

# PSYCHOACTIVE SUBSTANCE

- Definition
- ICD 10 , F 10 – 19

# Mental and behavioural disorders due to psychoactive substance use

F 10 – alcohol

F 11 - opioids

F 12 – cannabinoids

F 13 – sedative and hypnotics

F 14 – cocaine

F 15 – other stimulants including caffeine

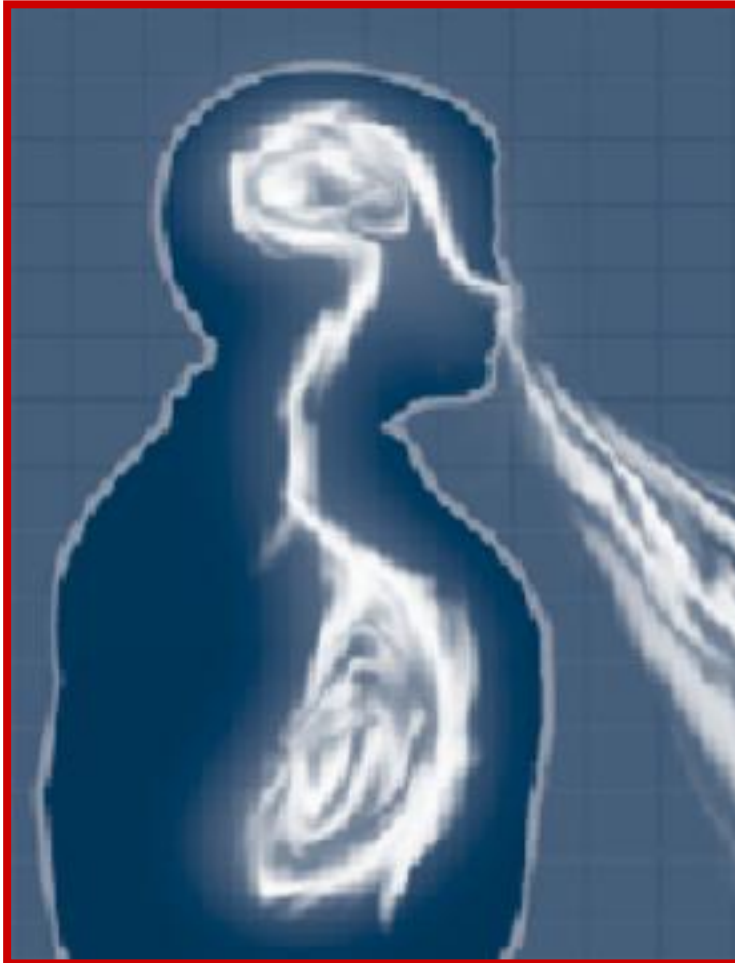
F 16 – hallucinogens

F 17 – tobacco

F 18 – volatile solvents

F 19 – multiple drugs

# INHALANT ABUSE



# OVERVIEW

- Introduction
- Epidemiology
- Pharmacology and toxicology
- Classification
- Signs and symptoms
- Adverse effects
- Management

# INTRODUCTION

- **Inhalants**, sometimes called volatile substances or solvents, are volatile hydrocarbons, which become gases at room temperature.
- These compounds are used in many household products as solvents, propellants, thinners, and fuels.
- Toluene, xylene, hexane, trichloroethylene and gasoline.

# INHALANT ABUSE

- Defined as ‘intentional inhalation of volatile substance that produces chemical vapors in order to achieve euphoria’ .
- Affects all demographic, ethnic, & socioeconomic groups.
- Important, yet-under recognized form of substance abuse, causing significant morbidity and mortality.

# Chemicals in Commonly Abused Inhalants

<b>Chemical</b>	<b>Commonly abused inhalants</b>
Toluene	Paint thinner, spray paint, airplane glue, rubber cement, nail polish remover, shoe polish
Butane	Lighter fluid, fuel, spray paint, hair spray, room freshener, deodorants
Propane	Gas grill fuel, spray paint, hair spray, room freshener, deodorants

<b>Chemical</b>	<b>Commonly abused inhalants</b>
Fluorocarbons	Asthma sprays, analgesic sprays, Freon <sup>®</sup> gas, spray paint, hair spray, deodorants, room fresheners
Chlorinated hydrocarbons	Dry-cleaning agents, spot removers, degreasers, correction fluid
Acetone	Nail polish remover, rubber cement, permanent markers



# Most commonly used by adolescents

## U.S.A

- Glue/Shoe polish,
- Gasoline,
- Spray paint,
- Correction fluid/Degreasers

## India

- Adhesives and rubber cements,
- Toluene,
- Iodex - a muscle stress relieving balm

*(Seth et al;2005)*

# EPIDEMIOLOGY

- Historically, ancient Greeks known to use inhalants for euphoria.
- Late 19<sup>th</sup> & early 20<sup>th</sup> centuries - nitrous oxide, chloroform and ether were popular among adults for intoxication
- In US in 1940s first reports of adolescent glue sniffing & in 1950s of petrol sniffing.
- Currently inhalant abuse known to exist in developed as well as developing countries.

- Emerging as a relatively common problem **among children and adolescents**
- Often, **this is the first** psychoactive used as a **'gateway' drug** before marijuana, alcohol & hard drugs.
- Onset in as young as 5 or 6 years
- Peak age 14-15 years
- Typically: use declines by 17-19 years but may continue into adulthood

- US: Since 1975 annual high school surveys by NIDA (National Institute on Drug Abuse) - Lifetime incidence of inhalant abuse 15-20%, 5-10% reported use during the previous year
- US 1983-1993: Risk of starting inhalant use among 12-17 year increased 3 times  
- from 7.2 to 21.5 cases per 1000

(Yehuda et al;1998)

- Adolescents with first use at **age 13-14** were **six times** more likely to be dependent than those who started at age 15-17 years
- In 2005: 72.3% of the 877 000 new volatile abusers were younger than 18 (mean 16.1 years)
- No significant male-female difference in lifetime prevalence in the 12-17 year age group
- Greater prevalence in men in the 18-25 year age group

<b>Prevalence of</b>	<b>%</b>
Use	13%
Abuse & Dependence	7% reported use
Emergency dept. visits	0.24% of drug abuse visits
Inhalant deaths	1.1% of substance related deaths

# Why are inhalants popular ?

- Cheap, easily/legally available
- Easy to hide (items of daily use)
- Commercial products containing volatile substances
- Faster onset of action, high is instant and lasts for 5–15 minutes
- Quick disappearance of symptoms of the use of inhalants
- No necessity to use specific equipment or make preparations for their use
- May not perceive them as harmful

(Pandina and Hendren 1999)

# MODE OF ADMINISTRATION

- **Direct application:** sprayed into mouth/nose, applied onto nasal mucosa, or fingernails/shirt collar/cuff
- **Bagging:** Paper/plastic bag containing the inhalant held to the mouth and nose





- **Huffing:** inhalant-soaked rag kept over mouth



- **Sniffing/Snorting:** breathing in through mouth/ nose while inhalant in original container



- **Glading:** inhalation of air freshener aerosols, computer/electronic cleaning products
- **Dusting:** abuse of computer cleaning products by placing the canister straw into the mouth or nose

(Williams et al, 2007)



**Paraphernalia** (set of equipment required for a particular activity)

- **Slang Terms & Street Names**

# Pharmacology and toxicology

- Sniffing through nose/huffing through mouth-trans pulmonary absorption with very rapid drug access to the brain.
- 15 – 20 breaths of 1% gasoline vapor produce several hours of intoxication.
- 100 ppm of toluene showed that 6 hour exposure produced a temporary neuropsychological performance decline

- Blood toluene concentration in hospitalized intoxicated persons - 0.8 to 8  $\mu$ /g
- Brain and fat achieve a higher concentrations than blood.
- Coadministration of alcohol dramatically raises toluene concentration.
- 20% of toluene dose is excreted unchanged in breath
- Metabolized to hippuric acid in liver
- Breath concentrations fall by half within few minutes
- In blood, undetectable in 4 – 10 hours
- Urine hippuric acid remains measurable somewhat longer

- Cellular mechanisms of inhalant action are unclear
- Toluene shown to inhibit NMDA receptor responsitivity in vitro
- Shown to increase type A  $\gamma$  aminobutyric acid and 5HT-3 receptor function
- Increase in dopaminergic neuronal activity in the ventral tegmental area.



- Behavioral actions suggests inhalants act like alcohol, barbiturates, and other depressants on the CNS.
- Produce motor stimulation at lower doses and motor suppression at higher doses, as well as sedation, ataxia and loss of righting reflex.
- Shows depressant-like, anxiolytic-like, anticonvulsant actions
- Alcohol and benzodiazepine are known to potentiate inhalant effects

# Characteristics of persons who abuse inhalants

- Juvenile delinquency
- H/O theft and burglary
- Poor school attendance and academic performance
- Anti social personality traits
- Attention deficit disorder
- Social outcast
- Poor parenting styles

- Female inhalant users
  - High prevalence of comorbid psychiatric disorders.
  - More susceptible to anxiety disorders
  - Worse course of psychopathology
  - More likely to experience three or more lifetime and past year psychiatric disorders

(Li-Tzy Wu a, Matthew Owen;Howard;2007)

# CLASSIFICATION

- > 1,000 potentially dangerous chemical products
- Can be classified on the basis of Chemical structure, Commercial Use ,Clinical classification
- Most commonly classified by **Pharmacological and behavioral effects** (Balster; 1998)
  1. Volatile solvents, aerosol and anesthetics
  2. Nitrous Oxide
  3. Volatile alkyl Nitrates
- Most frequently reported categories among youth: glue/toluene (3.6%) and gasoline/lighter fluid (3.0%).
- Most popular among young adults: nitrous oxide or “whippets” (3.4%) (SAMHSA 2002)

# Volatile solvents, Fuel, Aerosols

## VOLATILE SOLVENTS *(Evaporates easily)*

- Also termed as “glue-sniffing”
- Prototypic compounds are
  - Toluene and
  - Trichloroethane (TCE)
- Others :Methyl Butyl Ketone, n-Hexane, acetone, methylene chloride, ethyl acetate,
- Usually found in commercial products like :  
Glue, Paint thinner, Correction fluid, Permanent markers, Nail polish remover, Carburetor cleaner



# Toluene (Methyl Benzene)

- One of the most widely used solvents
- A clear and colourless inflammable liquid
- Inhalation is the major route of entry
- Some percutaneous absorption may occur.
- **Highest potential for abuse (among the solvents)**
- Acute effects of toluene-intoxication include
  - ataxic gait,
  - biphasic effects on motor activity and
  - anxiolytic actions
- Screening can be done by **urine test for Hippuric acid** (major metabolite) (Broussard, 2000)
- Breath analysis can also be done

# Trichloroethane (TCE)

- Colorless , branched synthetic isoparaffin solvent
- found as a liquid
- Evaporates quickly
- Sweet yet sharp odour
- Rapid anaesthetic action
- Most commonly abused through, **typewriter correction fluids and thinners**
- 25-40% of the inhaled TCE absorbed by the lungs (Nolan et al;1984)
- Readily crosses human blood-brain barrier; believed to cross the placental barrier.
- Psychoactive effects very similar to those of ethanol and other abused depressant drugs

(Balster, 1987; Evans and Balster, 1991; Bowen et al., 1996)

# Methyl Butyl Ketone (MBK) & n-Hexane

- Both are metabolized to the same neurotoxin **2,5-hexanedione (2,5-HD)**
- Produce an Insidious onset, identical clinical syndrome characterized by
  - abnormalities on EEG, VER (visual evoked responses) and colour vision testing
  - cranial neuropathy
  - spasticity
  - axonal degeneration
  - autonomic dysfunction
  - polyneuropathy



# Volatile solvents , Fuel, Aerosols

## Fuel

*(contain propellants and solvents)*

**Fuels:** Butane, Propane, Octane

**Aerosol :** Chlorofluorocarbons,

– Hydrocarbon

- Usually found in commercial products like

Refrigerants, Spray paint, Cigarette lighters, Gasoline, Deodorant spray, computer cleaning spray, Insecticide, Furniture protector, Room freshener



# Signs and Symptoms :Inhalant Abuse

## Physical appearance

- Paint or oil stains on clothing or body
- Chemical odour on breath
- Spots or sores in or around mouth
- Rhinorrhea
- Injected sclera
- Nystagmus
- Diplopia
- Stained fingernails

## Behaviour

- Dazed appearance
- Dizziness or unsteady gait
- Slurred speech
- Forgetfulness or difficulty concentrating
- Anorexia or nausea
- Irritability or excitability
- Anxiety
- Sleep disturbances

(Jones HE;1998)

## Immediate effects

- Similar to the early stages of anesthesia.
- Feels an initial 'rush,' then light-headed, disinhibited, excitable
- Intoxication lasts only a few minutes, slurred speech, dizziness, diplopia, ataxic gait, and disorientation occur
- As the inhalant dose increases, euphoria is followed by drowsiness, headache, and sleep
- Visual hallucinations after prolonged use

- Tolerance can develop with frequent use
- Withdrawal syndrome
  - Has been described, Infrequently
  - Start within 24 hours
  - Usually last for 5 days, can last one month or longer
  - Symptoms include sleep disturbance, irritability, jitteriness, diaphoresis, nausea, vomiting and tachycardia
- Relapse rates are high

# Adverse Effects of Inhalants

## Cardiovascular effects

- Dysrhythmias
- Hypoxia-induced heart block
- Myocardial fibrosis
- Sudden sniffing death syndrome

## Dermatologic effects

- Contact dermatitis
- Perioral eczema
- Severe frostbite (Case Report)

## Gastrointestinal effects

- Nausea or vomiting
- Hepatotoxicity
- Gastric perforation (Case Report)

## Hematologic effects

- Aplastic anemia
- Bone marrow suppression
- Leukemia

## Pulmonary effects

- Cough or wheezing
- Dyspnea
- Pneumonitis
- Emphysema

## Renal effects

- Acid-base disturbance
- Acute renal failure
- Renal tubular acidosis

# Neuropsychiatric Adverse Effects

## Neurologic effects

- Ataxia
- Cerebellar degeneration
- Change in speech
- Nystagmus
- Peripheral neuropathy
- Sensorimotor polyneuropathy
- Tremor
- White matter degeneration
- Dementia

## Psychiatric effects

- Depression
- Personality disorders
- Anxiety disorders
- Apathy
- Insomnia
- Poor attention
- Psychosis

(Brouette et al;2001)

- Inhalant abuse by pregnant
  - spontaneous abortion
  - **Fetal solvent syndrome:** low birth weight, small head size, facial malformations, and muscle tone abnormalities, similar to those occurring in fetal alcohol syndrome

(Anderson et al;2003)

# Causes of Death: Inhalant Abuse

- **Acute**
  - Direct causes:  
**sudden sniffing death syndrome** (fatal cardiac arrhythmia)  
methemoglobinemia
  - Indirect causes:  
suffocation,  
aspiration, trauma,  
fire
- **Delayed**
  - Cardiomyopathy
  - Brainstem dysfunction
  - Aplastic anemia, leukemia
  - Hepatocellular carcinoma
  - Nephritis, nephrosis, tubular necrosis

(Williams;2007)



- Largest number of sudden deaths from exposure to butane and propane

(Johns 1991)

- UK; 1971-1999: 1857 deaths – 87% males & 66% aged < 20 years (mostly aged 14–18)

(Field-Smith et al., 2001)

# MANAGEMENT

- Laboratory work
- Treatment : Pharmacological  
Non pharmacological

# Laboratory work

- These volatile compounds are detected in urine for only a few hours.
- These volatilize out of the samples during transfer or storage.
- Hippuric acid also may be produced from foods, raising a question of false positive findings
- Inhalants may bind to, or pass through, the plastic of urine cups or breath collection bags, reducing concentrations and making the compound undetectable

- Thus, the most careful monitoring of inhalant use would involve frequent urine samples at random times, collected in tightly sealed glass containers with little or no air space, carefully refrigerated until analysis
- Analysis – gas chromatography, flame ionization, electron capture, mass spectroscopic procedure

# Treatment

- No universal approach
- Little research exists on treatment modalities specific to inhalants abuse
- Clinicians rely on applying methods that are used to treat other addictive disorders.
- Inhalant abuse differ from other drug abuse
- Often have multiple problems, such as polydrug abuse, low selfesteem, poor academic records, personality disorders, and poor cognitive function, and may present with neurological deficiencies. Thus, treatment is more complicated

# Pharmacological treatment

- The treatment of acute inhalation-related injury and illness is generally supportive.
- Acute dysrhythmias should be treated according to established protocols.
- Acid- base and metabolic disturbances should be corrected.
- Cardiopulmonary monitoring is recommended because of the risk of apnea and cardiac arrest after acute exposure.

- Many acute neurologic findings are reversible after cessation of inhalants.
- Chronic neurologic sequelae (e.g., dementia, cerebral dysfunction, cerebellar dysfunction) are often permanent and difficult to manage.

# Non pharmacological treatment

## Counseling

- Detailed interviews, addressing use, establishing diagnoses
- Asses co morbidities
- Address experience of abuse or neglect
- Education about the effects and dangers of inhalants



- Group and individual therapy
- Motivational enhancement therapy
- Attend on site schools with special education teachers, planned recreational activities
- Structural family therapy
- Intervention to improve parenting or bonding skills or treatment of parental substance abuse may be needed
- Aftercare and follow-ups are particularly important

(Jumper-Thurman and Beauvais 1992; Brouette and Anton 2001)

- Treatment usually lasts for 3-12 months

- **Good prognostic factors for better outcome**

The youth has practiced a plan to stay abstinent,  
showing fewer antisocial behaviors

Has a plan to live in a supportive, drug free  
environment

Is interacting with family in a more productive way

Is working or attending school,

Is associating with drug free, nondelinquent peers

# Conclusion and Future Direction

- Inhalant abusers are a hidden population....rarely seek treatment....often undetected....'not on the radar screen'
- Substantial research on neurobiology largely focused on acute exposure to toluene
- Currently, treatment protocols are based on limited experience and research
- Future studies are needed to investigate the toxicological and neuropharmacological profile of inhalant exposure
- Increased research efforts to evaluate prevention and treatment approaches effective and specific to inhalant abuse
- Inhalant abuse education should be included in substance abuse prevention curricula in the primary and secondary grades

# Conclusion and future direction

- Hence Physicians needs to
  - be aware
  - be knowledgeable
  - assist in educating children, adolescents, parents, teachers, media representatives, and vendors of volatile substances
  - serve as a community resource regarding inhalant use awareness, prevention, detection, and management

**THANK YOU**