

Forensic Toxicology

Inhalants of Abuse



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Disclosures / Acknowledgments



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Learning Objectives




- Introduction to Abused Inhalants
- Pharmacology
- Application to DUID
- Laboratory Approaches

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Introduction 



- Understanding Inhalants
 - Prevalence
 - Volatile Solvents
 - Aerosol Sprays
 - Gases
 - Nitrites

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Prevalence 

12 years and older –
0.8% (2.2 million
people) – reported
using


3.6% of 8th graders,
2.4% of 10th graders,
and 1.8% of 12th
graders

12 years and older -
0.1% (335,000) –
found to have
inhalant use disorder


Monitoring the Future, National Results on Adolescent Drug Use. Overview of Key Findings (Online). Bethesda, Md: National Institute on Drug Abuse, U.S. Dept. of Health and Human Services, Public Health Service, National Institutes of Health, 2022. Print.

Substance Abuse and Mental Health Services Administration. (2022). Key substance use and mental health indicators in the United States: Results from the 2021 National Survey on Drug Use and Health (NSDUH) Publication No. PE22-07-01-005, NSDUH Series H-57. Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration. <https://www.samhsa.gov/data/report/2021-nsduh-annual-national-report>

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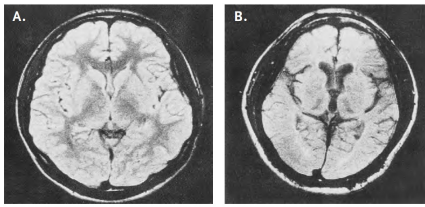
Prevalence – Concern for Our Youth 

- **Subtypes and Risk** – Youth with Depressive Episodes
- **Accessibility and Cost** – Cheap and sold everywhere
- **Stealthy Abuse** – Does not appear abnormal to own.



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Brain Atrophy – Toluene Abuser




Compared with the brain of an individual with no history of inhalant abuse (A), that of a chronic toluene abuser (B) is smaller and fills less of the space inside the skull (the white outer circle in each image).
Courtesy of Neil Rosenberg, M.D., *NIDA Research Report* (NIH 05-3618).

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Other Key Organs

- Liver
- Heart
- Kidneys
- Bone & Bone Marrow
- Key mineral decline
- Reduced Immunity



© Wilson, G. J., Hasbani, M. B., and Maddy, J. A. E., 1971. Hepatorenal damage from toluene in "glue sniffers". *British Medical Journal* 2:29-30.


Wiseman, M.N., and Baran, S., 1987. "Glue-sniffer's heart". *British Medical Journal* 294:739.

Reference: Zaidi, S.A., et al., 2007. Multi-organ toxicity and death following acute unintentional inhalation of paint thinner fumes. *Clinical Toxicology* 45(2):287-289.


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Volatile Solvents



- Household Products:
 - Lighter Fluid
 - Gasoline
 - Paint Thinner/Remover/Degreaser
- Office Supplies:
 - Glue
 - Felt-tip markers
 - Correction Fluid (White Out)




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Aerosol Sprays 


- Household
 - Deodorant Spray (Body Sprays)
 - Computer cleaning products (Duster)
 - Spray Paints


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Gases 

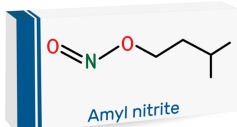
- Both commercially available products but also medical anesthetics
- Nitrous Oxide
- Chloroform
- Ether
- Halothane (Brand Name: Fluothane)
- Butane
- Propane




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Nitrites – “Poppers” 

- CNS Effects: Vasodilation, Relaxes Muscles
- Primary Use: Sexual Enhancement over Mood Enhancement
- Cyclohexyl nitrite
- Isoamyl nitrite (Amyl nitrite)
- Isobutyl nitrite




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Pharmacology 




- Route of Administration
- Distribution to Organs
- Metabolism
- Elimination


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Route of Administration 

- Sniffing / Snorting
- Bagging
- Huffing
- Balloons
- Direct spraying into the Nose/Mouth




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Distribution 

Due to a lipophilic nature, these compounds are swiftly absorbed and act directly on the CNS to induce mind-altering effects.

Rapid entry into the brain results in an almost immediate onset of effects.

Within mere seconds, users may experience intoxication and symptoms akin to those produced by alcohol.




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Metabolism

- Toluene
- 20-40% unchanged
- Primary
 - Hydroxylation


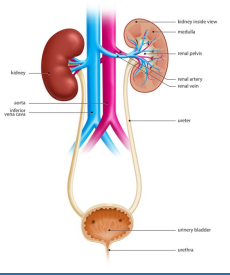
Cc1ccccc1 toluene
↓ mixed-function oxidase
Oc1ccccc1 benzal alcohol
↓ alcohol dehydrogenase
O=Cc1ccccc1 benzaldehyde
↓ aldehyde dehydrogenase
OC(=O)c1ccccc1 benzoic acid



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Elimination

- Lungs (Respiratory Excretion)
- Liver Metabolism
- Urinary Excretion
- Biliary Excretion
- Excretion Through Sweat and Saliva




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Application to DUI

- Sample Collection
- Common Product Highlight
 - Indications of Use




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Laboratory Approach 




- Important Considerations
 - Laboratory Methods
 - Effective Samples
 - Exemplar Case

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Laboratory Approach - Concerns 

Volatility	Detection Window	Lack of Standardization	Complexity of Analysis
Symptoms Mimic Other Conditions	Underreporting	Cost and Resource Allocation	Legal Challenges

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Detection Periods 

- Maximum Detection Limit (MDT) – 1,1 DFE
- 10 hrs (range 7-12 hrs)




Reference: Netto DC, Reis RM, Mendes CB, Gomes PCFL, Martins L, Siqueira ME. Headspace solid-phase microextraction procedure for gas-chromatography analysis of toluene in urine. *J Braz Chem Soc*. 2008;19:1201-6.

Hunt R, Johanson G. 1,1-Difluoroethane Detection Time in Blood after Inhalation Abuse Estimated by Monte Carlo PBPK Modeling. *Pharmaceutics*. 2020 Oct 20;12(10):997. doi: 10.3390/pharmaceutics12100997. Erratum in: *Pharmaceutics*. 2020 Dec 31;13(1). Erratum in: *Pharmaceutics*. 2021 Jul 07;13(7). PMID: 33092226; PMCID: PMC7588963.


Nicholas B Tiscione, Timothy P Rohrig, 1,1-Difluoroethane Forensic Aspects for the Toxicologist and Pathologist, *Journal of Analytical Toxicology*, Volume 45, Issue 8, October 2023, Pages 792-798, <https://doi.org/10.1093/jat/34-ab054>.

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Exemplar Case 

Case Example #1 – Fatal Crash & Serious Injury of a child.


- Arresting officer was told by witnesses that a passenger had thrown away a bag near the scene.
- SFST's were performed at the scene of the crash and the driver was arrested and charged with OVI.
- Medical history – none. Not currently prescribed any medications. Has had a history with depression and has problems sleeping. Last slept 48 hours ago.




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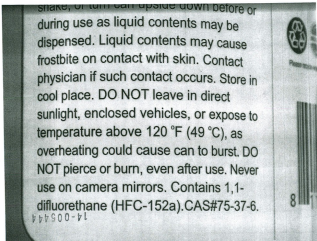
Exemplar Case 

- Initial observation:
 - Upon arrival the driver was making suicidal statements and needed to go back to the ER.
 - During the transport to the ER the driver indicated that she didn't want anyone to think she was "huffing."
 - Phone call was made to lab and photo of air can that was thrown away forwarded to director.
 - No balance problems were noticed, and the subject was very concerned about the child that was struck.




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Exemplar Case 




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Exemplar Case 

- DRE Observations
 - Horizontal Gaze Nystagmus - 4 clues
 - Vertical Gaze Nystagmus –observed
 - Lack of Convergence - Present
 - Blood Pressure 145/95
 - Pulse 80bpm, 82, and 86 (Normal 60-90)
 - Pupil Size – Normal (5.0 mm)
 - Rebound Dilation – (4.5 mm → 5.5 mm after exposure)
 - Reaction to Light – Normal
 - Body Temperature 97.8
 - Muscle tone - normal




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Exemplar Case 


11. EVALUATOR OPINION:

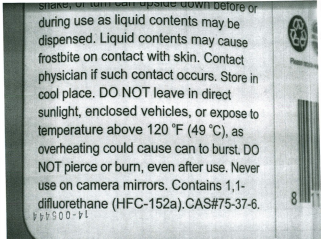
It is my opinion as a certified Drug Recognition Expert that the subject is under the influence of Cannabis and Inhalants, and that she is unable to safely operate a motor vehicle.

- Blood collected and submitted to lab.
- Initial Drug Results → THC-COOH + 63.32 ng/mL



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Exemplar Case 



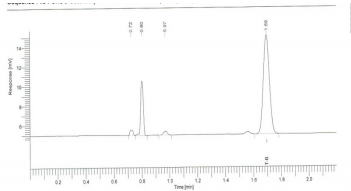
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Exemplar Case

Compound identified

- 1,1-Difluoroethane
- 4.4 mcg/mL

Source: Blood



BAC-1 Qualitative Analysis

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What made this case work?

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Get to know your lab and toxicologists

- When you start seeing things they need to know.
- Have them come to a DRE Cert, Recert, Etc.

2

Bullet proof the front end of the case (Officer Observations, Narrative)

- Consider setting up a lab liaison.
- See if the lab can supply you with "Scope" Cards

3

Understand the time frame issues with sample collection & preservation.

- Get the sample as quickly as possible

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Summary




- Rapid Collection
- Sound Testing Protocols
- Effective Communication




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THANK YOU



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