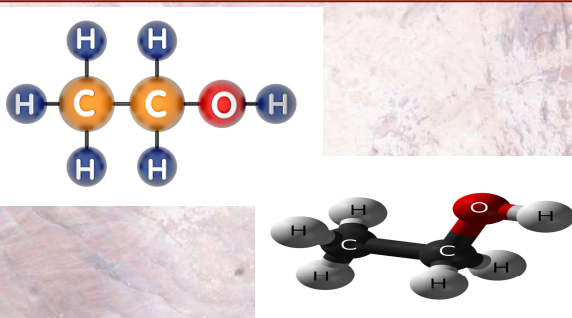


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## Ethanol



The slide features a ball-and-stick model of an ethanol molecule (C<sub>2</sub>H<sub>5</sub>OH) on the left, showing two carbon atoms (orange), five hydrogen atoms (white), and one oxygen atom (red). To the right is a microscopic image of a fingerprint ridge pattern.

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## Founder of GMFI: Tara's Story



The slide contains a large, blank, light-colored rectangular area, likely intended for a photograph or a detailed text block.

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## Blake Stutzman, B.S

Forensic Toxicology Consultant/Expert Witness

**Education**

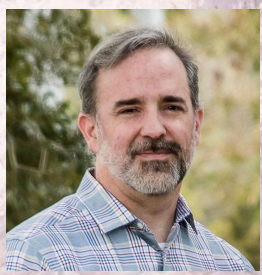
- Northeast Louisiana University - Toxicology - 1998

**Forensic Experience**

- Forensic Scientist - 1998-2017 - Louisiana State Police Crime Lab - Narcotics/Toxicology
- Certifying Scientist - 2017-2022 - Abbott Laboratories - Forensic Urine Drug testing

**Areas of Expertise**

- Narcotics/Toxicology
- Blood alcohol analysis
- Toxicology analysis
- Analytical Instrumentation (GCMS, LCMSMS)
- Expert testimony



A portrait of Blake Stutzman, a man with a beard and mustache, wearing a blue and white plaid shirt, set against a background of green foliage.

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What professions are represented?

- A) Attorneys
- B) Investigators
- C) Nurses
- D) Toxicologists
- E) Other

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Ethanol

**ALCOHOL:**  
The best "night-time",  
speech slurring, headache  
causing, dehydration  
making, drink spilling,  
charm killing, "so you  
think you can dance?"  
medicine...

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In what class of drug does ethanol belong?

- A. Stimulant
- B. Depressant
- C. Anti-depressant
- D. Aphrodisiac



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## Facts about Ethanol

- CNS depressant
- A drug
- Colorless, volatile, flammable liquid (bp 78C)
- Produced from the fermentation of sugars and starches in grains and fruits (grain alcohol) or distillation
- Least toxic of all alcohols and is tolerated by the body in small amounts
- Primary alcohol - OH group is bonded to a primary carbon atom

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## Sources of Ethanol

Perfumes/colognes

Cold medications

Mouthwashes

Alcohol wipes

Alcoholic beverages

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## Blood Alcohol Concentration (BAC)

In Louisiana, it is illegal to operate a motor vehicle with a blood alcohol concentration (BAC) of 0.08% or higher. For commercial drivers, the limit is 0.04%. If you are under 21, any detectable amount of alcohol in your system can result in a DUI charge.

<https://absellc.com/louisiana-alcohol-laws-a-comprehensive-guide>

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## Blood Alcohol Concentration (BAC)



(1)(a) "Alcoholic beverages" means any fluid or any solid capable of being converted into fluid, suitable for human consumption, and containing more than one-half of one percent alcohol by volume, including malt, vinous, spirituous, alcoholic or intoxicating liquors, beer, porter, ale, stout fruit juices, cider, or wine.  
https://law.justia.com/codes/louisiana/2019/revised/statutes/title-26/ps/2612.html

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## Alcohol Content of Various Beverages

Light Beer/Draft	3.5%	6-7 proof
Beer	4-6%	8-12
Wine	7-15%	14-30
Wine Coolers	6%	12
Champagne	8-14%	16-28
Distilled Spirits	40-98%	80-190

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## Fate of Ethanol in the body (ADME)

- Absorption
- Distribution
- Metabolism
- Excretion



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## Absorption

Process by which alcohol enters the bloodstream

- Mouth
- Esophagus
- Stomach
- Small intestines
- Portal vein
- Liver

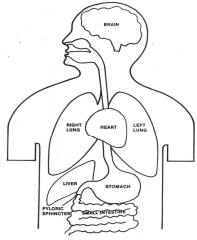


FIGURE 1. A REPRESENTATION OF HUMAN ANATOMY AS IT APPLIES TO ETHYL ALCOHOL ABSORPTION AND DISTRIBUTION

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## Factors affecting Oral Absorption

What affect does this have on absorption?  
Carbonated beverages



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## Factors affecting Oral Absorption

What affect does this have on absorption?  
Fatty or oily beverages



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### Factors affecting Oral Absorption

What affect does this have on absorption?  
Ethanol Concentration



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### Factors affecting Oral Absorption

What affect does this have on absorption?  
Altitude



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### Factors affecting Oral Absorption

What affect does this have on absorption?  
Food in stomach



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## Stomach

### Full Stomach

- Remains here longer
- Body metabolism keeps up
- Absorption influenced by
  - Food in stomach
  - Types
  - Beverages consumed
  - Amount of alcohol consumed

### Empty Stomach

- Alcohol gets through quickly
- Metabolism cannot keep up



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## Ethanol Absorption

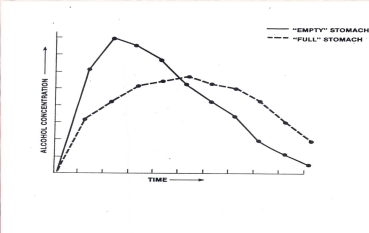


FIGURE 2: ABSORPTION OF AN EQUAL DOSE OF ETHYL ALCOHOL IN "EMPTY" VS. "FULL" STOMACH

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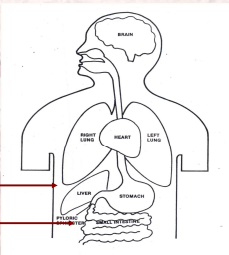
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## Absorption of Ethanol



**Liver**

**Small Intestines**

FIGURE 1: A REPRESENTATION OF HUMAN ANATOMY AS IT APPLIES TO ETHYL ALCOHOL ABSORPTION AND DISTRIBUTION

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## Absorption of Ethanol

Legend:  
■ Portal circulation  
■ Systemic circulation

Labels: Diaphragm, Esophagus, Stomach, Spleen, Superior epigastric vein, Splenic vein, Umbilical vein, Periumbilical veins, Inferior epigastric vein, Veins of abdominal wall, Portal vein, Inferior vena cava, Superior mesenteric vein, Inferior mesenteric vein, Anus.

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## Alcohol Distribution

- **Distribution depends on the water content of the fluid or tissue.**
- **Refers to the transfer of a substance from one part of the body to another part of the body**
- **In pharmacokinetic terms, distribution usually refers to movement from the blood into the tissues.**

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## Factors affecting distribution

- **Blood flow to tissues**
- **Lipophilicity**
- **pH**
- **Plasma protein binding**

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## Alcohol Metabolism

- Major site is the liver - approximately 95% of ethanol ingested



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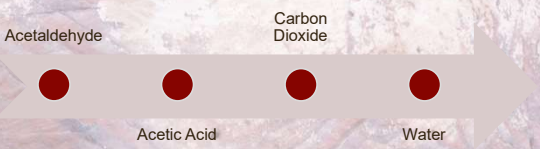
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## Alcohol Metabolism

### Ethanol



Acetaldehyde      Carbon Dioxide

Acetic Acid      Water

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## Alcohol Excretion



Elimination

Evaporation

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## Alcohol Excretion

- **“Time” is the only thing that can eliminate alcohol completely from the body**
- **Approx 0.015-0.018 g%/hour**



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## Retrograde Extrapolation

- **Widmark formula - relationship between a dose of alcohol and a resulting alcohol concentration**
- **Time**
- **Type of drink**
- **Gender**
- **Tolerance**

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## Urinalysis of Ethanol

- **Normal clearance - 8-12 hours**
- **Biomarkers for ethanol consumption**
  - Ethyl Glucuronide (EtG)
  - Ethyl Sulfate (EtS)

Urine to blood

$1.5 \xrightarrow{\quad} 1$   
 $\xleftarrow{\quad} 7$

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## Relationship of Blood and Breath

- Henry's law
- 2100-2300:1 - Breath/Blood ratio

Breath to blood

2100-2300  $\longleftrightarrow$  1

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## Breath alcohol

- Breathalyzer
- Must use deep lung air to get a result



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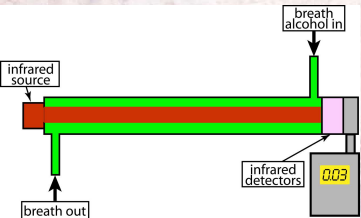
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## 0.01 - 0.05g/dl - Subclinical



- Influence/effects not apparent or obvious
- Behavior nearly normal by ordinary observation
- Impairment detectable by special tests

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### 0.03 – 0.12 g/dl - Euphoria

- Mild euphoria, sociability, talkativeness
- Increased self-confidence; decreased inhibitions
- Diminution of attention, judgement, and control
- Beginning of sensory-motor impairment
- Slowed information processing
- Loss of efficiency in critical performance tests



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### 0.09 – 0.25 g/dl - Excitement

- Emotional instability; loss of critical judgement
- Impairment of perception, memory, and comprehension
- Decreased sensory response; increased reaction time



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### 0.18 – 0.30 g/dl - Confusion

- Disorientation, mental confusion; dizziness
- Exaggerated emotional states (fear, rage, grief, etc.)
- Disturbances of vision and of perception of color, form, motion, dimensions



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**0.35 - 0.50 g/dl - Coma**

- Complete unconsciousness; coma; anesthesia
- Depressed or abolished reflexes
- Subnormal temperature
- Impairment of circulation and respiration
- Possible death



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**Is Ethanol volatile?**

- A) False
- B) True
- C) What does Volatile mean??

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**Volatile**

- Substance that is easily evaporated at normal temperatures
  - Ex: Ethanol, Petroleum ether, Hexane, Benzene



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### Gas Chromatography - Headspace

- Used with internal standard
- Measures the "headspace" above the sample
- Glass vials
- Crimp tops to seal the sample



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### Analysis of BAC



- Calibration curve
  - 6 points (0.05, 0.10, 0.30 etc.)
- Quantitative
- Gas Chromatography
- Run samples in replicate

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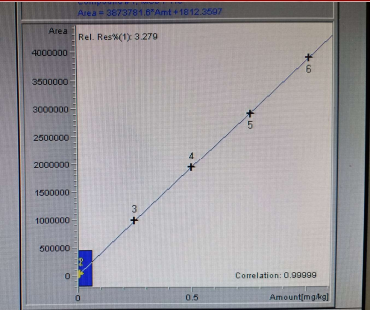
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### Calibration Curve



Area = 3823781.07\*Amount + 1812.3597  
Rel. Res%(1): 3.279  
Correlation: 0.99999  
Amount(mg/kg)

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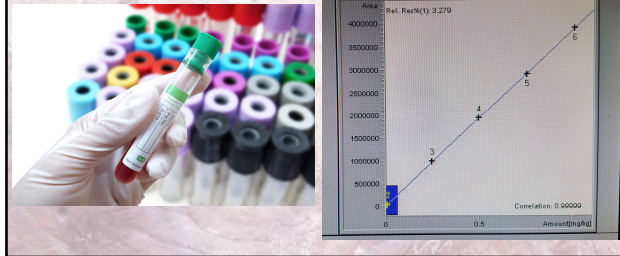
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## BAC Analysis



The chromatogram displays a linear plot of Area versus Amount (ng/ml). The y-axis ranges from 0 to 4,000,000, and the x-axis ranges from 0 to 0.5. Five data points are plotted and numbered 3 through 7. The correlation coefficient is 0.99999.

Point	Amount (ng/ml)	Area
3	~0.1	~1,000,000
4	~0.2	~2,000,000
5	~0.3	~3,000,000
6	~0.4	~3,800,000
7	~0.5	~4,000,000

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## Other sample matrices

- Plasma
- Serum
- Urine
- Vitreous fluid
- Gastric contents

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## Any Questions?



Request an estimate for your case now!

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