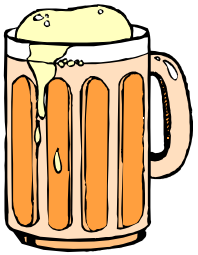
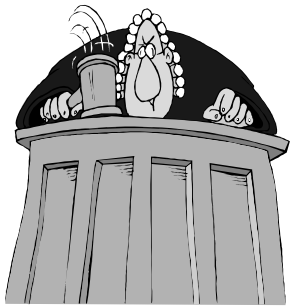


ALCOHOL :

SOME MEDICO-LEGAL PERSPECTIVES



Univ of Pretoria

MBChB - Block 18 (2012)

Prof G Saayman

Dept of Forensic Medicine

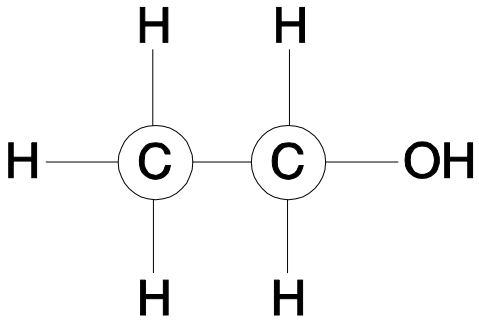
ALCOHOL:

"Absinthe"
(van Gogh)

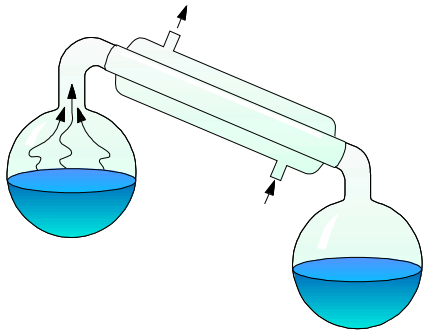
- ***Physical properties***
- ***Absorption, distribution & elimination***
- ***Effects :*** ***- acute intoxication } direct***
  - chronic effects } &
  - social impact } indirect
- ***Medico-legal perspectives: -***
  - dr's legal obligations
  - drinking & driving

Alcohol: Physical Properties

- *Chemical composition*



methanol, glycerol, propylalcohol, ethylene glycol



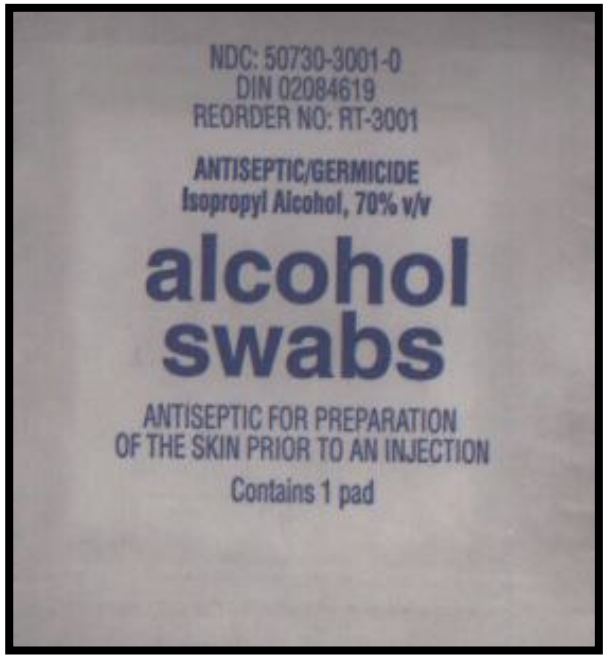
- *Fermentation (12 – 15 %)*
- *Distillation*

Alcohol can be made by three different methods:

1. **Fermentation** of fruit or grain mixtures.

2. **Distillation** of fermented fruit or grain mixtures (Spirit liquor such as whiskey, rum, vodka and gin are distilled.)

3. **Chemical**
   - **modification of fossil fuels** such as oil, natural gas or coal (industrial alcohol)
   - **combination of hydrogen with carbon monoxide** (methanol or wood alcohol)



FRAUD DUO BOTH IN LIQUOR TRADE

Two guilty of distilling, distributing 'lethal' brew

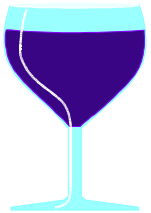
FATIMA SCHROEDER

TWO men convicted of fraud for manufacturing liquor containing lethal amounts of methanol will have to wait for more than a month before they are sentenced.

brands containing lethal amounts of the substance.

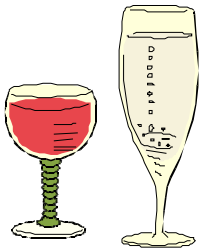
Evidence during the trial revealed that the products manufactured contained up to 22 times the legal limit of methanol per litre of absolute alcohol.

Alcoholic beverages



- *Concentrations: vol. / vol. (g vs ml)*
- *Volumes & units / measures*
- *Metric "tot": 25ml*

3-5%



10-12%

35-45%

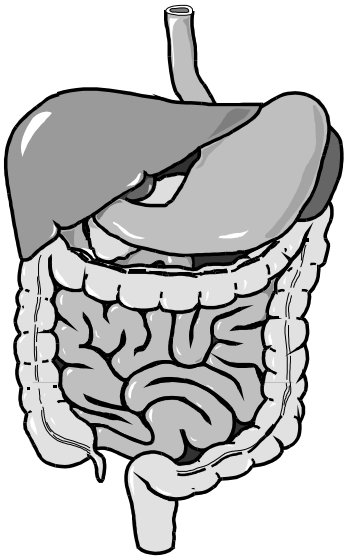
Standard drink

=

=

One 12 oz.	One 5 oz.	1.5 oz. of
beer	**glass of wine**	**distilled spirits**
(5% alcohol)	(12% alcohol)	(40% or 80 proof)

Absorption of alcohol



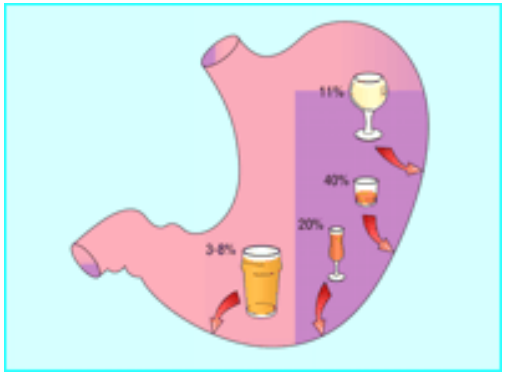
- *Anatomic / physical considerations*

-stomach vs intestine,

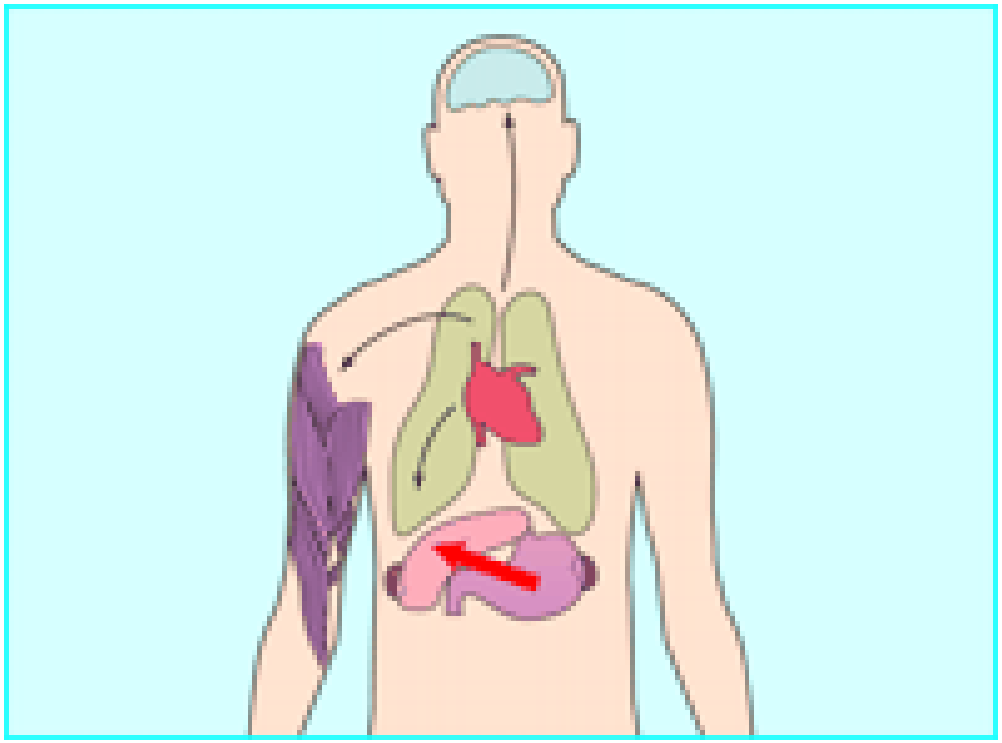
-up to10% not absorbed

- *Factors that influence absorption*

- food, medication, surgery, type of alcohol



Distribution of alcohol



Distribution of alcohol

- *Biological compartment*
- *Phase 1 & Phase 2*
- *Blood Alcohol Concentration*

  BAC = g / 100ml
- *Breath Alcohol (BrAlc):*

  mg/1000ml air
- *BAC to BrAlc: 2300:1*
- *Mellanby effect*

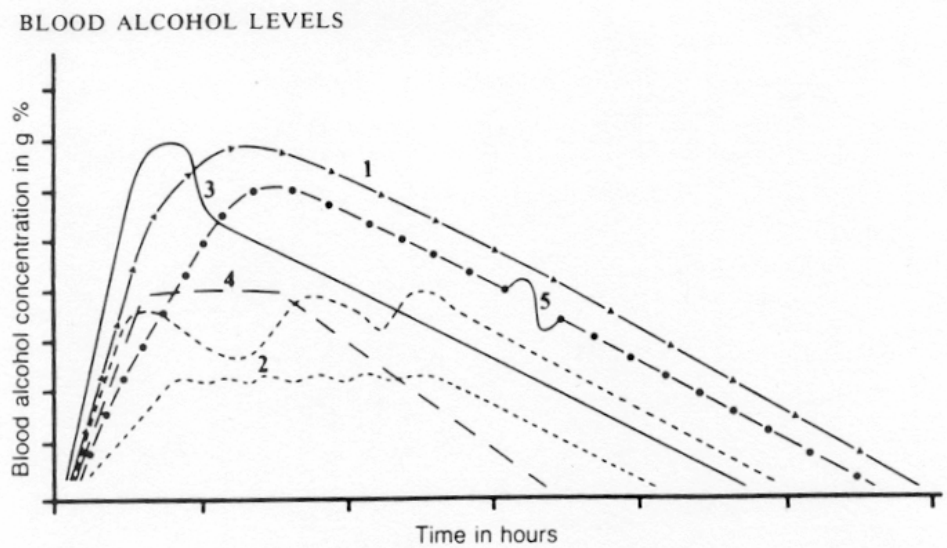


FIGURE 1

Schematic representation of the blood alcohol curve with variations

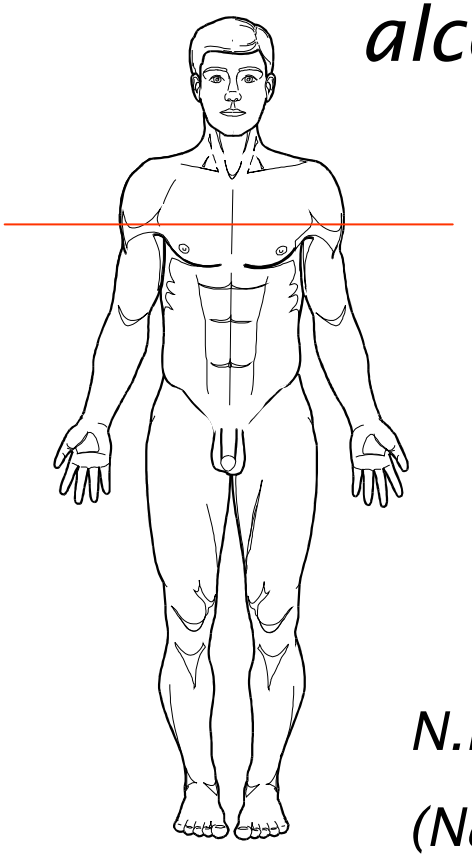
1. The normal curve;
2. The multiple peak curve (major and minor peaks);
3. The diffusion plunge;
4. The plateau type;
5. Transient variation.

"Alcohol, Drugs and Road Traffic"

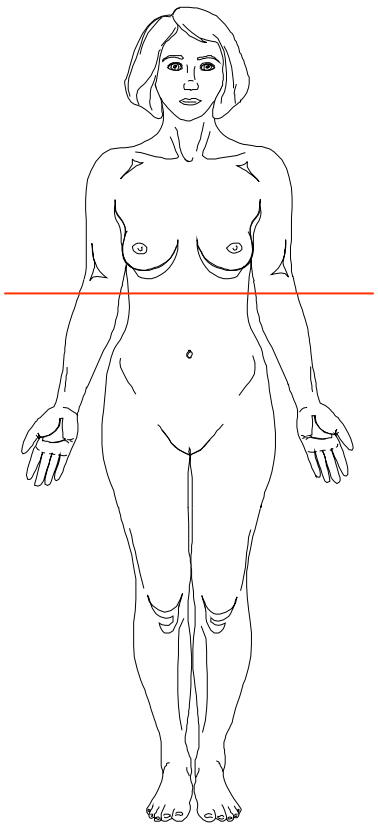
Cooper Schwar & Smith

The Blood Alcohol Curve

Distribution of alcohol



Water compartment
vs
Fat compartment



N.B.: Specimen collection!

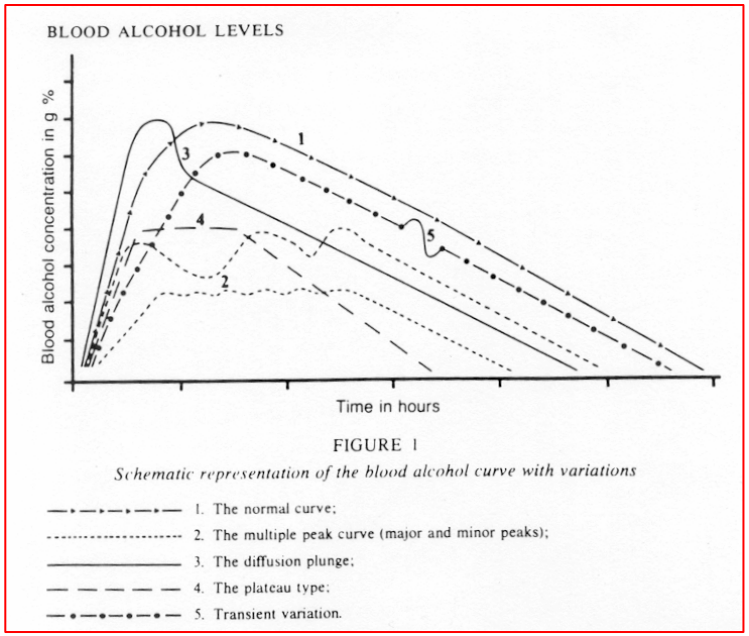
(NaFl & K-oxalate)

Elimination of alcohol

- *Zero - order kinetics: constant rate of elimination*

- *0,01 - 0,02 g / 100ml / hr ave.*

- *up to 0,05 g / 100ml / hr !*



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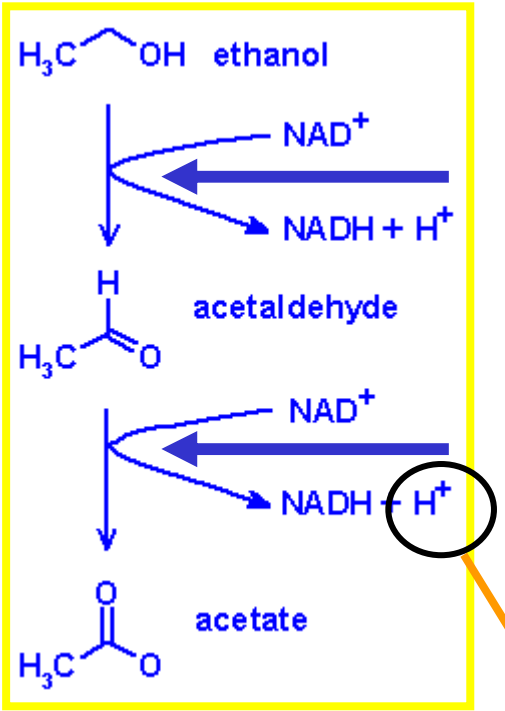
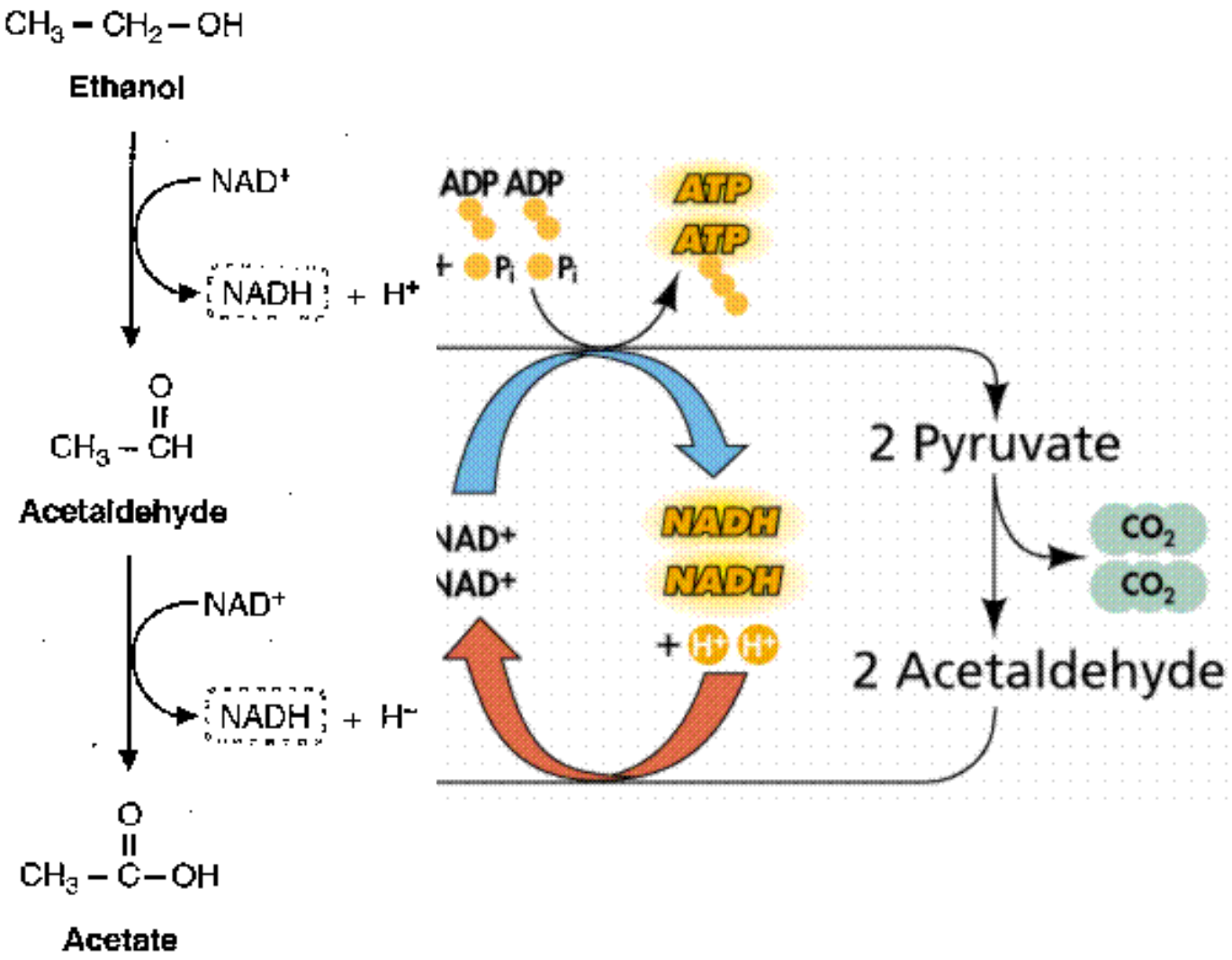


Alcohol dehydrogenase

Acetaldehyde dehydrogenase

H+ ions incorporated into

Uric acid, glucose, ketones, fatty acids & triglycerides


CH3 – CH2 – OH
Ethanol
NAD+
NADH + H+
CH3 – CH
Acetaldehyde
NAD+
NADH + H+
CH3 – C – OH
Acetate
ADP ADP
ATP
ATP
NADH
NADH
2 Pyruvate
CO2
CO2
2 Acetaldehyde

Calculations

- *C_{max} (g / 100ml) = 0,002 x dose (g / 70kg body weight)*
- *Widmark:*

blood alc. concentration in g/100ml

Widmark constant

$$A = 10 \times C \times P \times r$$

alcohol mass in grams

body mass in kg

- *Elimination rate: 0,015 g % / hr (average)*

Alcohol calculations:

eg. 70kg man (ave. build & regular social drinker) consumes four double tots of whiskey between 19:00 & 21:00. What is probable BAC at 22:00 ?

C_{max} = 0,002 x dose (g/70kg body weight)

= 0,002 x (4 x 20g)

= 0,16 g / 100ml

<u>BUT:</u> Has eliminated 3 x 0,02g% = 0,06g%

Therefore: BAC at 22:00 is approx.

0,16 - 0,06 = 0,10g%

Calculations: *...cont'd.*

Eg. 60kg. woman of ave build & light social drinker, consumes 3 glasses of wine between 19:00 & 21:00.

What will probable BAC be at 22:00?

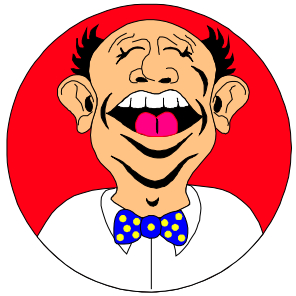
$A = 10\ c\ p\ r$ *i.e.:* $c = A \div (10 \times p \times r)$

$= 0{,}08g\%$

<u>Minus</u>: 3 hrs elimination @ 0,01g% = 0,03g%

Probable BAC = 0,05 g%

Effects of alcohol:



- ***Physiologic / pharmacologic effects***
- ***Potentiating effects***
- ***Tolerance & Mellanby effect***

‘The action of alcohol on the brain is from first to last like that of a narcotic drug’

‘It produces loss of emotional restraint and diminishes the inhibitions which civilization imposes on human conduct. Because in a social environment many people become more active, both in speech and manner, it is widely regarded as a stimulant’

Wayne 1963

Somestheto-psychic area:

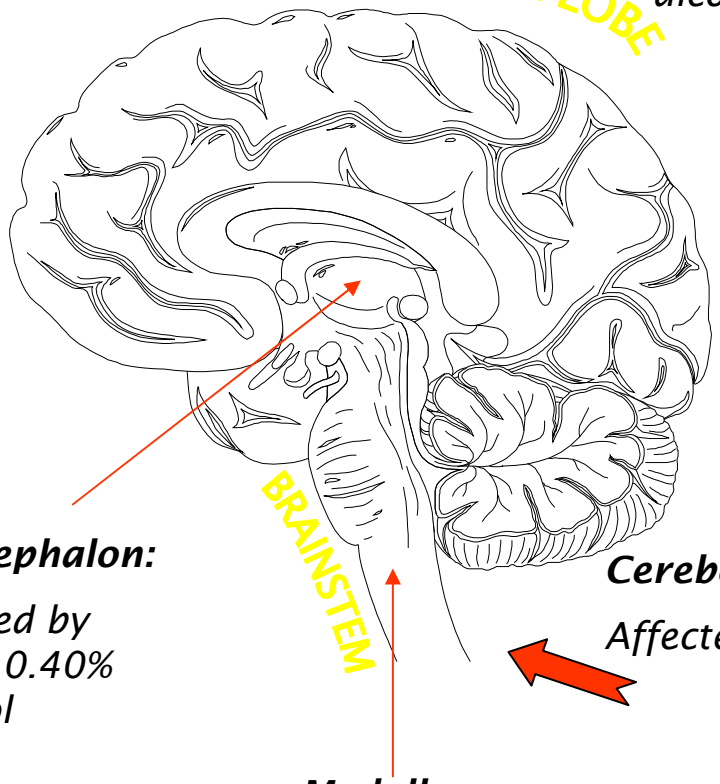
Affected by 0.10 - 0.30% alcohol

Psychomotor area:

Affected by 0.10 - 0.20% alcohol

Frontal lobe:

Affected by 0.01 - 0.10% alcohol



Visuo-psychic areas:

Affected by

0.20 - 0.30% alcohol

Diencephalon:

Affected by 0.25 - 0.40% alcohol

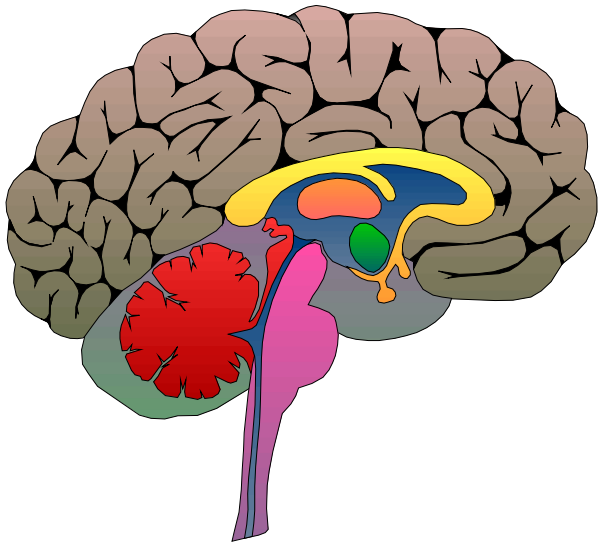
Cerebellum:

Affected by 0.15 - 0.35% alcohol

Medulla:

Affected by 0.4 - 0.5% alcohol

‘Alcohol is remarkable not only for the variety of disorders of the central nervous system it causes, but also for the diversity of pathological mechanisms underlying these disorders’



Shaw 1978

Effect of alcohol on emotions is probably the most complex and the least systematically explored problem area in alcohol research.

Sobriety disguiseth man

- Quincey

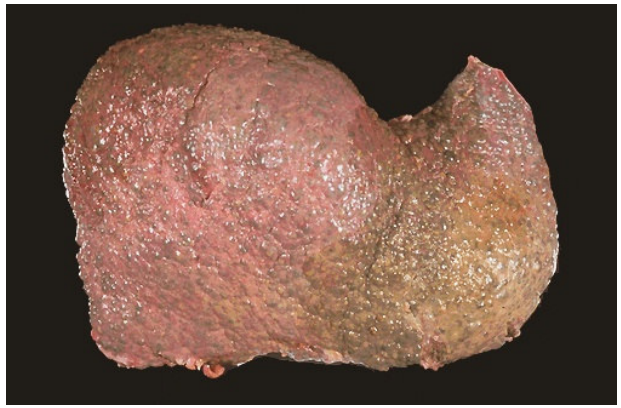
Categories of intoxication:

Light	-	*0 - 0,10g%*
Moderate	-	*0,10 - 0,15 / 0,20 g%*
Heavy	-	*0,20 - 0,30g%*
Very Heavy	-	*≥ 0,30 g%*

Fatalities mediated & induced by alcohol:

- *Risk taking behaviour & aggression*
- *Accidents (mva's, falls, drowning, burns)*
- *Respiratory depression*
- *Aspiration*
- *Additive effects:*
  - *Head injuries*
  - *Underlying disease*
  - *Medication & Drugs*
- *Natural disease*
- *Postural asphyxia …*

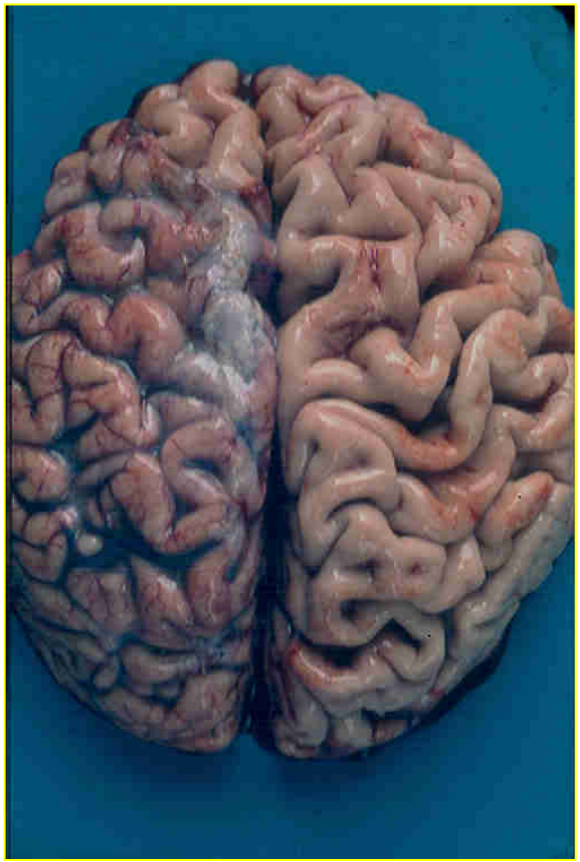
Alcohol induced disease:



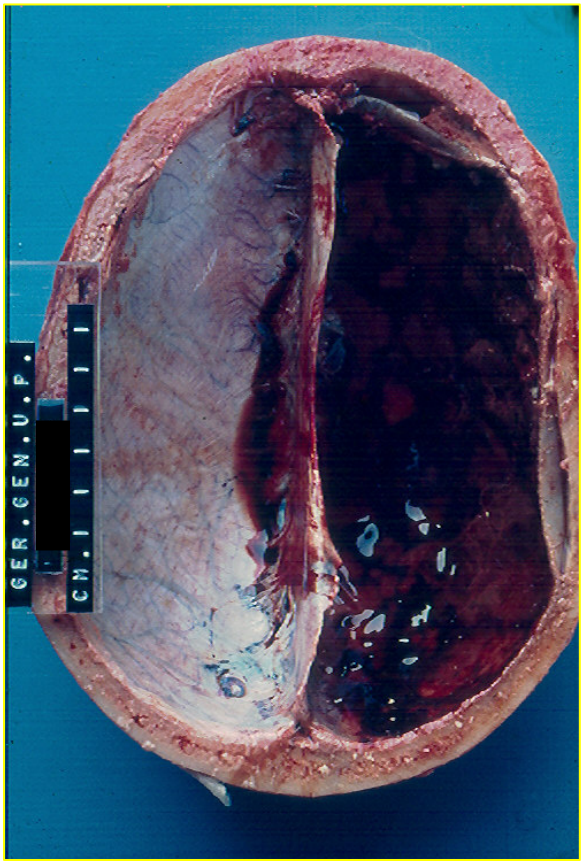
- **Cerebral:** Cortical atrophy, subdural haemorrhage, central pontine myelinolysis, Korsakoff's psychosis, Wernicke's encephalopathy
- **Heart:** Cardiomyopathy
- **GIT:** Acute gastritis
- **Liver:** Steatosis (fatty change), alcoholic hepatitis, cirrhosis
- **Pancreas:** Acute pancreatitis, "bronze diabetes"
- **Nutritional disturbances, etc.**

Alcohol induced disease:

Cortical atrophy

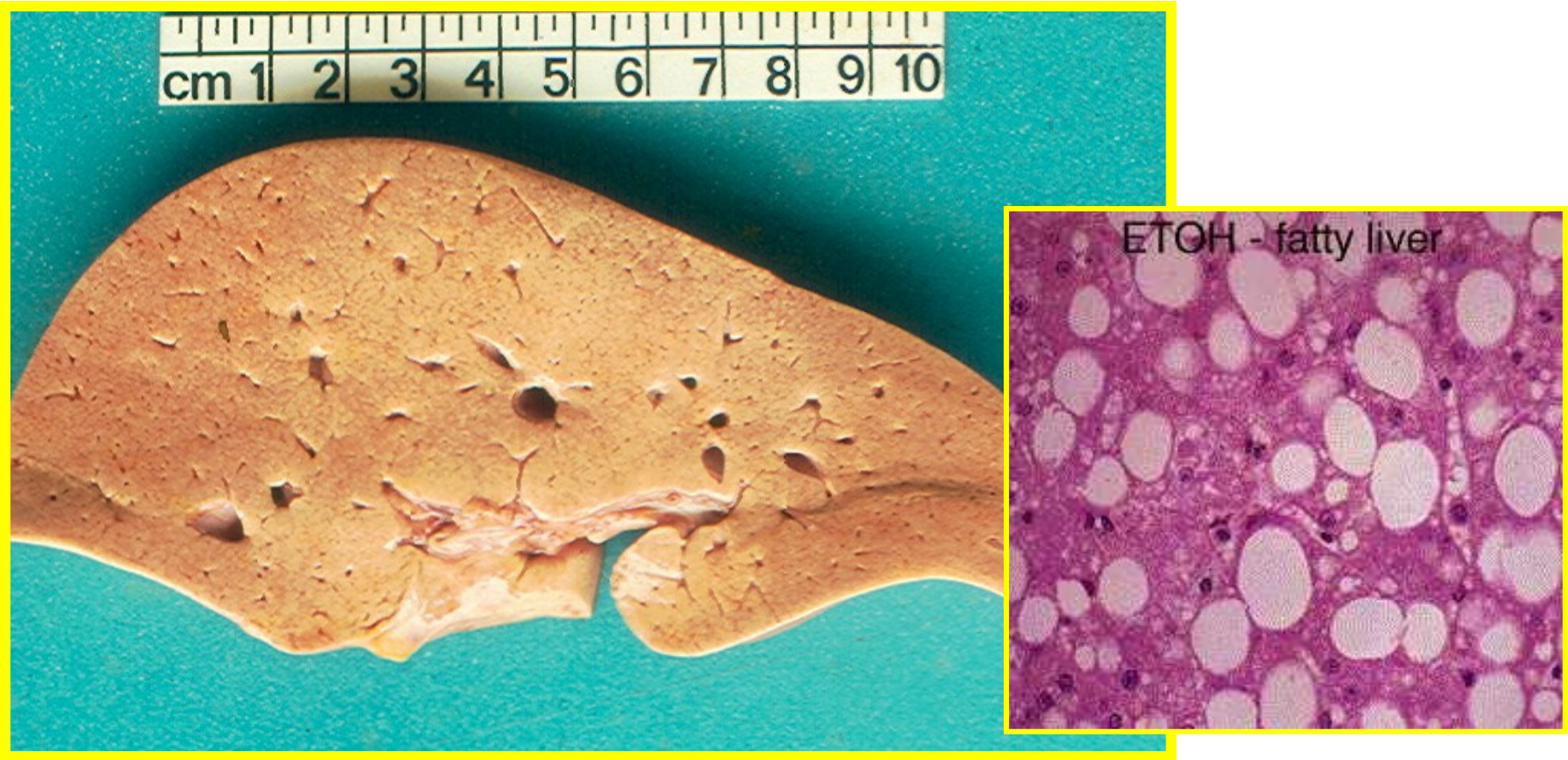


subdural haemorrhage



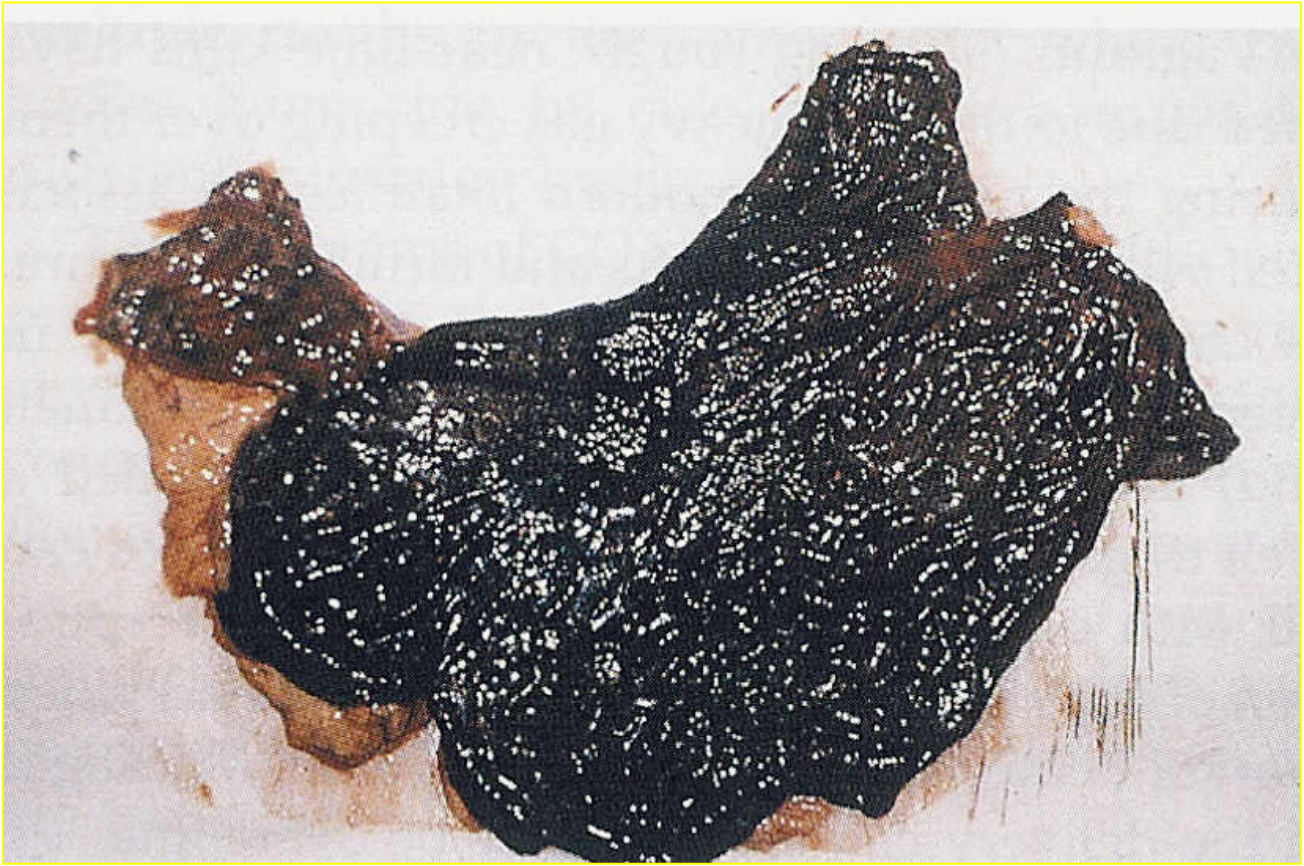
Alcohol induced disease:

Liver: Alcoholic Steatosis (fatty change)



Alcohol induced disease:

Acute haemorrhagic alcoholic gastritis



Gin Lane (Hogarth)

Foetal Alcohol Syndrome

Medico-legal aspects:

- *Doctor's duties*
- *Correlation of clinical intoxication & measured BAC*
- *Reasons for apparent discrepancies*
- *Specimen collection*
- *Markers of alcohol consumption*
- *Driving under the influence (DUI)*

Doctor's duties

- *Arrested individuals*

  SAP 308(a)

- *Hospital / other:*

  Criminal Procedure Act s37

N.B.: Criminal and civil proceedings

THE NATIONAL ROAD TRANSPORTATION ACT (1996)

Section 65: Driving while under the influence of intoxicating liquor or drug having narcotic effect, or with excessive amount of alcohol in blood or breath

(1) No person shall on a public road -

(a) drive a vehicle; or

(b) occupy the driver's seat of a motor vehicle, the engine of which is running, while under the influence of intoxicating liquor or a drug having a narcotic effect.

THE NATIONAL ROAD TRANSPORTATION ACT (1996)

Cont'd: …

(2) No person shall on a public road -

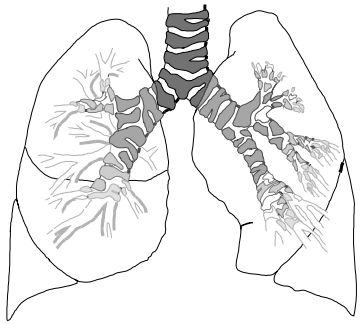
(a) drive a vehicle; or

(b) occupy the driver's seat of a motor vehicle, the engine of which is running, while the concentration of alcohol in any specimen of blood taken from any part of his or her body is not less than 0,05 gram per 100millilitres, or in the case of a professional driver referred to in section 32, not less than 0,02 gram per 100 millilitres.

THE NATIONAL ROAD TRANSPORTATION ACT (1996)

Cont'd: …

(5) No person shall on a public road -



(a) drive a vehicle; or

(b) occupy the driver's seat of a motor vehicle, the engine of which is running, while the concentration of alcohol in any specimen of breath exhaled by such person is not less than 0.24 milligrams per 1000 millilitres, or in the case of a professional driver referred to in section 32, not less than 0,10 milligrams per 1 000 millilitres.

THE NATIONAL ROAD TRANSPORTATION ACT (1996)

Cont'd: …

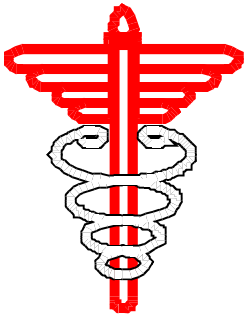
(8) Any person detained for an alleged contravention of any provision of this section shall not -

(a) during his or her detention consume any substance that contains alcohol of any nature, except on the instruction of or when administered by a medical practitioner;

(b) during his or her detention smoke until the specimen referred to in subsection (3) or (6) has been taken, as the case may be.

(9) No person shall refuse that a specimen of blood, or a specimen of breath, be taken of him or her.

Criminal Procedure Act (1977)



Section 37 (2) (a) and (b) - legal obligation of health care practitioners:

Any medical officer of any prison or any district surgeon or, if requested thereto by any police official, any registered medical practitioner or registered nurse may take such steps, including the taking of a blood sample, as may be deemed necessary in order to ascertain whether the body of any person referred to in paragraph (a)(i) or (ii) of subsection (1) has any mark, characteristic or distinguishing feature or shows any condition or appearance.

Criminal Procedure Act (1977)

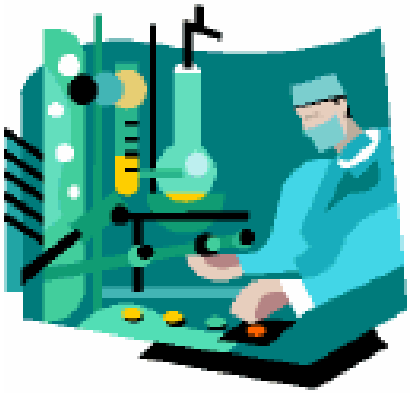
If any registered medical practitioner attached to any hospital is on reasonable grounds of the opinion that the contents of the blood of any person admitted to such hospital for medical attention or treatment may be relevant at any later criminal proceedings, such medical practitioner may take a blood sample of such person or cause such sample to be taken."

Criminal Procedure Act - Section 225:

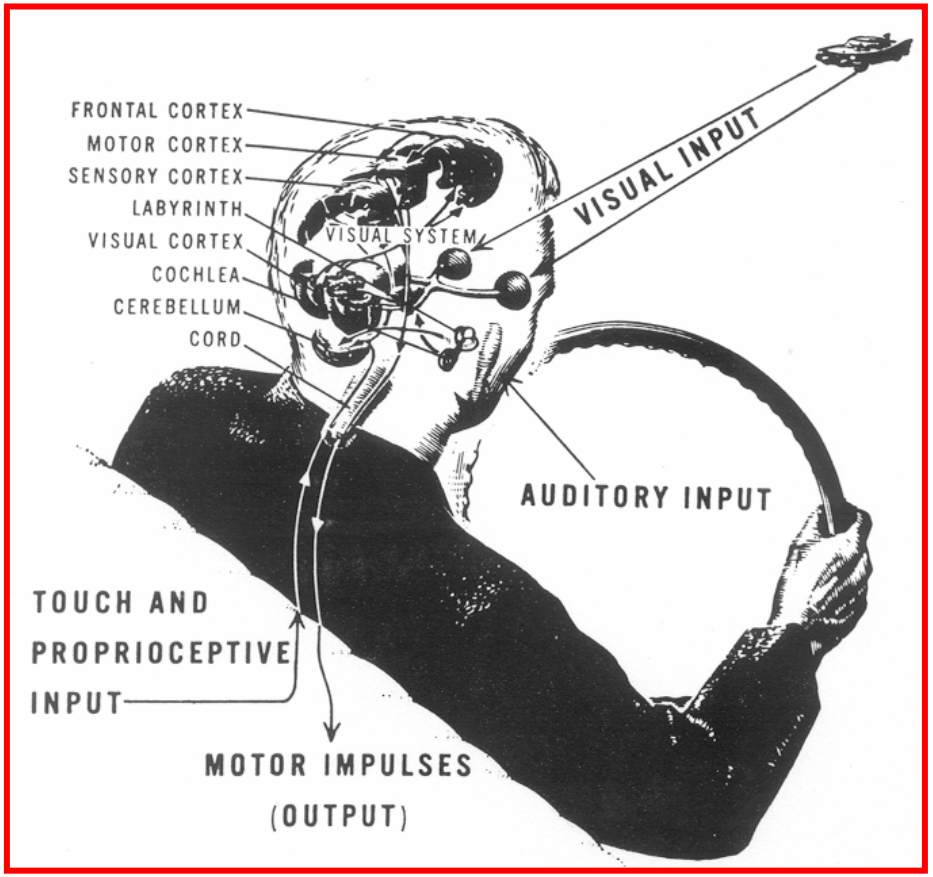
225. Evidence of prints or bodily appearance of accused: - (1) Whenever is it relevant at criminal proceedings to ascertain whether …… the body of … an accused has or had any mark, characteristic or distinguishing feature …. or showed any condition or appearance, *including evidence of the result of any blood test* of the accused, … shall be admissible at such proceedings.

Section 225 cont'd:

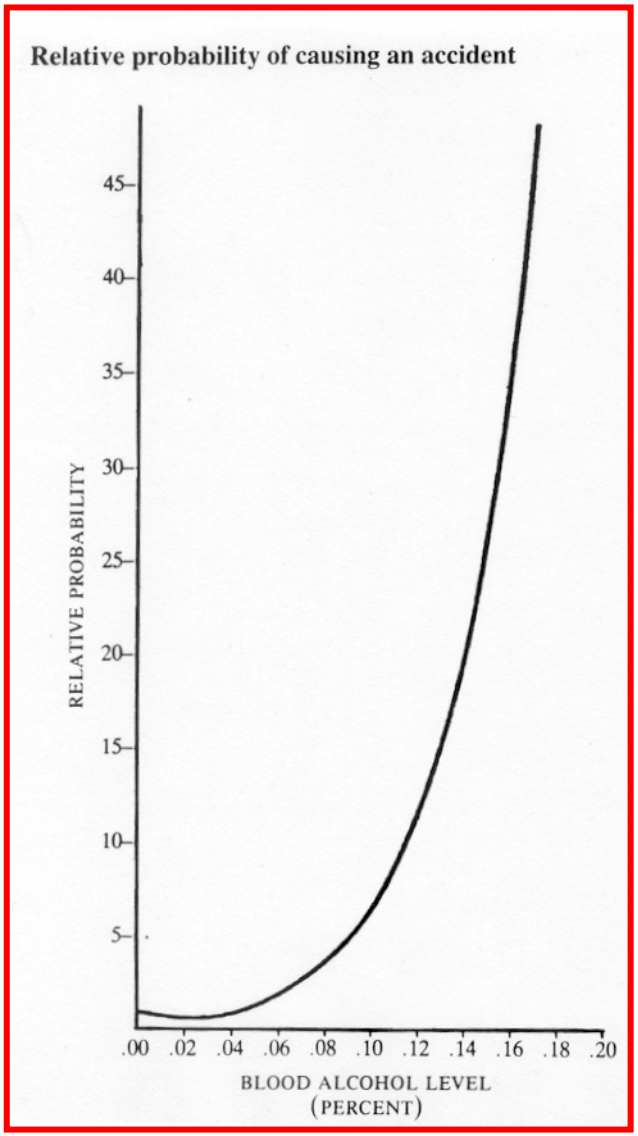
(2) Such evidence shall not be inadmissible by reason only thereof that the finger-print, palm-print, or foot-print in question was not taken or that the mark, characteristic feature, condition or appearance in question was not ascertained in accordance with the provisions of section 37, *or that it was taken or ascertained against the wish or the will of the accused* concerned.



Driving under the influence (DUI)



Kulowski: *" Crash Injuries" (1960)*



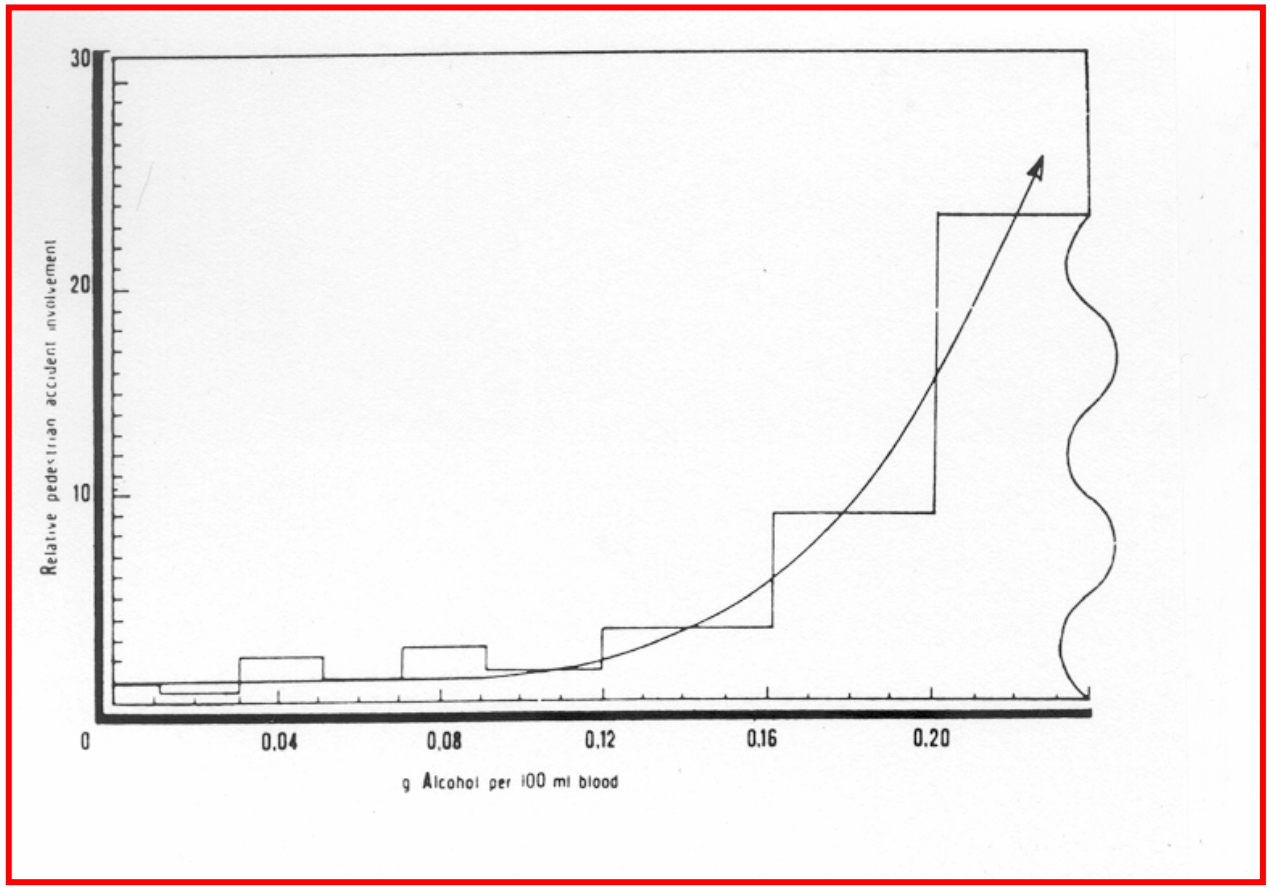
Road Traffic Accidents:

Relative risk for drinking drivers

Borkenstein:

"The role of the drinking driver in traffic accidents"

Grand Rapids Survey

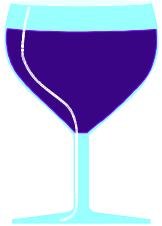


Pedestrian accident involvement with BAC

National Road Safety Council, Pretoria

"Robot" (no. 99, 1978

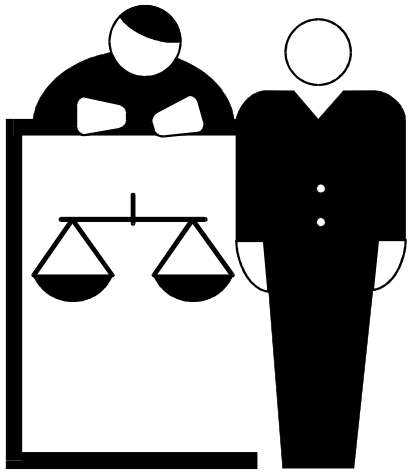
Other:



- ***Date rape**:* *Chloral hydrate ("Mickey Finn"),*
  Rohypnol (flunitrazepam)
  GHB (gamma hydroxybutyric acid)

- ***New Legislation:***
  eg. Canada

impaired colleagues…

http://www.dundee.ac.uk/forensicmedicine/welcome.htm

http://www.dundee.ac.uk/forensicmedicine/notes/alcohol.pdf