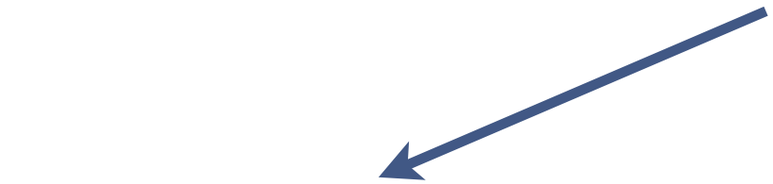
Osmolar Gap

is it worth bothering?

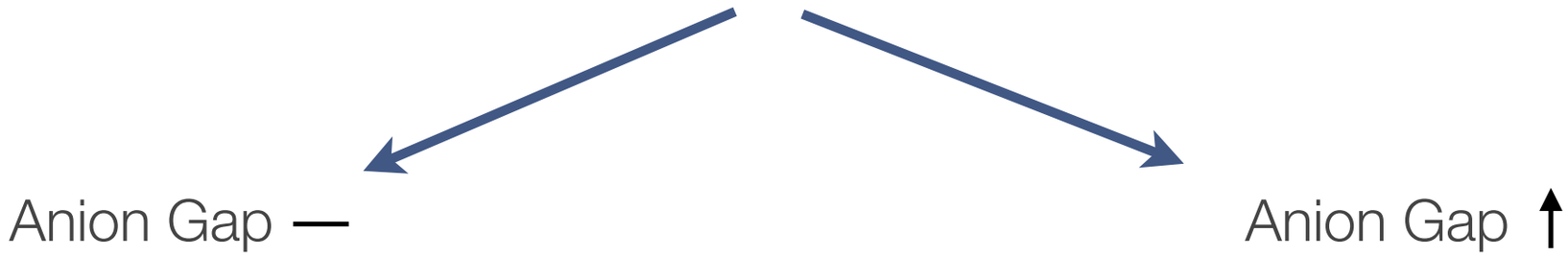
Metabolic Acidosis

Metabolic Acidosis



Anion Gap —

Metabolic Acidosis



Metabolic Acidosis

Anion Gap —

Anion Gap ↑

Loss of high SID fluid

- Gastrointestinal
  - diarrhoea
  - iliostomy
  - uretosigmoidostomy
- Renal
  - Acetazolamide
  - Renal Tubular Acidosis
  - Hyperparathyriodism
  - Hypoaldersteronism

Addition of low SID fluid

- Normal Saline

Metabolic Acidosis

Anion Gap —

Anion Gap ↑

Loss of high SID fluid

- Gastrointestinal
  - diarrhoea
  - iliostomy
  - uretosigmoidostomy
- Renal
  - Acetazolamide
  - Renal Tubular Acidosis
  - Hyperparathyriodism
  - Hypoaldersteronism

Addition of low SID fluid

- Normal Saline

Relative Hyperchloraemia

Metabolic Acidosis

Anion Gap —

Loss of high SID fluid

- Gastrointestinal
  - diarrhoea
  - iliostomy
  - uretosigmoidostomy
- Renal
  - Acetazolamide
  - Renal Tubular Acidosis
  - Hyperparathyriodism
  - Hypoaldersteronism

Addition of low SID fluid

- Normal Saline

Relative Hyperchloraemia

Anion Gap ↑

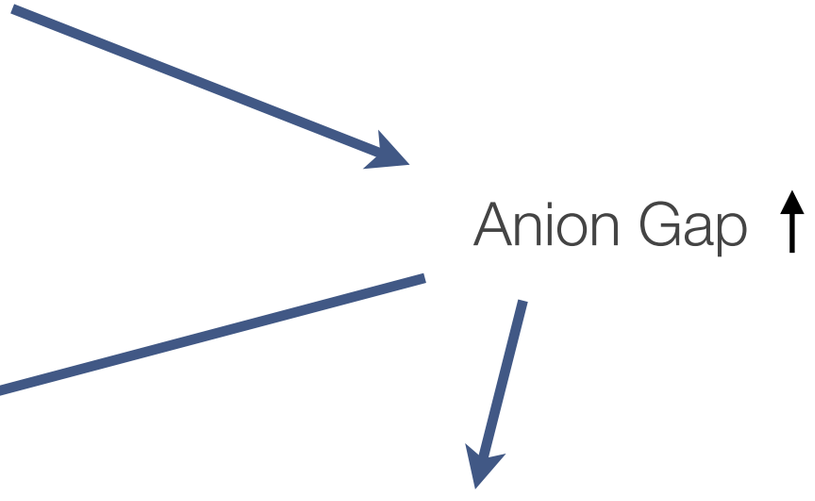
- Lactic Acidosis
  - Type A - increased production
  - Type B - decreased hepatic metabolism
    - insulin deficiency
    - metformin
    - Haem malignancies
    - rare enzyme defects
  - D-lactate - bowel fermentation
- Ketoacids
  - DKA
  - Starvation
- Exogenous Acid
  - Salicilate
  - Methanol
  - Ethanol Glycol

Metabolic Acidosis

Anion Gap ↑

- Lactic Acidosis
  - Type A - increased production
  - Type B - decreased hepatic metabolism
    - insulin deficiency
    - metformin
    - Haem malignancies
    - rare enzyme defects
  - D-lactate - bowel fermentation
- Ketoacids
  - DKA
  - Starvation
- Exogenous Acid
  - Salicilate
  - Methanol
  - Ethanol Glycol

Metabolic Acidosis



Osmolar Gap –

- Lactic Acidosis
  - Type A - increased production
  - Type B - decreased hepatic metabolism
    - insulin deficiency
    - metformin
    - Haem malignancies
    - rare enzyme defects
  - D-lactate - bowel fermentation
- Ketoacids
  - DKA
  - Starvation
- Exogenous Acid
  - Salicilate

Osmolar Gap ↑

- Methanol
- Ethanol Glycol

Not Such a Good Time

Methanol

- drowsiness, confusion & ataxia
- nausea, vomiting & abdominal pain

Ethelene Glycol

- drowsiness, confusion & ataxia
- nausea, vomiting & abdominal pain

Not Such a Good Time

Methanol

- drowsiness, confusion & ataxia
- nausea, vomiting & abdominal pain
- blurred vision or changes in colour perception
- hypotension and cardiac arrest
- permanent blindness
- seizures, coma & death

Ethelene Glycol

- drowsiness, confusion & ataxia
- nausea, vomiting & abdominal pain

Not Such a Good Time

Methanol

- drowsiness, confusion & ataxia
- nausea, vomiting & abdominal pain
- blurred vision or changes in colour perception
- hypotension and cardiac arrest
- permanent blindness
- seizures, coma & death

Ethelene Glycol

- drowsiness, confusion & ataxia
- nausea, vomiting & abdominal pain
- hypertension
- ARDS
- acute tubular necrosis and renal failure - probably due to calcium oxalate deposition

Not Such a Good Time

Methanol

- drowsiness, confusion & ataxia
- nausea, vomiting & abdominal pain
- blurred vision or changes in colour perception
- hypotension and cardiac arrest
- permanent blindness
- seizures, coma & death

Ethelene Glycol

- drowsiness, confusion & ataxia
- nausea, vomiting & abdominal pain
- hypertension
- ARDS
- acute tubular necrosis and renal failure - probably due to calcium oxalate deposition

Tax Evasion is a Crime !

Not Such a Good Time

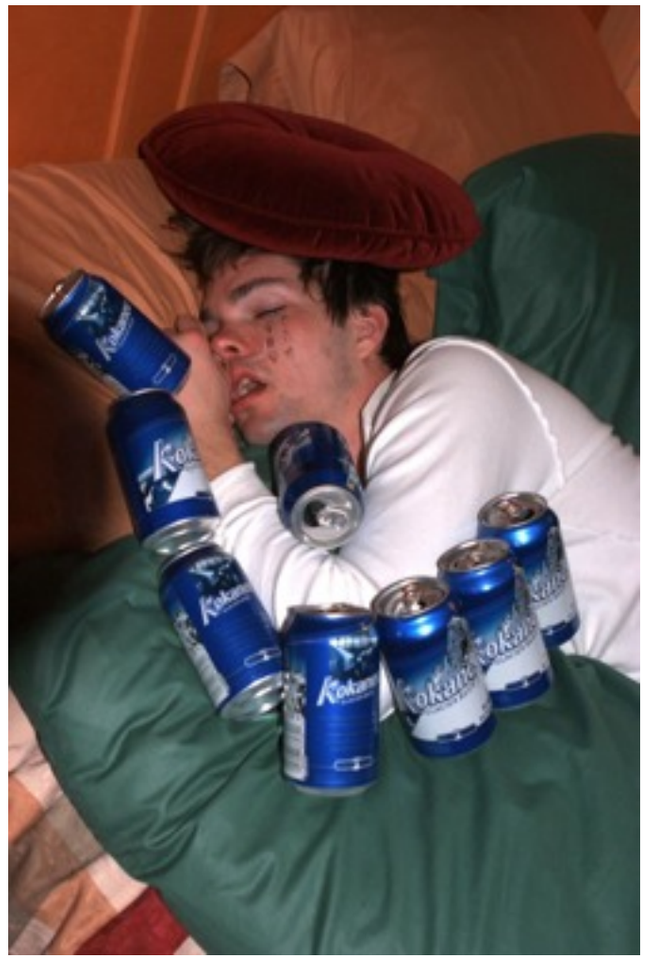
Methanol

- drowsiness, confusion & ataxia
- nausea, vomiting & abdominal pain
- blurred vision or changes in colour perception
- hypotension and cardiac arrest
- permanent blindness
- seizures, coma & death

Ethelene Glycol

- drowsiness, confusion & ataxia
- nausea, vomiting & abdominal pain
- hypertension
- ARDS
- acute tubular necrosis and renal failure - probably due to calcium oxalate deposition

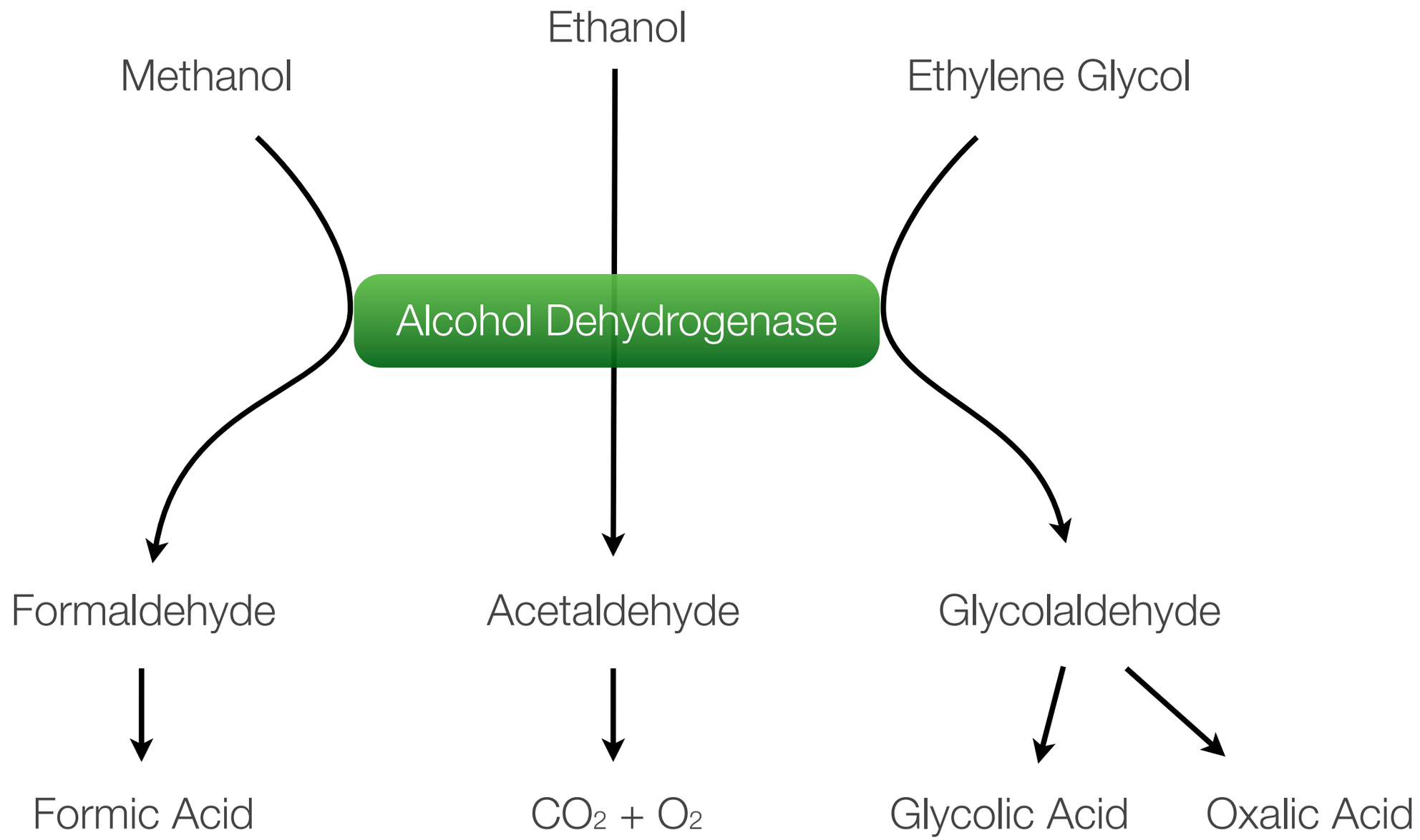
Ethanol



Tax Evasion is a Crime !

Acidosis?

Acidosis?


Methanol
Ethanol
Ethylene Glycol
Alcohol Dehydrogenase
Formaldehyde
Acetaldehyde
Glycolaldehyde
Formic Acid
$CO_2 + O_2$
Glycolic Acid
Oxalic Acid

Treatment

- 100% Ethanol infusion - BSL↓ in children
- Fomepizole - occupies alcohol dehydrogenase without the side effects

Osmolar Gap

Osmolar Gap = Calculated Osmolarity - Measured Osmolarity

Normal less than 10

osmolarity = osmoles of solute per litre of solution - Calculated

osmolality = osmoles of solute per kilogram of solvent - Measured

osmole = an Avagadro's number of particles ($6.022 \times 10_{23}$) in solution

Measuring Osmolality

Colligative properties depend only on the ratio of the number of particles of solute to solvent in the solution, not the identity of the solute

- vapour pressure depression
- freezing point depression
- boiling point elevation
- osmotic pressure

Measuring Osmolality

Colligative properties depend only on the ratio of the number of particles of solute to solvent in the solution, not the identity of the solute

- vapour pressure depression
- freezing point depression
- boiling point elevation
- osmotic pressure

Measuring Osmolality

Colligative properties depend only on the ratio of the number of particles of solute to solvent in the solution, not the identity of the solute

- vapour pressure depression
- freezing point depression
- boiling point elevation
- osmotic pressure

An osmole is the amount of a substance that yields, in ideal solution, that number of particles (Avogadro's number) that would depress the freezing point of the solvent by 1.86K

Calculating Osmolarity (properly)

$$\mathrm{Osm/L} = \sum_i \varphi_i \, n_i C_i$$

φ = osmotic coefficient - accounts for the degree of non-ideality of the solution.

n = number of particles into which the molecule dissociates

C = molar concentration of the solute

i = represents the identity of a particular solute

Estimating Osmolarity

Osmolarity = Cations + Anions + non-ionized Solutes

Estimating Osmolarity

Osmolarity = 2 Cations + ~~Anions~~ + non-ionized Solutes

Estimating Osmolarity

Osmolarity = 2 Cations + ~~Anions~~ + non-ionized Solutes

- Na
- K
- Ca
- Mg

Estimating Osmolarity

Osmolarity = 2 Cations + ~~Anions~~ + non-ionized Solutes

- Na
- ~~K~~
- ~~Ca~~
- ~~Mg~~

Estimating Osmolarity

Osmolarity = 2 Cations + ~~Anions~~ + non-ionized Solutes

- Na
- ~~K~~
- ~~Ca~~
- ~~Mg~~

- glucose
- urea
- lipids

Estimating Osmolarity

Osmolarity = 2 Cations + ~~Anions~~ + non-ionized Solutes

- Na
- ~~K~~
- ~~Ca~~
- ~~Mg~~

- glucose
- urea
- ~~lipids~~

Estimating Osmolarity

Osmolarity = 2 Na + glucose + urea

Osmolarity Estimations

- 2 Na
- 2.1 Na
- 2 Na + 7
- 2.63 Na - 65.4
- 2 Na + Urea
- 2 Na + Glucose
- 2 Na + Glucose + Urea
- 2 (Na + K) + Glucose + Urea
- 1.86 Na + Urea + Glucose
- 1.86 Na + Urea + Glucose + 9
- 2 Na + 0.933 Urea + 0.9 Glucose
- 1.75 Na + Glucose+ Urea + 10.1
- 1.85 Na + 1.84 K + Glucose + Urea + Ca + 1.17 Mg + 1.15

Dorwart WV, Chalmers L. **Comparison of Methods for Calculating Serum Osmolarity from Chemical Concentrations, and the Prognostic Value of Such Calculations.** *Clin Chem* 1975; 21/2:190-194

Osmolarity Estimations

- 2 Na
- 2.1 Na
- 2 Na + 7
- 2.63 Na - 65.4
- 2 Na + Urea
- 2 Na + Glucose
- 2 Na + Glucose + Urea
- 2 (Na + K) + Glucose + Urea
- 1.86 Na + Urea + Glucose
- 1.86 Na + Urea + Glucose + 9
- 2 Na + 0.933 Urea + 0.9 Glucose
- 1.75 Na + Glucose+ Urea + 10.1
- 1.85 Na + 1.84 K + Glucose + Urea + Ca + 1.17 Mg + 1.15

Dorwart WV, Chalmers L. **Comparison of Methods for Calculating Serum Osmolarity from Chemical Concentrations, and the Prognostic Value of Such Calculations.** *Clin Chem* 1975; 21/2:190-194

Osmolarity Estimations

Dorwart WV, Chalmers L. **Comparison of Methods for Calculating Serum Osmolarity from Chemical Concentrations, and the Prognostic Value of Such Calculations.** *Clin Chem* 1975; 21/2:190-194

- 2 Na + Glucose + Urea
- 1.86 Na + Urea + Glucose + 9

Using the Osmolar Gap

Using the Osmolar Gap

- Normal is roughly below 10

Using the Osmolar Gap

- Normal is roughly below 10

- Less sensitive for Ethelene Glycol

Using the Osmolar Gap

- Normal is roughly below 10

- Less sensitive for Ethelene Glycol

- Type of osmometer

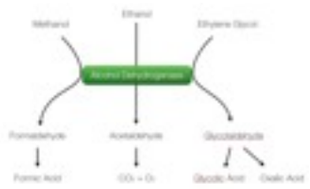
Using the Osmolar Gap

- Normal is roughly below 10

- Less sensitive for Ethelene Glycol

- Type of osmometer

- Time course



Osmolar Gap ↑ ⟶ Acidosis

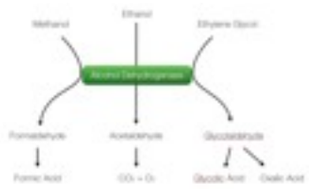
Using the Osmolar Gap

- Normal is roughly below 10

- Less sensitive for Ethelene Glycol

- Type of osmometer

- Time course



Osmolar Gap ↑ ⟶ Acidosis

- Ethanol Cloaking

  2 Na + Glucose + Urea + Ethanol

Osmolar Gap

is it worth bothering?