to-sample discrimination task with no effect on accuracy (Geller et al., 1985), (ii) affect vestibular function (Tham et al., 1984), (iii) induce conditioned taste aversion (Miyagawa, 1984), (iv) interfere with normal sleep-wake patterns (Arito et

al., 1984), or (v) cause an initial excitation followed by slowing of the electroencephalogram (Takeuchi and Hisanaga, 1977). In cats, a reported high dose brief exposure induced a 3-Hz spike and wave pattern in cingulate gyrus (Contreras Perez et al., 1979).

Effects of Repeated Exposure to Toluene

Hayden, et al, in their 1977 review of the toxicology of toluene, concluded that "despite numerous studies, there is little firm evidence that toluene exerts a specific toxic effect on any organ system (pp. 555)".

In recent subchronic studies (IRDC, 1982 a,b), rats and mice were exposed to 600 to 3,000 ppm toluene for six hours/day, five days/week for 15 weeks. There were no toluene-induced gross or microscopic lesions in the tissues examined.

Hudak dan Ungbary (1978) reported that exposure of female rats and mice to toluene during pregnancy was not teratogenic but retarded fetal growth.

Kostas and Hotchin (1981) gave toluene to female mice in their drinking water from mating through weaning and to the offspring thereafter. Open-field habituation was decreased by the highest concentration of toluene in offspring at 35 days of age, and rotor-rod performance was impaired in all test groups at 45 to 60 days of age. These results are difficult to interpret because of the low concentrations used (16 to 400 ppm) without any measure of how much toluene was actually absorbed by this route.

Lorenzana-Jimenez and Salas (1983, 1985) reported the results of two studies in which neonatal exposure to toluene was examined. In the first, no evidence for any persisting effect of exposure schedule was found. In the second study no effects on spontaneous cortical electrical activity were found.

Bruckner and Peterson (1981b) exposed mice and rats to 12,000 ppm toluene for 10 out of every 30 minutes over a period of 3.5 hours, 5 days/week for eight weeks. No evidence of acute injury or residual organ damage, as evidenced by clinical chemistry and histopathology, was found.

From reviewing the literature it is clear that the conclusions reached earlier by Hayden et al (1977) and Benignus (1981a, b) are still generally valid in terms of the relatively nontoxic nature of toluene. However, the finding that toluene is ototoxic in the rat raises the possibility that other adverse effects also have gone undetected in animal studies.

The human syndrome associated with abuse of solvents containing toluene includes cerebellar ataxia, motor disturbances, cerebral and cerebellar encephalopathy, optic neuropathy and other visual problems, and some evidence for auditory dysfunction. Only the last symptom has been reported in the laboratory. If toluene is responsible for the syndrome described, then it should be possible to reproduce some or all of those symptoms in an appropriate animal model. Until that is done the role of toluene in causing the syndrome will remain questionable.

Benzene, Xylenes and Styrene

The haemopoietic and potential carcinogenic effects of benzene are well known (Haley, 1977). Apart from the well established myelotoxicity of benzene, damage to other organs and tissues has not been considered to be great. However, such potential toxicity has not been investigated in the context of solvent abuse.

The acute pharmacological effects of benzene are, like toluene, concentration-dependent, with higher concentrations causing central nervous system depression, unconsciousness and death (greater than 20,000 ppm within 30 minutes). These higher concentrations would not be expected from inhaling the fumes from currently available products. Therefore, the main concern is from repeated inhalation of lower concentrations, and not much information is available in this regard.

Xylenes are found in many of the same products that contain toluene. Styrene is less common, but is present in home adhesives, rubber cements, and model cements (Sharp and Brehm, 1977). These solvents have been found to be relatively nontoxic in animal experiments when administered at relatively low levels. However, as with benzene, little information is available in the context of solvent abuse.

Hexane and Related Hydrocarbons

The discovery that n-hexane, methyl n-butyl ketone (MnBK), and related hydrocarbons could cause an insidious and only slowly reversible peripheral neuropathy represents a classic example of the kind of investigative work that will be needed to clearly identify chemicals that may be responsible for any toxic symptoms associated with solvent abuse. The history of this work has been described in detail (e.g. Spencer et al., 1980). The structural similarity between n-hexane and MnBK suggested a common mechanism and led, after numerous carefully controlled animal experiments, to the conclusion that the common metabolite 2,5-hexanedione was the proximal neurotoxicant. As a result of this discovery, n-hexane, MnBK, and related compounds are no longer included in consumer products to any extent, and their industrial usage is carefully controlled.

Acetone

Acetone is a component of some paint thinners, model cements, and fingernail polish removers. It can also be purchased in relatively pure form for use as a paint remover and degreaser. Acetone vapours are irritating to eyes, nose and mucous membrane, and cause central nervous system depression and unconsciousness at higher concentrations (Bruckner and Peterson, 1981a, b). Acetone is less potent than toluene as a depressant and is slower acting. However, it has a considerably longer duration of action.

Bruckner and Peterson (1981b) examined the toxic effects of acetone and concluded that acetone, like toluene, was relatively nontoxic. However, potential adverse effects on nervous system functions were not measured and appear not to have been systematically investigated to date.

Methylene Chloride

Methylene chloride is becoming widely used in spray paints, thinners, and paint removers. Because of its high volatility, methylene chloride can be expected to be present in high concentrations in the fumes inhaled from such products. A major concern about chlorinated hydrocarbons is their acute cardiotoxicity. Another concern is that methylene chloride is partially metabolized to carbon monoxide (see Winneke, 1981 for a recent review). Moderate to severe hypoxia caused by even relatively short exposures to carbon monoxide can cause brain cell death. However, carboxyhaemoglobin levels much above 10% have never been demonstrated to occur in animals or humans exposed acutely or chronically to methylene chloride.

Pryor et al (1978a) did not find any persisting adverse behavioural effects, nor was there any evidence of other organ toxicity as determined by haematological indices.

Trichloroethylene and Methyl Chloroform

Both of these trichlorinated hydrocarbons have been used as anaesthetics and occur in many industrial and household products used as cleaners and degreasers. Their toxicity has been known for some time and includes cardiotoxicity, hepatorenal toxicity, and neurotoxicity, in both humans and animals (NIOSH, 1976; Aviado, 1977; Annau, 1981). In animal experiments acute behavioural effects can be easily demonstrated depending on concentration and duration of exposure.

Pathological changes in the brains of dogs (Baker, 1958) and rabbits (Bartonicek and Burn, 1970) have been reported.

Solvent Mixtures

Only a few animal experiments have been done to examine the pharmacological and neurotoxicological effects of exposure to solvent mixtures.

Acute behavioural effects on performance of schedule-controlled operant tasks have been reported in rats (e.g. Colotla et al., 1980).

Evidence for altered brain morphology has been reported (Vasques-Nin et al., 1980) whilst others (Contreras-Perez et al., 1978; Alcaraz et al., 1978) have described the behavioural and electrophysiological effects of exposure of cats to thinners.

The "thinners" used by these different groups of investigators all contained substantial amounts of toluene (40 - 60%). The other components that were present in lesser amounts - including methanol, hexane, benzene, xylene and acetone - differed markedly in their proportions among the different thinners.

Pryor et al. (1977, 1978a, 1978b, 1980, 1984) described the acute, concentration-related pharmacological effects of exposure of rats to a solvent mixture made up of paint remover (methylene chloride and methanol) and paint thinner (toluene, heptanes and xylenes). Experiments with the separate components of the mixture revealed that the hind-limb flaccid paralysis and head jerking were associated exclusively with exposure to methylene chloride, whereas the abnormal scratching was caused by the toluene. Analysis of the "heptanes", showed that n-heptane and n-hexane caused only mild myotonic seizures, whereas methyl cyclohexane caused full seizures that were identical to those seen with the mixture of isomers. These results emphasize the markedly different pharmacological (and, by extrapolation, neurotoxicological) characteristics of various solvents, even though they may all be, and have been, generally described as CNS depressants. They also clearly demonstrate that the effect of exposure to a solvent mixture cannot be predicted from the known pharmacology of the components or vice versa.

The most complex mixture of all - gasoline - has received only scant attention in animal experiments for its pharmacological and neurotoxic effects in spite of its abuse and reported CNS damage.

Interactions Among Solvents

The mixture typically involved in solvent abuse clearly present the opportunity for various and complex interactions among components and with other substances (e.g. alcohol) consumed concomitantly. Solvents, when coadministered often reciprocally inhibit their metabolism and/or induce, with repeated exposure, liver microsomal enzymes involved in xenobiotic metabolism. The results of such interactions can be bad or good depending on the characteristic of the individual component. For example, "degreaser's flush" is observed in workers exposed to trichloroethylene who then have a drink or two. On the other hand, toluene prevents the seizures caused by exposure of rats to heptanes (Pryor et al., 1978b) and antagonizes the electrophysiological signs of peripheral neuropathy caused by exposure to hexane (Takeuchi et al., 1981).

An interesting interaction between toluene and alcohol in rats has been reported that may have important implications for human solvent abuse. Geller, et al. (1983) found that some rats repeatedly exposed briefly to high concentrations of toluene markedly increased their voluntary consumption of alcohol. Under very different exposure conditions, Pryor et al (1985) found that weanling rats exposed to toluene for 8 hours per day with a 6% alcohol solution as the only fluid available subsequently showed a strong and persistent choice of alcohol over water, whereas controls and those exposed to toluene alone showed a marked aversion to the alcohol.

Self Administration

The animal procedure that has the most empirical verification for predicting abuse potential is drug self administration (Balster and Lucas, 1955; Griffiths et al., 1979b; Johanson and Schuster, 1977). By this method an animal - usually a primate or rat - is allowed to perform some act such as pressing a lever to gain access - usually via an indwelling venous catheter - to the test substance. Sustained performance by the animal to obtain the substance is interpreted to imply that it is reinforcing and thus may have abuse potential in humans.

Research has demonstrated that, with few exceptions (e.g. hallucinogens), this is the case.

Yanagita et al. (1970) used this method to assess the reinforcing properties of chloroform, ether, and a lacquer thinner. Lever presses resulted in 2 to 5 minute deliveries of air or the test vapour via an implanted nasal catheter. With unlimited access, all monkeys initiated and maintained responding within a week or so. Daily intake was erratic, but they occasionally self-administered 80 to 100 inhalations a day, which resulted in ataxia and, in the case of chloroform, light anaesthesia.

Self-administration of nitrous oxide by inhalation has been studied in squirrel monkeys (Weiss et al., 1979). Lever presses resulted in the delivery of nitrous oxide to the monkey via a sealed helmet placed over its head. Responding was maintained under various exposure conditions and schedules of reinforcement. Wood (1978) also found that the monkeys who had been trained to self-administer nitrous oxide would also readily self-administer 0.1 to 0.3% toluene vapours.

Although limited thus far, these data suggest that some volatile substances have reinforcing properties in animal models that may be related to their appeal to humans seeking psychoactive effects. Such methods could be used to identify the attractive components in solvent mixtures and to assure that substitute solvents do not have greater abuse potential than those already in use.

Drug Discrimination

The procedure was developed to study the "subjective" effects of psychoactive substances in animals. By this procedure animals are trained to discriminate between the interoceptive stimuli caused by the substance under study and a placebo or vehicle. A typical procedure uses two levers where responding on one is reinforced when a psychoactive substance has been administered before the session and responding on the other lever is reinforced following vehicle administration. Once established, other substances can be compared as to their similarity to the training substance. Substances that generate responding on the lever associated with the training substance are assumed to generate interoceptive stimuli similar to those of the training substance.

As with the self-administration procedure, drug discrimination has been applied to a limited extent to the evaluation of volatile substances. Mice trained to discriminate between intraperitoneal injections of vehicle and pentobarbital responded on the pentobarbital lever after inhalation exposure

to toluene (Rees et al., 1985). A similar generalization was found for 1, 1, 1-trichloroethane and halothane, but not to flurothyl or isoamyl nitrite (Rees et al., 1986). Mice were also trained to discriminate between injections of toluene and vehicle, albeit with some difficulty (Rees and Balster, 1985), and this discrimination generalized to inhaled toluene. Some rats trained to discriminate toluene from vehicle generalized to methohexital and oxazepam (Knisely et al., 1986). These studies suggest commonalities in the effects of some abused inhalants and classical central nervous system depressants, suggesting a possible motivation for their use and abuse by humans. Clearly, more work is needed to verify the usefulness of this procedure for evaluating and, perhaps, better understanding the mechanisms underlying inhalant abuse in humans.

Conclusions

Volatile substance abuse usually entails the inhalation of the volatile components from various mixtures. As a result toxic manifestations of this practice are difficult to attribute to any one or a small combination of these components. Except in unusual cases, such as accidental exposure to relatively pure substances, epidemiological and clinical data can only suggest potential toxic agents for further study. In general, it is then necessary to confirm that the suspected components or the mixture itself are responsible in an appropriate animal model.

From this brief review and discussion of the animal literature, several points can be made. Firstly, the hexacarbons have been clearly established as neurotoxicants in humans and in animal models. Secondly, toluene, although strongly suspected from human clinical reports, has been found to be relatively innocuous thus far in controlled animal experiments, except for its ototoxic effects in rats. Thirdly, persisting neurotoxic effects have also not been clearly associated with the other solvents discussed, but the amount of relevant research done to date (i.e. using sensitive behavioural and neurophysiological methods and exposure conditions resembling those associated with human abuse) has been too limited to draw conclusions. Fourthly, the acute pharmacological effects of these solvents will clearly impair performance in animals and man, and as with any such substance (e.g. alcohol), should be considered dangerous in situations involving a potential for accidental harm, such as driving an automobile. Fifthly, some volatile substances have reinforcing properties and resemble classical CNS depressants in animals that may be associated with their abuse potential in humans. Finally, the human reports of neurotoxicological sequelae to solvent abuse cannot be discounted, and more intensive research for their causes appears warranted.

PHARMACOLOGIC AND NEUROBEHAVIORAL ASPECTS OF
SOLVENT TOXICITY BASED ON ANIMAL STUDIES

Dr. G.T. Pryor

Background Paper

The intentional inhalation of solvents for their psychoactive effects, especially by children and teenagers, has become prevalent worldwide and has caused considerable concern and alarm. As with any biologically active agent, the acute effects of solvent inhalation are generally a function of dose and can range from little or no effect to death. Related to the acute pharmacologic effects is the concern that the solvent, although not lethal, may cause persisting tissue or organ damage. With repeated exposure, even at relatively low doses, cumulative effects may occur that adversely alter the morphology and/or function of tissues or organs. Such alterations also could result in tolerance, thus requiring higher doses to achieve the desired effect and exposing the individual to higher concentrations with the increased risk of damage or death, or of physical and/or psychologic dependence.

A major concern is that solvents might cause neurologic damage because of their lipophilicity and their obvious pharmacologic effects on the brain. Another concern is that solvent abuse typically starts at a very young age (as early as 7 or 8 years old), and there is the possibility that still-developing tissues and organs may be especially sensitive to toxic insult. Since major psychosocial development is also occurring at this age, any agent that interferes with this development could cause long-lasting psychologic problems, including the propensity for further substance abuse.

An additional concern is that the solvents that are most frequently abused are typically adventitious mixtures formulated for their physical properties. Thus, the abuse of a particular pure solvent that has "good" psychoactive effects and is relatively nontoxic by itself may inadvertently expose the user to a variety of more toxic substances when contained in a mixture. Also, the various substances may interact to cause greater toxic effect or effects at lower concentrations than would be expected from exposure to the individual substances

alone. Moreover, if such a mixture does cause toxic effects, identification of the responsible constituent or constituents can be very difficult depending on the complexity of the mixture. Considerable detective work, based on the known toxicology of the components in the mixture and the results of carefully designed and controlled animal experiments, will usually be required to make the identification. Such a process can be very expensive and time-consuming indeed.

The discussion that follows is intended to provide a brief review of the pharmacological and neurotoxicological properties of some of the better-studied solvents that have been implicated in human solvent abuse. Toluene is discussed at some length because of its central role in solvent abuse, as well as because it has been fairly extensively studied recently. Other solvents and solvent mixtures are discussed more briefly with reference to recent reviews when available, in which more extensive discussions of the wide variety of substances found in various abused solvent mixtures can be found (e.g. Sharp and Brehm, 1977). Also, anaesthetic gases such as nitrous oxide and halothane are not discussed. Their abuse is relatively restricted to medical personnel and is of lesser concern to the general problem of solvent abuse.

Toluene

Toluene is found in high concentrations in a variety of easily accessible products that are subject to abuse (e.g. paint thinners, adhesives, spray paints). It can also be obtained illicitly as a relatively pure solvent from various industrial sites. For whatever reasons toluene and toluene-containing products appear to have great appeal to inhalant abusers, and it is implicated in a majority of cases that come to the attention of medical personnel because of complications. Interestingly, squirrel monkeys, like people, will also voluntarily inhale toluene vapors (Weiss et al., 1979) thus attesting to its properties as a reinforcer along with other psychoactive substances (e.g. opiates, barbiturates, stimulants). For these reasons, toluene must be considered of major concern, either as a primary toxicant or as a vehicle for exposure to other toxicants. Because of its ubiquitous distribution, toluene is also of concern as a potential industrial toxicant. As such it has received considerable experimental attention in the context of both solvent abuse and industrial hygiene (see Benignus, 1981a,b; Hayden et al., 1977, for recent reviews of the health effects of exposure to toluene).

Acute Pharmacology of Toluene

Toluene is similar in many respects to other central nervous system (CNS) depressants such as ethanol and the barbiturates, causing signs of stimulation at low doses and depression leading eventually to unconsciousness and death as the concentration and duration of exposure increase.

The Acute Toluene Syndrome

Several investigators have observed rats and mice which have been exposed to various concentrations of toluene for relatively brief periods of time (5 to 20 minutes) to simulate the human practice. In addition to interfering with on-going behaviour (grooming, rearing, normal exploratory behavior), toluene causes a characteristic abnormal motor syndrome that includes head tremor and aimless hindlimb scratching movements (Hinman, 1984; Pryor et al., 1984b). This syndrome is especially prominent during recovery from exposures to concentrations that cause unconsciousness and is accompanied by aimless, often ataxic, locomotion. With repeated exposures tolerance is seen to some of these acute effects, whereas increased sensitivity ("reverse tolerance") is seen to others (Hinman, 1984). These effects are observed at concentrations as low as 1,000 ppm depending on duration of exposure, and unconsciousness rapidly ensues at concentrations above 20,000 ppm.

Effects on Activity, Motor Coordination, and Schedule-Controlled Behavior

Gause et al. (1985) reported an initial increase in locomotor activity followed by a decrease after rats regained consciousness from exposures to 10,000 to 30,000 ppm toluene for 8 to 12 minutes. Moser and Balster (1985a) found that the concentration of toluene that impaired motor coordination on an inverted screen was 2,959 ppm after a 10-minute exposure and decreased to 1,445 ppm after a 60-minute exposure. The lethal concentrations for these exposure durations were 38,500 ppm and 19,000 ppm, respectively.

Schedule-controlled operant responding has been used to assess the acute effect of toluene on the performance of pigeons, mice, and rats. In one experiment pigeons were taught to peck one of two keys a fixed number of times before switching to the other key to obtain a reward (Weiss et al., 1979). Exposure to as little as 400 ppm toluene for 4 hours increased the rate of pecking on the "counting" key, whereas exposure to 3,200 ppm caused the birds to become grossly ataxic, and there was no response for about 30 minutes. Overall response

rates were increased by the lower concentrations (up to 800 ppm) and decreased by the higher concentration. Using a similar "counting" procedure with rats, Wood et al. (1983) found the effective concentration of toluene for behavioral disruption to be 1,081 ppm (4-hour exposure) when there were no external cues present, whereas no disruption was evident below 1,780 ppm when achievement of the "count" was signalled by a tone and light cue. Response rate changes were observed at 560 ppm toluene that were independent of performance accuracy.

Colotla et al. (1979) found a concentration-dependent increase in responding during the Differential Reinforcement of Low Rate (DRL) component of a multiple schedule paradigm, whereas there was a decrease during the Fixed-Ratio (FR) component. Geller et al. (1979) reported increases in both components of a Fixed Ratio-Fixed Interval (FR-FI) schedule when rats were exposed to 150 ppm toluene for up to 1 hour, whereas decreases were seen when the duration was increased further up to 4 hours. In mice responding under a FI-60 schedule, 1,000 ppm toluene increased responding, whereas 2,000 ppm decreased responding (Glowa, 1981). These effects remained essentially the same during 5 consecutive daily exposure-test sessions. A similar lack of tolerance in mice was reported for the rate-increasing effect of exposure of mice to toluene for a 30 minute (200 to 6,400 ppm) response on a DRL schedule (Moser and Balster, 1981). The latter investigators also reported the effective concentration for decreasing responding on a FR-100 schedule in mice to be 1,853 ppm toluene during a 15-minute exposure (Moser and Balster, 1985b).

Other investigators have used shock escape/avoidance to examine the acute effects of exposure to toluene. Shigeta et al. (1980) used a nonsignalled shock-avoidance procedure (Sidman avoidance; shocks are presented periodically, and a response postpones the next scheduled presentation). They exposed rats to 350 to 1,000 ppm toluene for 1, 2 or 4 hours and reported that the minimal condition for behavioral disruption (increased response rates, but no increase in shocks received) was exposure to 1,500 ppm for 2 hours. Using signalled shock avoidance (shock preceded for 5 seconds by a tone and a light), Mullin and Krivanek (1982) found no change in the performance of rats exposed to 1,570 ppm toluene for up to 4 hours, whereas disruption was seen after exposure to 3,260 ppm for 2 hours. Pryor et al. (1978b) trained rats to perform a multisensory conditioned pole-climb avoidance response and exposed them to 14,000 ppm toluene for 10, 20, or 30 minutes. Performance was disrupted as a function of exposure duration, and recovery time was inversely related to exposure duration.

Why Toluene?

The interesting hypothesis that people might inhale toluene for its tranquilizing effect has been explored with methods used to identify minor tranquilizers. Geller et al. (1983) found that 10-minute exposures to toluene (10,000 to 30,000 ppm), like diazepam, reinstated lever pressing that had been suppressed by punishment in rats. When toluene and diazepam were combined, the antipunishment effect was greater than additive. Wood et al. (1984) found that toluene (1,33311 ppm) antagonized pentylentetrazol seizures and attenuated the reduction in operant response rate caused by punishment with electric shock. The antipunishment effect was seen after exposure to 1,780 and 3,000 toluene for 2 hours. Similar effects were reported for the structurally related solvent m-xylene. On the other hand, de Ceaurriz et al. (1983) reported that toluene, along with a number of other solvents, decreased the time of immobility developed in a "behavioural despair" swimming test in mice which have been used as a screen for antidepressants. Further elucidation of why people select toluene as a solvent of choice is clearly of major importance in understanding its current abuse.

Other Acute Effects of Toluene

Geller et al. (1985) trained 4 baboons to perform a match-to-sample discrimination task and exposed them to 250 to 1,000 ppm toluene during the last 2 hours of a 3-hour test session. No effects on accuracy of performance were seen, but response times and the numbers of missed trials increased in 3 of the 4 baboons at higher concentrations.

Tham et al. (1984) studied the acute effects of a large number of industrial solvents on vestibular function in rats by measuring nystagmus caused by accelerated rotation. One group of solvents including halogenated saturated hydrocarbons like methylene chloride caused depression of the vestibulo-oculomotor reflex, whereas another group represented by benzene and its derivatives, including toluene, caused excitation.

Toluene has been reported to induce a conditioned taste aversion when injected intraperitoneally (200 to 800 mg/kg) and intravenously (20 to 40 mg/kg) (Miyagawa et al., 1984). A moderate effect was also seen after inhalation of 1,650 to 3,300 ppm for 4 hours. Injections of 200 to 600 mg/kg toluene into rats caused an initial increase in wakefulness followed by an increase in slow-wave sleep during the dark period (Arito et al., 1984). Excitation followed by a slowing of the cortical electroencephalogram (EEG) was also reported after acute inhalation exposure of rats to toluene (Takeuchi and Hisanaga, 1977).

Contreras et al. (1979) exposed chronically implanted cats to very high concentrations (12,000 to 52,000 ppm) of toluene or benzene for up to 2 minutes through an intratracheal cannula. They reported the development of a 3-Hz spike and wave EEG pattern in the cingulate gyrus after repeated exposures. Frank tonic-clonic seizures were seen in the cats exposed to benzene, but not toluene.

Effects of Repeated Exposure to Toluene

Hayden et al. in their 1977 review of the toxicology of toluene concluded that "despite numerous studies . . . , there is little firm evidence that toluene exerts a specific toxic effect on any organ system (pp. 555)." Four years later, Benignus (1981a) reached a similar conclusion. The discussion that follows will examine the extent to which these conclusions may need revision.

In recent subchronic studies (IRDC, 1982ab), rats and mice were exposed to 600 to 3,000 ppm toluene for 6 hours/day, 5 days/week for 15 weeks. There were no toluene-induced gross or microscopic lesions in the tissues examined. A two-year study in which rats were exposed to 30 to 300 ppm for 6 hours/day, 5 days/week was also negative in terms of toxicity and oncogenicity (Gibson and Hardisty, 1983).

Hudak dan Ungvary (1978) reported that exposure of female rats and mice to toluene during pregnancy was not teratogenic but retarded fetal growth. However, in a more recent report these investigators (Ungvary et al., 1983) found that toluene potentiated both maternal and embryonic toxicity due to acetylsalicylic acid (aspirin). They attributed this interactive effect to increased salicylic acid levels in the maternal and embryonic plasma due to depletion of glycine pools by the metabolism of toluene. Indeed, this effect was prevented by supplemental glycine.

Kostas and Hotchin (1981) gave toluene to female mice in their drinking water (16, 80, 400 ppm) from mating through weaning and to the offspring thereafter. Open-field habituation was decreased by the highest concentration of toluene in offspring at 35 days of age, and rotorod performance was impaired in all test groups at 45 to 60 days of age. These results are difficult to interpret because of the low concentrations used without any measure of how much toluene was actually absorbed by this route.

Lorenzana-Jimenez and Salas (1983, 1985) reported the results of two studies in which neonatal exposure to toluene was examined. In the first, rats were exposed to 40,000 ppm toluene for 15 minutes twice daily from 2 to 32 days of age. Development of swimming ability was retarded, and locomotor activity increased during the exposure phase. No evidence for any persisting effects of this exposure schedule was found. In the second study, visual- and somatosensory-evoked potentials were measured at 10 to 150 days of age in rats exposed to toluene under the same schedule as in the first study. Increases in peak latencies of both early and late components of the evoked responses were reported, especially in response to somatosensory stimulation. The effects did not appear to persist after the exposures were terminated. No effect on spontaneous cortical electrical activity were found.

Geller et al. (1983a,b) exposed rats to 30,000 ppm toluene for 10 minutes twice a week between 10 and 30 days of age. No effects on alcohol preference, measured beginning at 33 days of age, or on acquisition and performance of an operant task involving punishment, beginning at 75 days of age, were found.

Bruckner and Peterson (1981b) exposed mice and rats to 12,000 ppm toluene for 10 out of every 30 minutes over a period of 3.5 hours, 5 days/week for 8 weeks. No evidence of acute injury or residual organ damage, as evidenced by clinical chemistry and histopathology, was found. They concluded that toluene was relatively nontoxic, even under the extreme conditions of solvent abuse.

Pryor et al. (1983a, 1984b) used a battery of behavioral and electrophysiological tests to examine the possible long-lasting neurotoxic consequences of a relatively severe exposure schedule to toluene. Rats were exposed beginning just after weaning to 900 to 1200 ppm toluene for 14 hours/day, 7 days/week for 14 weeks. A progressive decrease in motor activity was seen during the first six weeks of exposure, after which apparent tolerance developed. There was no behavioural or electrophysiological evidence for any peripheral neuropathy as was seen with exposure to n-hexane, which was examined concurrently. However, a component of the brainstem auditory-evoked response was depressed and acquisition of a multisensory conditioned pole-climb avoidance (CAR) task and a 4-kHz tone-intensity discrimination task was impaired when tested several hours after each daily exposure ended. To determine whether the latter effects were transient or represented persisting nervous system damage, acquisition of the multisensory CAR was examined during the exposure phase or at intervals thereafter. The learning

deficit was found to be transient (Pryor et al., 1983b). However, the toluene-exposed rats appeared unable to hear the 20-kHz tone stimulus that was used in this experiment. Further examination revealed that the rats were partially deaf as measured both behaviourally and electrophysiologically (Rebert et al., 1983). These investigators then conducted a series of experiments to characterize this apparently specific sensory effect of exposure to toluene (Pryor et al., 1984a,c; Pryor and Howd, in press). The major findings were: (1) weanling rats were more sensitive to the effect than young adults; (2) the hearing loss was frequency dependent, being greater at higher than at lower frequencies; (3) there was damage to and loss of receptor (hair) cells in the cochlea; (4) the effect was concentration, duration, and exposure-schedule dependent with clear hearing loss seen after only three days of exposure to 2,000 ppm for 8 hours/day; and (5) subcutaneous injection of toluene was as effective as inhalation exposure.

Along a somewhat different line, Dyer et al. (1984) exposed rats to 1,000 ppm toluene for 6 hours/day, 5 days/week for 30 days. Contrary to earlier results (Takeuchi and Suzuki, 1975), they did not find any effect on pentylenetetrazol-induced seizures measured 1 or 14 days later. However, they reported that the latencies of the flash-evoked potentials from the second of two paired flashes were significantly altered on the day after the last exposure to toluene. The authors suggested that the effect might represent a change in excitability of the visual system.

From this brief review it is clear that the conclusions reached earlier by Hayden et al. (1977) and Benignus (1981a,b) are still generally valid in terms of the relatively nontoxic nature of toluene. However, the finding that toluene and related solvents are clearly ototoxic in the rat raises the possibility that other adverse effects have gone undetected in animal studies because of inadequate exposure schedules, use of inappropriate species, and/or measurement of the wrong parameters. The human syndrome associated with abuse of solvents containing toluene includes cerebellar ataxia, motor disturbances, cerebral and cerebellar encephalopathy, optic neuropathy and other visual problems, and some evidence for auditory dysfunction. Only the last symptom has been clearly established in the laboratory as an effect of exposure to toluene. If toluene is responsible for the syndrome described, then it should be possible to reproduce some or all of those symptoms in an appropriate animal model. Until that is done the role of toluene in causing the syndrome will remain questionable.

Benzene, Xylenes, and Styrene

The hematopoietic and potential carcinogenic effects of benzene are well known (Haley, 1977). As a result fairly strict controls on its use are in effect in the United States. Nevertheless, its presence in gasoline and as a contaminant in various mixtures containing toluene make benzene a potential toxic hazard in solvent abuse. Aside from benzene's well-established myelotoxicity, damage to other organs and tissues has not been considered to be great. However, such potential toxicity has not been investigated in the context of solvent abuse, where substantial concentrations might be inhaled even though the concentrations in the mixtures are low.

The acute pharmacological effects of benzene are, like toluene, concentration-dependent, with higher concentrations causing central nervous system depression, unconsciousness, and death (greater than 20,000 ppm within 30 minutes). These higher concentrations would not be expected to be achieved from inhaling the fumes from currently available products. Therefore, the main concern is with possible damage resulting from repeated inhalation of lower concentrations, and not much information is available in this regard.

Horiuchi et al. (1967, cited in Haley, 1974) reported decreased wheel running activity in mice exposed to 10 or 100 ppm benzene for 6 hours/day for 20 days, and rats were reported to exhibit a delay in conditioned reflex response time after exposure to 20 ppm for 5.5 months (Novikov, 1956, cited in Haley, 1977). Tilsin et al. (1980) injected rats subcutaneously with 550 mg/kg benzene on days 9, 11 and 13 postpartum. Motor activity was increased relative to controls in tests beginning at 100 days of age, whereas responsivity to d-amphetamine was decreased. Clearly, such results are suggestive, but need verification and further investigation.

Xylenes (usually as a mixture of the three isomers) are found in many of the same products that contain toluene. Styrene is less common, but is present in some adhesives, rubber cements, and model cements (Sharp and Brehm, 1977). These solvents have received considerable attention as potential industrial hazards, especially in Scandinavia. They have been found to be relatively nontoxic in animal experiments when administered at relatively low levels. However, as with benzene, little information is available in the context of solvent abuse, and only a few animal experiments have been done to investigate possible nervous system damage. As might be expected from their structural similarity to toluene, xylenes and styrene were also found to be ototoxic in rats (Pryor et al., 1984b; in press). The effects were seen at lower concentrations and after shorter exposure durations than for toluene.

Hexane and Related Hydrocarbons

The discovery that *n*-hexane, methyl *n*-butyl ketone, and related hydrocarbons could cause an insidious and only slowly reversible peripheral neuropathy represents a classic example of the kind of detective work alluded to in the introduction that will be needed to clearly identify the chemicals that may be responsible for any toxic symptoms associated with solvent abuse. The history of this work has been described in detail (e.g. Spencer et al., 1980). Briefly, outbreaks of sensorimotor polyneuropathy in Japanese workers in the early 1960s and in individuals voluntarily inhaling fumes from mixtures containing hexacarbons provided the first warnings that such chemicals might have neurotoxic properties. The common chemical present in these and similar outbreaks in Europe and the United States was *n*-hexane, which had enjoyed wide usage and was considered to have low toxicity. The syndrome was reproduced in some, but not all, animal experiments employing *n*-hexane, thus temporarily clouding the issue. Another industrial incident in the United States provided an additional important piece of the puzzle. Substitution of methyl *n*-butyl ketone (MnBK) for methyl iso-butyl ketone in a fabric factory was followed by another outbreak of peripheral neuropathy. The structural similarity between *n*-hexane and MnBK suggested a common mechanism and led, after numerous carefully controlled animal experiments, to the conclusion that the common metabolite 2,5-hexanedione was the proximal neurotoxicant. Moreover, it was found that other compounds having a di-ketone configuration were also neurotoxic. The sites of action (distal and retrograde axonal degeneration in the central and peripheral nervous systems) have been identified, and the biochemical mechanism involved are being actively explored. As a result of this fascinating story, *n*-hexane, MnBK, and related compounds are no longer included in consumer products, and their industrial usage is carefully controlled.

Another aspect of this story deserves mention. Methyl ethyl ketone (MEK) was also an early suspect in causing the neurotoxic insult, but was subsequently vindicated. However, MEK was convincingly shown to potentiate the neurotoxic effect of *n*-hexane and MnBK. Similarly, MnBK and cyclohexane were implicated in a few human cases, but these compounds failed to produce neuropathy in animal experiments. This emphasizes the need for verification of suspected toxic substances under controlled laboratory conditions.

Acetone

Acetone is a component of some paint thinners, model cements, and fingernail polish removers. It can also be purchased in relatively pure form for use as a paint remover and degreaser. Acetone vapours are irritating to the eyes, nose, and mucous membrane, and cause central nervous system depression and unconsciousness at higher concentrations (Bruckner and Peterson, 1981a, b). Acetone is less potent than toluene as a depressant and is slower acting. However, it has a considerably longer duration of action. Perhaps for these reasons it is less preferred than toluene as an abused solvent. Bruckner and Peterson (1981b) examined the toxic effects of acetone resulting from repeated, brief exposures of mice to high concentrations (19,000 ppm) of acetone. They concluded that acetone, like toluene, was relatively nontoxic. However, potential adverse effects on nervous system functions were not measured and appear not to have been systematically investigated to date.

Methylene Chloride

Methylene chloride is becoming widely used in spray paints, thinners, and paint removers. Because of its high volatility, methylene chloride can be expected to be present in high concentrations in the fumes inhaled from such products. A major concern about chlorinated hydrocarbons is their acute cardiotoxicity. It may be of some comfort that methylene chloride stands out as one of the least cardiotoxic chlorinated hydrocarbons (Aviado, 1977). Another concern is that methylene chloride is partially metabolized to carbon monoxide, which combines with haemoglobin to form carboxyhaemoglobin. The resulting loss in oxygen-carrying capacity of the blood leads to hypoxia (see Winneke, 1981 for a recent review). Moderate to severe hypoxia caused by even relatively short exposures to carbon monoxide can cause brain cell death. However, carboxyhaemoglobin levels much above 10% have never been demonstrated to occur in animals or humans exposed acutely or chronically to methylene chloride.

Pryor et al. (1978a) did not find any persisting adverse behavioural effects of exposure of rats 1 to 6 times daily of brief (10-minute), very high concentrations of a mixture containing mainly methylene chloride 5 days/week for 21 weeks. Nor was there any evidence of other organ toxicity as determined by haematological indices. Interestingly, the mono-methyl analogue of methylene chloride has been known for some time to be a potent neurotoxicant in humans and animals (Repko, 1981). Fortunately, it is not used in products subject to inhalation abuse.

Trichloroethylene and Methyl Chloroform

Both of these trichlorinated hydrocarbons have been used as anaesthetics and occur in many industrial and household products such as cleaners and degreasers. Their toxicity has been known for some time and includes cardiotoxicity, hepatorenal toxicity and neurotoxicity in both humans and animals (NIOSH, 1976; 1977; Annau, 1981). In animal experiments acute behavioural effects can be easily demonstrated depending on the concentration and duration of exposure. With repeated exposures, tolerance develops to some of these effects, whereas there is increased sensitivity to others. Pathological changes in the brain of dogs (Baker, 1958) and rabbits (Bartonicsek and Brun, 1970) repeatedly exposed to trichloroethylene have been reported. However, persisting functional changes appear not to have been investigated.

Solvent Mixtures

Only a few animal experiments have been done to examine the pharmacologic and neurotoxicological effects of exposure to solvent mixtures. The main experimental results have come from Mexico where the effects of commercial paint thinners thought to be abused locally have been studied in rats, rabbits, and cats.

Acute behavioural effects on performance of schedule-controlled operant tasks have been reported in rats (e.g. Colatla et al., 1980). Repeated exposures of rats (10 minutes, twice daily, 5 days/week for up to 16 weeks) to 50,000 ppm thinner beginning the day after birth resulted in decreased motor activity that was still present 4 weeks after the exposures ended (Colotla et al., 1980). The development of swimming behaviour was delayed in rats exposed under a similar schedule from 1 to 30 days of age (Lorenzana-Jimenez and Salas (1980). Latency to escape from water was also initially impaired but was not different from controls by the end of the exposures or 60 days later.

Evidence for altered brain morphology was reported after exposure of young adult rats to 50 or 100 ppm of a paint thinner for 15 minutes per day for up to 20 days (Vasques-Nin et al., 1980). Costero and Barroso-Moguel (1978) described morphologic changes in the brains of cats exposed repeatedly to another thinner. Others (Contreras-Perez et al., 1978) have described the behavioural and electrophysiological effects of exposure of cats to thinners.

The "thinners" used by these different groups of investigators all contained substantial amounts of toluene (40-60%). The other components that were present in lesser amounts -- including methanol, hexane, benzene, xylene, and acetone -- differed markedly in their proportions among the different thinners. Thus, identification of the component(s) responsible can only be speculated without further systematic investigation.

Pryor et al. (1977, 1978, 1979, 1984) described the acute, concentration-related pharmacological effects of exposure of rats to a solvent mixture made up of paint remover (methylene chloride and methanol) and paint thinner (toluene, heptanes, and xylenes). The syndrome consisted of ataxia, falling, hind-limb flaccid paralysis, abnormal scratching, head jerking, and finally prostration, unconsciousness and death with increasing concentrations. Experiments with the separate components of the mixture revealed that the hind-limb flaccid paralysis and head jerking were associated exclusively with exposure to methylene chloride, whereas the abnormal scratching was caused by toluene. Interestingly, exposure to and the heptanes (which was, on analysis, a complex mixture of isomers) revealed an unexpected effect that was masked in the mixture -- full tonic-clonic seizures that could be prevented by simultaneous exposure to toluene. On further analysis, it was found that n-heptane and n-hexane caused only mild myotonic seizures, whereas methyl cyclohexane caused full seizures that were identical to those seen with the mixture of isomers. These results emphasize the markedly different pharmacologic (and, by extrapolation, neurotoxicological) characteristics of various solvents, even though they may all be, and have been, generally described as CNS depressants. They also clearly demonstrate that the effects of exposure to a solvent mixture cannot be simply predicted from the known pharmacology of the components or vice versa.

The most complex mixture of all -- gasoline -- has received only scant attention in animal experiments on its pharmacological and neurotoxic effects in spite of its abuse and reported CNS damage. Pryor et al. (1984b) exposed weanling rats to the fumes from leaded or unleaded regular gasolines. Daily 8-hour exposures that were found in preliminary experiments to be slightly less than lethal were continued for 12 weeks. A battery of neurobehavioural tests administered at intervals throughout the exposure phase and for 8 weeks thereafter did not reveal any persisting effects suggestive of permanent damage. However, the rats exposed to the leaded gasoline, but not the unleaded gasoline, took longer to learn a radial maze than controls some 4 weeks later. This cognitive deficit was tentatively attributed to the tetraethyl lead in this gasoline, although other components could not be ruled out.

Interactions Among Solvents

The mixture involved in solvent abuse clearly presents the opportunity for various and complex interactions among components and with other substances consumed concomitantly (e.g. alcohol). The literature on metabolic interactions among solvents has become extensive and will not be reviewed here. Suffice it is to say that many of these solvents, when coadministered, reciprocally inhibit their metabolism and/or induce, with repeated exposure, liver microsomal enzymes involved in xenobiotic metabolism. The results of such interactions can be bad or good depending on the characteristics of the individual components. For example, "degreaser's flush" is observed in workers exposed to trichloroethylene who then have a drink or two. Under these conditions, blood levels of trichloroethylene can be over twice as high as in the absence of alcohol (Annau, 1981). On the other hand, toluene prevents the seizures caused by exposure of rats to heptanes (Pryor et al., 1978b) and antagonizes the electrophysiological signs of peripheral neuropathy caused by exposure to hexane (Takeuchi and Hisanaga, 1981).

The recent reports describe an interesting interaction between toluene and alcohol in rats that may have important implications for human solvent abuse. Geller et al. (1983) reported that rats repeatedly exposed briefly to high concentrations of toluene markedly increased their voluntary consumption of alcohol. Under very different exposure conditions, Pryor et al. (1984b and in press) found that weanling rats exposed to toluene for 8 hours per day with a 6% alcohol solution as the only fluid available subsequently showed a strong and persistent choice of alcohol over water, whereas controls and those exposed to toluene alone showed a marked aversion to alcohol.

Conclusions

Solvent abuse usually entails the inhalation of the volatile components from various solvent mixtures. As a result toxic manifestations of this practice are difficult to attribute to any one or a small combination of these components. Except in unusual cases, such as accidental exposure to relatively pure substances, epidemiological and clinical data can only suggest potential toxic agents for further study. In general, it is then necessary to confirm that the suspected components are responsible in an appropriate animal model.

From this brief review of the animal literature dealing with the pharmacological and neurotoxicological characteristics of various solvents involved in solvent abuse, several points can be made.

First, the hexacarbons have been clearly, but painstakingly, established as neurotoxicants in humans and in animal models. Second, toluene, although strongly suspect from human clinical reports, has been found to be relatively innocuous thus far in controlled animal experiments except for its clear ototoxic effects in rats. Third, persisting neurotoxic effects have also not been clearly associated with the other solvents, discussed, but the amount of relevant research done to date (i.e. using sensitive behavioural and neurophysiological methods and exposure conditions resembling those associated with human abuse) has been too limited to draw firm conclusions. Fourth, the acute pharmacological effects of these solvents will clearly impair performance in animals and man, and, as with any such substance (e.g. alcohol), should be considered dangerous in situations involving a potential for accidental harm, such as driving an automobile. Finally, the human reports of neurotoxicologic sequelae to solvent abuse cannot be discounted, and a further, more intense search for their causes, as was done for the hexacarbons, appears warranted.

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ABUSE POTENTIAL EVALUATION OF INHALANTS

Dr. R.L. Balster

Voluntary inhalation of volatile chemicals constitutes a form of drug abuse. Drugs differ in their potential for abuse and in the magnitude of the public health problems engendered by their abuse. Indeed, the international regulatory structure for drug abuse recognizes these differences among psychoactive drugs and controls some, but not others. Even with those that are controlled, assignment is made to different schedules based upon relative abuse liability. On the other hand, when considering inhalants, distinctions are infrequently made among them in terms of their abuse liability. Do inhalants differ in abuse potential? Are some preferred by users over others and why? Are some devoid of abuse potential? We are a long way from answering these questions very comprehensively; however, it should be possible to begin to develop data which would be helpful. This paper addresses some of the approaches which could be used in evaluating abuse liability of inhalants.

The first assumption which I believe can be made concerning the abuse potential of inhalants is that users of chemicals are doing so to produce a desired intoxication. This may not always be true since there may be some who voluntarily inhale volatiles for their odor, but in most cases users inhale sufficient quantities to produce effects on the central nervous system. Clearly there is a complex interrelationship between the "pharmacological" effects of inhalants and their odour and peripheral irritant effects. In many cases these latter effects may serve to discourage the voluntary inhalation of pharmacological doses. I will have more to say on this later.

The second assumption I will make is that strategies and procedures which are used to assess the abuse liability of drugs have applicability to the study of inhalants. Certainly the epidemiological approaches used for the assessment of incidence and prevalence of drug abuse have been used in studying inhalant abuse. One of the problems here is that very few of these types of investigations have attempted to discriminate among inhalants or types of inhalants, although some have. Clearly, good epidemiological studies, case-findings and clinical reports are very important in identifying inhalants which are popular and are especially useful in identifying specific inhalant products which are subject to abuse.

In this paper I wish to focus on another dimension of abuse potential assessment, the laboratory study of relevant pharmacological effects. Methods for assessing, and even predicting, the abuse potential of drugs are well developed. Many books, chapters, reviews and research studies have been published on the subject (e.g. Brady and Fischman, 1985; Griffiths et al., 1979b; Johanson and Schuster, 1977; Martin, 1973; Thompson and Unna, 1977; Yanagita, 1973), including a World Health Organization report (WHO, 1978). Approaches utilizing both human and animal subjects are available, and data from these studies are widely used in making regulatory decisions for drug abuse control. On the other hand, these approaches have hardly been applied at all to the study of inhalants.

What are the CNS effects of inhalants which can be measured and which may be helpful in assessing abuse potential? Clearly the most important effect is their ability to produce a desired intoxication. In technical terms, this means their reinforcing effects. Reinforcing properties of drugs can be studied directly by arranging for them to be available for self-administration by test subjects. Secondly, drugs produce subjective effects which can be inferred from various types of measures. The subjective effects of drugs can be compared to those of known drugs of abuse. It can be assumed that chemicals with similar subjective effects will have similar abuse potential. The reinforcing and subjective effects of drugs can be studied in both human and animal subjects. Because of problems which might be expected from giving inhalants to human subjects in the laboratory, animal studies may be particularly important in the present context.

Preclinical Abuse Potential Assessment

Animal studies are being widely used to gather evidence on the abuse potential of drugs. These studies in animals are particularly important in the context of drug development where information about abuse liability is needed before extensive human testing is done. The animal procedure which has the most face validity for prediction of abuse potential is drug self-administration (Balster and Lukas, 1985; Griffiths et al., 1979b; Johanson and Schuster, 1977). For example, one condition under which animals reliably self-administer drugs of abuse is when they are prepared with intravenous catheters and an arbitrary response such as a lever press results in drug infusion. There is a good correlation between drugs which animals self-administer intravenously and those which are abused (Griffiths and Balster, 1979; Johanson and Balster, 1978). This general approach can also be used to compare the relative reinforcing properties of drugs.

Self-administration studies with volatile chemicals present some obvious technical problems. On the other hand, at least one volatile solvent, ethanol, has been studied using intravenous self-administration (Winger and Woods, 1973) and methods for study of oral ethanol self-administration have also been well developed (Meisch, 1977).

There have been a few studies of self-administration via inhalation in animal subjects. Yanagita et al. (1970) used rhesus monkeys with implanted nasal catheters. The catheter was routed subcutaneously to the animal's back where it passed through a restraining arm to outside the cubicle. The animal wore a vest arrangement that also protected the catheter and was connected to the restraining arm. This flexible arm allowed the subjects relatively free movement within the cubicle. Responses on a lever switch within the cubicle resulted in 2 to 5 minute deliveries of air or test vapors. Two monkeys each were used to study chloroform, ether and lacquer thinner. They had unlimited access to these vapors for periods of two or more weeks. All animals initiated and maintained responding for these vapors within a week or so. Daily intake was erratic, but they occasionally self-administered 80 - 100 inhalations a day. The self-administered doses of these agents produced ataxia and in the case of chloroform, light anesthesia.

The most extensive study of self-administration via inhalation utilized nitrous oxide (Wood et al., 1977). Squirrel monkeys were seated in a chair with a helmet placed over their head. Lever presses resulted in 60-second exposures to various concentrations of nitrous oxide during 1-hour daily sessions. The subjects were initially trained to respond for 60% nitrous oxide. After the monkeys had learned to self-administer this concentration, other concentrations and other duration exposures were systematically studied. The subjects responded at much higher rates for shorter durations, self-administering as many as 200 inhalations in a 1-hour period with 15-sec deliveries. The animals could also be shaped to emit more than one response for each inhalation, with high rates of responding produced by fixed ratio 10 and fixed ratio 20 schedules (10 or 20 responses required for each reinforcer).

Wood (1978) also studied toluene self-administration under the same conditions as the nitrous oxide experiments just described. The monkeys who had been trained to respond for nitrous oxide readily self-administered 15-sec deliveries of 0.1 - 0.3% toluene vapor.

Although inhalation self-administration experiments with animals present complex technical problems, the studies which have been done suggest that this is a feasible approach.

Unfortunately, no systematic data presently exist on a variety of vapors using various test conditions. Much more research in this area is needed. At some time in the future it may be possible to evaluate vapors which possess reinforcing effects with the same predictive value as we presently can with intravenous drug administration.

If some vapors produce a reinforcing intoxication, what is that intoxication like? The hypothesis that we have used in studying solvent vapour intoxication in animals is that at least some abused solvents produce effects which are similar to those of classical CNS depressant drugs such as the barbiturates. We know that barbiturates and alcohol have many effects in common and produce similar intoxications in humans. Solvents, too, have been shown to have pharmacological effects similar to those of alcohol and the barbiturates. For example, acute exposures to a variety of solvent vapors produce clear concentration-dependent, reversible, "drug-like" effects on complex learned behavior of animals, and these effects are often similar to those of CNS depressant drugs (Balster et al., 1980; Glowa, 1985; Moser and Balster, 1985). Toluene and m-xylene have anticonvulsant effects in mice (Wood et al., 1984). Methyl chloroform (1,1,1-trichloroethane) enhances the depressant properties of ethanol (Woolverton and Balster, 1981) and chloroform has been shown to suppress withdrawal signs in barbiturate-dependent monkeys (Yanagita and Takahashi, 1973). The barbiturates and benzodiazepines have very selective effects on responding suppressed by punishment in animals (conflict procedure). Toluene has also been shown to have antipunishment effects (Geller et al., 1983; Wood et al., 1984). Thus, the abuse potential of some inhalants may be related to their ability to produce a depressant-like intoxication and depressant-like subjective effects.

A research approach developed by behavioural pharmacologists may make it possible to study "subjective" effects of drugs in animals. This procedure is called drug discrimination. Animals are trained to discriminate between the interoceptive stimuli produced by drug and vehicle injections. A typical procedure uses two levers where responding on one is reinforced when a drug has been injected before the session and responding on the other lever is reinforced following vehicle injections. After the subjects have acquired the discrimination, they can report on whether they had received a drug injection by either responding or not responding on the appropriate drug lever. A particular power of this approach is that animals can be tested with novel drugs. If they respond on the drug lever, this indicates that stimulus generalization occurred and that the interoceptive discriminative stimulus effects of the test drug are similar to those of the drug they were trained with. When

drugs are compared in this way, generalization usually only occurs with drugs that have similar pharmacological and subjective effects (Schuster and Balster, 1977; Schuster et al., 1981).

We have used this approach to study the discriminative stimulus effects of abused solvents. Most of our research has utilized mice trained to discriminate between i.p. injections of vehicle and a representative barbiturate, pentobarbital. After they have acquired the discrimination, they are tested with various drugs and solvents. Pentobarbital-trained animals generalize to hexobarbital and ethanol but not to morphine nor chlorpromazine, illustrating the specificity of these discriminative stimulus effects (Moser et al., 1984). They also generalize to inhaled toluene after 30-minute exposures to 1200 - 5400 ppm (Rees et al., 1985). More recently, we have also found that generalization usually occurs to inhaled 1, 1, 1-trichloroethane and halothane, but not to flurothyl or isoamyl nitrite (Rees et al., 1986). Although it is somewhat difficult, we have also been able to train mice to discriminate between injections of toluene and vehicle (Rees and Balster, 1985). These animals generalize to inhaled toluene. Rats also can learn to discriminate toluene injections from vehicle (Knisely et al., 1986), and many of these animals generalize to methohexital and oxazepam. Thus, these studies provide further evidence for commonalities in the effects of some abused solvents and classical CNS depressant drugs. We have begun to test a wider variety of volatile chemicals for their discriminative stimulus effects and hope to be able to provide data relevant to the prediction of their ability to produce depressant-like intoxications. These predictions may have value in evaluating their abuse potential.

In addition to reinforcing and discriminative stimulus effects, laboratory animal studies can also be conducted on other effects of inhalants which may be related to their abuse. Many volatile chemicals have severe irritant effects which may reduce their abuse potential. Direct studies can be made of the ability of chemical vapours to serve as negative reinforcers, i.e. to result in behaviours that allow the animal to escape or avoid them. For example, mice will learn to make a operant response to terminate "facial showers" of ammonia and acetic acid (Wood, 1979, 1981). These direct behavioural studies can supplement more traditional indices of respiratory irritant properties (Alarie, 1973).

The ability to produce tolerance and dependence are important components of the abuse potential of certain drug classes, including the CNS depressants. These properties of drugs can be studied in animals, although again there has been very little research in this area with inhalants. We have

conducted some studies in mice of the possibility of tolerance to the behavioural effects of inhaled toluene (Moser and Balster, 1981) and 1,1,1-trichloroethane (Moser et al., 1985). We find little, if any, tolerance with daily short exposures to behaviorally-active concentrations of these agents. This is another area for further study. Although the conditions of inhalant use would not seem to be likely to lead to the development of physical dependence, the fact that many of these agents have classical CNS depressant properties suggests that they may have the potential of producing dependence or cross-dependence as well. Animal models of physical dependence assessment of the CNS-depressant type are also well developed and could be used to study inhalants (Boisse and Okamoto, 1978; Yanagita and Takahashi, 1973; Yutzenka et al., 1985).

A comprehensive evaluation of the abuse liability of inhalants should include both their likelihood for being self-administered and the toxic consequences of these self-administered exposures. Thus, animal studies of the reinforcing effects of these agents will ultimately need to be done in the context of evaluating their toxicity. One area of toxicological assessment which is particularly amenable to combined evaluation is neurobehavioural toxicity. Dr. Pryor, in his presentation at this meeting, provides a review of the assessment of neurobehavioural toxicity of solvents in animals. As these properties of inhalants are studied more completely, we may find that some compounds may have a high potential for recreational use, but be of relatively less consequence to the user than other compounds which are less preferred. Even occasional use of highly toxic chemicals may present more of a public health problem than use of those which are more popular. Indeed, it may be that under some circumstances successful efforts to discourage the use of popular but relatively safe inhalants could lead to the use of more toxic chemicals. At this point, however, we have insufficient data to clearly address this aspect of the "risk/benefit" ratio for individual volatile chemicals.

Abuse Potential In Humans

Studies of abuse potential of drugs have often used human subjects as well. In the past, tests of new drugs in incarcerated drug abusers had been a major approach to evaluation (Jasinski, 1977; Martin, 1973). Increasing concerns over the ethics of prisoners giving informed consent for participation in drug studies has resulted in less frequent use of this approach. On the other hand, patients and normal human subject volunteers are very useful in providing good scientific data on abuse potential (e.g. Brady and Fischmen, 1985; Griffiths et al., 1979a; Johanson and Uhlenhuth, 1982).

Although many specific procedures have been used in human abuse potential assessment research, including self-administration and drug discrimination, one approach which is commonly used is to compare the effects of acute administration of the test drug to various standard drugs of abuse. Comparisons can be made of profiles of physiological effects and of subjective effects using standardized verbal report instruments such as mood scales and measures of feeling states. Also included are measures of subject liking.

These approaches have not been applied to the study of abused inhalants. Clearly, there are certain problems. Drugs have usually have been thoroughly examined for safety because they are intended for therapeutic use. With the exception of volatile anaesthetics, abused inhalants are not intended for human use; thus, much less is known about their safety. Indeed, many of them are known not to be safe, especially with repeated exposure. On the other hand, it should be possible to conduct low concentration acute exposures with many abused solvents. In fact, such studies are being done in the context of evaluation of potential behavioural toxicity (e.g. Dick et al., 1984; Savolainen et al., 1984). It would be very interesting and informative to utilize some of the procedures used for drug abuse potential assessment in humans to study abused inhalants. To my knowledge, this has not been done.

Summary

I have tried to describe how it might be possible to undertake a systematic scientific study of the abuse potential of volatile chemicals. It should be possible to use both preclinical and clinical procedures developed for drug abuse potential assessment. There have been some applications of the animal procedures of self-administration and drug discrimination to the evaluation of inhalants which appear promising. Clearly, there are many problems, not the least of which are the technical ones of controlling inhalation exposures in the laboratory. Another problem is the enormous range of chemicals with potential for abuse, many more than there are therapeutic drugs with abuse potential. Also, most sources of abused inhalants are not pure chemicals, but complex mixtures. Should the component chemicals or the mixtures be tested? We should not be discouraged by the scope of the problem. Many of the compounds to be tested are relatively clear, e.g. toluene and other aromatic hydrocarbons, methyl chloroform and other aliphatic halogenated hydrocarbons, nitrites, and anaesthetics. At present we know very little about their relative abuse potential or, indeed, anything at all about their acute behavioral effects. Research in these areas should be encouraged.

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Adverse Social and Health ConsequencesPsychosocial correlates

Several population subgroups are at increased risk to volatile substance use and abuse. Experimenters tend to be young, usually have a variety of personal and social problems (Medina-Mora et al., 1978; Cohen, 1979; Beauvais et al., 1985). They are apt to be socially isolated in institutional settings, such as prisons, boarding schools, and army barracks. Another risk factor is exposure to volatile substances at work, such as in the petrochemical, dry cleaning, hairdressing, and vehicular maintenance and repair industries. Lower socioeconomic groups and minorities tend to have higher use rates among both children and adults (Padilla et al., 1979; Boeckx et al., 1977; Nurcombe, 1970; Ellinson, 1964; Streicher et al., 1981). Children and adolescents with chronic abuse typically come from disrupted, multiproblem families (Leal, 1978; Barnes, 1979; de la Garza et al., 1978; Reed and May, 1984; Sourindhrin and Baird, 1984). As with other forms of substance abuse, males appear more often in both morbidity and mortality studies, but equal numbers of males and females apparently experimented with these drugs (Beauvais et al., 1985; Rosenberg et al., 1974; Cohen, 1973; Korman et al., 1980).

Social problems are virtually universal among chronic volatile substance abusers. Such children belong to families with poor interpersonal relationships, and often with drug or alcohol problems in one or both parents (Babst et al., 1978; Barker and Adams, 1973; Gilbert, 1983; Harbin and Mazier, 1975; Press and Done, 1967; Barnes, 1979 and 1980; Berriel-Gonzalez et al., 1978; Smart et al., 1970). Parents often do not actively stop their children from using these drugs, even when the drug use is known to the parents (Leal et al., 1978; Boeckx et al., 1977). For adult as well as childhood abusers, adjustment to the school or work environment tends to be marginal or poor (Ackerly and Gibson, 1964; Galli, 1974; Kandel, 1975; Massengale et al., 1963; Medina-Mora et al., 1978; Nurcombe et al., 1970; Schottstaedt and Bjork, 1977).

Volatile substance abusers coming to treatment have high rates of psychopathology, especially conduct disorder, emotional-neurotic problems and personality disorders (Korman et al., 1980; Alapin, 1972; Crites and Schuckit, 1979; Comstock, 1978; Korman, 1977; Skuse and

Burrell, 1982). Impulsivity and aggressiveness in association with volatile drug intoxication has been well described (Leal, 1978; Korman et al., 1980; Reed and May, 1984; Cohen, 1978). Poverty, social isolation, rapid culture change, and identity conflicts may contribute to epidemic volatile abuse among minorities and low socioeconomic groups (Nurcombe, 1970; Barnes, 1980; Berry and Annis, 1974; May, 1982; Schottstaedt and Bjork, 1977). As compared to other children, volatile substance abusers have lower intelligence scores (both verbal and performance) as well as attention deficit, short term memory, abstraction and poor judgement (Korman et al., 1981; Fornazzari et al., 1983). As one might expect, psychiatric morbidity appears higher among volatile abusers in psychiatric hospitals as compared to those in clinics attending to volatile abusers (Sourindhrin and Baird, 1984; Skuse and Burrell, 1982).

Many cases of substance abuse are sporadic, especially in certain industrial or institutional settings. Epidemic outbreaks depend heavily on peers who encourage one another's volatile use rather than discourage it. Such peer clusters usually manifest a spectrum of other socially deviant and self destructive behaviours, including polydrug use, delinquency, truancy, school dropout and unemployment (Clements and Simpson, 1978; Cohen, 1978; Kaufman, 1973; Medina-Mora et al., 1978; Berriel-Gonzalez, 1978; Mestoth, 1968; Stephens et al., 1978; Smart et al., 1970; Beauvais et al., 1985).

Clinical manifestations

Clinical manifestations resulting from self-exposure to volatile substances vary with the type of substance, the amount used and the length of exposure. This relationship holds for the ill-effect as well as for the extent of recovery. Thus most young abusers have little or no apparent symptoms while a few may be ataxic or incoherent. As the person becomes more dependent and a heavier user, dysfunction increases, as noted in the following section. The symptoms discussed in that section are not representative of most inhalant abusers but may occur in the most severe cases. Permanent disability and even death may ensue.

Certain volatile substances have been clearly correlated with pathological effects; every effort should be made to avoid exposure to them. These include benzene, hexane, methylbutyl ketone, and the chlorinated hydrocarbons.

With the potential that toluene may cause some hearing loss, reasonable efforts should be taken to diminish the level of exposure to this substance. However, this potential and very infrequently occurring toxicity does not justify the banning of toluene, or the reduction of the concentrations of toluene in any product at this stage. Substitution with other substances may increase rather than reduce the hazards associated with any toluene containing products. Despite the toxicity of toluene and other inhalants currently available even in substances which can produce nephrotoxicity such as paint sprays and other products, there are no other solvents that can replace them which do not also manifest similar or other toxic reactions.

Most toxic symptoms of volatile substance abuse are not the result of a single exposure. On the other hand, it is not currently known what number of exposures or concentration is necessary to cause clinical symptoms. Other environmental factors (including use of other drugs) may play important roles in determining the clinical outcome in any particular case.

Some of the cerebral, cerebellar, brain stem and neuromuscular symptoms appearing in inhalant abusers are as follows:

- (a) Dullness, apathy, lethargy, impaired attention, confusion.
- (b) Nystagmus, incoordination, slurred speech, unsteady gait.
- (c) Dizziness, vomiting.
- (d) Depressed reflexes, tremor, muscle weakness.

Serious complications may be present in inhalant abusers. The clinician should consider whether any of the following symptoms are present:

- renal acidosis and electrolyte imbalance.
- hepatic damage.
- peripheral nerve damage, often manifested by paresthesia affecting lower limbs.
- hearing loss.
- visual disturbances.

- decreased pulmonary vital capacity.
- cortical atrophy with intellectual impairment.

Lethal consequences

There have been numerous deaths attributed to solvent toxicity over the last 25 - 30 years (Bass, 1970, 1978, 1984; Garriott and Petty, 1980; Kringsholm, 1980; Anderson et al., 1985). In the 1960s and 1970s in the United States, the fluorocarbon deaths increased as a result of cardiac arrhythmias. These deaths have declined in the United States due to the restriction in 1980 of the use of fluorocarbons in aerosols. However, aerosol fluorocarbons are still a major concern in England (Anderson et al., 1985) and probably elsewhere.

Other hydrocarbons may also cause death by cardiac arrhythmia (Spencer, 1976; Yamashita et al., 1984; Nouchi et al., 1984; Gresham and Treip, 1983). Chlorinated hydrocarbons are associated with numerous deaths in England (Anderson et al., 1985; Jones and Winter, 1983) and Denmark (Kringsholm, 1980). These products range from hospital anaesthetics (halothane) to the more common solvents (di-, tri-, tetrachloroethanes, trichloroethylene). The desire to substitute these for toluene as a public safety measure may be contraindicated since fewer cardiac arrhythmias have been reported in toluene associated deaths.

However, a recent non-fatal respiratory arrest has been associated with abuse of a toluene-containing solvent (Cronk et al., 1985). In addition liver toxicities were noted in some lethal cases where halogenated hydrocarbons were used (Garriott and Petty, 1980).

More recently another source of chlorohydrocarbons derived from typing correction or "white lut" fluids has been judged to cause death (King et al., 1985). Respiratory complications have also been noted in deaths of inhalant abusers (Mee and Wright, 1980; Lecombe et al., 1983). The respiratory ailments in some cases may be exacerbated or caused by smoking and other factors. Despite the identification of direct cardiotoxic effects, many deaths result directly from asphyxia (such as a bag over the head), or by solvent aspiration, or by aspiration of stomach contents (Anderson et al., 1985).

Nephrotoxicity

Probably the currently most widely abused

substances, at least in the United States, are the spray paints. Hospitalization of spray paint abusers has been necessary to manage severe muscle cramps, and even muscle paralysis. Associated gastrointestinal (GI) symptoms, especially vomiting, further complicate the clinical picture.

Streicher et al. (1981) has identified the occurrence of distal renal acidosis in groups of paint and/or glue sniffers. Symptoms included hyperchloremia, metabolic acidosis, hypocalcemia and other electrolyte imbalances. Glomerulonephritis-like findings have been identified in workers using solvents, especially painters (Ravnskov et al., 1983). Several solvent mixtures are correlated with drug-induced glomerulonephritis or distal renal tubular acidosis. Although metallic spray paints are the type most often used, there has been no good clue as to which chemicals produce these kidney diseases. Attempts to reproduce these symptoms in animals using toluene (one of the more common chemicals) have not been successful. It is likely that these symptoms are due to a combination of toxicants - perhaps including the metals contained in the spray paint such as cadmium and lead which are nephrotoxic (Wedeen, 1984) or concurrent alcohol use. While renal acidosis or glomerulonephritis (Ravnskov, 1978) is often correlated with exposure to toluene containing substances, investigators have tended not to analyze the product used (Kroeger et al., 1980) or to measure the patient's blood or urine for specific substances.

Central neuropathology

For three decades, nervous system dysfunctions have been identified with inhalant abuse. Cortical and hippocampal dysfunction may be directly related to solvent toxicity.

These central nervous system effects may or may not be reversible. Enlarged ventricles, cerebral atrophy, cerebellar atrophy and EEG abnormalities have been noted. Little is known about the outcome of subjects identified as having cerebral atrophy with the exception of a follow-up study of house painters (Bruhn et al., 1981): minimal recovery (as noted by CT scans) was observed for these subjects. The occurrence of tremors may also indicate a more extensive exposure to paints or to different materials, as severe tremors are infrequently noted in "spray paint" abusers.

Ototoxicity

Hearing loss, perhaps irreversible, has been identified in several clinical cases (Ehyai and Freeman, 1983; Metrick and Brenner, 1982; Lazar et al., 1983). An epidemiological study of painters, printers and petrol truck drivers has established hearing losses associated with occupational petrochemical exposure (Bergholtz and Adkvist, 1984). Animal and other human studies have further defined these ototoxicities. Metrick and Brenner (1982) measured these changes precisely by brain stem auditory responses, finding damage similar to that observed in rats after toluene exposure. One study of impaired auditory evoked potential, in a patient with learning problems and other CNS impairments (Lazar et al., 1983), indicated that these untoward effects may diminish with time. A similar ototoxicity has been observed in an industrial accident (Biscaldi et al., 1981). Among two other subjects heavily exposed to a solvent containing only toluene (Boor and Hurtig, 1977), the heavier user showed a distinct "pancerebellar syndrome" that persisted for months while the other less heavy user showed a normal EEG but had a high frequency hearing loss in the right ear.

Peripheral neuropathies

Hexane

One of the more studied and now classical example of solvent toxicity is the neuropathy caused by hexane and its metabolites (Couri and Milks, 1982; Spencer et al., 1980). New individual cases are still being reported (Tenenbein et al., 1984) as well as industrial cases (Passero et al., 1983) which demonstrate that peripheral neuropathies continue to occur despite efforts to reduce the hexane and methylbutyl ketone contents of many products. Prockop and colleagues (Means et al., 1976) identified a thinner that produced a severe peripheral neuropathy in several inhalant abusers; the symptoms were believed to result from the 15% heptanone and/or 0.5% hexane present in the thinner. Whether the other chemicals present in the thinner exacerbated the condition or caused other neurological manifestations is still unknown. The "hexane" type syndrome includes "both sensory and motor neuropathy", with "axonal swelling, accumulation of neurofilaments in axons, myelin thinning and denudation, and skeletal muscle changes of neurogenic atrophy". (Prockop, 1979).

Care must be taken in assessing the actual nature of the volatile substance. In one case, a child reported

gasoline abuse but was actually inhaling naphtha with a hexane content (Tenenbein et al., 1984).

Chlorohydrocarbons

Subjects exposed to chlorohydrocarbons have been known to exhibit hepato-renal toxicities (Baerg et al., 1970); this is a well-established phenomenon corroborated by animal studies. Any individual inhaling these compounds would expect to develop hepato-renal toxicities depending on the dose and time of exposure (Buring et al., 1985). Correction or "white out" fluids contain these solvents (i.e. trichloroethylene and tri-, tetrachloroethanes). Extreme nephronectosis has been observed after exposure to mixtures containing methylene chloride and other halocarbons (Miller et al., 1985; Keogh et al., 1984). Since only a few cases have been noted involving methylene chloride. (Cherry et al., 1981) other factors may be important in the etiology of this condition. Most reports of methylene chloride exposure have found increases in carboxyhaemoglobin levels. In addition, anaesthetic chlorinated hydrocarbons (halothane, trichloroethylene, chloroform) are carcinogenic (Cohen, 1979) and have been associated with spontaneous abortions (Buring et al., 1985).

Nitrous oxide

Nitrous oxide is used as an anaesthetic and as a propellant primarily for whipped cream. "Laughing gas" as it is euphemistically called, was abused soon after it was discovered in the late nineteenth century. Only in the past decade has it been known that central and peripheral nerve damage results from high levels of N₂O exposure, even in the presence of adequate oxygen. Symptoms include numbness and weakness in the limbs, loss of dexterity, sensory input and loss of balance. Damage consists of a sensorimotor polyneuropathy of the posterior and lateral columns of the cord (Layzer, 1978). Studies focussing on the mechanism of action indicate that cobalamins are inactivated by nitrous oxide, yet vitamin B₁₂ does not aid recovery from this disease (Chanarin, 1980). Despite the widespread distribution of this information to the medical community and the reduced availability of nitrous oxide, cases of abuse by hospital workers are still being observed (Schwartz and Calihan, 1984).

Organic nitrites

Another group of substances, volatile liquid organic nitrites, are also used medicinally as vasodilators, to

treat angina pectoris, although much less so today.

As with nitrous oxide, a distinct group of individuals inhales isoamyl ('amyl') or isobutyl nitrites - in this case predominantly homosexuals. The nitrites are not usually considered toxic during inhalation because of syncope (fainting). However, a recent paper (Guss et al., 1985) noted a dangerously high 37% methemoglobin level in a normal subject who had used isobutyl nitrite (he had also used methaqualone). It has also been reported to reduce white blood cell activity (Lotzova et al., 1984) and to be potentially carcinogenic (Osterloh and Goldfield, 1984). This latter issue is of special concern in the development of acquired immune deficiency syndrome of AIDS (Newell et al., 1984; Haverkos et al., 1985) in that there is an association between the development of Kaposi's sarcoma and high butyl nitrite use.

Volatile substance dependence

Clinical experiences indicate the existence of dependence behaviour among chronic solvent abusers. These abusers, individually or as a group, are often preoccupied with the habit to the exclusion of other activities.

Volatile substances are obtained by a variety of methods, ranging from purchasing to stealing from the home or shops to breaking into those shops selling the agents. The inhalant user may also become involved in a variety of crimes with the specific aim of raising money to finance the purchase of solvents.

"Brand loyalty" to an agent is frequently seen. The user often becomes tolerant and gradually increases the frequency and quantity of these substances used. Long term users may be consuming quantities that are substantially larger than the amount used during the earlier part of their careers.

Craving is often experienced and is cited as one of the reasons for the repeated use of solvents. Use of other inhalants occurs when the favourite substance is not available.

No clearly defined syndrome of withdrawal effects is recognizable, but headaches, anorexia, insomnia, generalized restlessness and feelings of depression are observed. Hangovers, with headache, tremors and fatigue, are commonly reported by heavy abusers. Disorientation and occasionally seizures have also been recorded. These

symptoms may occur within hours or days, following cessation of use.

Frequently relapses occur in spite of the user's effort to cease the activity.

SOCIAL AND PSYCHOLOGICAL CHARACTERISTICS OF INHALANT ABUSERS

Dr. F. Beauvais

Evidence has been slowly accumulating that many of the chemicals that are inhaled because of their mood altering properties have extremely toxic side effects. A wide range of toxic effects from various volatile hydrocarbons have been catalogued by Comstock and Comstock (1977). Renal dysfunction has been cited by Moss et al. (1980). Fornazzari et al. (1983) have found CNS atrophy, and along with Korman, Matthews and Lovitt (1981) have noted neuro-psychological deficits. The danger from exposure to lead in gasoline has been reported by Coulehan et al. (1983), and Aviado (1977) has noted cardiotoxicity of both propellants and solvents in aerosol sprays. These few examples of what have been reported in the literature, serve to illustrate the breadth of the effects inhaled chemicals may have on the human system.

Despite the evidence of danger, throughout the world significant number of people, often very young children, are using inhalants. In the U.S. alone, almost 10% of youth will at some time try inhalants. What can be done to reduce inhalant use and its potential attendant dangers? Unlike other drugs, attempts to control inhalant availability will have limited effectiveness. Inhalants are readily available everywhere. Gasoline is in the tank of the nearest engine. Paints, thinners, paint removers and other construction materials are accessible almost everywhere. Glues, pastes, copy machine liquids, correction fluids, marker pens, and other office supplies can be readily purchased or even stolen. Aerosols ranging from such substances as spray paints, kitchen supplies, and cleaners can be easily obtained everywhere. It is extremely difficult to control access to inhalants. If we are to reduce inhalant use, we must first understand what motivates people to use inhalants and what might motivate them to avoid inhalants.

The paper will review the research on inhalant use, focusing on the social and psychological factors that have been found to correlate with inhalant use. Chronic abusers of volatile hydrocarbons do appear to form a distinctive group of drug abusers. Research on this group indicates that inhalant abusers differ in age and gender from other drug users, and differ in the social and psychological precursors of use, the use of other

chemicals, consequences of use, and treatment prognosis. In most ways, the differences are negative. The distinctions, of course, are not complete and while inhalant abusers show characteristic patterns there are also areas of overlap with users of other drugs. This review will focus on those variables that have been identified as being most common inhalant abusers.

Excluded from this review are users of certain classes of volatile substances that produce transient and very specific effects, such as nitrous oxide, the amyl and butyl nitrites, helium, chloroform, etc. These substances are much harder to obtain, much more expensive, and tend to be used by older drug users, not by the youth who are the predominant users of volatile hydrocarbons. These substances may produce problems in their own right, and may incline an individual to a certain preferred avenue of drug administration, but study of these drugs is not really relevant to the task at hand.

The range of social and psychological factors found to be related to inhalant abuse is quite diverse. To bring some organization to the discussion, these will be grouped under the following headings:

- Social Structure
- Socialization Links
- Psychological Characteristics
- Associated Behaviours
- Peer Influence

When the body of research is viewed globally, there are a number of areas of agreement on the psychological and social characteristics common to inhalant abusers. Despite considerable general agreement, however, the data from different studies often show discrepancies. For example, while it is generally held that inhalant use is more concentrated among minority groups of low socioeconomic status, a number of studies do find inhalant use among all SES strata. One reason for these conflicting results may be the lack of a distinction between use and abuse. Nearly everyone has sniffed a volatile chemical. One 9th grader recently interviewed by the author was asked if she or her peers ever used inhalants. She responded, "Oh, yes, we like the smell of the paper when it comes out of the duplicator" -- hardly a case of inhalant abuse, yet it could well be reported among lifetime prevalence figures on a general population survey. This common type of sniffing would likely show no particular relationship to SES. Another study, however, that focuses on chronic abusers, (i.e. those who use inhalants several times a week) may show that these users are predominately found in lower SES environments.

Furthermore, inhalant abuse, like any other complex behavior, has multiple determinants. So, while people of low SES may show higher rates of use, some use may certainly be found across all strata due to other determinants. For instance, a child from a well-educated, wealthy family, where there is considerable emotional turmoil, may begin to associate with peers who have similar emotional instability, and these youth may begin to use inhalants as a way of coping. A child or group of children so identified would appear to be counter to the otherwise strong correlation between SES and inhalant abuse.

Simply put, perfect relationships between predisposing factors and inhalant use cannot be found when those predisposing factors are studied individually. Furthermore, the strength of the relationships will depend on what groups are chosen for study and on the definition of inhalant use or inhalant abuse.

Clear relationships are further confounded by the low base rate of chronic inhalant abuse in most populations. While a serious problem, inhalant abuse is not frequent. Any analysis attempting to study relationships with a behavior that has such a low base rate will encounter problems in characterizing the groups engaged in that behavior.

In an effort to circumvent some of these issues, the review which follows will try to be clear about which studies are of general populations and which concentrate on groups identified as chronic abusers. In general, it was found that many population studies did not make a clear distinction between use and abuse and may not have sampled the same populations; thus, the findings from different studies sometimes conflict with one another.

Social Structure

Social structure refers primarily to demographic variables that tend to be associated with inhalant abuse.

Age

It is generally thought that inhalant users tend to be younger than most other drug users, although this conclusion may be confounded somewhat by a lack of a distinction between drug use by drug involved children who occasionally sniff chemicals and the more serious pattern of obsessive and chronic inhalant use that occurs predominantly in young adults. Further complications are introduced by failure to specify the difference between lifetime prevalence (whether a person has

"ever tried" inhalants) and current use (whether inhalants are being used now). Theoretically, lifetime prevalence within a population should always increase with age since once people have used inhalants, even if only one time, they would always respond affirmatively to lifetime use questions no matter how old they were. Interestingly enough, many surveys find a lower lifetime prevalence rate as age increases. Many people may be either denying or forgetting earlier use. Perhaps as they get older it seems irrelevant to include innocuous sniffing while young as a form of drug use. Furthermore, older inhalant users may not be included in surveys since they are likely to have dropped out of the population that is surveyed (e.g. schools).

When current use is studied or when retrospective questions (such as "how old were you when you first tried inhalants?") are asked, however, there is evidence for more inhalant use at younger ages. Medina-Mora et al. (1978) in a large study in Mexico found an earlier age of first use for inhalants than marijuana with the highest first use of inhalants occurring among 14 - 17 year olds. Similar findings were reported by Cohen (1979) in a large group of adolescents admitted to drug treatment programs. Fishburne, Abelson and Cisin (1980) in a large scale household survey conducted in the United States found current inhalant use (use within the last month) of 2% for 12 - 17 year olds compared to 1.2% for 18 - 25 year olds and 0.5% for those older than 26. In a representative sample of Indian youth in the U.S., Beauvais, Oetting and Edwards (1985) found that by age 12 nearly one-fourth of Indian youth had used inhalants; this increased to 32% by age 18. In that same study, however, current use dropped almost linearly from 13% at age 11 to 4% at age 17. As inhalant use dropped with age, the use of other drugs increased through this same age span. Similar results emerged in a study in New York state, although the age of highest current use was slightly older at 13 (Stephens et al., 1978). The data generally confirm that the highest rates of inhalant use are found among younger adolescents.

While tending to concentrate in the early adolescent years, inhalant use is by no means restricted to that age. Considerable use has been found among very young children in two native populations in the U.S. and Canada (Boeckx, Postl & Coodin, 1977; Kaufman, 1972). Current use among adults is generally quite low at 0.5% in the general U.S. population (Fishburne, Abelson & Cisin, 1980), although when inhalant use does occur in adults it is likely to represent severe use (Streicher et al., 1981). Hershey and Miller (1982) caution about a possible recent increase in adult users.

Gender

When studies of high risk populations such as delinquents or psychiatric patients are conducted, it is common to find a much higher percentage of males than females who abuse inhalants. In 1973 Cohen estimated a 10:1 ratio, but a few years later Korman et al. (1980) revised that overall estimate to 3:1. However, since males are more likely to be identified as deviant or apprehended for deviant behavior, the high male to female ratio may be an artifact. General population studies usually show much closer rates for males and females. In a national study of high school seniors in the U.S., Johnston, O'Malley and Bachman (1985) report lifetime prevalence rates of 18% for males and 11% for females. Use during the last 30 days was 2.5% and 1.2% respectively. A study of American Indian adolescents (grades 7 - 12) shows much higher overall rates, with a 31.8% lifetime prevalence for males and an almost equivalent 32.8% lifetime prevalence for females (Beauvais, Oetting & Edwards, 1985). Use during the last 30 days was slightly higher for females (9.1%) than males (7.6%). Interestingly, in Goldstein's (1976) survey of 2200 American Indian youth, 65% of the inhalant users were female and 35% were male. One population study in Mexico showed a four times higher rate for males. Some of these gender differences may be due to population differences, but Rosenberg et al. (1974) speculate that as attitudes toward drugs have become more liberal in recent times the male-female differences have tended to converge.

Ethnicity and Socioeconomic Status

It is a common finding that inhalant use is higher among minority groups. Higher rates of use have been found for American Indians (Beauvais et al., 1985), Hispanic youth in Los Angeles (Padilla et al., 1979), Canadian Indians (Boeckx et al., 1977) and Australian aboriginal groups (Nurcombe et al., 1970). Since minority status is often correlated with poor socioeconomic condition it is difficult to judge the effect of the latter. Several studies do report a strong relationship between low socioeconomic status and inhalant use (Elinson, 1964; Medina-Mora et al., 1978; Streicher et al., 1981). When prevalence rates are looked at in more general population studies, however, inhalant users are found equally distributed across socioeconomic strata (Gosset et al., 1971; Press & Done, 1967; Stephens et al., 1978).

The resolution to these conflicting findings may lie in the distinction between experimental and heavy or chronic use (Cohen, 1979). Studies of chronic users almost always identify these users as of lower socioeconomic status. The population studies usually do not discriminate between types of use.

The low base rate of heavy users may not effect the overall rates of use when all levels of user are combined. Each of the groups where inhalant use is a really serious problem is also a minority group that is physically isolated, and is severely disadvantaged. Those population studies that show no SES differences may not have adequately sampled these groups.

Family Structure

The research is nearly unanimous in finding family disruption as being associated with chronic inhalant abuse. The most extreme example is provided by Leal et al. (1978). They describe a group of young inhalant abusers (ages 13 - 16) in Mexico City who live in the streets and have either severed all ties with their family or have only sporadic and stormy contact with them. The families from which they come had a very high proportion of fathers missing. The lack of one parent in the home, usually the father, is a common theme in numerous other studies (Barnes, 1979; Guitierrez, Hernandez & Rabago, 1978; Korman, 1977; Reed & May, 1984; Sourindhrin & Baird, 1984). No consistent relationship has been found between size of family and inhalant abuse, although Gutierrez et al. (1978) argue that very large families were less able to provide adequate economic and emotional support for the young inhalant users they studied.

Socialization Links

These are the connections between individuals and the major elements of the social environment -- family, peers, school, community, etc.

Family Relationships

The disrupted family structure discussed above is a reflection of the general family dysfunction found among chronic inhalant abusers. Even when the family is intact, in families where a youth is abusing inhalants, family relationships, especially with the father, are poor (Babst et al., 1978; Barker & Adams, 1973; Gilbert, 1983; Harbin & Mazier, 1975; Press & Done, 1967).

Additionally, there are numerous studies showing extensive drug and alcohol abuse among the parents of inhalant abusers (Barnes, 1980; Berriel-Gonzalez et al., 1978; Blatherwick, 1972; Gutierrez et al., 1978; Massengale et al., 1963; Smart, Fejer & Alexander, 1970). Barnes (1979) found this relationship to be so strong that he included "Parental Drug Use" as one of four major causative factors in youth inhalant abuse.

Family Sanctions Against Inhalants

The disrupted family structure and the poor family relationships may have a further influence on inhalant abusers -- the lack of effective values antagonistic to inhalant use and, therefore, little restriction regarding use. In part this may be simply due to lack of supervision exemplified most clearly in Leal et al.'s (1978) description of the street children in Mexico City. In addition, however, there is evidence that even when families are intact there may be a general lack of concern about the welfare of the children, and specifically, there may be few sanctions against inhalant use. As an extreme example, one report from an American Indian community describes a family practice of passing around gas to inhale among all family members at the end of the evening meal (Boeckx et al., 1977).

School Success/Adjustment

Inhalant abusers have significant educational problem both in terms of achievement and adaptation to the school setting (Ackerly & Gibson, 1964; Nurcombe, 1970; Schottstaedt & Bjork, 1977). Barnes (1980) concluded that poor academic performance was not due to lower intelligence, rather to poor motivation. Korman et al. (1980) likewise found no difference in intelligence between inhalant abusers and non-drug users using an estimate of intelligence from the Psychiatric Interview Record. The existence of more specific cognitive deficits resulting from inhalant use and which could hinder school performance is open to question. A discussion of this issue appears in the next section.

Psychological Characteristics

Included in this category are the motivational, personality and psycho-pathological markers of chronic inhalant abusers. While it is possible to find studies on nearly every possible psychological trait, the discussion will focus on those areas where there seems to be some agreement.

Psychopathology

Most studies tend to find higher rates of chronic psychopathology, and thus a poorer prognosis, among inhalant users. Korman et al (1980) found higher levels of Personality Disorders and Drug Dependents among their group of 162 inhalant abusers. Alapon (1972), in a British and Polish sample, and Comstock (1978), in a Texas study in the U.S., recorded exceptionally high levels of psychiatric disorders. Korman (1977) examined the pooled MMPI data from two other studies and found a mean profile with elevations on Psychopathic Deviance, Schizophrenia and Mania.

Personality Traits

The data in this category are probably the least coherent since each of the many one-time studies employed different selections from a very wide range of scales. Despite the plethora of reported personality traits related to inhalant use, some common findings emerge. Many studies find inhalant abusers to have higher levels of depression and, in some cases, associated motor retardation and suicidal ideation (Barnes, 1980; Comstock, 1978; Gutierrez et al., 1978; Korman, 1977; Massengele, 1963; Torres-Ruiz, 1976). Other common findings are high levels of anxiety (Barnes, Comstock, Nurcombe) and of withdrawal (Barnes, 1980; Torres-Ruiz et al., 1976). Some authors conclude that inhalants are often used to reduce high levels of anxiety.

Even though depression and passivity are often present, there is also evidence for a considerable amount of aggressive behavior among inhalant abusers. Leal et al (1978) for instance, report extreme aggressiveness among the street youth in Mexico City. Korman et al. (1980) also reported high levels of aggressive behavior in a group of Texas inhalant abusers. May (1984), in contrasting inhalant abusing and non-abusing delinquents, found that abusers committed far higher levels of aggressive and violent crime than other delinquents. While the link between inhalant abusers and aggressiveness appears well-founded, it is not clear whether this behavior is due to the chemical effect or is a more general trait. Cohen (1977) tends towards the former belief and states "Those in the immediate vicinity of solvent intoxicated persons may be at risk because of their unpredictable, bizarre, impulse ridden behavior" (p.8).

Motivation

Only one study has directly examined motivation levels of inhalant abusers -- the results point clearly toward differences between inhalant users and users of other drugs (Matthews & Korman, 1981). In this study 188 inhalant users were compared with 157 heavy polydrug users and 157 light polydrug users. For each group four levels of motivation and seven levels of consequences of drug use were measured. The inhalant users were found to suffer much greater levels of negative consequences due to their use, and, as might be expected, had much higher levels of motivation to abuse substances -- primarily inhalants. The picture that emerges is of a group of adolescents desperately striving to relieve stress, even in the face of severe consequences. In a similar vein, Cohen (1979) observed that inhalant abusers, because of the effect of inhalants on the central nervous system, probably experienced more relief from anxiety than other drug users.

Acculturation/Marginality

The frequent observation of higher levels of inhalant abuse among minority groups has led to a great deal of emphasis on possible cultural explanations. These explanations do not, of course, apply to all inhalant abusers since inhalant abusers are found among people of all ethnic backgrounds and among those who share the culture of the majority population.

The cultural theories generally do not imply that specific cultural elements, such as beliefs or medical practices, inherently make people susceptible to inhalant use. Instead, a stress factor resulting from rapid acculturation is implicated in the genesis of inhalant abuse. Stress is typically then seen as leading to such psychological factors previously discussed as anxiety, depression or withdrawal resulting from alienation. For this reason acculturation is discussed here as a psychological variable rather than above under "Social Structure".

Nurcombe (1970) attributed the rapid deterioration of aboriginal traditional life to the high rates of inhalant abuse found among these groups. Many studies among American and Canadian Indians also point to cultural disintegration as a causative factor (Barnes, 1980; Berry & Annis, 1974; May, 1982; Schottstaedt & Bjork, 1977).

Gutierrez et al. (1976) used the construct of "marginality" to explain high rates of inhalant abuse in Monterey, Mexico. Their study populations were rural groups who had migrated to the city. While the migrants shared the same ethnic background as their urban counterparts, the transition from the rural to an urban environment was described as producing "culture shock." The attempts of these groups to integrate into city life were generally unsuccessful. And, having left behind the supportive environment of their rural homes, they became culturally "marginal." The stress generated led to the use of inhalants as a coping strategy, especially among the young. Similar conclusions were reached by Gilbert (1983) of a less transient, but still marginal group in central California in the United States.

Cognitive Deficits

While impairment in cognitive functioning has been mentioned in a number of studies (Allison & Jeromm, 1978; Berry, Heaton & Kirby, 1984; Korman et al., 1980, 1981; Fornazzari et al., 1983), the evidence is equivocal. The research designs

generally have not excluded pre-existing cognitive impairment, the use of other drugs, or immediate intoxication effects as possible explanations for the findings on cognitive impairment. Furthermore, there is no indication of whether the deficits were reversible with time. Until better controlled studies are conducted it must be concluded that cognitive functioning may be impaired to some extent during intoxication but long term effects are unknown.

Associated Behaviors

Inhalant abuse appears to be only one of a constellation of related anti-social behaviors. When inhalant abuse occurs it would be unusual not to find significant dysfunction in other areas. Jessor and Jessor (1977) have labelled these syndromes of acting out as "problem prone behaviors," and find them a common pattern among poorly socialized youth.

Other Drug Use

There is little question that inhalant abusers commonly use a variety of other drugs (Barnes, 1980; Beauvais et al., 1985; Korman, 1977; Stephens et al., 1976; Streicher et al., 1981). This general association may however obscure different patterns of drug use. One pattern may consist of polydrug users who use whatever is available and given the high availability, use inhalants frequently but not exclusively. A second pattern may be one of relatively pure inhalant abuse pretty much to the exclusion of other drugs. Matthews and Korman's study (1981) contrasting those who used primarily inhalants and polydrug users suggests significant differences between these two groups in terms of their motivation to use drugs and the consequences they suffered.

Crime and Delinquency

Reed and May (1984) reviewed the literature in this area which revealed a strong relationship between crime and inhalant abuse. In their subsequent study comparing inhalant abusers and other delinquents there was little question that the abusers were far more involved in almost every category of crime. Nearly identical findings were obtained by Lockhart and Lennox (1983) when they studied two groups of delinquent males in Northern Ireland. More seriously troubled youth in a "secure unit" used significantly higher levels of inhalants than those confined to a more open community center.

School and Employment Problems

The difficulties encountered by inhalant abusers in adjustment to the academic demands of school have already been discussed. Related to this are the findings of high truancy rates, dropping out of school (Barnes, 1980; Stephens et al., 1978; Medina-Mora et al., 1978) and negative interactions with school authorities (Korman, 1977).

When older inhalant abusers were studied, there was a pattern of employment problems as are reflected in the high rates of unemployment (Medina-Mora et al., 1978; Streicher et al., 1981).

Peer Influence

The body of literature on drug use in general, especially as it applies to adolescents, makes it very clear that the encouragement and support from peers to use drugs is a central factor in drug involvement. This idea is so well accepted that many investigators think that there is little need for further investigation. There is, however, a substantial body of research demonstrating the potency of peers in sustaining inhalant abuse. The most striking example of peer influence comes once again from the study of street children in Mexico City (Leal et al., 1978). These young people have, for the most part, severed all ties with their families and are living independently in small groups. Interestingly, roles developed within these groups in some ways resembled those of the family. Much of the direction provided by these roles, however, surrounded the acquisition and use of inhalants as well as alcohol and other drugs. The groups provided the total context for inhalant abuse, from decisions about how to obtain money for inhalants to providing help for those who got into trouble either for stealing or from other inhalant related activities.

While the above group is extreme, it does illustrate the types of influences which peers can provide even in more normal contexts. Most studies report that inhalant use occurs in groups, although once the behavior is established solitary use may occasionally take place (Clements & Simpson, 1978; Cohen, 1978; Kaufman, 1973; Medina-Mora et al., 1978; Nurcombe et al., 1970). Even in Streicher et al.'s (1981) sample of toluene sniffing adults there was a great deal of group activity, although being a more chronic group, there was also a lot of solitary use.

It is also evident that one's peers are important in initiating inhalant use. Two thirds of Berriel-Gonzales' (1978) subjects began use at the invitation of a friend or relative.

FIGURE 1
A MODEL OF INHALANT ABUSE

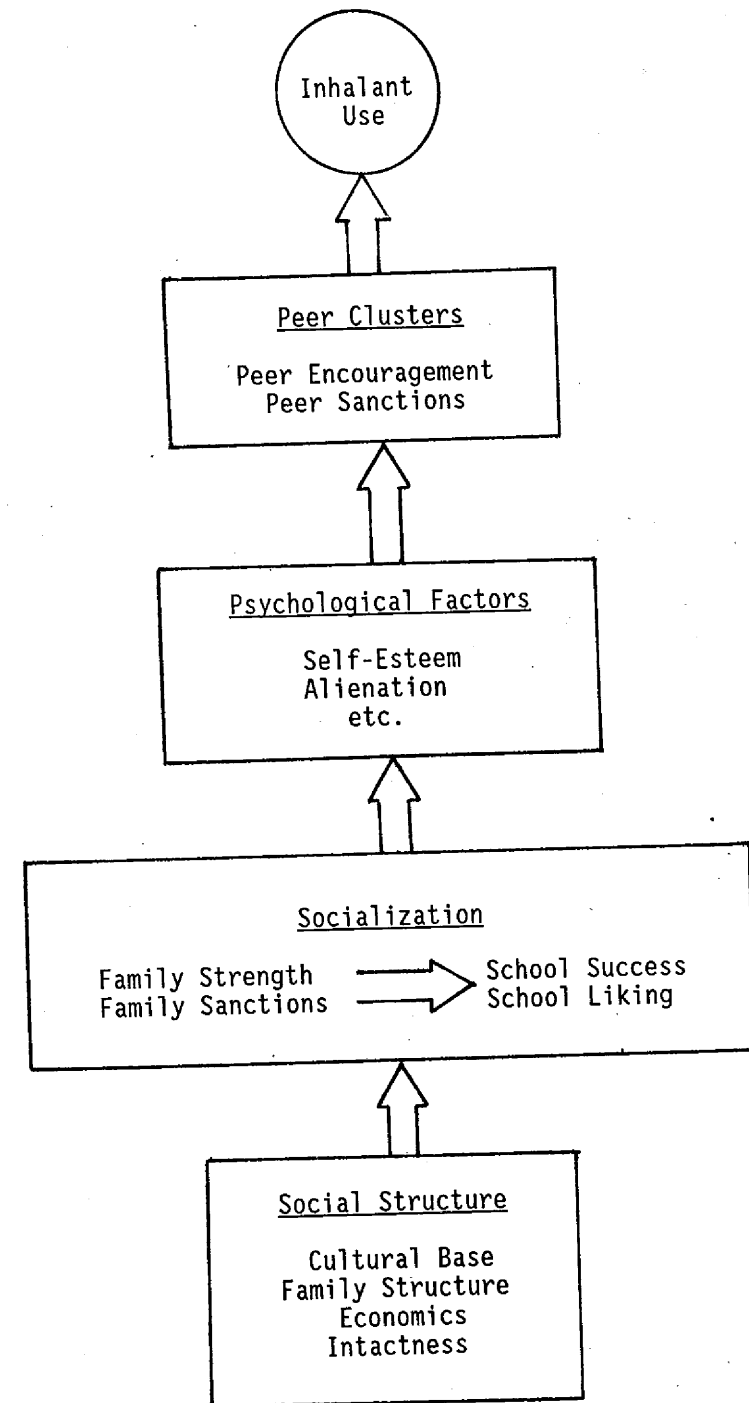
Mesteth (1968) reports that 75% of his American Indian sample started use because of friends or relatives. Another finding supporting the importance of peers is the large percentage of friends who also use inhalants (Stephens et al., 1978). Smart, Fejer and White (1970) demonstrated that, in addition to friends, a high percentage of inhalant users had siblings who also used inhalants.

Beauvais et al. (1985), in order to take a closer look at the mechanism of peer influence, separated the construct into two components -- encouragement to use inhalants and sanctions against its use. Each factor operated independently in their sample of nearly 1400 American Indian adolescents. For instance, it was possible to find youths who had friends who encouraged inhalant use but had other friends who applied strong negative sanctions. The most important finding emerged when the extreme combinations of peer influence were compared. Among youth who reported low encouragement from their friends and strong sanctions against use, 19% had tried inhalants and 3% had used in the last month. By contrast, those youth reporting high encouragement and weak sanctions, 84% had tried inhalants and 41% had used recently. The power of these two factors is evident. Interestingly, nearly one-third of the sample reported a combination of both high encouragement and strong negative sanctions. Their lifetime use and past month use were 37% and 12% respectively. This might indicate that the instillation of sanctions within groups of young people might be a better preventive strategy than trying to reduce encouragement. Active, strong messages against inhalant use from peers seem to have a significant effect.

A Model of Inhalant Abuse

A large number of factors found to be characteristic of inhalant abusers have been discussed. They have generally been grouped under the headings of Social Structure, Socialization Links, Psychological Characteristics, Associated Behaviours and Peer Influence. Previous theories advanced by Matthews and Korman (1981) and Barnes (1979) see a causative path from stress produced by a dysfunctional social structure and socialization to ineffective intrapersonal (i.e. psychological) attempts to cope with this stress to the use of inhalants as a maladaptive strategy to reduce stress.

Another model is proposed here which uses essentially the same domains of variables but orders them somewhat differently and incorporates peer influence as the most powerful factor in the development of inhalant use (Oetting & Beauvais, in press). Figure 1 shows the ordering of the variable domains. In its



simplest form the model proposes that there are underlying conditions that make an individual susceptible to inhalant use. These are a combination of social factors (i.e. Social Structure and Socialization Links) and psychological characteristics. These variables interact to form a substrate that can make an individual susceptible to inhalant use, or alternatively, inoculate them against use. These variables are truly interactive and it is difficult to specify which is prepotent to the other. From a time perspective, it may be reasonable to place the social factors first. For example, the existence of a disrupted family structure probably precedes the stress experienced by a child. However, once the process has begun, all social and psychological factors assume a reciprocal causality. For instance, a child with inadequate parenting, and thus psychological stress, will likely experience difficulties with other social systems, especially the schools. Conflicts with the school, even to the point of dismissal, may lead to further intrapersonal stress, and so on. This is the fertile ground that sets the stage for the development of inhalant use.

When inhalant use appears, however, it is always a reflection of the peer group. The literature makes this clear. Friends, acquaintances and siblings provide access to inhalants and teach the young person how to use them. Peers shape attitudes and provide the social context for use. When young people share their ideas, they help form the rationales that the youth use to explain and excuse drug use. Eventually small groups form that use inhalants together, use them at particular times and places in the same way, and share the same ideas, values and beliefs about inhalants. These groups have been labeled "peer clusters" (Oetting & Beauvais, in press). When the group is involved with inhalants, those inhalants may play an important part in defining the group, in maintaining its structure and in shaping its actions. In addition, as seen in the previous discussion, inhalant "peer clusters" not only use inhalants but may engage in a variety of "associated behaviours" such as crime.

The peer cluster construct is a much narrower and more specific mechanism than the general construct of peer influence. It specifies the functions played by peers in the initiation and perpetuation of inhalant use. And, within the model presented here, it places peers as the crucial intervening variable in the inhalant abuse process.

The salience of peers in the process of drug abuse was demonstrated in path analyses recently conducted by the author and his colleague (Oetting & Beauvais, 1985). Peer influence was found to be the most proximal link to drug use in the path

structure with the other variables being placed much further back in the path. Peer influence accounted for 95% of the predictable variance in drug use. After peer influence was accounted for, all other social variables only added 5% to the predictable variance.

Recognition of the importance of peer clusters has many implications for treatment. Further discussion of this is beyond the scope of this paper although one critical aspect will be mentioned. It is often tempting to place inhalant-using youth or those at risk together in a treatment facility. While this may provide some advantages in terms of resources and staffing it may also serve to help foster the formation of inhalant using peer clusters. It may be more effective to develop strategies for working with youth and their peer clusters in their normal environments where attempts can be made to break up inhalant-using clusters, or to weaken the bonds between a youth and the cluster.

Summary

The evidence from research studies has been helpful in pointing towards those groups at high risk for inhalant abuse. No one description can include everyone who may possibly use inhalants, but enough is known to target for intervention those groups who are most susceptible to inhalant use.

Certain background conditions are likely to set the stage. Families from ghetto or culturally marginal areas suffer many forms of disadvantages. They are cut off from the goals of the society in which they live and do not have the economic or educational tools for success. The stresses induced by these conditions can lead to serious breakdowns in the structure and functioning of the family. Children from these families, lacking the nurturance and psychological health needed to successfully encounter the many demands of society, are early on confronted with a number of conflicts. They are likely to do poorly in school and have few other opportunities to develop a sense of competence and self esteem. At this point psychological and social deficits become interactive leading to further levels of dysfunction among many youths.

The stage is now set. Youth who have been cut off from familial and other adult support and guidance seek support from among their peers. Unfortunately, their peers fare little better and the group seeks ways of reducing stress and conflict in their lives. Inhalants are cheap and available in these surroundings and are an easy route to relief. These groups, or peer clusters, actively encourage one another in their use of

inhalants and provide few or no sanctions against use. Inhalants are used in the group and the group devises strategies for obtaining supplies. Theft and other forms of crime become common. Over time, rationales or reasons for use evolve -- these not only reinforce the behavior within the group but also provide the "advertisement" by which other marginal youth become attracted to the peer cluster. Once inhalant use becomes firmly established within the peer cluster some youth may become so involved with the substances that some solitary use develops and some youth enter into long term chronic patterns that may extend into adulthood.

Inhalant abuse is not simply an individual pathology -- it is a group function or a group action. The "problem prone" youth is more likely to join an inhalant-using group or to help lead the group toward inhalants, but if effective action is to be taken, it must deal with the peer clusters, not merely with the individual troubled youth.

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CLINICAL AND MEDICAL
MANIFESTATIONS OF VOLATILE SOLVENTS

Dr. C.W. Sharp

To correlate specific clinical symptoms of humans that result from exposure to various volatile chemicals is not easy. First and foremost, it is difficult to find suitable human subjects to study. One does not usually want to study those subjects reported in surveys who have used once or less in the last 30 days. Only those who inhale several times weekly or repeatedly go on "binges" for hours at a time or on weekends are likely to show any symptoms of toxicity. Sometimes months to years of exposure are necessary for the expression of some disease states. In any large general drug survey of thousands, no more than 30 persons are likely to meet such conditions. Thus identification in such surveys of inhalant abusers whose health is compromised is low.

With many drugs, subjects are often admitted to hospitals for problems associated with those drugs such as overdose or dependency. However, this by and large is not a way to access inhalant abusers whose disease state is seldom identified as resulting from inhalant use in out-patient clinics or hospitals. These subjects are also poorly represented in many drug treatment programmes.

As with most drug dependent subjects, these are poly drug users - these may have the widest drug repertoire of all. Therefore, any clinical symptoms identified in these subjects may be related to other drugs or substances as well as to inhalants. Because of this broad drug repertoire and other environmental factors, it seems that the 'inhalant use' category is often missed or poorly detailed in drug histories or other aspects of the general clinical workup of these subjects when they are encountered in the clinics.

The bottom line is that many clinical inhalant abuse studies are conducted on very few subjects. Therefore, with few exceptions, despite its severe limitations anecdotal data remains the best source of information on inhalant abusers. In this review we will also utilize clinical epidemiological studies as well as retrospective clinical case studies, whether from abuse or occupational exposures, to identify particular hazards that may result from inhalation exposure.

There are, in addition to the numerous deficiencies inherent in retrospective studies, the confounding problems relating to the identification of the substances in the mixtures. Not only do the items selected vary from month to month and place to place but also the ingredients in each product vary over time. In addition, even when a specific commercial item is identified as the likely health hazard it is difficult to ascertain many of the substances contained therein and even more importantly the percent composition of each.

It is also worth restating some of the obvious limitations to any human studies. Probably of most importance are the determination of all the confounding variables (e.g. other drugs, alcohol, smoking, city or industrial environment; nutrition and other health problems) that may be relevant to the identified problems under study. In addition to these external factors, genetic factors seen in hypersusceptible individuals may be responsible for augmentation of the toxic reaction if not directly for some of the incidences themselves. Another unknown factor is how the basic neurophysiology of the type of person who becomes dependent on drugs especially solvents, may be manifest in the test results of these individuals as well as in their clinical symptoms.

First, I would like to summarize some of the lethal consequences of inhalant drug abuse. There have been numerous deaths attributed to solvent toxicity over the last twenty-five to thirty years (Bass, 1970, 1978, 1984; Garriott and Petty, 1980; Kringsholm, 1980; Anderson et al., 1985). In the 60's and 70's in the United States, the fluorocarbon deaths appeared to be most conspicuous due to the number of related cases and also because of the associated ventricular fibrillations or induced cardiac arrhythmias. These deaths have declined in the United States due to the restriction in 1980 of the use of fluorocarbons in aerosols. However, aerosol fluorocarbons still appear to be of major concern in England (Anderson et al., 1985) and probably elsewhere. It is not as evident but the results of several cases link fibrillation or other cardiac insufficiencies to the use of other halocarbons (Spencer et al., 1976; Yamashita et al., 1984; Nouchi et al., 1984; Gresham and Treip, 1983). These chlorinated hydrocarbons are associated with numerous deaths in England (Anderson et al., 1985; Jones and Winter, 1983) and Denmark (Kringsholm, 1980) as well as in the United States and elsewhere. These products range from hospital anesthetics (halothane) to the more common solvents (di-, tri-, tetrachloroethanes, trichloroethylene). The desire to substitute these for toluene may be contraindicated on this basis since fewer cardiac arrhythmias have been reported in toluene associated deaths. However, a recent non-fatal

respiratory arrest has been associated with solvents (containing toluene) abuse (Cronk et al., 1985). In addition liver toxicities were noted in some lethal cases where halogenated hydrocarbons were used (Garriott and Petty, 1980).

More recently another source of chlorohydrocarbons derived from correction fluids has been judged the cause of death (King et al., 1985). Respiratory complications have also been noted in deaths of inhalant abusers (Mee and Wright, 1980; Lecombe et al., 1983). The respiratory ailments in some cases are likely exacerbated or caused by smoking and other factors. Despite the identification of direct cardiotoxic effects, most deaths appear to result from asphyxia directly (such as a bag over the head) or indirectly by solvent displacement or by inhalation of stomach contents (Anderson et al., 1985).

The increase in the use of rags soaked in solvent and applied to oral cavities (a practice common in the United States) rather than inhalation from bags, and the setting of outdoor areas, contrasted with closets or closed spaces, may lead to a decrease in the number of deaths. Overall, it is difficult, however, to determine just how many deaths result from solvent inhalation. The medical examination seldom includes measures of solvents or metabolites in the body either of which are difficult to measure under the best of circumstances. Only occasionally do they check for tell-tale signs of solvent abuse or inquire sufficiently into the individuals lifestyle to correlate death with inhalant use. It is interesting to note that with the recent reports of deaths due to ether in Denmark and other reports of chloroform parties (Hutchens and Kung, 1985), we now seem to have gone full circle to where inhalant abuse began in the mid 1800's with the advent of these anesthetics.

Of greater concern are the debilitating disease states that arise from inhalant abuse. Central neurological disorders, peripheral associated neuropathies, and neurotoxicities in general are probably, the diseases of greatest concern for inhalant abusers; yet they are the least well documented of all the conditions resulting from inhalant abuse. These and other disease states will be discussed in relation to the exposure from various types of organic solvents used to expose these individuals. Even under the best conditions the various methods used to correlate these dysfunctions with any specific solvent or additive, or even inhalant exposure itself, have severe limitations; thus the conclusions are often very tentative. In the following, I will identify some of the more probable hazards, only a few of which have been verified through animal studies or carefully detailed studies of repeated analyses of human subjects.

Probably the currently most widely abused substances, at least in the United States, are the spray paints. Painters also abuse these substances and have been widely studied in Scandinavian countries. The exposure to these and similar substances have been the most common cause of hospitalization of inhalant abusers. The primary reason for hospitalization has been severe muscle cramps ranging up to paralysis with or without associated gastrointestinal (GI) involvement, including vomiting (see Group A, in the Table). Some years ago Streicher et al., 1981, identified the occurrence of distal renal acidosis in groups of paint and/or glue sniffers from the Southwest and Hawaii. Although these were not the first reports of renal dysfunction associated with these solvents of abuse, it was endemic to these groups and the disease state reoccurred in many individuals who returned to their habit. Their symptoms include hyperchloremic metabolic acidosis, hypokalemia, hypocalcemia and other electrolyte imbalances. Also, glomerulonephritis has been identified in workers using solvents -- especially painters (Ravnskov et al., 1978). As identified in group A, several kinds of solvent mixtures are correlated with symptoms of glomerulonephritis or distal renal tubular acidosis -- although these somewhat different diseases do not usually occur in the same individuals. Although metallic spray paints are the type most often used, there has been no good clue as to which chemicals produce these kidney diseases. Attempts to reproduce these symptoms in animals using toluene (one of the more common chemicals) have not been successful; it is very possible that these symptoms are due to a combination of toxicants -- possibly including the metals contained in the spray paint such as Cd and Pb which are nephrotoxic (Wedeen, 1984) or concurrent alcohol use or infections.

In this regard, it is interesting to note one study (Ravnskov, 1978) which shows an association between infection and glomerulonephritic changes. Shortly after a sore throat or a defined infection occurred, the subjects were exposed to paints, glues or thinners in an occupational setting and subsequently developed renal malfunctions. The unusual finding of another kidney ailment (recurring calculi formation) in one subject (Kroeger et al., 1980) may represent his use of different solvents or maybe more likely a unique sensitivity of that individual to these substances and/or his environment. Although glomerulonephritis is considered an advanced stage of kidney damage probably resulting from continuous perturbations of the tubules (Kluwe et al., 1984), earlier stages of milder tubular lesions may occur and go undetected in individuals exposed for shorter periods or under less extreme conditions. Thus, it is important that individuals exposed to high doses of solvents be checked for nephrotic changes.

I think it is important to point out that renal acidosis or glomerulonephritis (Ravnskov, 1978) is often correlated with exposure to toluene and/or toluene containing substances but usually there is no analysis of even the most common substance or product used (Kroeger et al., 1980) or any measure of the blood or urine for specific substances. Toluene may sometimes be present only in very small amounts in these products which contain many other substances; therefore other factors probably are as, if not more, important in determining the outcome. These may include combined alcohol (or other drug use), infectious diseases and possibly nutrition as important factors.

In some studies (Bartolucci and Pellettier, 1984), there are indications that the CNS as well as the kidney may be affected from sniffing these types of products. A "toluene-glue" sniffer "had a metabolic acidosis" and "was completely disoriented, incoherent and extremely aggressive." As many "paint sniffers" or "glue sniffers" are described by the latter conditions, it may well be important to determine the electrolyte imbalance of more of these individuals. Although electrolyte supplement may resolve both the muscle incoordination as well as the CNS effects, it is unclear how or whether the two conditions are connected. One group (Bartolucci and Pellettier, 1984) felt their patients were unusual in that they had a choreoathetotic movement that could be treated with neuroleptics. However, as electrolyte repletion often corrects muscle spasms etc., the use of neuroleptics for these symptoms may not be indicated or necessary. However, treatment of any lingering psychosis should be treated independently and the neuroleptic drug not used as a "solvent replacement." i.e. treat the condition, but do not remove the "drug".

Although most subjects with electrolyte imbalance have responded to treatment, one subject died despite a reasonable period of electrolyte replenishment (Kirk et al., 1984). Muscle weakness, ataxia or other mild peripheral anomalies were also present in these individuals. As noted above, occasionally these subjects show CNS abnormalities (seizure, dysarthria).

The limited occurrence of these symptoms in any pronounced manner could indicate their expression is not primarily due to any of the solvents inhaled but to other substances and/or predisposed physiological states. It could also be that these symptoms are indicative of a more heavily exposed individual.

One case report (Ehyai and Freeman, 1983) was of interest in that only minor neurological and muscular dysfunction was noted on the first examination. However, 2 years later the subject showed clinical metabolic acidosis; also, vision and hearing loss were present. It is unfortunate that little is known about

the type of solvent and other important environmental factors that may have contributed to the change in conditions from the first visit to the second.

The importance of good drug histories and the precise identification of the most important agents that contribute to a condition may also be emphasized by another study. Although this group (Fischman and Oster, 1979) identified renal dysfunction in several subjects, they originally reported that toluene derived from transmission fluid caused the problem. It was quickly pointed out to them that toluene is not present in commercial transmission fluid. They state that they positively identified toluene by chemical analysis but did not indicate the details of this analysis. As the products these subjects used may not have been commercial transmission fluid the presence of substances other than toluene is very possible. Thus, all toxicants(s) contributing to these subjects' symptoms may not yet be identified.

The term "organic brain syndrome" has been thrown about loosely and frequently when describing inhalant abusers. Although in the past, persistent neuropathies have been rarely demonstrated, a few have been recently described in more detail. This is partly due to improved diagnostic and evaluation techniques available to the clinician in determining the extent of any neurobiological deficit (Prockop, 1977; Rosen, 1984; Wennberg, 1984). Even using the best techniques it is often difficult to associate any specific irreversible neurological deficit to a specific substance or to inhalant exposure. It is obvious that during the acute stages of inhalation, CNS and peripheral nerve conductions are impaired. However, most subjects are greatly improved if not normal a few days after inhalation of these products ceases. In addition many other factors including the environment, genetic variables, dietetic variables, and other drugs all contribute in distinctly different ways. For example, lead has often been found in inhalant abusers - especially gasoline sniffers - which by itself causes neuropathies. Therefore, one cannot expect to readily identify any specific symptom relative to a specific solvent to be present in the individuals who inhale a variety of solvents and take other drugs. It is worth noting here that only a few neuropathies have been corroborated or identified in animal studies (see Pryor's review). Those key elements that lead to differing degrees of renal and CNS dysfunction after glue or paint sniffing are difficult to determine. With the knowledge at hand, neither products nor the extent of inhalation seem to be important criteria in determining which area is affected.

Still, for two to three decades now, nervous system dysfunctions have been identified with inhalation abuse (Group B, in the Table). I will try to summarize what appears to be the most salient neurological dysfunctions related to solvent abuse. Although muscle incoordination such as ataxia or tremors may be due to hypokalemia, there may also be direct actions of the solvent on the neurons. Also, some affectation of cortical and hippocampal dysfunction may be directly related to solvent toxicity. For example, hearing loss was identified to result from toluene in animals (see Pryor's paper) at about the same time as several clinical studies (Ehyar & Freeman, 1983; Metrick & Brenner, 1982; Lazar et al., 1983) identified the problem in inhalant abusers. This dysfunction does not appear to be reversible if the exposure has reached certain limits. Also, a recent study of painters, printers and petrol truck drivers identified audiological changes derived from chemical exposures in an occupational setting (Bergholtz and Odkvist, 1984).

There are some other central effects which may or may not be reversible. In many subjects enlarged ventricles (cerebral, cerebellar or other atrophy as defined by computerized tomography scans (CAT) and/or EEG measures have been noted. Little is known about the outcome of subjects identified as having cerebral atrophy with the exception of a followup study of house painters (Bruhn et al., 1981). There was little recovery (as noted by CT scans) observed for subjects in this group. The older age range of this group may be an indication of an irreversibility of this condition as one becomes older. The occurrence of tremors may also indicate a more extensive exposure to paints or the presence of and exposure to different materials as severe symptoms of this type to be less frequently noted in "paint spray" inhalant abusers. In milder cases, symptoms may not persist longer than a few weeks in those subjects who no longer inhale and are under good nutritional care. One study demonstrates the importance of obtaining complete clinical histories to learn all the possible contributory factors (Allister et al., 1979). Although, the solvent may have triggered the seizures in this individual, it seems likely that the subject was conditioned to this state by a high fever in early childhood and/or a genetic predisposition. In animals, seizures have been noted for some solvents whereas others may reduce them (see Pryor). Thus, one should be very careful before stating that any specific solvent leads to seizures in humans.

Even when the composition is known, it is important to know that the volatilization of each substance is different. Testing the vapor composition in a bag (Takeuchi et al., 1981), the thinner composition shown in the Table in the ratio 7:2:1:0.3:0.3 for the solution changed to 12:12:2:5:x in the early vapour phase. Thus, both the acetate and the alcohol were

proportionately higher in the vapor phase. It is well known that the concentration of individual components of a mixture in the solvent vapor differ from the early periods of volatilization to the last drops to be volatilized. Thus, an early sniff of the bag mixture will therefore have an entirely different composition than the final sniff.

An early study by Knox and Nelson (1966) illustrates the problem of identifying the causative agent. The subject started off with glue, gasoline, acetone and benzene before settling down with "pure toluene" (bought from a commercial supplier). What hospitalized the subject was the use of carbontetrachloride which he used when he could not get the toluene. The hepatic toxicities were most likely related to the carbontetrachloride but the nystagmus, dysarthria, enlarged ventricles and abnormal EEG could have resulted from any one or several of the agents.

A most dramatic and insidious CNS effect of solvent intoxication has been recently established. Coincidentally, animal and detailed human studies were characterizing these audiotoxicities. Although several studies have identified hearing losses in inhalant abusers (Group C in the Table), Metrick and Brenner (1982) precisely measured the changes by measuring brain stem auditory responses (BAER); very similar to that observed in rats after toluene exposure (see Pryor). In this case the audiotoxicity can be correlated to one specific group of compounds; mono-, or dimethyl-benzenes. Whether non-methylated benzene compounds also lead to this toxicity is unknown. Although many CNS effects were noted, no electrolyte imbalances were observed in these subjects. Although one study of impaired auditory evoked potential (with learning problems) and other CNS impairments (Lazar et al., 1983) indicated these effects may diminish with time, Metrick's and Brenner's more detailed studies as well as the animal studies indicate little change over time. A similar audiotoxicity has occurred in an industrial accident (Biscaldi et al., 1981). One report on CNS toxicities of solvent exposures are interesting in that both subjects were believed to be heavily exposed to a solvent containing only toluene (Boor and Hurtig, 1977). The apparent heavier user showed a distinct "pancerebellar syndrome" that persisted months later (laquer thinner user) while the other less heavy user showed a normal EEG but had a high frequency hearing loss in the right ear (toluol user). It is interesting that they observed no abnormal auditory signs in the heaviest user. As the heaviest user was intentionally using drugs (mainly solvents) and the other was exposed in his professional duties; could an inadequate diet or other environmental factors be contributory to the cerebral atrophy observed in the inhalant abuser?

Reports of other CNS effects related to glue sniffing include optic neuropathy (Ehyai et al., 1983) and hallucinations (Channer and Stanley, 1983). Hallucinations are often associated with inhalant abuse. This seldom is seen or identified in studies of groups of inhalant abusers and may be expressed only in certain susceptible individuals or as a high state of intoxication. Based on the numerous studies and reports I have read, hallucinations are not any more common in inhalant abusers than in alcohol users. However, there is strong evidence that inhalant users are more aggressive. This latter state may be related to the hallucinations. However, a direct effect of solvents on nerve conduction leading to neurological discharges that mimic a "crawling insect feeling" (see Goldings and Stewart, 1982) may be the basis for the instigation of severe hallucinations. It is evident that a more comprehensive study of these individuals is needed.

Visual damage is difficult to determine in animals except when indicated by measures of the visual evoked responses (VERS). However, several studies indicate mild to extreme visual (VERS verified) anomalies (Keane, 1978; Ehyai and Freemon, 1983; Malm and Lying-Tunell, 1980; Metrick and Brenner, 1982; Lazar et al., 1983; Berg, 1971). Whether these are related to the extent of solvent inhalation and/or other mitigating factors (e.g. diet, environment, genetic predisposition, other solvents, other drugs), is not at all clear. If the other groupings (e.g. Group A, Group B, etc. in the chart) are meaningful; the optineuropathies become even less understandable as they are infrequently represented in any group.

Despite the likelihood that solvents irritate the lungs, there have been few cases noted where the pulmonary system is severely compromised. Solvents have nevertheless been noted to affect the pulmonary pathways and alveoli. In some reports (Group D in the Table) pulmonary hypertension, higher residual volume and restrictive ventilation are the common findings. However, there was no electrolyte imbalance noted in these cases even though high concentrations of toluene were present in the compounds used by one group (Schikler et al., 1984). Smoking may have been a contributory factor in one study (Schikler et al., 1984) and was not ruled out in the others. In another study of a group of workers using waterproofing aerosols containing trichloroethane (Woo, 1983), acute respiratory distress has also been noted. Although solvents irritate the pulmonary system, it is not at all clear from the limited studies to date how extensive or what types of pulmonary damage one might expect. Any change may be very slow in onset but most likely will be enhanced by the other substances volatilized along with the solvent (e.g. polystyrenes, tars) or utilized by the subject (e.g. tobacco). Because of the potential for cause and augmentation, the amount of smoking should always be considered in any studies on pulmonary function.

One of the more rigorous studies and now classical examples of solvent toxicity is the neuropathy caused by hexane and its metabolites (see Group E in the Table; Couri and Milks, 1982; Spencer et al., 1980). New individual cases are still being reported (Tenenbein et al., 1984) together with industrial cases (Passero et al., 1983) which demonstrate that peripheral neuropathies continue to occur despite efforts to reduce the hexane and methylbutyl-ketone contents of many products. Prockop and colleagues (Means et al., 1976) identified a thinner that produced a severe peripheral neuropathy in several inhalant abusers. In the final analysis the symptoms were believed to result from the 15% heptanone and/or 0.5% hexane present in the thinner. Whether the other chemicals present in the thinner exacerbated the condition or caused other neurological manifestations are still unknown. The "hexane" type syndrome includes "both sensory and motor neuropathy." "Microscopic examination has revealed axonal swelling, accumulation of neurofilaments in axons, myelin thinning and denudation, and the skeletal muscle changes of neurogenic atrophy" (Prockop, 1979). When these conditions are apparent one should be alert for the possibility that the subject may have been exposed to hexane or related ketones even if the original case history does not identify any of these substances. In one case, it was the clinicians' pursuit of the precise nature of the product being inhaled. The child said it was gasoline but in reality it was naphtha with a much higher hexane content of 20% that enabled a better diagnosis of the cause of the peripheral muscle weakness in these recent cases (Tenenbein, 1984). It is a valuable lesson in the study of clinical symptoms. Not only should the condition be carefully monitored and evaluated but in depth pursuit of the identity of any and all substances used by the subject and the environment should be evaluated. One should at least analyze a sample of any product being used with appropriate high resolution gas chromatography or other techniques when called for.

In addition to this well characterized peripheral neuropathy associated with 2-ketones, others have been described. One peripheral neuropathy case was not linked to hexane type compounds although gasoline (which usually contains a small amount of hexanes) was one of the substances abused (Gallassi et al., 1980). They observed no axonal swelling characteristic of the hexane type neuropathy. They also found no CNS involvement typical of "leaded" gasoline (with tetraethyl-lead) toxicity. No value for the within normal range of lead found in the serum was presented. Another peripheral neuropathy noted by Devathanan et al. (1984) for children solvent abusers in Singapore more clearly resembles that in subjects exposed to methylbutylketone (MBK) or hexane (Spencer et al., 1980). That

is, they have a severe peripheral neuropathy without reflexes, a condition not often observed in inhalant abusers in the United States where MBK is less common in commercial preparations. Although the investigators identified only toluene, MBK type components may have also been present in the rubber solution or in the petrol or thinner also used by these subjects and inhaled in sufficient quantities to cause this neuropathy.

One area of solvent abuse, gasoline (Group F in the Table) needs emphasis from two directions - one, that the main toxicity appears to result from the tetraethyl lead (or its metabolite triethyl lead) and the other, that any solvent abuser probably exposes himself to sufficient amounts of gasoline to result in some "lead" toxicity. In all cases where high lead levels are observed, there are hallucinations and disorientation ranging to dysarthria, chorea and convulsions. The symptoms also have included moderate to severe ataxia, insomnia, anorexia, slowed peripheral nerve conduction, limb tremors, dysmetria and sometimes limb paralysis. In most cases the EEG is normal but in severe states, an abnormal to severely depressed cortical EEG is observed. Only in one lethal case was there any kidney damage noted; electrolytes are usually in the normal range. Because many of these symptoms in the early stages of the disease can be reversed by chelation therapy with EDTA, BAL and/or penicillamine, it is important to check the serum lead levels in any chronic inhalant abuser to see if this treatment should be prescribed.

One subject exposed primarily to naphtha (hexane) before the first visit exhibited a peripheral neuropathy expected for hexane (Tenenbein, 1984).

However, two years after treatment for this, the subject apparently switched to regular gasoline and upon readmission showed an abnormally high serum lead level. The symptoms observed the second time more closely resembled those described for leaded gasoline.

Although this review does not cover methanol, this substance is common in thinners and paint removers. An early report of a subject using paint remover containing methanol showed retrobulbar involvement. However, the investigator stated the symptoms were not those representative of methanol toxicity (Berg, 1971). Maybe methyl ethyl ketone, a very common constituent of this type of commercial product, modifies the methanol effects or causes similar effects when present with other substances.

Although few examples of solvent interactions have been identified, a few years ago workers, who had been exposed to spot remover (trichloroethylenes and perchloroethanes), subsequently drank alcoholic beverages and had a severe facial flush. This became known as "degreaser's flush" (Stewart et al., 1974). Although this was one of the first solvent-drug interactions recorded; other solvent interactions may be identified in more careful analyses and follow-up of human case or group studies.

Subjects over exposed to chlorohydrocarbons have been known to exhibit hepato-renal toxicities (Baerg et al., 1970; Clearfield, 1970); this is a well established phenomenon corroborated by animal studies (see Pryor). Any individual exposing him/herself to these compounds would expect to develop hepato-renal toxicities depending on the dose and time of exposure (Buring et al., 1985). Thus, the recent increase in the inhalation of correction fluids which contain trichloroethylene and tri-, tetrachloroethanes increases the likelihood of observing more of these toxicities in inhalant abusers. This disease state is exemplified in two recent reports of apparent occupational (poorly ventilated areas) over-exposure. Extreme nephronocrosis and associated hepato-toxicity were observed after exposure to mixtures containing methylene chloride and other halocarbons. Although the conditions were attributed to the methylene chloride in the mixtures, methanol (Miller et al., 1985) and trichloroethane (Keogh et al., 1984) were also identified in the inhaled compounds used by these subjects. As few cases such as these have been noted for methylene chloride (Cherry et al., 1981) other factors may have been important in the etiology of the disease condition. Most reports of methylene chloride exposure have been concerned with an increase in carboxyhemoglobin levels (a condition which also occurs with cigarette smoking) and toxic symptoms related thereto. In addition to the aforementioned toxicities, there is increasing evidence that anaesthetic chlorinated hydrocarbons (halothane, trichloroethylene, chloroform) are carcinogenic (Cohen, 1979) and have been associated with spontaneous abortions (Buring et al., 1985). Also, hematopoietic effects were identified in a subject using glue (trichloroethylene) in his hobby; cessation of the symptoms occurred when he ceased his hobby (Pinkhas et al., 1972). Although this condition may have resulted from different solvents used in his hobby, it also may be a result of the individual's sensitivity.

Toxicologists are often concerned about absorption of solvents through the skin and the resulting health consequences. Any long term effects are difficult to evaluate because one is always breathing in the fumes that are in contact

with the skin. Thus inhalation may cause higher levels of these substances than that occurring through skin absorption. However, some acute episodes have shown that contact dermatitis occurs in subjects that did not suffer any internal toxicities, i.e., no neurological or renal dysfunctions (Wells & Waldron, 1984; Hansbrough et al., 1985) or acute solvent-induced narcosis. This occurred after parts of the body were soaked in the solvent for 15 - 30 minutes. In these instances the skin was almost keratinized.

Two other substances are often considered as inhalants but are unique both chemically and in their physiological action, as well as in the primary group using them and also in their marketing. The first substance, nitrous oxide, is used as an anesthetic and as a propellant primarily for whipped cream. Laughing gas (N_2O) as it is euphemistically called was abused soon after it was discovered in the late nineteenth century. Only in the past decade was it known that central and peripheral nerve damage resulted following high levels of N_2O exposure, even in the presence of adequate oxygen. The symptoms include numbness and weakness in the limbs, loss of dexterity, sensory loss and loss of balance. The neurological examination indicates sensorimotor polyneuropathy of the posterior and lateral columns of the cord (Layzer, 1978). Studies focusing on the mechanism of action indicate that cobalamins are inactivated by N_2O . Vitamin B_{12} does not aid recovery from this disease (Chañarin, 1980). Rehabilitation proceeds with abstinence and is relative to the extent of neurological damage. Despite the widespread distribution of this information to the medical community and the reduced availability of metal cylinders, cases are still being observed (Schwartz and Calihan, 1984).

Another group of substances, volatile liquid organic nitrites, are also used medicinally as vasodilators to treat angina pectoris, although much less today. Although they are not usually considered solvents, they are often included in "inhalant abuse." As with nitrous oxide, a different group of individuals inhale isoamyl ('amyl') or isobutyl nitrites - in this case predominately homosexuals. The nitrites are not usually considered toxic during inhalation because of syncope (fainting). However, a recent paper (Guss et al., 1985) noted a dangerously high 37% methemoglobin level in a normal subject who had used isobutyl nitrite (he had also used methaqualone). It has also been reported to reduce killer cell activity (Lotzova et al., 1984) and be potentially carcinogenic (Osterloh and Goldfield, 1984). This latter issue has recently surfaced and is of special concern in the development of AIDS (Newell et al., 1984; Haverkos et al.,) in that there is an association between the development of Kaposi's sarcoma and high amyl-butyl nitrite use.

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Introduction

The abuse of volatile substances has been identified as a problem in the USA for more than twenty years (Merry and Zachariadis, 1962). In the UK, the first cases of solvent abuse were recognized in Scotland in the early 1970's (Watson, 1982) and since then the problem has received a great deal of public attention and media coverage. The possibility that solvent abuse may cause permanent damage to the nervous system has been considered by many and the seriousness of the problem if that were the case does not need to be emphasised further. This article attempts to review the current knowledge of the effects of solvent abuse as they manifest neurologically, psychiatrically or in terms of intellectual deterioration. The fact that surveys carried out in the UK (Watson et al., 1982; Sourindhrin and Baird, 1984) suggest that 90% of abusers use toluene-containing adhesives makes it necessary to concentrate on the effects of this solvent, mentioning others less commonly used such as trichloroethylene, trichloroethane and butane only when relevant. Petrol sniffing or inhalation of nitrous oxide and chloroform are rare in the UK and will not be dealt with in this review.

This is a review of the possible long-term neurological, psychiatric and intellectual deficits that may result from solvent abuse. The emphasis is on the effects of toluene, the most commonly abused solvent in the United Kingdom.

The Acute Effects Of Toluene

The threshold limit value (TLV) for toluene, the airborne concentration to which industrial workers can be safely exposed for long periods of time, is 100 ppm (parts per million). Toluene abusers are exposed to concentrations approximately fifty times greater, albeit for shorter periods.

Toluene is a lipophilic substance which is rapidly absorbed into the blood stream by inhalation. After 10 to 15 minutes of exposure 60% of the peak blood concentration is achieved and a plateau is reached after about half an hour. Concentration in the brain and other richly vascularised organs are at least four times higher. Toluene cannot be detected in blood 4 to 6 hours after the cessation of exposure and by that time the urinary concentration of its main metabolite, hippuric acid, decreases to 30% of its maximum value.

Toluene, like alcohol, exerts an initial excitatory effect on the central nervous system followed by a depressive phase and its effects are closely related to blood concentrations. Feelings of euphoria and disinhibition are followed by drowsiness, incoordination and difficulty in focussing. At higher concentrations coma and death eventually occur. Other features of acute intoxication include tinnitus, sneezing and coughing, diarrhoea, diffused pains and epileptic attacks. Visual and auditory hallucinations have also been reported in variable numbers. Increased tolerance develops after short periods (Glaser and Massengela, 1962), but withdrawal symptoms appear to be rare and to be present only in very severe abusers (Press and Done, 1967).

During acute intoxication only a minority of abusers require hospital admission and in such cases neurological impairment is the rule. In a series of twenty consecutive admissions reported by King (1982) five were in coma, three had epileptic attacks, five were dysarthric and ataxia was present in the rest. Impairment of consciousness and other acute neurological signs appeared to be quickly reversible in most patients and only 19% of over one hundred admissions reported by Francis et al (1982) remained in hospital for more than twenty-four hours.

Toluene-containing products appear to be less frequently implicated in cases of death than other solvents and Anderson et al (1982) found that nearly two-thirds of the deaths directly attributable to the effect of solvents occurred in those inhaling aerosol contents, while less than a quarter were related to the effects of toluene. Toluene was, however, implicated in a number of deaths that occurred as a result of accidents while the subjects were intoxicated.

The Persistent Effects Of Toluene

Cerebellar Syndrome

Grabski (1961) was the first to describe a cerebellar syndrome in a patient who had inhaled toluene and gasoline for over two years. Cerebellar signs were still present six years later, but carbon tetrachloride abuse may have played

a part in their persistence. Cerebellar signs in pure toluene abusers have, however, been reported (Boor and Hurtig, 1977; Sasa et al., 1978; Malm and Lying Tunell, 1980; King, 1982; Ehyai and Freemon, 1983) and there is little doubt that toluene is capable of causing them.

The largest series of toluene related cerebellar signs have been reported by Fornazzari et al (1983) who found them in 11 out of 24 abusers admitted to a Canadian centre for the treatment of drug abuse. The severity of the clinical symptoms was correlated with the presence of cerebellar abnormalities in the CT scan. However, these subjects were comparatively older than other abusers (mean age 24) and had longer histories. The lack of long follow-up studies makes the prognosis of these symptoms uncertain and the possibility that they might persist for long periods in a small proportion of patients, as in the case reported by King et al (1981), needs to be explored further. The only available post-mortem study of a patient with persistent cerebellar signs (Escobar and Aruffo, 1980) reported a loss of approximately 70% of Purkinje cells with axonal damage, gliosis of the molecular layer and demyelination of the white matter. However, the possibility that some of these lesions could be due to n-hexane cannot be excluded.

Neuropathy

Optic neuropathy has been reported in a handful of toluene abusers, in isolation (Channer and Stanley, 1983), associated with CT abnormalities (Keane, 1978; Fornazzari et al., 1983), or with neural deafness (Malm and Lying Tunell, 1980). In these cases the visual abnormalities were mild and only detected during careful clinical or electrophysiological investigation.

In contrast with substances such as n-hexane, known to cause peripheral neuropathy, the toxicity of toluene to the peripheral nerve appears to be low. The most convincing cases of peripheral neuropathy have been reported by Fornazzari et al (1983) in two abusers who were older and had longer histories of abuse than in most other series. Added support for this comparatively low toxicity comes from the studies of Shirabe et al (1974), Korobkin et al (1975) and Towfighi et al (1976) who reported the development of peripheral neuropathy in long-standing toluene abusers only when n-hexane or other toxic solvents were unexpectedly introduced by the manufacturers into their favourite brand of glue. In one case improvement took place even when the patient continued using an adhesive containing toluene only.

Radiological Abnormalities

CT scan abnormalities have been reported in some isolated cases of toluene abuse (Boor and Hurtig, 1977; Escobar and Aruffo, 1980; Lewis et al., 1981; Ehyai and Freeman, 1983), but the possibility that alcohol or other drugs could have contributed to the production of these abnormalities is clearly important in some of the patients. The most convincing claim that toluene can cause enlargement of the ventricular system and widening of the cerebral and cerebellar sulci comes from the study of Fornazzari et al (1983) already mentioned. Fourteen patients were scanned during the second week of abstinence and when their scans were compared with those of neurological patients reported as normal they were found to have significantly larger ventricles and wider cerebral and cerebellar sulci. The control group used in the study is unlikely to represent a truly "normal" population and could have maximised the differences found between the two groups. However, the possibility that a proportion of comparatively older, long-standing abusers could have structural brain changes cannot be dismissed. The radiological appearances described in these patients are similar to those found in alcoholics (Ron 1983), although cerebellar abnormalities appear to be more prominent in this group. The neuropathological changes that account for these radiological abnormalities are unknown and it remains possible that CT scan appearances could improve with prolonged abstinence as is the case in some alcoholics.

Neuropsychological Deficits

The possibility that solvent abuse may cause intellectual impairment, even if mild, in a large group of subjects is clearly important and many studies have addressed themselves to this question. Unfortunately, serious methodological flaws have invalidated many of their conclusions, or made them difficult to interpret. Few studies have allowed for a period of abstinence prior to testing, hence confusing long-term sequelae with short-term effects. The poor documentation of the type of substance and frequency of abuse, together with the very different approaches to psychological testing, make comparisons between studies often impossible. Of even greater importance is the fact that these studies are usually poorly controlled, making it difficult to differentiate pre-existing learning deficits, frequent in certain socioeconomic groups, from the impairment resulting from the abuse of solvents.

In the study of Fornazzari et al (1983) cognitive impairment was found in 16 out of 24 comparatively older toluene abusers two days after admission using the Halstead Reitan battery (Halstead, 1947). The presence of

intellectual impairment was significantly correlated with the presence of neurological signs and CT scan abnormalities, but there was no significant correlation with the duration or severity of toluene abuse. In younger subjects with shorter histories the results have been less clear. Berry et al (1977) reported a group of 37 younger abusers who performed significantly worse than a control group on the Halstead Reitan battery. However, the considerable differences in IQ between the two groups may have accounted for most of the observed differences. The same could be said of the studies reported by Tsushima and Scott Towne (1977) and Korman (1981). On the other hand, the early studies of Barker and Adams (1963), and Dodds and Santostefano (1964) failed to find any significant abnormalities in groups of toluene abusers when they were more carefully matched to controls for educational and social background.

Two recent studies reported in the UK with more careful methodology are worth mentioning, even though their numbers are too small to allow definite conclusions to be drawn. Zur (1983) compared 12 delinquent male toluene abusers (mean age 16.4) with 12 controls (mean age 14.9) matched for education and severity of delinquency. Tests were administered 12 to 24 hours after the last inhalation. The two groups were well matched for IQ and when the effects of age were taken into account the only differences between them were the lesser accuracy of the abusers in psychomotor tests despite their greater speed of response, and their inability to improve on performance in successive trials. Memory was intact and the duration and severity of abuse were not correlated with the presence of these mild deficits. The possibility that these abnormalities represent short-term effects of toluene abuse remains to be disproved.

More informative is the study by Racska (1984) who selected 14 toluene abusers and 14 controls from a community home for offenders. Both groups were closely matched for age and premorbid IQ and the abusers reported periods of abstinence of at least three days before testing. No significant differences between the groups were found using an extensive battery of tests and once again the level of performance was not related to the severity or duration of toluene abuse.

In summary, although the flaws of the available studies make it difficult to draw final conclusions, it would appear that psychometric deficits, if present, are mild and limited in the age group which most frequently abuses toluene. These deficits might, however, be more severe and common in older abusers.

Psychiatric Disability

As with psychological deficits, behavioural and perceptual abnormalities during acute intoxication need to be distinguished from more lasting sequelae, and psychiatric problems predating the abuse from those ensuing from it.

In the UK the rates of psychiatric morbidity in solvent abusers vary depending on the populations sampled. Sourindhrin and Baird (1984) found that only 6% of those referred to a clinic dealing exclusively with solvent abusers needed psychiatric treatment and a third of them were already receiving it before referral. On the other hand, Skuse and Burrell (1982) found that two-thirds of the adolescent solvent abusers seen at the Maudsley Hospital received a psychiatric diagnosis, usually conduct or emotional disorder. However, the type and frequency of psychiatric diagnosis was the same if the severe abusers were compared with those who only used solvents infrequently. The authors concluded that toluene abuse does not appear to be a cause of psychiatric disturbance, but that it occurs in a groups of individuals with high psychiatric morbidity. Similar results have been reported by Masterton and Sclare (1978), Biggs et al (1983) and Lockhart and Lennox (1983).

In a population of polydrug users, those who abuse solvents tended to have more severe problems with other drugs and alcohol (D'Amanda et al., 1977) and to have received a diagnosis of antisocial personality more often than those who did not abuse solvents (Crites and Schuckit, 1979). However, the frequency and severity of affective and schizophrenic symptoms did not appear to be higher in this group.

In the few cases of schizophrenia reported in solvent abusers (Alapin, 1973; Lewis et al., 1981) the psychosis preceded the substance abuse, although transient deterioration of the mental state may have occurred after inhalation of toluene.

In summary, the rates of psychiatric morbidity vary according to the population under study. They are highest in those referred to psychiatric hospitals and lowest in clinics dealing exclusively with solvent abusers. While there is little evidence that specific persistent psychiatric disability results from this practice, there is little doubt that personality disorders of an antisocial type are common in this group and particularly in those who also abuse other drugs and alcohol. In these cases, solvent abuse is likely to be one more manifestation of a disorganized lifestyle.

Conclusions

Occasional experimentation with toluene-containing products is fairly common in adolescents up to the age of 16 to 17 and rare thereafter. Only a minority of those who experiment with these substances go on to abuse them regularly. The brunt of the acute effects of toluene is short-lived, but early experimental studies in humans (von Oettingen et al., 1942) have suggested that non-specific symptoms such as fatigue or irritability can persist for days, even after a single exposure.

Among the persistent neurological sequelae attributed to toluene cerebellar signs are perhaps the commonest. In most cases the signs are transient and they may persist only in a minority for weeks or months. The long-term outcome of the more severe cases is still unclear. Toluene appears to have low toxicity for the peripheral or cranial nerves. These abnormalities appear to be commoner in older abusers with comparatively longer histories, and this also applies to the structural brain changes detected with computerized tomography.

Persistent neuropsychological sequelae may also occur in the older subjects, but so far there is little evidence that they take place in a sizeable proportion of adolescent abusers. Psychiatric morbidity, on the other hand, is high among solvent abusers but there is little evidence to consider it as a direct consequence of the practice. The presence of antisocial personality or conduct disorder is likely to be the cause rather than the effect of solvent abuse.

Further research is needed to increase our understanding of the long-term sequelae of solvent abuse. Of particular interest would be a study of a group of severe abusers "at risk" of developing neurological and intellectual deterioration, which would dog them for a prolonged period. Special care will need to be paid to the methodological problems outlined here in order to separate abnormalities that precede the abuse from those resulting from it and to distinguish between the acute and the permanent effects of these substances.

In the light of our present knowledge, and given the methodological flaws of many of the available studies, the possibility that brain damage with its corresponding manifestations may occur in a sizeable proportion of solvent abusers remains inconclusive.

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Outreach Strategies

Persons with substance dependence problems, especially children and adolescents involved in volatile substance abuse, are not likely to present themselves in treatment centres and programmes. It is therefore of primary importance to find appropriate ways to contact those in need of care by active outreach strategies rather than waiting for them to show up.

Various methods are currently used in the different countries and settings:

- street workers establish contacts, provide information on available help for medical, psychosocial and legal problems, motivate users to engage in a treatment programme;
- peer groups are instructed and trained on how to respond to users who address themselves to peers when in need of help;
- problem families with abusing offspring are actively approached;
- walk-in centres and day centres are established with minimal threshold for access (e.g. no administrative procedures required, confidentiality and anonymity guaranteed) situated within the high risk areas;
- parent groups, teachers and primary health care workers are instructed on how to respond to perceived needs of abusers and how to guide them to seek further help;
- contacts are established routinely with marginal populations in shelters for homeless young people, in prisons, etc.

The choice of method varies not only with the initiative and willingness of persons and agencies to become involved, but also with the resources available in the community and with the characteristics of the population at risk for volatile substance abuse.

Contacts with persons in need of treatment with the respective services are also established by a variety of referral procedures (through the school system, court and law enforcement bodies, parents and peers, etc.) although sometimes such referrals tend to be followed by higher drop-out than self-referrals.

General aspects

The reasons for which an abuser presents himself, or is brought to the attention of primary care and treatment agencies, show a large range of variations. They may include health, psychological, school, financial or family problems, etc. In order to respond properly to the individual needs of the user and of those also involved, the assessment process has to start with identification of priority needs. Later on in the process, when a confident relationship is established, other and eventually more urgent needs may surface. This process takes time, especially with children and adolescents, and undue haste and an aggressively inquisitive assessment procedure risk rebuking the abuser rather than encouraging him to go along with a programme.

Nevertheless, some aspects should not be overlooked whatever the motives for establishing the first contact are, and during the assessment process these aspects should be considered in a systematic way. These aspects are dealt with in the following sub-chapters.

Clinical assessment of abuse related physical health problems

Health consequences of volatile substance abuse are in many instances not obvious to the user. Therefore, care has to be taken to look out for eventual sequelae during the assessment process. If complaints or obvious symptoms are present, the patient will be more readily prepared to undergo a clinical check-up. This check-up includes a careful interview as well as a physical examination. A tentative check-list for assessment includes the following items:

- symptoms of actual intoxication or withdrawal syndrome.
- drug abuse history (age and context of first use, patterns of use, dose and type of drugs used).
- present state of physical functions and eventual complaints.
- past health problems and their relation to drug abuse.
- past attempts to control or discontinue drug abuse and their results (phases of abstinence, impact on health, etc.).

indicators for renal, hepatic, respiratory dysfunction, peripheral or central nervous system impairment, auditory or visual impairment, reduced nutritional state, any infectious disease due to reduced defense potential, and for deficient production of blood cells due to bone marrow depression.

This clinical assessment is indicated in order to detect conditions which may need adequate medical treatment, to ensure survival, integrity of physical functions and optimal health conditions for successful engagement in the psychosocial treatment process. It may be followed by laboratory testing if clinical symptoms indicate the presence or pathology which should be further investigated, be it an acute intoxication or a chronic condition. Depending on the case, it may be helpful to obtain a urinalysis, complete blood count, liver profile, renal function, electromyogram (EMG), electrocardiogram (ECG), electroencephalogram (EEG), or computerized axial tomography (CAT) scan of the head.

Assessment of abuse-related psychiatric problems

Acute intoxication as well as chronic abuse may result in psychiatric conditions that make treatment necessary (for example confusional or delusional states, hallucinatory syndromes, anxiety syndromes, depression with or without suicidal impulses, panic attacks, etc.).

Volatile substance abuse may also follow a psychiatric condition, as a kind of self-induced attempt to relieve anxiety or tension.

A careful assessment of psychopathology, its history and relation to abuse is needed in order to initiate adequate treatment.

Psychological assessment

Continued volatile substance abuse is known to be followed and preceded by problems with learning and other task performance, by school drop-out or loss of job (Kaufman, 1973). It may become crucial to ascertain if learning and attention deficits, memory impairment or other psychological dysfunctions are present which handicap efforts to involve a patient in a therapeutic or rehabilitative programme. The presence of such deficiencies also calls for intensified efforts to induce abstinence as most psychological impairment is essentially reversible under conditions of abstinence.

Family assessment

The treatment of inhalant users, especially adolescents, can be greatly facilitated if the family can be involved. Therefore, it is important to assess family strengths and weaknesses. Frequently, early in treatment, relationships with the family may be so impaired that they may not be of much help. However, as treatment progresses the family can be called upon and become an integral part of the process. When involving the family in treatment it is important to know in what ways they are capable of being helpful. They may be burdened with so many other problems that they simply cannot help. On the other hand, there may be avenues of assistance that they may not be aware of and that the treatment provider can help them to see. If family problems are extreme, treatment might be expanded to help resolve them.

This requires a careful assessment of the relationship between the user and family and would include answers to the following questions: What is the history of the relationship? Has it ever been better than now? Does the family have any control over the user's behaviour? How can this be increased? Which family members could be especially helpful? If the user has been alienated from the family now, how can reconciliation be induced and facilitated?

A good knowledge of family assets can be critical to treatment. This perspective allows the treatment provider to call upon resources that might be overlooked if the focus remains solely on the user. Furthermore, at some point, the user will have to return to the family and if those relationships have not been improved a relapse to inhalant use might well occur.

Assessment of peer relations

It has long been recognized that peers of inhalant users exert a very strong pressure to use inhalants. In the treatment of inhalant users it is essential to gather a clear picture of what the user's peer structure is. If most peers are encouraging the use of inhalants, treatment will be hampered until these influences can be broken.

Assessment of peer relationships is also important for older inhalant users, including adults. If they are to make lasting changes in their drug use they must restructure their personal relationships to help them avoid those situations that previously led to inhalant use. The treatment provider must be aware of these lifestyle factors in order to help induce life-style change.

A careful investigation about peer relations outside the drug-using community is of primary importance. This eventually could be used to build up a social network for the user, protecting him from returning to the old habit when crisis situations occur.

Medical management of acute effects

First aid in case of acute intoxication

Acute intoxication can be hazardous in many ways. Physically, the lack of oxygen and the accident risks are in the foreground, necessitating immediate action (artificial respiration, oxygen supply, removal of accident risks, observation and control for the entire period of intoxication). Cardiac defibrillation in order to prevent sudden sniffing death will rarely be available in time.

Stages of intoxication, panic, aggressiveness, suicidal behaviour, and confusion during acute intoxication need careful control and observation. If dangerous actions are expected, hospitalization will have to be considered unless adequate means of calming the patient down psychologically or by means of sedative medication are sufficient.

Management of acute withdrawal symptoms

Withdrawal states may ensue with chronic, heavy use of certain solvent-inhalants. Symptoms can include tremulousness, tachycardia, disorientation, hallucinations, seizures, and agitation. These conditions begin within hours or a few days after cessation of use. Treatment consists of a long-acting sedative drug (such as phenobarbital or diazepam), given in doses sufficient to produce calm. Seizures may develop and make antiepileptic medications necessary.

Medical management of long-term health effects

Most hepatic, renal, haematopoietic, pulmonary, and central nervous system damage from solvent-inhalants improve with abstinence and time alone. This fact greatly emphasizes the importance of active substance abuse treatment, with establishment of abstinence, regular reassessment, and monitoring. If detection and treatment have been timely, complete return to normal function may be anticipated. Incomplete recovery or even permanent disability can result if detection and treatment are delayed (Tsushima et al., 1977).

Patients abusing gasoline containing tetraethyl lead should be evaluated for lead poisoning. If this is present, chelating agents should be administered to hasten excretion. Such agents include penicillamine, British anti-lewisite (BAL), dimercaprol and calcium disodium versenate (Valpey et al., 1978).

Likewise, most psychiatric conditions due to volatile substance abuse tend to recover under abstinence. It may be necessary, however, to provide psychiatric treatment and supervision for a prolonged period of time, especially when psychiatric conditions are the basis for volatile substance abuse.

Long-term psychosocial management and rehabilitation

In order to achieve the necessary changes in orientation and life-style, including abstinence, a prolonged psychosocial management and educational process is needed. Medical and/or psychiatric care as a rule are not an adequate method for this achievement but they may be required for a successful psychosocial management.

Psychosocial management and rehabilitation mainly follow the experiences acquired in the management of other forms of adolescent or adult substance dependence.

New approaches have been set up, nevertheless, especially with respect to severely deprived, homeless or otherwise marginalized abusers.

It is necessary to point out, before discussing specific settings and methods, that knowledge of the outcome of treatment is limited and is not an adequate basis for well-established recommendations.

Treatment settings

Treatment settings will vary depending on the needs of the individual patient and the resources available in the community. A number of settings have already been tried and the main ones are as follows:

Hospital based settings

In-patient treatment is probably appropriate for only a small minority of cases when physical or mental illness of sufficient severity is present. In most cases this type of treatment will be short-lived and patients will need to be moved to other out-patient settings.

Community homes or community centres

These should be based in the area where the patients live; in some cases they will be residential, while in others a day centre will be more appropriate (Sourindhrin and Baird, 1984). Examples of residential community settings can be found in many countries such as the one

functioning under the auspices of the Institute of Psychiatry in Mexico City (de la Fuente, 1986). Community centres where patients attend regularly while living at home are more common and can be found in many countries (Gay et al., 1982; O'Connor, 1983).

In other cases the treatment will need to be carried out in the patient's home or in other settings where the patient lives, such as community homes, prisons, etc. In such cases the programmes that may have been devised for more structured settings will require modification to adapt them to the specific needs of each case.

The person, or persons, involved in the treatment will also vary according to the setting. Whilst medical staff will be more appropriate in an in-patient setting, other primary health care workers or educators and social workers will be more appropriately involved when treating patients in community settings or in their homes.

Approaches to treatment

Various approaches have been tried in the treatment of volatile substance abuse. Most of them are complementary and best used in combination, although a pragmatic approach, taking into consideration the specific individual problems and the available resources of the community, is to be recommended.

The main approaches are:

- Group therapy: This involves peers who also abused solvents. It is important to emphasize that group treatment should be aimed at improving peer relationships and at providing alternative recreational activities without the use of drugs. This implies that the focus of treatment should be wide and not centred exclusively on the practice of volatile substance abuse.
- In many cases the group approach may need to be combined with individual therapy. The aims of this treatment are to improve social skills and overcome other outstanding psychological problems. Brief psychotherapy, often of behavioural type, has been used (O'Connor, 1983).
- The patient's family is also in need of help in many cases. Family counselling and therapy should be aimed at improving the family relationships, but at the same time education and support of other family members may be necessary.

Modification of social circumstances is also an integral part of the treatment. Vocational guidance, change in life circumstances and expectations, etc., are some of the issues to be considered here.

Group therapy, family counselling and therapy, and modification of social circumstances are applicable and effectively applied in most treatment settings. Continued involvement in these approaches after returning to the community and during rehabilitation increase the chances for a positive outcome.

Treatment goals and outcome

Other sections of this report have highlighted the multifactorial etiology of volatile substance abuse. Individual, family and social problems are implicated and the available treatments aimed at modifying them are outlined. It follows from this that the outcome of treatment should be evaluated and attention paid to these areas; abstinence or further use of volatile substances should not automatically be equated with success or failure.

Current knowledge about the effects of treatment is limited, but drawing analogies from the experience acquired dealing with other drug problems, relapses in volatile substance abuse can be expected to take place, even if other areas of function have improved. This would suggest that treatment should continue or be repeatedly available over long periods of time to effect changes in behaviour and to provide an opportunity for personal development, thus minimizing the risk of untoward consequences of volatile substance abuse.

Experience with other drug problems also suggests that a number of patients will give up the practice without treatment, while others will be resistant to even the most comprehensive therapeutic approaches. This points to the need for objective evaluation of the effects of treatment by comparing the results of different programmes between them and with the rate of spontaneous recovery in those untreated.

To give advice as to how best to use the often overstretched existing resources is an invidious task but in the present state of knowledge it is perhaps appropriate to recommend that priority should be given to identifying and treating as many cases as possible, even if perforce the treatment will have to be less comprehensive than if it was aimed at only a few volatile substance abuser.

Professor J. Westermeyer

Introduction

Little has been written regarding the treatment of solvent-inhalant abuse. In a bibliography of the solvent abuse literature, published in 1979, there were no studies of treatment from the 440 citations (Barnes & Vulcano, 1979). Instead, investigators focused primarily on such topics as case reports, pathology, epidemiology, and laboratory analysis.

In only a few case reports, the authors have remarked parenthetically on treatment approaches and subsequent course (MMWR, 1985; Schottstaedt & Bjork, 1977). More commonly, the attending clinicians have described the care of acute toxic complications or a course of progressive deterioration, without comment regarding attempts at treatment of the substance abuse syndrome (Taher et al., 1974; Valpey et al., 1978; Hansen & Sharp, 1978; Fischman & Oster, 1979; Goldings & Stewart, 1982). Some authors have emphasized the poor eventual prognosis in many solvent-inhalant abusers (Taher et al., 1974; Watson, 1979; Epstein & Wieland, 1978), suggesting a crucial need for early recognition and vigorous treatment. At the other end of the spectrum, some observers have emphasized the benign and experimental course of solvent-inhalant abuse (Watson, 1984; Bowers & Sage, 1983), indicating that patient education and reassurance are sufficient and that even "controlled use" of certain less dangerous solvent-inhalants may be feasible (Bowers & Sage, 1983).

In summary, the literature on treatment approaches for volatile solvent/inhalant abuse is rather inadequate in terms of guiding the clinician in selecting, recommending or applying therapy. This problem results from the following factors:

- (a) Many investigators on this topic are not in clinical fields, but rather are specialists in epidemiology, biochemistry, education, pathology, toxicology, pharmacology, sociology or social psychology (Watson, 1978; Poklis & Burkett, 1977).
- (b) The few clinical investigators of solvent-inhalant abuse work in fields concerned with biomedical diagnosis and acute management, rather than with psychosocial assessment and on-going care for substance abuse. These biomedical fields include gastroenterology, pediatrics, renalogy, haematology, neurology and pulmonary medicine (Escobar & Aruffo, 1980; Nunn & Martin, 1934; Piakela et al., 1984).

- (c) Clinicians who are concerned with psychosocial assessment and care of substance abuse tend to encounter relatively few solvent-inhalant cases over a period of a year or two. This inveighs against clinical studies of patients in numbers adequate to justify firm conclusions regarding treatment and course (Glaser, 1966; Clinger & Johnson, 1951; Adams, 1933; Kashimma et al., 1969).
- (d) Clinicians sited in various locations encounter different types of cases. The clinical picture varies depending on the timing of the case (i.e. early experimental use or late deterioration), the drug use context (i.e. endemic, epidemic, spontaneous appearance), and the facility (e.g. emergency room, primary care, psychiatric unit) (Campbell & Watson, 1978; Watson, 1980).
- (e) Treatment efficacy and treatment outcome is a much neglected topic in the field of substance abuse at large. Thus, the lack of knowledge regarding treatment is not specific only to solvent-inhalant abuse. Our ignorance stems from the following:
 - length of follow up required to evaluate treatment (ideally 1 to 2 years);
 - the difficulty of isolating and evaluating treatment modalities in multimodality programmes;
 - the strong influence of pre-treatment factors (e.g. genetic factors, education, marital status, occupation, employment status) and extra-treatment factors (e.g. patient compliance) on post-treatment outcome; and
 - and the expense of such studies (Westermeyer, 1986).

Despite these methodological problems and the lack of careful research, there are some general guidelines for the treatment of solvent-inhalant abuse. In this report, these guidelines are based on reports in the literature on substance abuse in general as well as on solvent-inhalant abuse, as well as the author's experience in treating and researching substance abuse in the United States and Asia over the last twenty-five years.

Early Detection and Groups at Risk

A key to the successful treatment of substance abuse lies in early recognition and timely treatment. This is true for all drug-of-abuse, since unchecked substance abuse often leads to

decline of the patient's social network, alienation from family, decrease in the patient's material resources, loss of job, and biomedical complications. With many solvent-inhalant drugs, the urgency may be especially great due to the potential for irreversible or life-threatening organ damage. Examples include freon propellants, carbon tetrachloride, ethyl gasoline, diesel fuel, aniline, and naphtha (Fischman & Oster, 1979; Luckstead et al., 1978; Robinson, 1978). Even the "safer" solvent-inhalants -- such as ether, chloroform, nitrous oxide (some of which have or had medical uses) -- can produce sudden death from anoxia or ventricular fibrillation, or lead to nonspecific concomitants of substance abuse (e.g. poor judgement, inadequate diet and self care).

A key to early detection lies in being alert to the possibility of solvent-inhalant abuse in certain groups. The lifetime prevalence of solvent-inhalant abuse tends to be relatively low in most populations, even though millions of people around the world have briefly experimented with these drugs. While it may be inefficient to screen for solvent-inhalant abuse in the general population, primary and secondary preventive efforts can be directed at targeted subgroups.

Perhaps the groups at greatest risk are those whose work brings them into contact with solvent-inhalants. Examples include shoemakers (Arbbritti et al., 1976), sandalmakers (Yamamura, 1969), cabinetmakers (Herskowitz, 1971), and printers (Paulson, 1976). To this list, based on clinical experience, the author would add the following workers in gas stations, car repair shops, bicycle repair shops, and dry cleaning establishments; hair stylists (because of the availability of hair sprays), maintenance workers using solvent-inhalants; painters; and those involved in the manufacture or refinement of petroleum products or products containing solvent-inhalant substances. Increased availability of petrochemicals and other solvent-inhalants throughout the workplace has markedly increased the number of reported cases over the last half century (Knabenhans, 1941).

Medical workers have long been at risk because of their exposure to solvent-inhalants used for medical purposes. The earliest reports involved abuse of the anaesthetics ether (Beluze, 1886 - 1887; Joel, 1928; Kerr, 1891), chloroform (Kornfield & Bikeles, 1893; Nevole, 1941), and trichloroethylene (Jordi, 1937; Vliet, 1959). More recently, emergency room and operating room technicians have abused the anaesthetic fluothane (Halothane), at times with fatal results (Spencer et al., 1976).

Children and adolescents are susceptible to epidemics of solvent-inhalant abuse. These may occur in virtually any community (Watson, 1975 and 1984), but appear most apt to persist in communities with widespread unemployment, poverty, marital and family disruption, high prevalence of substance abuse among adults, community disorganization, minority status, negative self image, limited recreational outlets, little available adult supervised recreation and sports, and few hobbies (Kaufman, 1973; Cohen, 1975; Epstein & Wieland, 1978; Padilla et al., 1979; Gilbert, 1983; Beauvais et al., 1985). Children and adolescents away from home in boarding schools may also be especially at risk (Schottstaedt & Bjork, 1977). Most young users are 7 to 19 years old, but occasionally abuse can occur even in children as young as 4, 5, and 6 years of age (Berkowitz & Booth, 1978; Reed & May, 1984). Young abusers obtain solvent-inhalants from the home, school, grocery stores, institutional cleaning supplies, hobby stores, hardware stores, gas stations, paint stores, and gas tanks of cars, motorcycles, tractors, chain saws, and unattended machinery (Block, 1978; Abgle & Eade, 1975). They have been found to abuse gasoline, glue, naphtha, paint, lighter fluid, nail polish remover, clothing spot remover, marker pens, deodorants, kerosene, aerosol cans (e.g. food, spray paint, hair spray), "white out" or typing correction fluid, gas jets in school science laboratories, nitrous oxide (used to enhance acceleration of racing vehicles), lacquer thinner, transmission fluid (toluene), gun cleaning solvents, and fire extinguishing agents (Cohen, 1975; Tenenbein et al., 1984; Steadman et al., 1984; King et al., 1985, Ackerly & Gibson, 1964).

Due to the frequent association of solvent-inhalant abuse with delinquency, crites and Schuckit (1979) recommended that there should be a routine inquiry of "all adolescents in trouble" as regards such abuse. The earliest reports of sniffing by children go back twenty-five years (Lawton & Malmquist, 1961). As these children have grown, we now find a larger number of solvent-inhalant abusers to be older adolescents and young adults (Hershey and Miller, 1982; Keeler and Reifler, 1967).

Mentally retarded adolescents and young adults may also be vulnerable to solvent-inhalant abuse. In some of these cases constitutional retardation appears to have predated the volatile-inhalant abuse (Carroll & Abel, 1973; Masterton, 1979; Gouldings & Stewart, 1982). In other cases, chronic solvent-inhalant abuse during childhood appears to have caused acquired mental retardation (Lewis et al., 1981). The mentally retarded person is often able to obtain continued supplies of these drugs due to their widespread and easy availability as well as low cost, whereas alcohol or illicit drugs may not be accessible to them. Gasoline, glue, and toluene abuse have been reported in this group.

Certain chronic patients are at risk to develop solvent-inhalant abuse. Uremic patients undergoing haemodialysis have become addicted to denatured ethyl alcohol used to clean the skin and dialysis equipment (De Santo et al., 1975). Over-the-counter as well as prescribed inhalants containing stimulants have also been abused by hay fever sufferers, asthmatics, and others (Pentel, 1984; Escobar & Karno, 1982; Thompson, 1983; Schoelzel & Menzel, 1985). While drug use in these chronic patients usually began in clinical settings or during symptomatic periods, continued sniffing had led to daily use at home even during asymptomatic periods.

In recent years, homosexuals have used amyl nitrite and butyl nitrite for sexual enhancement. Amyl nitrite was formerly used for angina pectoris and is still used as a "smelling salt" for faintness. Butyl nitrite is present in certain deodorizers and incense. These drugs may be sniffed to delay ejaculation, and thus prolong sexual activity, to relax inhibitions, to facilitate relaxation of the anal sphincter during penile penetration of the anus, to enhance orgasm, or to feel "high" while engaging in sex. "Poppers" (as they are often called) may also be used in homosexual settings to relieve anxiety and promote calmness while meeting new people, conversing, listening to music or dancing. Most users report taking the drug a few to several times on one occasion (Israelstam et al., 1978). Some people sniff as often as fifty times over a several-hour period, primarily to avert ejaculation, and thereby maintain an orgasm for repeated sexual acts with many partners. A hundred or more sniffing episodes per weekend are not unusual under these circumstances. Such sexual and social activity appears to be mutually reinforcing with the nitrite inhalation, since homosexual nitrite sniffers have sought treatment when unable to discontinue this combined sex-drug behavior on their own.

Some young adults inhale solvents along with or as substitutes for other substances, such as alcohol and marijuana. They typically come from lower socioeconomic backgrounds, have minimal job skills, and live in disorganized neighborhoods. Some are migrants who exist on the economic and social margins of society. These patients often abuse solvents such as commercial lacquer thinner, petroleum distillates, transmission fluids and commercial glues to which they have been exposed during episodic work (Prockop et al., 1974; Szapocznik et al., 1977).

Those incarcerated in jails, workhouses and prisons are also apt to abuse solvent-inhalants. Army training barracks and other isolated settings away from alcohol or drug supplies also involve risk. Abuse in these settings is probably more common than occasional reports would indicate (Samples, 1963; Press &

Done, 1967; Valpey et al., 1978). In the author's experience, many substance abuse patients presented for treatment after a period of incarceration report that they abused solvents while in prison or jail. However, they usually do not abuse solvent-inhalants when other substances are available. Substances abused during incarceration include personal grooming items (e.g. deodorant or hair sprays), kitchen aerosols, cleaning and maintenance solvents, and industrial products used in prison workshops.

Sometimes solvents might be taken by ingestion rather than by inhalation through the nasal and respiratory mucosa. Reports in the literature have included ingestion of spray disinfectant and hair spray (which may contain appreciable levels of ethyl alcohol), as well as chloroform. These substances may be diluted with beer or mixer before swallowing (Storms, 1973; Morse & Thomas, 1984).

Assessment and Treatment Planning

Rationale

For some pathological entities, the diagnosis infers a highly specific and set treatment. Examples include streptococcal pharyngitis or Colles fracture. At the other end of the spectrum, no treatment exists or is needed for conditions such as pityriasis rosea or torus mandibularis, so the therapeutic regimen is benign or watchful. For most entities, however, treatment planning depends upon numerous factors besides simple diagnosis; careful patient assessment is required before a treatment course can be set. Treatment alternatives depend upon factors such as the acuteness or chronicity of the condition, patient willingness and ability to undergo the treatment, and access to treatment resources. Examples range from cholecystitis to mitral valve disease, from ulcerative colitis to major depression.

Substance abuse, including solvent-inhalant abuse, falls clearly within the last category of disorders requiring extensive and intensive patient assessment beyond mere diagnosis. Careful assessment is especially necessary in five areas. First, the duration and severity of the substance abuse should be explored, including abuse of other substances besides volatile-inhalants. Second, associated conditions such as chronic hepatitis, panic disorder, or mental retardation which may influence the treatment plan should be defined. Third, treatment planning depends on certain characteristics such as genetic predisposition, personality, organic complications, and the patient's resources (such as occupation and family relationships). Fourth, previous attempts at treatment should

be reviewed to discover such concomitants of treatment as acceptability to the patient, compliance by the patient, and previous treatment efficacy or inefficacy. And fifth, the clinician will want to determine those factors which may motivate and sustain the patient during recovery (an often lengthy and difficult process), elements which might undermine the treatment, and indicators which will permit prompt recognition of relapse in the event that it occurs.

Unit of Assessment

In some phases of recovery, the unit of treatment is the individual patient. Medical management of organic damage from solvent-inhalant abuse, treatment of associated mental disorders, or the monitoring of body fluids during recovery only requires the presence and collaboration of the individual substance abuse patient.

Family assessment is also critical, since eventual recovery often hinges strongly on the family's ability to cooperate with, support and even implement certain aspects of the treatment plan. Particularly among children and adolescents with chronic inhalant-solvent abuse, family disorganization may exist. Family disorganization can be due to factors such as the following: numerous young children overstressing the resources of the family; a single parent home; parental substance abuse (including solvent-inhalant abuse); parental mental retardation, mental disorder or personality disorder (Blatherwock, 1972; Kupperstein & Susman, 1968; Press & Done, 1967). It is important to ascertain whether the family is alarmed at the solvent-inhalant abuse, or accepts it merely as "childhood play". Child abuse or neglect should be considered and ruled out in the case of young patients. Many solvent-inhalant abusers may have little or no current family contacts, as in the case of prisoners, army inductees, adolescents in training camps or boarding school, homosexuals, poor or unemployed migrants, or those alienated from their families. Nonetheless, an attempt should be made to identify significant figures in the patient's eventual recovery. These individuals are critical for obtaining relevant information, monitoring treatment response, and supporting the patient through the recovery process.

The patient's reference groups should also be assessed in order to ascertain whether the case is a sporadic one, or whether the patient represents only one case among many in an endemic or epidemic solvent-inhalant abuse problem. Frequently one individual discovers independently that inhaling a particular substance produces a desirable effect. This is especially apt to occur in work settings which involve solvents, as well as in situations involving prolonged high stress levels with access to solvents (e.g.

haemodialysis units). Even isolated cases, if undetected and treated, can lead to epidemic solvent-inhalant abuse. Solvent-inhalant abuse is especially apt to spread undetected in an epidemic fashion among subcultural groups which maintain an identity outside the mainstream of society. These groups include children, adolescents, ethnic minorities, homosexuals, the poor, migrants, the unemployed, army inductees, and prisoners.

While clinicians can and should assess families routinely, they may or may not be able to conduct a community assessment. This may be feasible if the clinician works in a village or small town, a clinic within a close-knit neighborhood, a plant or industry which uses solvents, or certain closed institutions (e.g. boarding school, army post, prison). In many urban and hospital settings, however, the clinician must depend on the local public authority to make this assessment. Depending on skills, interest, training and local contacts, the community evaluation may be conducted by a public health nurse, an epidemiologist, or other person trained in relevant public health methods (Peers, 1981).

Clinical Assessment Methods

A common mistake lies in ceasing all further inquiry once the fact of solvent-inhalant use has been identified, whereas this should be merely the first step. The clinician will then want to determine the following: time and context of initial use; frequency, duration and pattern of use; dose and type of solvent-inhalant drugs. It should be kept in mind that the patient may take a variety of solvent-inhalants, or misidentify them (Tenenbein et al., 1984). Thus collateral informants and possibly laboratory analysis should be sought to confirm the history as obtained from the patient. Since substance abuse typically involves heavy use or abuse of multiple substances, the same information should be sought for all other psychoactive agents potentially consumed by the patient, whether licit or illicit (i.e., tobacco, alcohol, caffeine and other stimulants, cannabis, opioids, sedatives, hallucinogens).

Next, the types of problems which have ensued from the substance abuse should be ascertained. Depending on the type of solvent-inhalant drug, as well as duration and intensity of use, the patient may have biomedical damage to the central nervous system, peripheral nervous system, kidneys, liver, lungs, or bone marrow (Schikler et al., 1984). Nutritional deficiency, infections of respiratory or urogenital systems, and trauma may be present as nonspecific complications from inadequate self care and poor judgement. Psychological complications include personality change, social withdrawal, depression, paranoia, assaultiveness,

delusions and hallucinations. Children and adolescents may manifest declining school performance, less interest in sports, and incorrigibility (Kaufman, 1973). Employees often produce less, alienate coworkers, and injure themselves accidentally. Homosexuals may be less discerning in choosing partners or more promiscuous while using inhalants, thus exposing themselves to the risk of violence, venereal disease, or acquired immune deficiency syndrome (AIDS). Pregnant women can induce a foetal solvent-inhalant syndrome in their offspring (Goodwin et al., 1981). Since the patient or other informant may not link these problems to solvent-inhalant abuse, it is necessary to inquire about these potential manifestations routinely (as is done in a complete review of systems).

In taking a family history, specific inquiry should be directed to substance abuse, depression, suicide, criminality, and other psychosocial dysfunction in family members (including spouse and relatives-in-law, if the patient is married). A complete psychosocial history should be taken, as in any psychiatric disorder. This includes information regarding the patient's childhood, premorbid personality, coping mechanisms, education, hobbies or sports, occupations, employment history, social network, aspirations and achievements, sexual and marital history, material resources, family relationships, accomplishments, delinquency or criminality (if present), and problems with the law. Inquiry should be made regarding past and current medical, surgical, and psychiatric treatment.

Physical examination and mental status examination may provide evidence of recent or current solvent-inhalant use. Glue, "white out" flecks, or other substances may be noted about the nose or mouth, on the hands, or on the clothes. Inflammation or erosion of nasal membranes or discharge from the paranasal sinuses may be observed. Depending on the type of solvent-inhalant drug and the duration of use, there may be peripheral nervous system findings (e.g. palsies, sensory deficit), tenderness of the liver or kidneys, hypertension, or cardiac arrhythmias. Signs of intoxication, withdrawal, or central nervous system damage resemble those of alcohol and include slurred speech, ataxia, disorientation, incoordination, dilated and unresponsive pupils, hallucinations, delusions, seizure, or advanced dementia.

Laboratory findings can contribute to the diagnosis by demonstrating organ damage. Depending on the case, it may be helpful to obtain a urinalysis, complete blood count, liver profile, renal function, electromyogram (EMG), electrocardiogram (EKG), electroencephalogram (EEG), or computerized axial tomography (CAT) scan of head. Aspermia has been reported in association with chronic thinner abuse

(Suzuki et al., 1983). Infrequently, a biopsy of the affected tissue may be helpful in guiding or assessing therapy. Since use may be episodic (and thus give false negative tests) and specific tests for most solvent-inhalants are not widely available, it is not possible to rely solely on laboratory analysis or solvent-inhalants in blood or urine for diagnosis. An exception to this general rule is tetraethyl lead gasoline: the lead can be demonstrated in the chronic abuser by basophilic stippling of the red blood cells, increased blood levels, increased 24 hour urine lead levels, or increased erythrocyte protoporphyrin level (Robinson, 1978; MMWR, 1984). Psychological and psychobehavioural testing may demonstrate decreased memory and attention span, poor concentration, cerebellar dysfunction, or impairment of nonverbal intelligence (Allison & Jerome, 1984).

Principles of Treatment

The first step in treatment consists of detecting and attending to any acute or life threatening conditions. This may include damage to the liver, kidneys, lungs, brain, spinal cord, peripheral nervous system, or bone marrow. Or there may be associated psychiatric problems, such as depression, suicide attempt, or psychosis. Once this early phase is completed, and the patient's immediate survival is assured, subsequent measures can be initiated.

Next, the patient's abstinence from all substances of abuse (not just solvent-inhalants) must be established. Often times the patient is at least partially motivated to attempt abstinence due to a serious medical complication or a psychosocial crisis (such as confrontation at home, school, or work). If the patient (or family, in the case of a juvenile) is not so motivated, it may be necessary to induce motivation. This may be done by confrontation, contingency contracting, behavioral modification, legal commitment to treatment by a court, or state adjudication of a juvenile as incorrigible (with subsequent assumption of parental obligations by the state) (Westermeyer, 1986).

Once the patient has a few weeks to several months of sobriety, it is possible to ascertain whether further treatment or intervention is necessary. Depression, family disorganization, intellectual deficits, or recurrent infections may clear with abstinence alone. However, such problems may appear, persist or even become worse with continued abstinence. Since panic attacks, affective disorder, and similar problems may not manifest themselves for some weeks or months following the establishment of abstinence, it is necessary to follow and reassess the patient at regular intervals for at least a year and preferably two years.

Patients abusing tetraethyl lead gasoline should be evaluated for lead poisoning. If this is present, chelating agents should be administered to hasten excretion. Such agents include penicillamine, British anti-lewisite (BAL), dimercaprol, and calcium disodium versenate (Valpey et al., 1978).

Patients with renal damage may manifest hypertension. If severe, nitroprusside or phentolamine may be necessary to control elevated blood pressure until the kidneys return to normal. A period of dialysis may be required if the patient is uremic.

Patients manifesting hallucinations, delusions, paranoia, assaultiveness, or severe agitation may be manageable with reassurance, repeated reorientation to time and place, and a relatively quiet and safe environment. If this does not suffice, one of the butyrophenone-type drugs (such as haloperidol) is usually effective in small doses over several days. During this time the patient should be protected from getting too hot (e.g. in a hot bath or shower, vigorous exercise, exposure in the hot sun), so as to prevent manifestations of the malignant neuroleptic syndrome (e.g. hypotension or hyperthermia).

Cardiac arrhythmias may persist for some hours following solvent-inhalant use. If an arrhythmia is present, intensive care with electrocardiographic monitoring should be implemented to avoid the risk of life threatening arrhythmias, especially ventricular tachycardia. Beta blockers should be given for supraventricular tachycardias. Immediate electro-cardioversion must be administered for ventricular tachycardia.

Withdrawal states may ensue with chronic, heavy use of certain solvent-inhalants. Symptoms can include tremulousness, tachycardia, disorientation, hallucinations, delusions, seizures, and agitation. These conditions begin within hours or a few days after cessation of use. Treatment consists of a long-acting sedative drug (such as phenobarbital or diazepam), given in doses sufficient to produce a calm, seizure-free state. The medication is then withdrawn over a five to ten day period.

Chronic seizures may develop in patients who have abused neurotoxic agents over months or years. Medications with low abuse potential, such as diphenylhydantoin, should be prescribed. In a stable patient whose EEG returns to normal, it may be possible to withdraw the anti-seizure medication after several months in order to see whether the seizures resume.

During the time that the patient is being reassessed at regular intervals, the clinician must also monitor the patient for recurrence of substance use (either the solvent-inhalants formerly abused, or new substances). If rapport with the patient is good and there is motivation towards recovery from substance abuse, the patient may voluntarily report any relapse. One should not rely totally on this source of information, however. A collateral informant should accompany the patient on clinic visits, or at least make regular reports. Collateral informants may include spouse, parents, friends, siblings, teachers, coworkers, employer, social worker, parole officer, or public health nurse. Another means of monitoring recovery is through laboratory tests. Depending on the type of organic damage and substance abused, the clinician would want to see lower blood or urine lead levels, improved renal or kidney functions, a normal mental status, or a normal neurological examination result. Repeated observations on appearance, behaviour, vital signs and weight may also be helpful. Improved grades at school or check stubs from regular employment also indicate a stable recovery.

Follow up visits should be continued even for the recent user seen during a solvent-inhalant epidemic. In one study of 105 young gasoline abusers undergoing treatment (Remington and Hoffman, 1985), 12 of the 105 Canadian patients were seen clinically on four or more occasions with repeated gasoline sniffing. A similar percentage of long-term deterioration was observed in a group of Japanese adolescents being treated for glue-sniffing (Suwaki, 1983). Compared to a variety of control groups, solvent-inhalant abusers, especially if young, manifest a variety of deviant and psychopathological characteristics which warrant attention (Reed & May, 1984; Epstein & Wieland, 1978; Clements & Simpson, 1978; D'Amanda et al., 1977; Szapocznik et al., 1977; Watson, 1979). Solvent-inhalant drugs are well known as stepping stones to subsequent abuse of other drugs.

Acute Medical Management

Most hepatic, renal, haematopoietic, pulmonary, and central nervous system damage from solvent-inhalants improves with abstinence and time alone. This fact greatly emphasizes the importance of active substance abuse treatment, with the establishment of abstinence, regular reassessment, and monitoring. If detection and treatment have been timely, complete return to normal function may be anticipated. Incomplete recovery or even permanent disability can result if detection and treatment are delayed (Tsushima et al., 1977).

Resuscitation of anoxic patients is especially relevant for solvent-inhalant abusers, who may collapse while inhaling out of an air-tight container. Immediate assisted ventilation should be undertaken. Intravenous mannitol can be administered to reduce cerebral edema, a common and often fatal or at least disabling complication of anoxia. Steroids may be given for the same purpose, but their clinical efficacy is not so apparent.

Establishing Abstinence

Helping the patient establish and maintain abstinence is the next critical step in treatment. This may be accomplished by reducing availability of or access to the solvent-inhalant, as in the following case:

A 28 year old hair stylist presented for medical treatment had shortness of breath. Breath sounds were reduced, exercise tolerance was poor, and chest x-ray showed bilateral diffuse granulomatous pulmonary change. Drug history revealed that he had inhaled hair spray at work over the previous several years. During a six week treatment period and leave of absence from work, he was able to cease all inhalant use. His pulmonary status showed mild improvement. Upon return to work, however, he could not restrain himself from again inhaling hair spray. A job change was recommended, and he received training as a barber. In this occupation, he was able to avoid hair spray use and recovered from his substance abuse.

A variety of other milieu changes can be employed to the same end. When several children were unable to maintain abstinence in their own disorganized family setting, placement in supervised foster homes led to cessation of their gasoline sniffing (MMWR, 1985). Besides change in occupation or home setting, other milieu changes include changing school, friends or playmates.

In the midst of a solvent-inhalant epidemic, several measures are available to reduce drug availability. Parents, teachers, and employers can closely monitor the use of these materials. Decreased access to gasoline can be effected by locked gas caps. Stores selling these products can provide limited access to supplies, sell only to adults, or maintain a record of sale.

Treatment During Recovery

Abstinence alone does not necessarily result in a stable, lasting recovery. Once abstinence is established for some days

or weeks, the clinician must be concerned with helping the patient to cope with and to adjust to life while abstinent. Unless changes are undertaken in the patient, family, or social milieu, recurrence is likely. The following case provides an example:

A 16 year-old student presented with fatigue, trouble with concentration and memory, decline in grades, and inability to maintain former skill at sports. Since his liver was enlarged and urinalysis was abnormal, serological tests for hepatic and renal function were obtained. These were markedly abnormal. Although he had denied substance abuse, when presented with these data he admitted to daily sniffing of gasoline, kerosene, cleaning solvents over the previous three years. The family agreed to clinical monitoring of his laboratory findings and they were willing to ensure his abstinence from solvents, but they refused family counseling for themselves or admission to a drug treatment programme for the patient. The patient discontinued his solvent abuse, but was presented for treatment three years later at age 19 with cannabis and alcohol abuse.

Family involvement with treatment is important with patients of any age, but it is especially critical for children and adolescents. Substance abuse in the other members must be considered and, if present, should receive treatment. Solo parent families and families with a mentally retarded or mentally ill parent will need extra support and direction. Placement of the patient out of the family for a time may be needed in order to disrupt destructive interactions and to allow some respite from the problems associated with substance abuse. Family members should learn, about the usual manifestations and course of substance abuse, and the recovery course as well, in order to cope better with their relative's problem (Skuse & Burrell, 1982).

Adolescent and adult patients should be engaged in a programme of recovery from substance abuse. These programmes vary from culture to culture, but usually involve the following:

- support and encouragement for abstinence;
- opportunities for social interaction and recreation in a drug-free setting;
- development of new attitudes and new behaviours, such as assertiveness training or self relaxation techniques, which may reduce the likelihood of recurrence;
- the learning of new methods for dealing with anxiety, drug craving, social frustration, loss and other negative

feelings; this may be accomplished by various means such as sociodrama, counselling, various forms of psychotherapy (Stybel, 1977); hypnotherapy with suggestion has also been used (O'Conner, 1982). acquisition of a new and positive social identity as a person recovering from substance abuse.

Major psychiatric syndromes often seen in the first year of recovery include major depression (Massangale et al., 1963), panic attacks, chronic anxiety, hypomania or mania, paranoia, organic brain syndrome, and sexual dysfunction. Patients should be encouraged to identify and deal with these problems. While many patients do improve over several weeks with abstinence alone, other patients require psychiatric treatment. Such treatment facilitates a full recovery and reduces the risk of recurrence, as in this case:

A 44 year old woman employed in a cleaning establishment complained of increasing fatigue, somnolence, tremor, and incoordination. Her liver was enlarged and tender, and hepatic serological tests were markedly abnormal. She readily admitted to carbon tetrachloride inhalation at work over the previous few years, with a marked increase of sniffing frequency over the last several weeks. Following the early phase of abstinence, she manifested symptoms of a major depression, which increased in severity over a four week period despite improvements in her hepatic function. Antidepressant medication and weekly psychotherapeutic sessions were initiated. Subsequently she made an uneventful recovery and was able to return to work at the cleaning establishment, in a position which did not involve exposure to solvents.

Epidemics of solvent abuse, whether in children or adults, call for special public health interventions. The mass media can be used to warn about the dangers of particular solvent-inhalants. Such public education may of course induce use where it has not occurred. However, once an epidemic is present and solvent-inhalant abuse is already widespread, this becomes less of a consideration. Education should be directed not only to the individual abuser, but to the family, friends and other associates of the abuser. These latter people must learn about the following: pathological patterns of use; symptoms and signs of acute intoxication and chronic abuse; methods for supportively confronting the abuser and motivating the person to treatment; sources of referral in the community; and alternatives for dealing with the resistant user. Children can be effectively involved in this process. Education can also

be directed at persons such as teachers, physicians, social workers, and probation officers who are apt to encounter cases of solvent-inhalant abuse. Law enforcement officers have also contributed to the resolution of this problem among youth in some settings (Sourindhrin & Baird, 1984).

Another means of dealing with an epidemic is to reduce drug availability. Several methods for accomplishing this have been described earlier in this paper. Enhancing personal and ethnic self identity has also been employed (Nurcombe et al., 1970; Goldstein, 1976; Barnes, 1979).

If a particular solvent-inhalant is being abused during an epidemic, it may be possible to add a noxious agent to the substance. Such additives as mustard oil, horseradish essence, or other benign nauseant may reduce experimental use (Rubin & Babbs, 1970; Cohen, 1975; King et al., 1985). In one area the addition of sulfur dioxide to industrial nitrous oxide was mandated by law (Cshwartz & Calihan, 1984). Legislation regarding aerosol propellants should be considered if public health warrants it (Nicholl, 1983).

Self help groups can be immensely helpful. Parents of abusers as well as abusers themselves can benefit from organizing and supporting one another. Community task forces can include parents, teachers, primary health care workers, law enforcement officers, social agency representatives, and community leaders.

Creative social approaches have been applied in childhood, adolescent, and boarding school epidemics. Examples include recreational and sports programmes, hiring counselors, reducing the adult-to-child ratio in institutional settings, and obtaining volunteers from nearby professional schools (Schottstaedt & Bjork, 1977; Merrill, 1978; Masterton, 1979).

Innovative approaches are also necessary in managing the pandemic of homosexual nitrite inhalant abuse. It seems likely that, like AIDS, this practice may eventually involve heterosexuals as well. One educational approach consists of providing instruction on alternate means for meeting the same sexual functions, such as squeezing the erected glans penis in order to delay premature ejaculation. Treatment of chronic substance abuse in this group may also demand modification of sexual practices, as in this case:

A 22 year old waiter with a diagnosis of "pre-AIDS" was referred due to inability to cease amyl and butyl nitrite abuse (up to 100 "hits" between Friday and

Sunday). He had tried to do so, but then experienced premature ejaculation during sexual activity. When he resumed nitrite abuse, he also resumed promiscuous sexual activity -- a practice he was trying to stop. Informed of his pre-AIDS diagnosis, he was determined to cease sexual intercourse but was unable to persist in his decision when he sniffed nitrites at homosexual parties and social gatherings. It was necessary for him to first maintain sexual abstinence in order to establish abstinence from nitrites and other substances. A homosexual self help group was valuable in supporting his recovery. His "pre-AIDS" did not progress to full blown AIDS, and he made a successful recovery from his nitrite abuse and compulsive sexual promiscuity.

During recovery, the patient undergoes many biological, psychological and social changes, all of which need not necessarily receive specific therapeutic interventions so long as they are proceeding uneventfully. These changes usually are greatest during the first year of recovery, but often continue over a period of three to five years even in optimal cases. Recurrences of substance abuse, while not uncommon during the first year of recovery, impede this process of natural healing or recovery. Medical involvement should continue for at least two years following the establishment of abstinence in order to assure optimal chances for this recovery process to occur. If the patient does not demonstrate a continuing and stable recovery, consultation should be obtained from an expert in the field of substance abuse.

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EXPERIENCE IN THE TREATMENT AND REHABILITATION OF INHALANT USERS IN MEXICO

Dr. R. De La Fuente
Mrs. E. Medina-Mora

In Mexico, as in most countries, inhalation of substances with psychotropic effects has spread. These substances, result of advances in petrochemistry, have important applications. Therefore their complete restriction is not possible.

Concern with this practice is not limited to its availability and size of population that uses them, but with the portion of the population affected. This is mainly children and adolescents in a period of physical and emotional development. Due to the association of this practice with psychological deficit^{9, 22}, poor school performance¹⁹, and in some cases, with delinquency¹⁴, it requires immediate intervention.

Reports in international literature on treatment specially oriented to young inhalant users are scarce mainly because in other countries the use of multiple drugs is more frequent¹⁵. Among Mexicans and Hispanics in the United States¹² there is a group of inhalant users that differs in many aspects from other drug users, and thus requires specific treatment alternatives.

The purpose of this paper is to review some experiences in the treatment and rehabilitation of inhalant abusers in Mexico. In order to introduce this subject, in the first part of the paper, some epidemiological data and characteristics of users will be presented. A description of existing intervention programmes will be included and finally an alternative pilot experiment will be described.

Prevalence of use and trends

Prevalence of inhalant use has been studied through household surveys of people 14 years and over, conducted between 1974 and 1980. The age range of the ever use group was from 14 to 24 years and represented of 1% of the study population range between .1% to 2.1%^{17, 18, 20, 23, 24, 30}.

School population from 14 to 21 years of age, in a national survey conducted in 1976, was reported to be of a similar rate 0.85%⁸. In 1978 the rate of ever-use for the school population in the Federal District increased significantly to 5.4%. Use in the last month and heavy-use did not vary much, the rates being were 1.1% in 1976 and 1.5% in 1978².

In 1978, use was mainly reported by males between 14 and 15 years of age, and attending schools located in areas of low socioeconomic level².

In 1980 experimental use had not shown significant changes; 4.4% of the students reported use. In this survey, the age group studied was increased to include those 18 years of age. The age was widened to include students up to 18 years of age and schools located in areas of all socioeconomic level³. Also, students of schools situated in all socioeconomic levels were studied.

In 1981 the rate of ever use at a national level did not change, i.e. 4.1%⁷.

Rates of drug use are higher among non students either living in communities²⁸ or working on the streets¹⁹. No exact estimations are available in relation to the extent of this group and the prevalence of drug use.

In 1982 a study was conducted in order to develop a methodology to study the group of minors with no stable place of residence and to estimate the prevalence of drug use (N = 329). 95% of the group studied were males, with an age range of 6 to 18 years (X = 12.8) 67% did not go to school and 47% slept on the streets. They worked as car washers, sellers or helpers in commercial establishments among other activities.

The rate of ever-use was 27% and of daily use 22%. 9% reported inhalation of 4 or more times per day. The second choice of drug was marijuana with rates of 10.3% and 1.5% for ever and daily use respectively.

Drug use was significantly predicted ($R^2 = .647$) by the following variables: not attending school at the time of the survey, having started to work on the streets at a younger age compared with non users (X = 8.7 and 10.2 years respectively), small income and not living with the family. A high percentage of users were born outside Mexico city and often had brothers and friends used drugs¹⁹.

Results from other surveys confirm this relation of variables with drug use among children that work on the streets mainly school attendance and family life^{4, 9, 14, 25, 29}.

The number of children that work on the streets is related to the economic condition of the country. The child's contribution to the family income is significant. Unfortunately in the process some become involved with drug users and eventually leave their homes¹⁴. This group presents a special challenge for intervention.

Characteristics of inhalants users

In order to offer the inhalant users an alternative, it is very important to understand the process of their becoming involved with drugs and the dynamics of their lives on the streets. Two problems need to be overcome i.e. to get them to submit to treatment and to have a rehabilitation programme based on the needs of this group.

Inhalant users vary considerably in their characteristics and socioeconomic origin. Nevertheless due to the need to develop appropriate models for children of low socioeconomic status, this paper will focus on this group of the population.

The families of these inhalant users are usually broken; the mother often lives with a man who is usually not the child's father; the child is sent to the streets to earn some money for all the family and eventually he prefers to stay out of the house. The decision to leave the house or the school or both is directly related to the initiation to drug use. They could survive on the street when they were children. But when they become adolescents it becomes more difficult to get work or money. At this time the adolescent engages in different activities including delinquency. The wayward child lives in the community as in a small family; the adolescent will act as the authority or father and he teaches the small guy how to survive on the street to earn money and to be brave. This relationship is very strong. Before the adolescent leaves the area he advises the young child and they will not speak to each other for a month before the separation. The child's life in the streets can be described as oriented towards drug use and endeavours to earn enough money to eat and buy inhalants or to steal them. In the group one's status has to be earned. The child will try to perform activities that are admired by his peers. An example would be to run away from institutions^{14, 21}.

Available intervention programmes

Contact with the intervention programmes depends on the social definition of drug use, consciousness of undesirable condition, needs of the inhalant users. The type of programme depends on elements such as the definition of the population it is aimed at.

Inhalant users are not conscious of being physically affected by the use of drugs. Thus they do not seek medical treatment. Though some of them make use of the community health facilities, the majority of users are contacted by other agencies.

Perhaps the specialized treatment centres for drug addict (Centros de Integracion Juvenil), are the biggest organization, in the country aimed at dealing with this problem. There are 32 such facilities over the country and they attend about 4 000 persons per year. In 1982, 47% of the patients were inhalant users⁵. The structure of the programme is based on the medical model but shows important variations depending, among other factors, on the region of the country and the socioeconomic standard of the area.

In spite of the fact that they attend to an important sector of drug users, their involvement with young inhalers is limited in part because of the medical orientation of the model. Inhalant users do not voluntarily involve themselves in this type of programmes. Also of the requirement for family participation is a constraint.

The law has the greatest involvement with drug users in general and with inhalant users in particular. This is due to the frequent association of such users with delinquency and also because of the lack of alternatives within the health system.

Under the law, residential treatment is mandatory for minors under the age of 18 years. The period of treatment depends on the offense and the number of times the illegal activities are committed. That the family cannot take responsibility for the child also becomes a factor for consideration.

In Mexico City in 1978, 8% of the males contacted were interned due to the use of drugs of these, 76% were inhalant users and 16% marijuana smokers. The rates of drug use among the group interned due to other offenses are considerably higher²⁶. There exists also other residential programmes that are supported by the social welfare section of Department of the Federal District; in this agency educational, vocational and labour training as well as food and clothes are provided. Young inhalant users use these social welfare programmes according to their needs. When they get sick, need shoes, or a hair cut, for instance, they deliberately place themselves in the streets at night in the route of the vehicles that catch the persons sleeping in the streets and take them to special houses. The rate of children taken to these houses increases during special occasions when food and toys are given. When their needs are fulfilled these children run away and return to their drug subculture where they are admired for having run away.

Pilot experiment in the treatment
and rehabilitation of inhalant user

As a result of the growing concern by Health Authorities in Mexico of the increasing presence in their service units of children with a history of inhalant abuse, a pilot programme to see to the treatment and rehabilitation of the affected population was initiated in 1979. This program was developed under the auspices of the Mexican Institute of Psychiatry and the College of Psychology of the National University of Mexico.

The major concern and therefore the principal project priority was the young inhalant (7 - 13 years) abusers in Mexico City. The characteristics of this population required that the programme modality selected be suited to their developmental needs. In order to promote the development and progress of the program the participants, a nurturing treatment environment should be established. The family environment serves in the normal process of child development as the principal promotor for growth and physical and mental well being. A substitute family environment, would at best only support attempts at treatment of this problem population.

Similar considerations and recommendations have come forth from the field of juvenile corrections and delinquency treatment. Experience with the development of treatment environments has suggested that hospital-like institutional environments (e.g. reformatories, mental hospital) are associated with high failure rates (recidivism, re-institutionalization) and the promotion undesirable outcomes (e.g. institutionalization syndrome, criminal careers):

As a result, the predominant trend in this field has been to develop community-based treatment programmes. The same trend has been observed in the field of mental retardation, where the number of institutionalized mentally retarded has significantly been reduced and a growing number are placed in community based programmes³².

While the consensus of opinion suggested that a community-based family style treatment environment would best suit the population of young inhalant abusers, the treatment philosophy that would most efficiently utilize the environment was not so clearly spelt out.

Treatment philosophies that are employed in the treatment of substance abusers are, in the majority of cases, based on an illness model of deviant behaviour. Based on this model highly trained professionals should be responsible for the treatment of the "underlying mental disease" while child-care staff will

provide adequate custodial care. Unfortunately, the child care staff employed were often too poorly trained and overworked to serve as teachers and models of the complex skills for successful community life.

An alternative model of deviant behaviour, is the behaviour deficiency model derived from modern social learning theory. In this concept of deviant behavior, problems of children are viewed as deficiencies in essential skills. These behavioural deficits are considered a result of inadequate histories of learning and instruction. Thus, treatment programmes based on this model are designed to establish the important behavioural competencies that the child has not learned. The role of the environment and care staff is one of critical importance under this model of treatment. They serve as the social ecology for appropriate instruction and learning to occur. A successful model of productive community life for most children is the family environment. The utilization of a family style environment in conjunction with a treatment philosophy that promotes its impact on learning of successful community life, became the major concern in the design of the treatment programme to be developed for the young inhalant abusers in Mexico City.

Such a treatment model was developed in Kansas for the treatment of delinquent, retarded and emotionally disturbed children²⁵. This model is known as the teaching-family model. Though a programmatic application had not been directed to populations of substance abusers at the time the programme in Mexico was initiated, the similarities in behavioural patterns between the delinquent and the substance abusers suggest the possibility of a successful replication

When the teaching-family model is a residential treatment, the programme is carried out in a group-home facility within the community. The group-home is a large residence adapted to house six to ten children and two live-in staff. The staff of the programme is a highly trained couple that serve as the primary staff of the programme and are responsible for its administration. The teaching-parent in the Mexican programme were married couples who were graduate students at the College of Psychology of the National University of Mexico. A major distinction between the teaching-parents and the more traditional house parents or foster parents that usually participate in group-home treatment programmes is the level of training and the programme responsibilities the teaching-parents receive.

While the group-home facility and the staffing patterns promoted a family-style atmosphere, the implementing of an effective instructional ecology requires a series of programmatic components that further identify this model of child treatment.

Among the salient features of the model are:

- (a) Community-based. The residents live 24 hours a day in a group-home within the community. They and the staff running the programme are in constant contact with community standards. They utilize the community resources for education, recreation and employment. Furthermore, a board of directors composed by community members has the final authority over the programme policies and operation.
- (b) Structured motivational system. Within the program structure several motivational systems are in operation. These systems are based on a token economy that is flexible and geared to individual needs. Its main function is to promote the child's learning of the appropriate living skills through involvement in diverse programme activities. In the final stages of the programme the structured motivational system is gradually withdrawn and a more natural set of consequences serve as a motivational system.
- (c) A self-government system. Peer group involvement in the treatment process of a teaching-family home is assured by a semi-democratic government system where the residents participate in rule making and the decision of consequences for their own behavior. The components of the system are the peer manager system and the self-government meetings. Both components are designed to involve the child in assuming some of the responsibilities for programme operation and supervision. The self-government system make the staff accountable to the residents of their decisions, thus making the programme more sensitive to the child's needs and insuring its fairness¹⁰.

The involvement of the child's family in the treatment process is an integral part of the programme. The natural parents with to the child will eventually return after graduation from the programme participate significantly in the programme by assuming responsibility for supervision and rule enforcement during the almost weekly home visit of their child. The teaching-parents provide weekly family session with the parents and the child, where an assessment is made of the child behaviour during the home visit. The parents follow a structured role evaluation and limit setting, gradually undertaking more responsibility for dishing out consequences to the child.

Other community agents such as the school teacher also participate in the treatment process. One of the programmes main objectives is that the community resources be utilized in the process so that the child is exposed to a normal environment.

Although the majority of the children that participate in the programme have been expelled from school or are in immediate danger of being expelled from school, great effort is made to maintain them in a regular school setting. A remote control classroom management system in which the school teacher reports the child's behaviour while teaching-parent decides the consequences in the treatment environment has proven to be a particularly effective programme procedure¹³. The procedure requires only a minimal amount of time from the classroom teacher and allows her to maintain a positive interaction with the child.

The treatment programme for young inhalants in Mexico based on the teaching-family was established in a residential community in Mexico City. Although the initial objective was to establish the group-home facility in the immediate community where the majority of the children came from, the lack of adequate housing in those communities led us to establish the facility in a middle class neighborhood.

While the establishing of the group-home outside the children's community of residence modified somewhat the original concept of the teaching-family model, the level of resources (e.g. school, medical clinic, sanitation facilities) available in the "zonas marginadas" where the children came from was inadequate to provide appropriate programme support.

Since the initial phase of the programme, the mechanisms of referral proved to be a major obstacle. While in the U.S. the group-home facility was a referral source for several child placement agencies (Juvenile Probation Departments, Child Welfare agencies, etc.), the system in Mexico City which has no centralized agency, and where no clear demarcation of jurisdiction of the child was available, such a facility proved to be an unreliable source of referrals. Further contributing to the referral problem is the fact that no legal penalty or violation has been established for the inhalation of solvents.

These difficulties required that personnel be made available to establish a process of community search and referral on inhalant abusers to the programme. This increased the number of staff involved in the programme and its expenses.

A total of 22 children with a history of inhalant abuse were participants of the programme during its two years of operation. All the children came from poor families, had been expelled from school, had records of theft and ranged in age from 7 to 13 years ($X = 10$ years). More than 50% of the children had a pathological EGG and enuresis. Their average days per month of intoxication with inhalants was 19 with an average 10 liters of glue or paint thinner used for such a purpose.

The children's average length of stay, was 10 months and their participation was voluntary and not court mandated as in U.S. teaching-family homes. The results published elsewhere^{16, 31} show the effectiveness of such programmes in reducing and eliminating inhalant abuse in the children. While a year prior to their entrance to the programme 100% of the children reported inhalation of glue or paint thinner, only 25% of the children reported inhalant use during treatment. During the 2 years after graduation from the treatment; 32% of the children reported continued inhalant use. Of these 32% their average number of days of inhalant use dropped from 19 days a month to 3 days a month during treatment and 5 days a month after treatment. While these results tend to indicate a 68% effectiveness rate in eliminating inhalant abuse in the children exposed to the programme, the lack of an appropriate comparison control group where no treatment was provided suggest that such results should be treated with caution. However, these results are similar to the ones reported by Jones (1978)¹¹ in the first national evaluation of the teaching-family programmes for delinquent youths in the United States.

The results of the operation of the teaching-family group-home programme for inhalant abusers were contrasted to number of children treated and the cost of the programme. On this basis, the Institute of Psychiatry decided to request a modification of the initial programme, where the residential modality was dropped and an out-patient model was employed.

The modified treatment programme initially tried to preserve as many features and methods employed by the original teaching-family model program²⁵. However, due to increased needs and demands for the service of the treatment programme, it gradually became a community service centre where services which were offered to substance abusers included counselling,

education, vocational and prevocational training¹. While the results of this programme appear to be positive, there was 16.7% recurrence of substance abuse. The lack of appropriate control comparison limits their significance. The segment of the population served then shifted to the older drug users.

The search for an out-patient service programme for drug abusers terminated the original residential programme which was originally established for young inhalant abusers. As has been pointed out in the preceding sections of this paper, the abuse of inhalants is still a problem of relatively high incidence in urban areas in Mexico with an increasing risk population of children.

As of 1982, the organization of social assistance programme at a local state and federal level has been modified and the central agency now serves as a central referral source (DIF). This reorganization may now provide an opportunity for the further development, and replication of the teaching-family.

To serve the young child of poverty-stricken environments with a chronic history of inhalant abuse, a residential family style environment appears still to be the treatment of choice. Our initial results seem to further substantiate this statement. Now that improvement has been made to the process of referral, it seems suitable for continued research into this model of treatment.

The needs of the young inhalant abusers and those of adolescent poly-drug users are best served by different treatment environments.

While the treatment of the substance abuser in Mexico has expanded in a multitude of treatment programmes, for the young inhalant abusers, there exists very few programmes geared to their needs in Mexico.

Our experience suggests that option for treatment are available and that results appear to be positive.

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SOLVENT ABUSE - A CLINICAL PERSPECTIVE

Dr. M.I. Akhter

Inhalation of volatile substances is a comparatively recent phenomena. In the United States this practice was started in the early '50s and in the United Kingdom recognised as a problem in the 1970s (Bass, 1970). However, the practice was known to exist in different parts of the world throughout history. A large variety of organic substances were burnt and inhaled in religious and social practices with the express aim of producing intoxication and to alter consciousness. A variety of anaesthetic gases soon after discovery, became substances of abuse leading to serious consequences.

The first clinical record of a case of solvent abuse in an adolescent has been described by Lewin (Louis Levin, 1881). In his book called "Narcotics and Stimulating Drugs, Their Use and Abuse" he described in great clinical detail a case of benzinomania producing neurological deficits. He says:

"These are interesting cases because they manifest the shifts to which man can be reduced in the desire to experience cerebral sensations different from those of everyday life. Benzine seems unsuitable for this purpose but it is used, and its use continued if its effects are agreeable experiences.

"Some children and adults who habitually inhaled benzine vapours for their pleasure have been the object of various investigations. A girl suffered from disagreeable disturbances of sight due to a central scotoma. According to the report of her mother, who cleaned gloves for a living; she had had for some years the habit of smelling the rag soaked in benzine or of holding the petrol bottle to her nose. Specially before bed time the craving was so violent that neither punishment nor entreaty was of any avail and although the mother attempted to lock up her store of benzine the patient had her own supply which she always replenished from a hiding place in the garden. The girl bought more of the liquid as soon as she had collected a few pence. She was removed from home and placed in a Convent. According to the evidence of the nuns, she was not able to indulge in her old habit, although during the first few days she did everything she could to obtain the substance. After three months the relative scotomas of red and green had completely disappeared, but normal sight which had been disturbed was not re-established."

"Benzinomanic glove cleaners have also been observed. The statement of the man who used benzine in his business praises the sensations experienced after the inhalation of the vapour. He declared that he had previously consumed considerable amounts of liquor, but for six months not a drop had passed his lips. He had inhaled benzine vapours instead. The benzine was at his disposal in his profession as a bandage maker and these inhalations had completely substituted alcohol. He said he had experienced a wonderful feeling of peace and had agreeable, delicious dreams. A colleague from Southern Germany had taught him this way of applying petrol, but the agreeable effects of benzine diminished after some time.

Hallucinations appeared; the patient heard the unpleasant music of barrel organs and unharmonious singing by voices known to him; red ants crept about on his body; he saw several figures of animals and dwarfs; and once the whole room seemed to be full of coloured silk flags which fluttered to and fro."

"In all probability these symptoms were due to effects of benzine and cannot be explained by the cessation of the use of alcohol".

Levin also referred to the practice of atheromania which was prevalent at that time in England, France and Germany and suggested that the reason for this spread was "imitation and seduction experienced by the description of its agreeable effects, and elevation of physical and mental troubles."

In Britain, solvent abuse first attracted official attention in Lanarkshire, Scotland, in November 1970 when the police arrested a number of young people who were acting drunk and disorderly. It was established later that intoxication was due to sniffing fumes from a degreasing agent stolen from a local industrial works. Several more incidents occurred which were highlighted by the case of a 10 year old boy who was found unconscious in the school playground after inhaling shoe conditioner. This abuse of solvents by school children illustrated a disturbing trend towards the involvement and corruption of younger age groups in the Glasgow area. In 1970 the average age of glue sniffers in the Glasgow area was 17 years of age. However, by 1976 there were reports of children 7 - 8 years old sniffing glue fumes. (Watson, 1975).

Prevalence of Abuse

Various studies in the United Kingdom and in America suggest a point prevalence of 9.8% amongst boys aged 13 - 15 (Ramsey, 1982), a life-time prevalence of 9.8% for boys aged 12 - 17.

(Fisher et al., 1980). Gay et al (1982) looked at 304 abusers and found that 77% were between 14 and 17 years of age. In this group only 24% had abused solvents for more than six months and 4% of this sample had abused other drugs or alcohol.

The register established in Birmingham in the year 1983/84 recorded the names of 600 abusers in one year alone (Education Welfare Office Statistics).

Profile of the Abusers

Our experience in Birmingham and a study of the Education Welfare Services statistics indicate that the abusers can be divided into three significant groups. Cases of children abusers as young as 6 - 8 years old have been reported. Mostly, the practice had been picked up from older siblings. Abuse is commonly seen in the age group of 12 - 17 years. As in most studies in other parts of the world males are represented in substantially higher numbers compared with females. The three categories noted are "the experimenters", "the abusers" and the "chronic sniffers".

The Experimenters

These are children who are curious, who hear about these practices or observe them in various situations and then find out for themselves what it is all about. Once the curiosity has been satisfied after one or two attempts, they do not continue the practice.

"Peer Group" Sniffers

In the majority of cases, glue sniffing is a group activity involving a number of other adolescents who sniff for 10 - 20 sessions over a period of a few months. Initially the majority of members of the peer group conform, merely to maintain the membership of that group. Usually the group activity is associated with antisocial behaviour but eventually the group moves on to other activities that excite their interest - and sniffing stops.

TABLE 1

Setting of Volatile Substance Abuse (n = 36)	
Groups	16
Groups + Alone	11
Alone	4
With "Minder"	2
Others	3

A number of children were noted to abuse in pairs and while one person was inhaling solvents the other one acted as a look-out "minder" to warn the abuser of an approaching policeman or to prevent any serious complications.

"Chronic Sniffer"

Once the group has lost interest usually one or two children continue to inhale solvents because it tends to alleviate their boredom or "resolve" their personal difficulties. These children eventually become the chronic sniffers. Such children are noted to have disharmonious home environments. In a series of cases seen at the Regional Drug Addiction Unit in Birmingham, 44% had a history of drug abuse in other members of the family. Emotions such as hatred and feelings of rejection and resentment towards the family was not uncommon. 78% were from broken homes.

Reason for Sniffing

When asked about the reason for sniffing 12 suggested that it was to release them from boredom, depression, family difficulties and anxiety and 9 said that they wanted to feel happy and experience hallucinations. Asked about the methods of introduction to the practice 22 said that they were told about this by friends, mostly at school. 7 learned the practice from an inmate in a care institution. 2 said that they learned about it from watching a television documentary. 4 learned the practice from seeing others sniffing in the city parks.

TABLE 2

Reason for Sniffing	
Boredom	17
Depression	9
Curiosity	5
For Fun and Enjoyment	5
Felt 'dependent'	5
To join in	4
Pressure from friends	2
No reason given	2

Method of Use

The main method of use was:

- (a) Sniffing or inhaling directly from tins, bottles or tubes through the nose or mouth

- (b) Fluids dabbed on the sleeve or jacket lapel and sniffing from there
- (c) Handkerchief or piece of cloth saturated with solvents and held over nose or mouth
- (d) Inhalation from empty crisp packets or small plastic bag which contains the solvent
- (e) Large plastic bag containing the solvent or saturated material placed over the head, It was supposedly to accelerate the process of intoxication
- (f) Aerosol sprayed directly into the nose and mouth, a practice which is known to cause instantaneous death (instantaneous aerosol death).

In Birmingham the sporadic appearance of the practice in different schools in totally different parts of the city at various times was noted. There did not seem to be any logical explanation of the appearance of this behaviour and it was felt that occasional media reports of the practice triggered off the experimentation. However the practice was seen to die down after a short period of time and only a small number of cases were referred to the Clinic. One District Health Authority in the area opened a clinic for the specific purpose of counselling solvent abusers but this clinic had to close within a short period of time because of the lack of referrals. A number of adolescents expressed reluctance to go to a community based clinic which was identified for solvent abusers and it was suggested that they preferred the anonymity of the clinic within hospital settings.

Substance Abused

Various studies in the United Kingdom indicate that most of the abusers tend to adhere to the adhesives containing Toluene and Acetone, the commonest being a proprietary product called Evo-Stik. There were some reported cases of use of nail polish remover, Tipp-Ex (correcting fluid), lighter fluid and modelling glue. There have been a very small number of cases of petrol sniffing. There is as yet no record of a case of Amylnitrate abuse among adolescents in the United Kingdom.

There has, however, been a fairly rapid increase in heroin abuse over the last few years in the country. A number of solvent abusers admitted to occasionally sniffing heroin as part of their poly drug abuse. Since there are similarities in the sniffing practices, transition from glue-sniffing to "chasing the dragon" is but only a small step. Davis et al (1985) has reported a number of cases of solvent abuse leading to heroin addiction. Poly drug abusers are known to continue with their habit of solvent abuse (Crides et al., 1979).

Criminal Behaviour

The association of criminal behaviour and solvent abuse is well established. In our series almost all the patients seen had a criminal record, some including a wider field of offences. Almost all had a record of petty theft. The other examples were aggressive behaviour, disturbance of peace, obscene language, vandalism, car thefts and burglary and the carrying of an offensive weapon. We had one case with a record of grievous bodily harm, and one case of arson. A number of offences were related to shoplifting glue for their own and for the use of their friends, and there were a number of cases where the abusers broke into Do-It-Yourself shops to obtain large supplies of solvents. This practice is akin to breaking into the chemist's to obtain narcotics and other controlled substances.

Cognitive Impairment

In a study carried out in association with the University of Aston in Birmingham, 12 solvent abusers were matched against 12 controls. The mean age of the solvent abusers was 16 years 6 months and the mean age of the controls were 16 years 3 months. They were all males and the solvent abuse group had been sniffing Toluene for a period ranging from a minimum of 6 months to 4 years. As far as possible the groups were matched for age, intelligence and socio-economic background. All 24 subjects were tested by using a neuropsychological test battery which comprised eleven tests. The tests used were: Reaction time, Purdue Pegboard Test, Speech Sounds Perception Test, Token Test, Canter Background Interference Procedure (BIP) for the Bender Gestalt Test, Seashore Rhythm Test, Stroop Colour and Word Test, Trailmaking Test - Part A and B, Symbol Digit Modalities, written and oral, W.A.I.S. and W.I.S.C. Vocabulary, Annett Handedness Questionnaire.

The detailed analysis of the tests showed that on seven out of eleven tests the experimental group performed significantly less well than the control group. The most highly significant difference concerned verbal and motor skills. Ron (1986) in a review on the subject has suggested that if impairment is present it is mild and limited although more extensive tests might have uncovered other deficits.

Mortality

A fairly large number of cases of sudden death have been reported as a result of solvent abuse (Bass, 1970 and Reinhart et al., 1977) who stated that death among teenagers was caused by cardiac sensitisation. Bass (1970) noted that sudden deaths happened frequently just after sniffing and some forms of exercise or stress, mainly associated with aerosol sniffing.

Mortality from Toluene, the main substance of abuse appears, however, to be rather low. Many solvent deaths reported have been from associated trauma (Anderson et al., 1982), or aerosol abuse or inhalation of Benzene and Trichlorethylene.

In the United Kingdom 169 deaths have been reported since 1971 and 1981. Anderson et al (1982) analysed 140 deaths between the period of 1971 and 1981.

TABLE 3

Mechanism of Death	Percent
Trauma	8
Plastic Bag	19
Inhalation of Stomach Contents	14
Asphyxia	49
Other/not known	11
Total	100

(Anderson et al 1982)

TABLE 4

Substances	Percent
Solvent in Adhesive	23
Butane	27
Aerosol	15
Others (incl. Toluene in adhesives)	26
Other/not known	9
Total	100

(Anderson et al 1982)

Anderson suggested that these solvent abuse deaths accounted for 1% of all deaths in males aged 10 - 19 years and 3% deaths from injury or poisoning in males aged 10 - 14 year. However, when compared to the figures associated with alcohol consumption leading to cirrhosis of the liver, it indicates an increase from 1016 in 1950 to 1771 in 1977. Solvent abuse deaths, therefore, are still low by comparison with those due to alcohol. Gay et al (1982) looked at 304 abusers and found that 77% were between 14 and 17 years of age. In this group only 24 had abused solvents for more than six months and 4% of the sample had abused other drugs or alcohol.

The register established in Birmingham in 1983/84 recorded the names of 600 abusers in one year (Education Welfare Office statistics).

Treatment and Prevention

In spite of the fact that solvent abuse has existed in a recognised form for about thirty years no specific treatment modalities have been worked out. Solvent abusers are regarded as poor prognostic subjects (Watson, 1979). There are difficulties in establishing specific treatment programmes partly because of the limited number of abusers referred and because of the relative non-compliance of the patients with therapeutic programmes. Solvent abusers also present a special problem because of the personality difficulties and a multiplicity of behaviour problems.

The "experimenters" and "Peer group abusers" are relatively easy to deal with and their abuse is relatively short lasting and their response to health education programmes, if properly presented, is satisfactory. Exaggeration or the adoption of a too soft approach can be counter-productive. In our experience a matter-of-fact approach remains the best option. We have discouraged the special workers from going and talking to schools and have emphasised and impressed on the schools the need to incorporate health education with regards to solvents and other drugs of abuse in a wider topic-promoting healthier style of living. We have encouraged teachers to take this up as part of classroom curriculum and now several supporting materials are available from TACAD (Teachers Advisory Council on Drug Abuse).

Long-term abusers, however, require a more intensive approach. We are currently engaged in the study of a series of cases referred to us and are looking at various clinical profiles including electro-encephalographic and electro-cardiograph data as well as enzyme studies. Quite often the discussion of test results if somewhat abnormal have

produced a great deal of motivation to change their behaviour patterns. It is also important to emphasise the improvement likely in test results (like Gamma GTs) if solvent abuse is stopped. The presence of family alienation is dealt with by a team of social workers and we are currently establishing a programme of family therapy.

There is a close association of unemployment with solvent abuse. Boredom is offered as a principle reason for indulging in the practice. We find that involvement in various training schemes sponsored by the Government or other voluntary agencies also have beneficial effects.

Youth workers have proved an asset as solvent abusers are more likely to identify with people of younger age groups as compared to the professionals. Group discussions in youth clubs in association with gymnasium programmes also have had a great deal of impact.

A number of Study Days have been organised for groups which are likely to come in contact with the young adolescents and these include youth workers, probation officers and teachers. Such programmes are difficult to evaluate but the number of referrals to the Drug Addiction Unit has been reduced considerably. The practice is not as visible as it was a few years ago. However, the graduation to heroin abuse in a small number of cases remains a major cause for concern.

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SOLVENT ABUSE IN THE UNITED KINGDOM THE PROBLEM AND THE ATTEMPTS TO DEAL WITH IT

Dr. M.A. Ron

Introduction

Solvent abuse has become a problem in the United Kingdom over the last decade and several treatment approaches and government policies have been put forward to deal with it. This review attempts to give an account of the magnitude of solvent abuse in the UK and of the attempts so made to deal with it.

The misuse of volatile substances was recognized as a problem in the United Kingdom in the 1970's and has since received considerable attention from health workers as well as extensive media coverage. Despite the potential importance of the problem our knowledge of its size and of the possible long-term sequelae is still limited and little is known about the efficiency of the various treatment methods employed so far. This paper will focus attention on some of the epidemiological and social features of solvent abuse in the United Kingdom and on the treatment approaches and government policies that have originated in an attempt to manage the problem.

The Size of the Problem in the United Kingdom

The prevalence of solvent abuse in the United Kingdom is not known as large, representative epidemiological studies have not been performed. The available information refers to groups of schoolchildren and it may not be accurate to extrapolate this information to the general population. However, some indication of the extent of the problem is already emerging. In the west of Scotland, where the problem was first identified, 400 cases were recorded between 1975 and 1981 (Watson, 1982), and Ramsay 1982 using a questionnaire found a point prevalence of 9.8% among boys aged 13 to 15 who attended a secondary school in Glasgow. No cases of abuse were reported in those over the age of 16. 50% of those who had used solvents had done it only once, 28% had tried it more than once but not regularly, and only 21% were regular abusers; this represents a frequency of 1 in 50. It is likely that the numbers may have been higher if those who were absent from school at the time of the study had been included in the sample, as severe abusers are less likely to attend school regularly. These figures are similar to those reported by Fishburn et al (1980) in the USA who found a lifetime prevalence of 9.8% for those aged 12 to 17 in a study

that sampled urban and rural populations. Within this age group only 2% had used solvents in the month prior to the study; an indication that only a small proportion of those who experiment with solvents go on to abuse them regularly.

A more recent study (Faber, 1985) found a prevalence of 8.1% in children between the ages of 11 and 18 attending schools in urban and rural areas of East Sussex. Although abusers were also found outside this age group, their numbers were smaller.

As can be expected, the figures are lower if only those who come to the attention of helping agencies are considered. Gay et al (1982) identified 304 abusers during a six-month period from a population of 250,000 individuals at risk. 77% of the subjects were under the age of 17. In this sample 24% had abused solvents for more than six months and only a small proportion (4%) had used alcohol and other drugs as well. The majority of the referrals in this sample were initiated by the Police (67%) or by the Educational Authorities (23%); social services, probation officers, casualty departments and child guidance clinics only identified a very small proportion of the cases.

Abuse of solvents as the presenting problem or as a contributory factor accounted for 3.5% of all referrals below the age of 16 to the Department of Child Psychiatry at the Maudsley Hospital (Skuse and Burrell, 1982). A third of these were chronic abusers, while the rest used solvents sporadically.

Compared with other causes of accidental or voluntary poisoning solvent abuse appears to be relatively uncommon and enquiries related to its effects accounted for only 1% of the requests for information received by the National Poisons Information Services (Francis et al., 1982).

A survey of the deaths resulting from volatile substance abuse (Anderson et al., 1985) detected 282 cases in the period between 1971 and 1983. 80 of these deaths had occurred in 1983, an increase from previous years. All areas of the UK were affected, although more cases had been recorded in Scotland and in urban areas of England. These figures accounted for 2.4% of all deaths in males aged between 15 and 19, and 3.4% of all deaths in that age group due to injury or poisoning.

The Abuser and the Substances Abused

Although it is outside the scope of this paper to describe in detail the psychological and social features of those who abuse solvents, some brief comments are worth making. No clear

association between solvent abuse and social class has been found (Skuse and Burrell, 1982; Faber, 1985) and there is no evidence that the practice is confined to one racial group. As in other countries, in the UK solvent abuse is commoner in boys than girls.

Solvent abusers can be roughly divided into two types, those who abuse these substances in the social context of a peer group and those who do it in isolation. Gay et al (1982) found that only 13% of their sample abused solvents when alone and the children in this group tended to have longer histories of abuse, to use other drugs and alcohol, and to come from more disrupted family backgrounds when compared with those who abused solvents as part of a group activity. In the recent East Sussex study (Faber, 1985) 23% were lone abusers, and a further 10% abused solvents both as a group activity and when alone.

Surveys carried out in the UK (Watson, 1982; Sourindhrin and Baird, 1984) showed that nearly 90% of abusers used adhesives containing toluene and acetone. Other products such as nail polish remover, hair lacquer, fire extinguisher fluids, petrol etc are much less commonly used. Toxicological studies (Oliver and Watson, 1977; Francis et al., 1982) have confirmed these reported preferences by the analysis of blood and urine samples.

There are indications from studies currently in progress that solvent containing products other than glue are becoming increasingly popular among solvent abusers, perhaps as a result of the attention paid to glue by the media. However, there is as yet no clear evidence that abuse of heroin or other drugs follows solvent abuse in a sizeable proportion of cases. Sporadic cases of solvent abuse leading to heroin addiction have been reported (Davies et al., 1985) and in populations of polydrug abusers (Crites and Schuckit, 1979) solvent abuse occurred in those who were more severely addicted to other drugs. However, large follow-up studies, so far unavailable, will be necessary to determine whether drug escalation occurs in a large proportion of solvent abusers.

Other problems, such as an increase in criminal activity are also known to occur in solvent abusers. The extent of the problem has not been systematically documented, but theft connected with procuring solvents, criminal damage and burglary have been found to be comparatively common offences (O'Cibbir, 1983). Faber (1985) found that 10% of the abusers from East Sussex had been involved in some sort of criminal activity and Masterton and Sclare (1978) reported a three-fold increase in delinquent behaviour in adolescents after they started using solvents.

The possible psychiatric, neurological and cognitive sequelae of solvent abuse have been discussed in another paper (Ron, 1985). Suffice it to say here that in the age group commonly engaged in the practice the evidence for permanent brain damage resulting from solvent abuse is inconclusive except for a few isolated cases, and that although solvent abusers are a group with high psychiatric morbidity, this is likely to be the cause rather than the consequence of the abuse of these products.

The Treatment of Solvent Abuse

A number of approaches have been tried to deal with this problem. Health education in schools is widely accepted as being useful in preventing abuse, or at least in reducing its potential dangers (Woodcock, 1982; O'Connor, 1983), although the effectiveness of this approach has not been systematically evaluated. The education programmes used so far include information about other drugs and alcohol as well as solvents.

For the already-established abuser, referral to specially set up clinics or to other treatment facilities is the rule. In the last few years clinics have been created to deal with solvent abuse in many parts of the country and, although they vary in their approach to the problem, most of the elements used in treatment are common to many of them. O'Connor (1983) described the work of one of these clinics in the Newcastle area where solvent abusers are referred by several sources including police, general practitioners, social services etc. After a period of assessment, specific therapeutic approaches individually selected for each client are instituted. These include brief client-orientated psychotherapy, behaviour modification (e.g. social skills training) and the use of suggestion techniques such as hypnosis. The family of the abuser also receives counselling, and new referrals are often incorporated into groups which include clients who have achieved abstinence. This type of approach, similar to that proposed earlier by Masterton (1979), is aimed at dealing with the personal problems and difficulties in relationships that the abusers may have, and not only at preventing the practice of solvent abuse. Group therapy and fostering alternative activities are the approaches favoured for the gregarious abuser whose problem is "socially" determined, while a more psychotherapeutic approach has been suggested for the lone abuser whose solvent abuse is caused by "psychological" factors.

The results of treatment have not been systematically assessed. O'Connor (1983) reported short-term improvement in half of those who accepted treatment, but the long-term effects remain to be explored. Moreover, nearly a third of those

referred to the clinic refused treatment and the outcome of this untreated group should be used to judge the benefits of any therapeutic intervention. Similar success rates have been reported by Skuse and Burrell (1982) in those referred to a child psychiatry department, and therefore likely to have more severe psychiatric problems.

The Government Policy

The Secretary of State for Social Services assumed responsibility for coordinating the various responses to the problem in 1981 and consultations with professional and voluntary organizations were initiated by the Government at the beginning of 1983. The results of these discussions can be divided into two parts:

(a) The Laws Dealing with the Problem

Solvent abuse is not in itself a criminal offence and the Government has opposed the introduction of legislation to make it so. However, it is possible to bring a prosecution for offences committed while under the influence of solvents, including abusive or threatening behaviour as well as offences of violence or criminal damage. Existing powers under the Children and Young Persons Act of 1969 allow the police to remove a person under the age of seventeen to a place of safety in order to sober up and receive advice. These powers are usually applied in two sets of circumstances: First, if the police officer has reason to believe that the juvenile is being abused or neglected at home or if he is an habitual abuser, and, second, in an emergency when death or injury could result from the abuse. In most cases where a juvenile is detained in a place of safety, the local social services are informed at the earliest opportunity.

Legislation has just been introduced in England and Wales which makes it an offence for a person to supply substances to those under the age of eighteen if that person knows or has reasonable cause to believe that the substance or its fumes are likely to be inhaled for the purpose of causing intoxication. A person guilty of such an offence is liable to imprisonment for up to six months and/or to a fine. This legislation brings England and Wales in line with Scotland where similar laws are already in operation.

The Government has, however, rejected the idea of instituting controls on the supply, composition or labelling of products which contain solvents.

(b) The Need for Information

The Government approach to the problem of solvent abuse has been one of spreading information and of trying to use the already existing resources in the best possible manner, while at the same time trying to avoid ill-judged publicity which could have contributed to the further spread of the problem.

As a result of the Government consultations a number of publications and aids for training professionals are now available. Among the publications it is worth mentioning a leaflet entitled "What to do about glue sniffing" which is addressed to parents and gives clear information on how to detect glue sniffing and how to deal with it. Similar guidelines have been made available to the police and to retailers. Local and regional seminars have been held for those professionals who are likely to encounter solvent abuse, and a video tape ("Illusions") and a training manual published by the Health Education Council are now available. A logical extension to this campaign has been the funding of research aimed at establishing the possible long-term sequelae of solvent abuse.

A different educational approach has been proposed by the Institute for the Study of Drug Dependency (ISDD). Based on the premise that health education is not an effective way of preventing experimentation with solvents, but that it may be effective in modifying the type of substance abused (Woodcock, 1982), the ISDD published a leaflet intitled "Teaching about a Volatile Situation" in which advice is aimed at reducing the likelihood of physical harm resulting from the practice, rather than at its prevention. This document has met with considerable criticism, but if it is confirmed that the choice of solvent is moving away from toluene-containing glues toward potentially more dangerous products, as some current studies suggest, the approach proposed by the ISDD may merit further consideration.

Summary and Conclusions

Solvent abuse is now a recognized problem in the United Kingdom. Its prevalence varies depending on the population sampled and it is difficult to draw definite conclusions as to its frequency. However, there is little doubt that it is a problem of considerable social and medical importance. It is uncertain whether the habit is still spreading, or whether it leads to the abuse of alcohol or other drugs. Current studies suggest that the choice of solvents may be changing and there is a danger that more harmful chemicals might be used with ensuing risks.

Treatment efforts have been considerable and usually aimed at dealing with the many problems experienced by abusers as well as trying to achieve abstinence. Treatment methods include a variety of psychotherapeutic and behavioural approaches similar to those used in child and adolescent psychiatry and emphasis is placed on utilising available resources effectively. The outcome of these methods remains to be evaluated.

The Government has been actively involved in dealing with the problem during the last few years using a two-pronged approach of introducing limited legislation and giving information and training to lay and professional people.

Many aspects of the problem, however, still remain to be explored and epidemiological research together with careful evaluation of treatment methods is clearly needed.

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CHAPTER 6: PREVENTION - AN OVERVIEW

Introduction

This section deals mainly with primary prevention: early case finding at community level is dealt with in Section 6 "Treatment".

Although many countries have solvent abuse problems and a few preventive efforts have been tried, almost no research has been undertaken. A variety of legal changes have been made to reduce the availability of solvents or to penalize those who sell solvents to children. In addition, a few promising community and school-based programmes have been attempted but few evaluations have been made. In total, therefore, results of prevention programmes are largely unknown.

The best approaches for prevention have not been evaluated to ascertain what their effects have been or what problems they have raised. In short, little is known about how to prevent solvent abuse. Nevertheless, a few prevention programmes have been tried in some countries. Solvent abuse prevention programmes have been mentioned in various reports (e.g. Barnes, 1981; Watson, 1980; O'Connor, 1984) but the details have not been published and hence the range of attempted programmes is difficult to assess.

Problems With The Prevention of Volatile Substance Abuse

One difficulty with mounting solvent prevention programmes is the low level of use in the general population. In most countries solvent use occurs in a small minority of the younger population and is even rarer among adults. Most users are infrequent users. Hence, major mass media educational programmes are not necessary in most countries; authorities would prefer to concentrate their limited resources on the more frequently abused drugs such as alcohol, cannabis, or opiates. Solvent abuse requiring prevention programmes is seen to be a problem in a few communities such as some ghetto areas.

Many communities that do have a solvent abuse problem tend to be isolated and disorganized, with few support systems. Many communities with large solvent problems are poor and have few recreational or other social programmes to support a prevention programme. Also, in some of those communities solvents are abused by adults and children alike and not thought to be a

problem (Barnes, 1979). Consequently, adults, who should be the initiators and supporters of prevention programmes, are indifferent to the need for them. Solvent abuse is often closely related to ghetto poverty and hence prevention may depend on drastic socio-economic changes beyond the ability of health planners to achieve.

Limiting Availability

Much research shows that where drugs are freely available there are more users, more heavy users and more users with problems. Limits on availability, if successful, can be helpful in controlling most forms of drug abuse. However, solvents and volatile substances are easily available. It has been found in practice to be impossible to limit or reduce the availability of volatile substances which can be inhaled. Some legal efforts have been made to limit the access of potential and actual inhalants but without much success.

Legal controls on volatile substances are of questionable value in preventing abuse and hence should not be the sole focus of preventive efforts. The substances taken, such as glue, paint thinner, nail polish remover, gasoline, etc. are all sold legally and are easily available both to abusers and the general public. Typically, it is difficult for authorities to control the abuse of drugs or substances that are sold legally. The user raises no complaint to police. Also, there is no illicit market and hence no traffickers or importers. With drugs such as heroin or cannabis police detect users during the search for illegal drugs or trafficking and many "possession" charges are laid as a result of such detection. However, possession of volatile substances is usually legal and the police can take little interest in their abuse except in rare circumstances, e.g. public intoxication, solvent use and driving, etc.

Some countries have prohibited the recreational (but not legitimate) use of glue and other solvents or have defined it as juvenile delinquency. In some countries the law is enforced but there have been very few convictions; hence its impact must be limited. In other countries such as Japan there have been a large number of convictions but it is not clear that glue sniffing has been reduced by the enactment and enforcement of these laws. In general, legal sanctions against inhalant abusers is not a preferred method of prevention. Such sanctions do not appear to reduce abuse and they create additional problems for users.

Many jurisdictions have legislation that forbids the sale of solvents to minors. For example, legislation was introduced in New York City to prohibit the sale of glue to anyone under 18

years of age unless he had a "hobby card" (Barnes, 1979). Cases of glue sniffing have reportedly declined but it is not clear whether the legislation was responsible. Other communities have made it illegal to have volatile solvents on open shelves where they may be stolen by minors.

Legislation was enacted in many American cities in the 1960s, chiefly to limit access to solvents or to make solvent abuse illegal (Press and Done, 1967). Most law enforcement officials reported that it was a "useful tool", but some claimed that the legislation was difficult to enforce. However, the actual effects are not known.

Perhaps some solvents could be prohibited from sale altogether or prohibited for minors. Total prohibition is unlikely as there are so many solvents and it is well known that users often switch from one to another. Controlling sales of some solvents to users could only be effective if there were no substitutes. Laws limiting availability may have a limited impact but in some communities they are felt to be necessary and useful. It is believed that they help to establish and clarify community values about solvent abuse and may have an important symbolic effect.

It was noted that prohibiting sales to minors will have a very limited impact on some types of volatile substance abuse. In Indian communities in Canada (see Smart, 1986, for a review) the popular sniffing agent is gasoline, which is left outside houses in large drums, or in petrol pumps, boats, cars, and snowmobiles. Controls on sale would not be effective but perhaps drums could be more carefully stored and gasoline tanks fitted with locking caps. Many solvent abusers could change to other products if these new procedures were followed but perhaps not all would do so.

Rather than making volatile substance abuse illegal many hope that it will be possible to make them safer to use or perhaps less attractive. For example, many aerosol sprays earlier included fluorocarbon propellants but few do now (Wega, 1978) and hence these hazardous products are less likely to be sniffed. Industries should be asked to limit the use of harmful chemicals where possible and to pay attention to the possibility that their products may be inhaled by abusers.

Many solvents and inhalants such as glues, nail polish remover, etc. can have chemicals added to prevent prolonged inhalation (Fernandez, 1978). These deterrents typically have a foul smell, or cause nausea or crying when inhaled. Of course, they affect both legitimate users and sniffers and because they make products so unattractive they are not popular with

manufacturers. Consequently, the search for good chemical deterrents seems to have stopped. It is recognized now that such deterrents cannot be added to all products and that abusers may inhale them regardless. Again, if chemical deterrents were added to one solvent many confirmed sniffers would simply switch to another.

Rapid progress is being made in some countries with the removal of lead from gasoline. Most new cars in North America now require unleaded gasoline for pollution controls, and leaded gasoline is disappearing from the market. However, boats, snowmobiles and other small motors can still use the much cheaper leaded gas. As the lead is removed from gasoline the chances of lead poisoning are reduced. However, it has been pointed out that lead is often replaced by toluene, which is also dangerous. In most countries unleaded gasoline is still not widely available. Use of such gasoline would decrease problems from solvent abuse as well as decreasing environmental pollution. Plans to substitute unleaded for leaded gasoline should be accelerated wherever possible.

Social and Community Programmes

It is clear from much research that sniffing of volatile substances is essentially a social and community problem. Sniffing is often done in groups in parks and recreational areas by young people who have little else to do. There is an indication that sniffing frequently takes place in impoverished communities, often rather isolated areas or big city ghettos. Also, school-based programmes cannot be depended upon because in many developing countries few adolescents go to school. What is usually needed is some sort of community based approach, carefully tailored to the needs of the community. Such approaches might differ considerably from place to place. For example, prevention programmes for gasoline sniffing in Northern Canada will probably be different from those for glue sniffing in Mexico or in the United States. At present, too few programmes have been evaluated or described to be sure just how they should differ or what the ideal elements should be.

In Canada, a community development approach to solvent abuse has been developed (Wilkinson, 1978). At the start, community members share information about solvent abuse and the availability of solvents. Abusers are identified and provided with recreational alternatives and family counselling. Each abuser is assessed and given treatment, if necessary, or peer counselling. The suggested approach involves activities at several levels and should be effective, at least in small communities where there are few sources of solvents and few abusers.

In Winnipeg (Canada) an "Anti-Sniff Coalition" (Sub-Committee on Alcohol and Other Drug Problems, 1980) was formed, along the lines suggested by Wilkinson (1978). The goals of the "Anti-Sniff Coalition" were to prevent solvent abuse, assist children and families with a solvent problem, educate the community and try to prevent indiscriminate sale of inhalable solvents. The Coalition picketed stores which sold solvents for sale of solvents to people under 18 years of age and requiring that solvents not be placed on open shelves. They have also sponsored workshops and conferences on volatile substance abuse. In addition, they promoted an informal programme between schools and police wherein the police will notified schools about specific solvent abuse problems. The sniffing of solvents should not be a crime, since the legal system cannot cope with sniffing which is essentially a community problem. Unfortunately, no evaluation has been made of the effects of the Anti-Sniff Coalition on solvent abuse. However, in keeping with most community-based programmes they emphasize the giving of information of solvents to the community as a priority.

In Mexico, a programme called "Sociodrama" (de la Garza et al., 1984) has been developed as an educational approach to solvent abuse in Mexico. Dramas involving likely situations that develop with solvent abusers are performed in high risk areas. This type of approach is important because in many countries solvent abusers are not in school.

Volatile substance abuse has also been an important problem in the west of Scotland. A variety of treatment and community approaches used in managing volatile substance abuse have been attempted there (Masterton, 1979). Some have involved provision of recreational facilities and health education for parents and professional workers and the assessment and psychological treatment of abusers. The long-term strategy for Scotland will include legislation aimed at banning solvents, and the establishment of solvent abuser registers, both of which might be difficult. However, the ultimate aim would be to produce deterrents which can be added to solvents but which would allow legitimate use.

School-Based Programmes

Because abusers are typically young and many are still at school, several school-based programmes have been tried. However, these programmes do not reach the older solvent abusers and early school drop-outs. However, since the average age of starting to sniff is 12 - 14 years, nearly all users should be accessible through schools. School officials are often

concerned that education programmes about volatile substances may encourage inhalation abuse and actually give instruction on how to inhale solvents. In areas where abuse levels are low education programmes will often not be acceptable. If introduced they should be general in nature and not give information likely to encourage use. Only in areas where the abuse is common are special drug education programmes likely to be effective.

Numerous school drug education programmes have been developed to deal with drug abuse in general but few are focussed on solvents. Most in North America seem to emphasize the most often abused drugs such as alcohol, tobacco, cannabis and hallucinogens. Solvents seem to be a very small part of such programmes and hence their effects on solvent abuse are rarely assessed. One evaluated drug abuse prevention programme (McClellan, 1975) emphasized teaching and discussions of attitudes, beliefs and lifestyles, and referral of students to community agencies for alcohol and drug-related problems. Students were selected for the programme (but not forced to participate) by the school's Drug Resource Coordinator; most were known heavy drinkers or drug users. The programme led to considerable reductions in the use of many drugs - among them volatile substance inhalation.

In 1980 the Institute for the Study of Drug Dependency (ISDD), England, took a "casualty reduction" approach rather than "total eradication" to school drug education. They recommended that special attention be paid to the most dangerous solvents - gasoline because of its lead content and aerosols because of their fluorocarbon content. Glues containing toluene are said to cause few physical problems but are dangerous because they make users intoxicated or unconscious or because they are used with plastic bags causing suffocation and death. The ISDD recommended that this casualty-reduction approach be employed by schools and other health education system, but no empirical trial of the method has been undertaken.

In order to have good school-based programmes it is necessary to have well-informed teachers. An extensive teacher education programme for solvent abuse has been developed and evaluated in Mexico (de la Garza, 1986). In general, the programme seems to be very effective in improving the knowledge levels of teachers and introducing them to the issues around solvent abuse in schools. School systems which wish to proceed with solvent abuse education should develop clear guideline for solvent abuse courses for students, and for the training of teachers.

Another comprehensive programme for solvent abuse has been developed for the Teachers Advisory Council on Alcohol and Drug Abuse Education (TACADE) in England (O'Connor, 1984). It suggests that when faced with glue sniffing among students schools should:

- (a) seek support and cooperation from parents and community
- (b) undertake its own prevention programme; and
- (c) refer problem children to appropriate agencies for treatment and counselling.

In this programme work on solvent abuse should be integrated into a more general programme of health, social and personal education. TACADE also recommends structured discussion groups which are part of a "personal relationships" programme. Such groups discuss adolescent problems in general and refer to solvent sniffing only if the problem is raised by students.

Two interesting and non-traditional prevention programmes for North America Indians in schools have been described. One (Schottstaedt and Bjork, 1977) describes a prevention programme for an Indian boarding school in Oklahoma. School counsellors identified 37 habitual sniffers among 291 students (12.7%). They sniffed gasoline from tractors and cars and obtained spray paints, glue and solvents from stores and the school maintenance department. A multi-factor approach was tried to limit availability of solvents in the prevention programme. School staff locked up any supplies which could be sniffed and cut up plastic bags before discarding them and also turned all the gas in school laboratories. A local Indian group conducted campaigns to encourage local stores to keep solvents out of reach of children.

The staff-child ratio was improved and more staff worked in the evenings. A volunteer programme was started with students at a local youth centre. The volunteers provided recreational activities and more adult contact at mealtimes and in the evenings. Also, individual abusers were seen by a social worker from a local drug abuse programme. The total programme appeared to be successful, as only a few additional children became sniffers after the programme started, but the evaluation report was not extensive and did not cover a long-term period.

The Berens River Pilot Project involved a solvent prevention project on a Canadian Indian Reservation in Manitoba. The aim of this project was to allow opportunities for Indian children,

who experience little success at school, to work outside school in different settings (in airports, logging camps, stores, etc.), the work experience counting towards school credits. The students' self-acceptance was expected to increase as the need for drugs decreased. A preliminary evaluation did indicate some positive effects of solvent sniffing but a more extensive evaluation would be necessary to be certain of the conclusion.

These school and community based programmes demonstrate the need to tailor individual programmes to local needs and to the facilities and staff available. Most community based programmes involve several approaches i.e. education about solvents, efforts to limit availability and getting users into treatment programmes. At present, it is not possible to determine which of the various elements is most effective, or whether any of the programmes can reduce solvent abuse in the short or long term.

The Mass Media and Volatile Substances

Since solvent abuse is rare in most countries, detailed knowledge about just what solvents can be inhaled and how is not widespread. Many young people get their knowledge about drugs from friends and if few friends are users, information on use will diffuse only very slowly. For these reasons it is important that mass media reports should not contain detailed information on what products are being sniffed or just how it is being done. Some media reports have provided explicit details and pictures and therefore probably encouraged solvent use among potential users. Efforts should be made by professionals interested in solvents to educate local and national media about the solvent problem in ways that will not promote use. This means taking a low key, non-provocative approach and possibly not focussing on solvent abuse in areas where it is not epidemic. In order to have such influence on media people it will be necessary to develop close relations with them over a long period of time.

Professional Education and Volatile Substances

Most professionals will rarely encounter solvent abusers in their daily work. However, many physicians, psychiatrists and social workers in high abuse areas, certain ghettos or depressed areas, may encounter users without recognizing them. Most professional schools have little material on solvent abuse in their curricula. An exception is the programmes for dentists in some countries, although the material is concerned with anaesthetic gases. Several countries are creating printed and audio-visual material on solvent abuse, making it available on request or through special courses and seminars. Most countries will require an improvement in the level of professional education about solvents and volatile substances.

The Role of the Primary Health Care Worker

At the community level the primary health care worker can play a vital role in the prevention programme of volatile substance abuse. He/she can be trained to:

- (a) create awareness at the community level on the problem.
- (b) provide information and education to parent groups, schools, churches and other religious institutions.
- (c) detect cases early and motivate the abuser to seek treatment.
- (d) provide support to the families of abusers.
- (e) undertake counselling and a follow-up of volatile substance abusers after their discharge from the treatment centres.
- (f) provide information to teachers that will enable them to identify volatile substance abuse early among the student population.

Conclusions

Given that so little evaluation has been done it is too early to suggest an ideal or even minimal prevention programme. A national approach should involve as many of the elements as possible in a multifaceted approach. The most extensive programmes include identification of high-use areas, attempts to limit availability of solvents, educational programmes for parents, teachers, and students, and professional education and contacts with the mass media. These can be utilized only in areas with acknowledged solvent abuse problems and they must be applied within the resources available. As more programmes are tried and evaluated, more information will become available about the best approach in each type of solvent abuse problem. All prevention programmes that are attempted should be evaluated.

PREVENTION APPROACHES FOR SOLVENT/INHALANT ABUSE

Dr. R.G. Smart

Although many communities have solvent abuse problems and a few preventive efforts have been tried, almost no research has been done on them. A variety of legal changes have been made to lower the availability of solvents or to penalize those who sell to very young children. Also, a few promising community and school-based programmes have been attempted but not evaluated. In total, therefore, the results for prevention are unimpressive. We do not know what the best approaches are, what their effects have been or what problems they have raised. In short, we do not know much about how to prevent solvent abuse. The task here is to examine the problems with preventive programmes and to summarize those which have been tried. Reviews of solvent sniffing sometimes mention prevention programmes (e.g. Barnes, 1981; Watson, 1980; O'Connor, 1984). However, programmes are often thought to be solely of local interest and hence details are not published.

Problems With The Prevention Of Solvent Abuse

One difficulty with mounting solvent prevention programmes is the low level of use in the general population. Most North American studies find no more than 4% to 6% of high school students are current users and most of those are infrequent users. Hence major programmes are not necessary in most communities or schools; they would prefer to concentrate efforts on the more popular drugs such as alcohol or cannabis.

Many communities which do have a solvent abuse problem tend to be isolated and disorganized with few social supports. Many Indian reservations with large solvent problems are poor and have few recreational or other social programs which could be used in a prevention programme. Also, in some of those communities solvents are abused by adults and children are not thought to be a problem (Barnes, 1979). Consequently, adults who should be the initiators and supporters of preventive programmes are indifferent to the need for them. Solvent abuse is often closely related to ghetto poverty and hence prevention may depend on drastic socio-economic changes beyond the ability of health planners to achieve.

Despite these problems a few programmes have been introduced in various countries. Several programmes are innovative and appear to be successful but evaluations of them simply do not exist to support this positive outlook.

Prevention Activities And Programmes For Solvent/Inhalant Abuse

Various activities and programmes have been directed at preventing solvent abuse. Some of them are simple legal changes, others are community development or school-based educational programmes. Usually they focus on only one aspect of prevention, e.g. students in school, the legal system, etc.

- (a) Legal controls on solvents and inhalants are of questionable value in preventing abuse. The substances taken, such as glue, paint thinner, nail polish remover, gasoline and the like, are all sold legally and are easily available both to abusers and the general public. Typically, it is difficult for authorities to control the abuse of drugs or substances which are sold legally. The user raises no complaint to police. Also, there is no illicit market and hence no traffickers or importers. With drugs such as heroin or cannabis police detect users during the search for illegal drugs or trafficking and many "possession" charges are laid as a result of such detection. However, possession of solvents is usually legal and the police can take little interest in solvent abuse except in rare circumstances, e.g. public intoxication, solvent use and driving, etc.

Some jurisdictions such as Alberta have prohibited the recreational (but not legitimate) use of glue and other solvents under the provincial Public Health Act. The use of substances for inducing euphoria, hallucinations or intoxication is forbidden as is their distribution for such purposes. The maximum fine is \$100,000. Unfortunately, the law is seldom used and there have been very few convictions under it. The impact is thus limited.

Sometimes, solvent use is seen as evidence of juvenile delinquency, but this often depends upon individual magistrates. Drug-related delinquencies constitute only 2 - 3% of all cases in Canada (Smart, 1983) and most of those involve cannabis. Cases involving glue or solvents are rare. Delinquency proceedings affect very few solvent abusers in Canada, but substantial numbers in some parts of the United States (Reed and May, 1984). It is not known how the delinquency proceeding and probation affects later solvent use.

In Winnipeg, solvent sniffing was defined as a "vice" under the Juvenile Justice Act, similar to sexual immorality. However, it has had a recent legal challenge and police are not preceeding with more cases until the appeal is heard.

According to Barnes' review (1979) legislation was introduced in New York City in 1964 - 65 prohibiting the sale of glue to anyone under 18 years of age unless he had a "hobby card". Cases of glue sniffing reportedly declined but it is not clear whether the legislation was responsible.

Press and Done (1967) reviewed solvent legislation enacted in 26 American cities in the 1960's, chiefly legislation to limit access to solvents or to make solvent abuse illegal. It was difficult to be sure whether the new legislation had reduced solvent abuse. However, most law enforcement officials did report that it was a "useful tool" although some claimed that the legislation was difficult to enforce.

Perhaps some solvents could be prohibited altogether or prohibited for minors. Total prohibition is unlikely as there are so many solvents and it is well known that users often switch from one to another. Controlling sales of some solvents to users could only be effective if there were no substitutes. Some communities have made efforts to have sales of solvents limited to adults only. For example, a Winnipeg Anti-Sniffing Coalition got the City Council to pass a By-Law in 1979 prohibiting adults from selling or giving solvents to people aged under 18. The By-Law also prevents the sale of glue and other solvents on open shelves where they can be easily stolen. Many people feel that the By-Law is unenforceable but one prosecution of a store owner has been made. It is uncertain who effects these efforts have had.

Prohibiting sales to minors will have a limited impact on some types of solvent abuse. In Indian communities (see Smart, 1985 for a review) in Canada the popular sniffing agent is gasoline which is left outside houses in large drums, or in petrol dumps, boats, cars and snowmobiles. Controls on sale would not be affective. Perhaps drums could be more carefully stored and gasoline tanks fitted with locking caps.

(b) Reductions In The Dangerous Effects Of Solvents

Rather than making solvent use illegal it might be possible to make them safer to use or perhaps less attractive. For example, many aerosol sprays earlier included fluorocarbon propellants but few do now (Wega, 1978). Such additions made these hazardous products less likely to be sniffed.

Many solvents and inhalants such as glues, nail polish remover, etc., can have denaturants added to prevent prolonged inhalation (Fernandez, 1978). These denaturants typically have a foul smell, or cause nausea or crying when inhaled. Of course, they affect both legitimate users and sniffers and because they make products so unattractive they are not popular with manufacturers. Consequently, the search for good denaturants seems to have stopped. Fernandez (1978) has claimed that "universal denaturing of all volatiles and the products that contain them is neither safe nor practical, nor technically possible". If denaturants are added to one solvent many confirmed sniffers would simply switch to another.

Rapid progress is being made in some countries with the removal of lead from gasoline. More cars in North America and Europe now require unleaded gas for pollution controls. However, boats, snowmobiles and other small motors can still take leaded gas and it is much cheaper to use. As the lead is removed from gasoline the chances of lead poisoning are reduced. However, it has been pointed out that lead is often replaced by toluene which is also dangerous.

(c) Treatment of Solvent Abusers

The successful treatment of solvent abusers should contribute to prevention. Early intervention should prevent the development of heavy use patterns and permanent brain damage. Since solvent use is often done in groups, treatment of abusers could reduce chances for young users to model themselves on more experienced users and thereby limit the spread of sniffing practices. Though successful treatments of solvent abusers have been reported (Black, 1967; Faucett and Jensen, 1952), some treatments have failed. For example, Neal and Thomas (1974) had little success treating an 18 year old gasoline sniffer with a variety of therapies. The patient was treated by a

psychiatrist for several years and had a pattern of heavy sniffing episodes followed by a few months of abstinence. Also, Ackerly and Gibson (1964) found that probation, foster homes and training schools were unsuccessful for four out of five male sniffers.

Rubin and Babbs (1970) tried a variety of treatment methods. They found that the best method involved special teachers working with the sniffers on a daily basis, a peer group with a probation counselor and heavy involvement of families in various recreational and counselling activities. About half of the sniffers stopped sniffing under this regime although it should be noted that it is a long and costly approach.

Barnes (1979) has also pointed out that a new combination of probation for juvenile delinquents and treatment at the Addiction Research Foundation was coincidental with a reduction in the number of glue sniffers found in surveys. However, Barnes also stated that it is impossible to be sure that the reduction was due to the new programme and nothing else. In general, research on combined treatment and probation programmes for solvent abusers is very sparse and conclusions are difficult to make.

More recently, Sourindhrin and Baird (1984) have described a treatment programme for solvent abusers in Glasgow. They reported on 300 children seen at the clinic in 1979 - 80. The clinic provides medical and psychiatric help and health education and counselling for parents and teachers. Surprisingly, only 6% of the children were considered to need psychiatric care. Children were seen usually once and only if accompanied by parents. There was an emphasis on parents and children discussing the sniffing problem and taking responsibility for improving the situation. Children were placed under the supervision of a plain clothed police officer in community development who arranged for recreational facilities and further support. About 19% were re-referred to the clinic for a second time and 6.7% for a third time at which point they were often sent to court. In general, this minimal intervention seems to be successful.

A "management" programme for solvent abusers has been developed by O'Connor (1983) based on his extensive experience in treating abusers. He suggests guidelines for parents such as rules to improve listening to

children, providing affection, promoting sports and other recreational activities, giving a good example by avoiding excessive smoking, drinking and drug use, and being available at home for at least several days a week. Sniffers are also helped to manage their dependency by examining their feelings about sniffing and talking about them. When he has decided to stop he can follow guidelines such as avoiding other sniffers, developing recreational pursuits and getting over the ill effects of sniffing by exercising and improving his diet.

Social And Community Programmes

It is clear from much research that sniffing of solvents is essentially a social and community problem. Sniffing is often done in groups, in parks and recreational areas by young people who have little else to do. Much research (see Smart, 1985) indicates that sniffing often takes place in impoverished communities, often rather isolated Indian reservations or big city ghettos. What is usually needed is some sort of community-based approach, tailored to the needs of the community. Such approaches might differ considerably from place to place. For example, prevention programmes for gasoline sniffing in Northern Canada will probably be different from those for glue sniffing among Hispanics in the Southern United States. At present, there are too few programmes evaluated or described to be sure just how they should differ.

Wilkinson (1978) suggested a community development approach to solvent abuse. At the start, community members share information about solvent abuse and the resources to deal with it. The group then approaches retailers and asks them to reduce the availability of solvents. Abusers are identified and provided with recreational alternatives and family counselling. Each abuser is assessed and given treatment if necessary, or peer counselling. The suggested approach involves activities at several levels and should be effective, at least in small communities where there are few sources of solvents and few abusers.

In 1978 an "Anti-Sniff Coalition" (Sub-Committee on Alcohol and Other Drug Problems, 1980) was formed somewhat along the lines suggested by Wilkinson (1978). It developed as a community action group rather than a government inspired effort. Unfortunately, it did not get the support of the Native community, which probably needed the programme more than most. The goals of the "Anti-Sniff Coalition" were to prevent solvent abuse, assist children and families with a solvent problem, educate the community and try to prevent indiscriminate sale of

inhalable solvents. The Coalition picketed stores which sold solvents for sniffing. They also got the City Council to pass a "Sniff Bylaw" prohibiting the sale of solvents to people under 18 years of age, and requiring that solvents not be on open shelves. They have also sponsored workshops and conferences on solvents. In addition, they promoted an informal program between schools and police wherein the police will notify schools about specific solvent abuse problems. The Coalition has argued for social betterment in housing and recreational facilities for affected areas. They have publicly taken the approach that sniffing solvents should not be a crime and that the legal system cannot cope with sniffing which is essentially a community problem. Unfortunately, there is no evaluation of the effects of the Anti-Sniff Coalition on solvent abuse.

Solvent abuse has been an important problem in the west of Scotland. Masterton (1979) has described a variety of treatment and community approaches used there in managing solvent abuse. Some have involved provision of recreational facilities and health education for parents and professional workers, and the assessment and psychological treatment of abusers. A long-term strategy is said by Masterton to include legislation aimed at banning solvents, or the establishment of solvent abuser registers both of which might be difficult. However, the ultimate aim would be to produce deterrents which can be added to solvents but allow legitimate use.

School-Based Prevention

Because solvent abusers are typically young and many are still at school several school-based programmes have been tried. Of course, they miss older solvent abusers and the early dropouts. However, since the average age of starting to sniff is 12 - 14 years nearly all should be accessible through schools.

Numerous drug education programmes have been developed to deal with drug abuse in general, but few seem to be focused on solvents. Most in North America seem to emphasize the most popular drugs such as alcohol, tobacco, cannabis and hallucinogens. Solvents seem to be a very small part of such programmes and hence their effects on solvent abuse are rarely assessed. One drug abuse programme in Milwaukee did provide information on solvent abuse. The "Pulaski" Project (McClellan, 1975) was concerned with preventing "self-abuse" by any means. It was done in one school in 1974. It emphasized teaching about natural "highs" through recreational alternatives, classroom presentations and discussions on attitudes, beliefs and lifestyles, and referral of students to community agencies for alcohol and drug-related problems. Students were selected for

the programme (but not forced to participate) by the school's Drug Resource Co-ordinator; most were known heavy drinkers or drug users. The programme led to reductions in the use of many drugs - among them solvents. About 10.7% of all students reported a decrease in solvent use, 89.3% reported no change and none reported an increase after the programme was completed.

The Institute for the Study of Drug Dependency has described a number of "health education strategies" for minimizing solvent abuse problems. The I.S.D.D. (1980) has taken a "casualty reduction" approach rather than "total eradication". They recommend that special attention be paid to the most dangerous solvents - gasoline because of its lead content and aerosols because of their fluorocarbon content. Glues containing toluene are said to cause few physical problems but are dangerous because they make users intoxicated or unconscious or because they are used with plastic bags causing suffocation. The I.S.D.D. stated "the implications are that educators should seek to ensure that such sniffing as does occur does so in those circumstances in which casualties are least likely". Of course, users should be encouraged to employ safe practices and the less hazardous products. As a part of their position I.S.D.D. recommends that a casualty-reduction approach be employed by schools and other health education systems, but no empirical trial of the method has been found. Of course, this sort of approach would be less effective in places such as Northern Indian communities where gasoline is sniffed and rarely other solvents.

Another educational programme for solvent abuse has been developed for the Teacher's Advisory Council on Alcohol and Drug Abuse Education (T.A.C.A.D.E.) (O'Connor, 1984). It suggests steps that schools should take when faced with glue sniffing among pupils. For example, the school should (i) seek support and co-operation from parents and community; (ii) undertake its own prevention programme; and (iii) refer problem children to appropriate agencies for treatment and counselling. Work on solvent abuse should be integrated into a more general program of health, social and personal education. T.A.C.A.D.E. also recommends structured discussion groups which are part of a personal relationships programme. Such groups discuss adolescent problems in general and refer to solvent sniffing only if the problem is raised by a student.

Two interesting prevention programmes for Indians have been described. The study by Schottstaedt and Bjork (1977) describes a prevention programme for an Indian boarding school in Oklahoma. School counsellors identified 37 habitual sniffers among 291 students (12.7%). They sniffed gas from tractors and cars and obtained spray paints, glue and solvents from stores

and the school maintenance department. At one point, even the gas jets in classrooms had to be disconnected as students filled bags with gas for sniffing later.

Several different approaches were tried to limit availability of solvents in the prevention programme. School staff locked up any supplies which could be sniffed and cut up plastic bags before discarding them. A local Indian group conducted campaigns to get local stores to keep solvents out of reach of children.

Other approaches were based on the concept that sniffing occurred because of emotional needs and deprivation. The staff-child ratio was improved and more staff worked in the evening hours. A volunteer programme was started with students at a local health centre; they provided recreational activities and more adult contact at mealtime and in the evenings. Also, individual abusers were seen by a social worker from a local drug abuse program. The total program appeared to be successful as only a few additional children became sniffers after it began but the evaluation reported is superficial.

The last project (Berens River Pilot Project, undated) involved a solvent prevention project in the Berens River Indian Reservation in Manitoba. The aim of this project was to allow Indian students to experience success in their school program. Many Indian children, of course, experience little success at school. Students were given opportunities to work outside school in different settings (in airports, logging camps, stores, etc.) but still have the work experience count toward school credits. It was hoped that their self-acceptance would increase and the need for drugs would decrease. Unfortunately, the programme was of short duration because the director left. A preliminary evaluation did indicate some positive effect on solvent sniffing, however, a more extensive evaluation is necessary.

In Conclusion: An Ideal Prevention Programme?

Given that so little evaluation exists it is difficult to suggest an ideal programme. The best approach is to make use of all available resources and to have a multi-faceted approach. The most extensive programmes include identification and treatment of abusers, attempts to limit the availability of solvents through legal or persuasive means, education about solvents for both potential users and the general public and a recognition that social, emotional and economic factors are important in solvent abuse. Whether any one approach can be successful on its own is uncertain. A cautious stance is to recommend that all aspects of prevention be attempted by communities wishing to deal with the problem of solvent abuse.

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SOCIODRAMA AND MASSIVE COMMUNICATION IN DRUG ADDICTION PREVENTION

Dr. G. De La Garza

Introduction

We are well aware that prevention is the shortest and definitely the most economical way of drug abuse management both in resources and human suffering. Nevertheless, curing and caring for the patients are the best kinds of assistance provided by mental and physical health institutions.

Experience as well as the poor prognosis for patients who have incurred on drug addiction shows how hard the rehabilitation effort must be.

Preventive methods are currently undergoing a reliability crisis. The evaluation means used in different systems have failed to show their efficacy and as a result have not earned confidence.

Using several techniques to communicate with large groups, our team has worked in urban Monterrey zones that have been endemically populated with drug abusers, in an effort to prevent the use of inhalants by children from spreading. This paper will discuss two of these techniques:

- (a) Education on drug addiction for school teachers; and
- (b) Sociodrama

Massive Communication, The Teacher, And Prevention

Prevention of drug abuse under an educational approach is one of the most valid ways. The Expert Committee on Prevention of the European Council (Strasbourg, March, 1980) has pointed out that "an educational approach that considers psychological and socio-cultural factors seems to be preferable to the legal and medical model." (Newsletter, June - Sept. Issue, 1980, p.1)

We feel that one of the fundamental functions in education is what we could call 'life-training' to enable one to cope in a world where rapid and far-reaching change is constantly causing new problems, and drug abuse is unquestionably one of the most severe. Educators cannot ignore this fact.

In a recent experience² with three thousand teachers, they confessed they were ill-equipped, both academically and emotionally, to confront and help children with this type of problem.

In Mexico, educational programmes and faculties do not have the institutional structure required to implement concrete actions to assist children who show any sign of antisocial behaviour. It is thus a fact that the school gradually selects disciplined pupils and rejects the more conflictive ones. There are actually no financial or physical means in real practice to provide education for all the children who actually come from adequate intellectual and family environments. (Mexico has a scholarship average of 3.5 years). Thus, we could hardly expect any special attention for those who are handicapped in any way, including minor offenders or drug abusers.

Marginal drop-outs abandon school more readily in the face of the many obstacles they have to overcome for a good school performance¹³. Their allowance of time to attend school is also short, since financial problems will necessarily make them look for a job early in life.

Several studies have shown the psychological context of the inhaled¹⁰, and epidemiological research has measured abuse incidence in schools^{9, 11, 12}. In our own research⁷, on 281 minor offenders, we found that most of them had worked for some time and the average age (11.6) when they started earning money matched the time when they dropped out of school i.e., during adolescence and the onset of drug addiction.

It seems to be that school in itself prevents deviated behaviour while it maintains the minors within the school system, with their time structured, and in a productive activity where they feel a drive for accomplishment. In this perspective, it seems to be that an unavoidable task for schools is implementing preventive measures which are both accessible to the pupils and have a realistic approach as regards the teachers.

Background

In Mexico, elementary school teachers may advance in their careers by attending summer courses to become high school teachers. This gives them a better academic status and a chance to earn more income.

For this purpose, over seven thousand teachers travel every summer to Ciudad Victoria (capital of the state of Tamaulipas), and around six hundred to Matamoros (a border town in

Tamaulipas), to attend these courses during six-week terms. (The requirement is three consecutive terms). The assignments required in the different areas that must be covered practically take up all the teachers' time.

We addressed the conductors of these programs with a plan of our own. They showed interest, and allowed us access to the teachers for half a day in two weeks.

The conditions for this task involved financial and material limitations. Our challenge was conducting a course on drugs in a very short period of time to a considerably large number of teachers.

Objectives

It is not advisable to offer educators "recipes" to solve the problems they may face without letting them know the various lines of action involved. Then, depending on their actual circumstances - which generally include low funds - they will set out to implement any means they can actually afford.

In this context, our course is designed to:

- (a) sensitize teachers as to the importance of a drug abuse prevention effort both in schools and communities.
- (b) provide basic information on the general aspects of drug abuse.
- (c) define the counseling role of teachers in drug abuse problems.
- (d) conduct a critical discussion on the policies that are to be followed upon the emergence of a drug abuse situation.

Method

The information is shown through a closed TV circuit system, connected to five monitors installed in the schoolrooms. This gives simultaneous access to 30 - 40 teachers in each classroom. Thus, we can work with around 200 teachers in the morning, and a similar number in the afternoon, each day.

In an intensive schedule we were able to cover a population of thousands of teachers in a couple of weeks.

While the projection is conducted, two instructors are assigned to each group to coordinate the projection, answer questions, and to facilitate the discussion. They are also responsible for expediting group dynamics so that our material would be criticized, and passive attitudes could be prevented.

Audiovisual Material

Before the course was conducted, we wrote a script on the subject of drug abuse and recorded an audio-visual show in videocassette. The topics were arranged in this order:

- (a) History of Drug Addiction.
- (b) Smoking
- (c) Alcoholism
- (d) Inhalants

The first year our 'completely imported' visual material was borrowed from the Mexican Psychiatry Institute. In the second year, we revamped it to meet the requirements of our course and to make it more applicable to the teachers' actual environment. In the course of the last 3 years, we have continued to improve our audio-visual show. This summer the trainees will be divided into two groups. One will attend a course on Drug Education and the other one on Sex Education. (*)

The Instructors

A preliminary course was conducted for the twelve professional instructors (psychologists and social workers) who would act as promoters and facilitators of the group discussions. The basis of this training is a book addressed to teachers: *La Juventud y las Drogas***6. It is written in a question-and-answer format where the most usual concerns are expressed in a simple manner and answered with the most practical prevention measures that schools are able to implement.

Since our success depends on the quality of instructions, we have chosen those who have leadership traits and we have spent more time and effort in their training in recent years.

Discussion Groups

When the audio-visual show ends, the participants are asked to form discussion groups and attempt to answer these questions:

- (a) How important is drug abuse prevention in schools?
- (b) What are the obstacles in your school to the implementation of preventive measures?
- (c) What experience have you had in facing drug-abuse problems and how have you acted?
- (d) What resources encourage preventive efforts in your school environment?
- (e) What concrete alternative actions can you suggest to overcome the drug-abuse problem in schools?

(*) This material is available on request.

(**) The book was recently published in French.

The conclusions from these discussion groups are then read to the whole group in an attempt to get statements of concrete alternatives.

Evaluation

Before the course starts, participants are asked to answer a questionnaire on general drug-abuse knowledge. The same questionnaire is answered later, after the discussion groups have completed their task.

This procedure tells us whether the teachers have actually improved their knowledge and changed their opinions concerning the course and training material. We have made changes in the material as a result of this critique to better adapt it to real life and trainees' needs. Our decision to conduct a course on sexual education this summer was the result of these evaluations.

I should mention here that teachers' knowledge at drug abuse in general is usually very poor before the course, probably due to inadequate training. Our course improves this general knowledge, but nevertheless there are different rates of achievement, depending on the groups. Rural teachers got a better score, perhaps because they are more concerned about their pupils than urban teachers. Math and Chemistry majors learned more than Biology or Psychology majors².

An interesting experience is learning that many teachers become more aware of their own drug habits and a better social consciousness is created to help minors, such as refraining from smoking in class and even within the school grounds.

Results

We have conducted this course in both cities for over 170 groups (approximately seven thousand teachers) in two years. The teachers have 30 - 40 children in each classroom. Hopefully, this knowledge will be spread exponentially as they pass it on to their pupils.

The course is also a personal living experience that allows educators to adopt a critical attitude in the overall teaching areas, over and above drug abuse.

Sociodrama And Drug Abuse Prevention In Different Cultures

As a result of our contact with adolescent drug abusers and their families^{3, 4}, a need arose to communicate with groups that were frequently illiterate. Studying the communication styles in those communities, we arrived at the idea of using sociodrama as our vehicle.

Thus we were able to attract the attention of large groups that were resistant to other approaches by arousing interest in those who had had little or no exposure to theatre performances.

This method allows access to the target population who can understand our message despite their illiteracy.

This experiment was initiated in high-risk communities and those with a high rate of inhalers. Our intention was to spread critical awareness-creating information on the use of drugs and health in general. Hundreds of children and their teachers in schools were captivated by the performances.

When we saw how powerful this method turned out to be, we extended its application to other types of communities and more developed countries, such as the United States and Spain.

Method

Each performance is short, not more than twenty minutes. The scripts are based on a thorough knowledge of the marginal and communal reality of the school environment.

The script does not have highly structured guidelines and is thus easily adapted to different situations, depending on earlier analysis of the audience.

The play topics are multiple, but emphasis is made on those of interest to the particular audience (drug abuse, nutrition, health, education, etc). In general terms, the children's lives are told in a straightforward manner that includes their peer and group relations, and the negative consequences of using drugs. Rehabilitation means as well as the possible alternatives open to the individual and the community are stressed.

A brief example of these scripts would be:

JUANITO. An adolescent, and the main character. The story of his life told in the play has much in common with the stories of the lives of the children in the audience. Then we go on to perform his first and consequent use of drugs, as well as the school, family and repression vicissitudes marginal children are subject to.

DON CAGUAMAS (after the name of a popular beer). Juanito's father. He dresses like any ordinary man in the community. He is aggressive, physically punitive, macho, alcoholic, unemployed, illiterate, and plays around with women.

DONA CHONA. Juanito's mother, she works as a laundress. A self-sacrificing woman with many children, illiterate, unaware of being exploited, she's a suffering martyr who is always complaining.

TEACHER. A repressed, bitter, irritable, spinster. Her personal family and financial problems make her a marginalized civil servant and a poor educator.

POLICEMAN. Any typical Latin American police officer.

PULMON (lung). A negative child leader. He is an adolescent drug seller who induces Juanito to use drugs. He serves as the scapegoat for the group, and is presented as an agent, not as the cause of the problem. He is both a victim and the offender.

(The following three characters are presented in grotesque, structured disguises. They become the target of the audience's hostility, as they symbolize what is bad and undesirable. Inside each disguise is an actor (generally a child from the school) dressed in a T shirt with the \$ sign printed on it, representing money interests behind drugs.

EL POMO (the jar). This disguise is a can of plastic cement which is (the favorite inhalant in these groups) constructed, as the others, with wire and canvas. It has the face of a drugged individual, with red-shot eyes, and a skull is painted on the outside, symbolizing poison.

CANCERONET. A cigarette pack.

CACARDI (the word 'shit' plus a popular brand of rum). This disguise is constructed to depict a bottle of liquor.

SUPER-CONSCIENCE. This character is derived from the television myth of super-heroes, a parody of Superman. Instead of being an alienating character, he questions and analyzes the situations that have been performed and ends up by destroying his own image and myth, and recognizing the absence of magic solutions for the problem of marginality.

DOCTOR. He points out the physical damage cause by drugs.

AUDIENCE. We have held large school audiences captivated by the performances. Up to 800 children may be gathered for a single show. However, our street performances have not drawn such large crowds although we have always tried to perform in places where people usually congregate.

Sociodrama In Closed Communities

In 1980 - 1983 we conducted an experiment with inhaler prison inmates in the Monterrey prison. The first obstacle/challenge in this type of environment is gaining the confidence of the inmates, and it can be quite overwhelming. Our objective was to make an extensive research on chronic inhalers in this prison who belonged to groups characterized by their high aggressiveness and reincidence in delinquency. They had the worst cells and were feared by other inmates. Thus, one may define them as "marginated within marginality".

The goal was to recruit them for a biomedical, toxicological and psychological study. However they were totally uncooperative. They feared being hurt and betrayed to the authorities.

Script

In order to address such a unique community, we decided to use the Sociodrama. After learning more about the reality of the prison environment, we wrote a script with the following plot.

A physician visits the inmates in a ward where they are overtly inhaling. He asks them to participate in the research effort. The inmates mock him and speak of their fears. One of their fantasies is that the proposed blood samples will be sold.

Finally only three inmates agree to help and let their samples be taken.

The following scene dramatizes the dynamics of our procedure: taking the blood samples, making the physical examinations, and announcing the findings. It explains to the inmates how the readings from their tests have turned out to be practically "normal", except for one who has amoebiasis (an endemic disease in prisons), another with haematuria (a possible transient consequence of inhaling) and a third one with a liver lesion (as a consequence of alcoholism or hepatitis).

Since the inmates do not understand the medical terms because of poor education, the actors show the audience their abdomen and lumber region where each one had earlier drawn the intestines, kidney and liver with make-up. The physician explains the consequences of the findings to the inmates and the likely treatment. Inmates ask whether the conditions found are the result of inhaling solvents, and the physician, without exaggerating, tells them the risks of this practice.

The Performance

Over one hundred inmates - the most feared and troublesome - gathered in the prison auditorium for the performance, which was to be preceded by popular music played and sung by the inmates.

For the first time in the history of this prison, they were the centre of attention, and attended the performance gladly. The music cheered them up and some danced on the stage, encouraged by the audience's cheering. We started our performance after the musical number. When our actors mimicked inhaling, the inmates threw them bags with glue to make it more real.

The plot gradually absorbed them, and they finally became silent, watching with attention the development of our play.

Findings

Over and above the entertainment for the inmates, and their clowning before the show, the group of researchers accomplished considerable recognition in the prison in a very short period of time. Fear of us practically disappeared and in the following day we had a list of applicants that exceeded our requirements^{6*}. To our knowledge, this study is the first to measure toluene concentrations in blood samples of toluene-abusing subjects under experimental conditions. The concentrations we found were also the highest yet reported, with the highest over 30 mg/l. It should be noted that the previously reported fatal concentrations had been in the range of 10 - 28 mg/l⁸.

Sociodrama In The United States

We have been invited several times to conduct courses on sociodrama and drug-abuse prevention in the United States.

Attempting a performance in a developed country was a considerable challenge. It also provided us with the chance of learning the scope and limitations of theatre techniques in getting a health message through to a society with a set of values different from the ones in Mexico. Obviously, we had to overcome many obstacles, mainly those involving cultural differences, since education and poverty are highly dissimilar from one nation to the other.

In the United States, illiterates have a considerable body of information from TV and are aware of the effects and damage caused by drugs; but continue to use them. Furthermore, poverty and unemployment have different manifestations from those in developing nations.

* The book Sociodrama, Marginality and Drugs includes detailed descriptions of the different experiences in other prisons in New Mexico, U.S.A., and a prison for minors in Barcelona.

Social Security allows poverty to hide behind masks that are different from the ones found in our underprivileged neighborhoods. Margination and drug use are also manifested differently, and all these factors required a thorough analysis of reality and changes in our approach. In the United States, people tend to gather in a different way from that in Mexico, and streets are frequently deserted. The unemployed and children do not chat or play outdoors, and generally spend their time inside their homes.

We decided on four types of performances to suit the following situations:

- (a) Marginal and Hispanic communities.
- (b) Malls with people from all walks of life.
- (c) A public school with an Indian student majority.
- (d) Prison inmates.

This experience was successful and allowed us to conduct a course in San Antonio, Texas (being equipped with a better knowledge of the idiosyncrasy of people in the United States) for a marginal group of Mexican-Texans in a neighborhood by the name of "La Tripa". We addressed the following topics:

- (a) Drug abuse.
- (b) Cultural shock and identity as an ethnic group.
- (c) Economic and ethnic discrimination.
- (d) Education and language issues.

Sociodrama In Spain

We conducted two courses, in Bilbao and in Barcelona. The group of trainees had a priority motivation in drug-abuse prevention. We approached two labour communities with drinking and opiate-addiction problems, and performed in schools in high-risk communities. In Barcelona we had a particularly interesting experience in a school of minor offenders with a majority population of gypsy children.

Evaluation

Sociodrama has shown to be effective when performed in places of difficult access where one finds paranoid attitudes that are characteristic of closed communities such as prisons. Sociodrama was seen with empathy and trust, and we were able to recruit inmates for different research tasks. Other techniques take much longer and sometimes fail to accomplish communication and confidence in groups (such as chicanos, blacks, illegal immigrants, etc.) that are by nature distrustful of outsiders.

We have conducted evaluations of the actual use of information on drugs by means of comparative studies of three different schools, one exposed to the our sociodrama, another where the traditional lecture and discussion approaches had been used, and a third school without any exposure at all. The children were asked to draw pictures about their knowledge of drugs with their own school materials one day before the performance. These drawings were compared later with those made one week after the performance. The slides show how the children are able to capture the smallest details of the play and can tell what happened step by step.

Six months later, they were again asked to draw, and we were then able to tell how much of our message they had retained. In the videocassette we could see how the anatomy lesson of the locations injured by drugs and the story of Juanito had been firmly implanted in their memories.

In the group exposed to our performance, the message was not only assimilated by a larger number of children, but awareness of bodily injury and the causes thereof were quite clear for the large majority.

Summary

Two drug-abuse prevention approaches were discussed: Sociodrama and Mass Education for Teachers. The methods used, evaluation systems, and experiences in different cultures were described.

These techniques are both economical, easy to implement, and capable of sensitizing large numbers of people. Thus, we feel that they are good tools in drug abuse prevention.

Sociodrama has proven to be highly adaptable to different environments, and the course of time has allowed us to watch how a method that grew out of marginal communities with very modest expectations can now be used in different cultures.

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