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Prehospital Care Series

Fluid Guidelines

Presented by:
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Specialist Paramedic

11th August 2025

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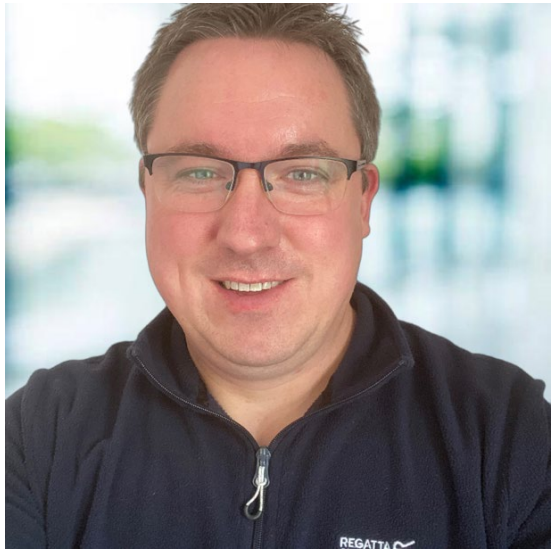

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Welcome Back!

- **Fluid Guidelines**
- Prehospital Bloods
- ALS: the ‘Other’ Drugs
- Magnesium Sulphate
- Life-threatening Arrhythmias
- Diazepam vs Midazolam (& Flumazenil)
- Suggestions Welcome!

Tonight's Session

- Current prehospital guidelines
- Limitations of fluid resuscitation
- Sodium Chloride vs Hartmann's
- The role of hypertonic saline
- Cold vs Warm
- Glucose
- Q&A session

Ways to Interact

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Mentimeter

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Case Study

- 24 y/o female camera operator on a film set
- Camera tower has collapsed onto her
- Significant head injury

- RR 16, SpO_2 96% (RA), HR 62 (Reg), BP 99/50, GCS 1/2/3
- Airway is managed, RR is monitored, IV access gained
- No significant past medical history

- Is she indicated for IV fluids (as per JRCALC)?

Interactive Quiz

Mentimeter

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Current Guidelines

- NICE vs JRCALC
  - Holistic vs Prescriptive
- Haemorrhagic vs Non-Haemorrhagic

- Accurate Systolic BP
- Clinical assessment of perfusion

- What about Mean Arterial Pressure (MAP)?
  - Diastolic + 1/3 of the Pulse Pressure (Systolic – Diastolic)
  - Normal: 70-110 mmHg, **<60 mmHg** considered significantly low

- What about patients with hypertension?

- Always flush first to confirm patency
- Slow administration to maintain patency (TKVO) is outdated and considered poor practice

Haemorrhagic Emergencies

- Apparent (external) & Concealed (internal)
- Where possible: **Control haemorrhage first!**
- Main trigger: **Impaired organ perfusion (shock)**

- Penetrating trauma to the trunk
- Penetrating trauma to the limbs
- Blunt trauma to the trunk and/or limbs
- Trauma to the head (all types)

- If more than one category: treat for the one most likely to be causing shock
- Fluid therapy should never delay on scene time – do it en route!

Haemorrhagic Emergencies

- Penetrating trauma to the trunk
  - Palpable **central** pulse
  - Adequate cerebral perfusion (LOC)
  - Systolic BP: **60 mmHg (permissive hypotension)**
- Penetrating trauma to the limbs
- Blunt trauma to the trunk and/or limbs
  - Palpable **peripheral** pulse (on unaffected side)
  - Systolic BP: **90 mmHg**
- Trauma to the head (all types)
  - Hypotension is uncommon, but significant and **must** be addressed
  - Systolic BP: **110 mmHg**
  - But treat for the most likely cause?

Haemorrhagic Emergencies

- Administer in **250ml** boluses
- Assess for continued indication
- Maximum dose: **2 litres**

What about Crush Injuries?

- Patients at risk of **Crush Syndrome** are treated differently
- Traumatic Rhabdomyolysis
- Myoglobin released from damaged muscle cells
- AKI, arrhythmias, circulatory collapse
- Patients (generally) only deteriorate after rescue
- Treatment is proactive rather than reactive
- Aim is to dilute the toxins to reduce effects

- Ideally treat before release – but this can be challenging
- Treat as soon as possible after risk identified

- Dose: **2 litres stat**, rapidly infused (large bore IV cannula)

Interactive Quiz

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Non-Haemorrhagic Emergencies

- Treat the underlying cause first
- Rapid replacement can make things worse!
- We don't treat dehydration

- Main trigger: **Impaired organ perfusion (shock)**
  - A systolic BP **<90 mmHg** may indicate this

- Administer in **250ml** boluses
- Assess for continued indication
- Maximum dose: **2 litres**

Non-Haemorrhagic Emergencies

- There are exceptions!
  - Burns
  - Sepsis
  - Anaphylaxis
  - Diabetic Ketoacidosis (DKA)
  - Adrenal Crisis

Burns

- Dependant on:
  - **Size** (% TBSA)
  - **Distance from hospital**

- **<15%** – Not indicated
- **15-25%** – If >30 minutes to hospital
- **>25%** – Indicated

- Administer **1 litre** over **1 hour**

Sepsis

- Administer in **250ml** boluses
  - Not too fast – 10-15 minutes
- Assess for continued indication
- Maximum dose: **1 litre**

- Blood pressure <90 mmHg?

Anaphylaxis

- Systemic extravasation of circulating volume
- Shock develops rapidly
- True anaphylaxis is still (thankfully) rare
- The priority remains **Adrenaline**

- Administer in **500ml – 1 litre** rapid challenges
- Assess for continued indication
- Maximum dose: **2-3 litres**

Diabetic Ketoacidosis (DKA)

- Challenging to diagnose without bloods
- Blood/Urine ketone testing is common
- Treatment helps reduce metabolic disturbance

- Are they shocked?
  - Yes: **500ml** over **15 minutes**
    - Are they still shocked?
      - Yes: Repeat **500ml** over **15 minutes**
      - No: Repeat **500ml** over **45 minutes**
  - No: **1 litre** over **1 hour**
- In all cases Maximum Dose: **1 litre**
- Young adults (18-25) with a low BMI: Refer to Paediatric guidelines

- What about HHS?

Adrenal Crisis

- Rapid circulatory collapse is common
- Failure to produce cortisol
- Priority remains **Hydrocortisone**

- Administer **1 litre** over **30 minutes**

Interactive Quiz

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What about Children?

- **The child that lets you give them fluid, needs fluid!**
- There are challenges:
  - IV access
  - Diagnosing shock
  - Dosage is weight dependant

- Medical cause: **10ml/kg**
  - Heart or Renal failure: **5ml/kg** – stop if any deterioration
- Traumatic cause: **5ml/kg**
  - Burns: **10ml/kg**

- Maximum Dose: **20ml/kg**

What about Children?

- DKA – the worry about <u>cerebral oedema</u>
  - It is thought to be rare, but fluids can increase the risk
  - Stop if deterioration in GCS or acute neuro signs

- Burns – the guidelines are similar, but:
  - **<10% TBSA** - Not indicated
  - **10-20% TBSA** - If >30 minutes to hospital
  - **>20% TBSA** - Indicated

- Remember: **10ml/kg** for burns, over **1 hour**

Interactive Quiz

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Limitations of Fluid Resuscitation

- The evidence base – or lack thereof
- Time consuming – sometimes
- Large volumes can cause hyperchloraemic acidosis

- Fluid is (usually) cold
  - Think ‘Trauma Triad of Death’
- Fluid doesn’t clot
  - It can dislodge existing clots
- Fluid doesn’t carry oxygen or carbon dioxide
  - Haemodilution causes relative anaemia

- What are we actually trying to achieve?
  - Think Bainbridge Reflex & Frank-Starling Mechanism (bedtime reading)

Fluid Overload

- Hypervolaemia
- 2/3 of normal saline extravasates – leading to oedema
- The risk is increased in:
  - Those with cardiac disease (heart or vessels)
  - Those with renal failure
  - Children (cerebral oedema)
  - Rapid infusions

- In those at risk:
  - Give cautiously (slower/smaller infusions)
  - Assess lung fields for signs of pulmonary oedema

Are there any better options?

- Crystalloids vs Colloids

- Crystalloids (NS, Hartmann's):
  - Contain smaller molecules
  - Molecules can extravasate – increased oedema
  - Isotonic solutions closely resemble biochemistry
  - Evidence of harm in large quantities (mainly renal)

- Colloids (Albumin, Dextran, Gelofusine etc):
  - Contain larger molecules
  - Molecules remain in circulating volume
  - Exhibit greater osmotic actions
  - Therefore, last longer and less is required
  - Adverse reactions are much more common
  - Not all are vegetarian
  - Much more expensive

- Both are supported by NICE
- Crystalloids are generally favoured in initial resuscitation, and are (usually) the only option out of hospital

Sodium Chloride vs Hartmann's

- NICE & JRCALC support both
- Sodium Chloride 0.9% (Normal Saline) – Isotonic Crystalloid
  - Na^+ 154
  - Cl^- 154
  - pH 4.5

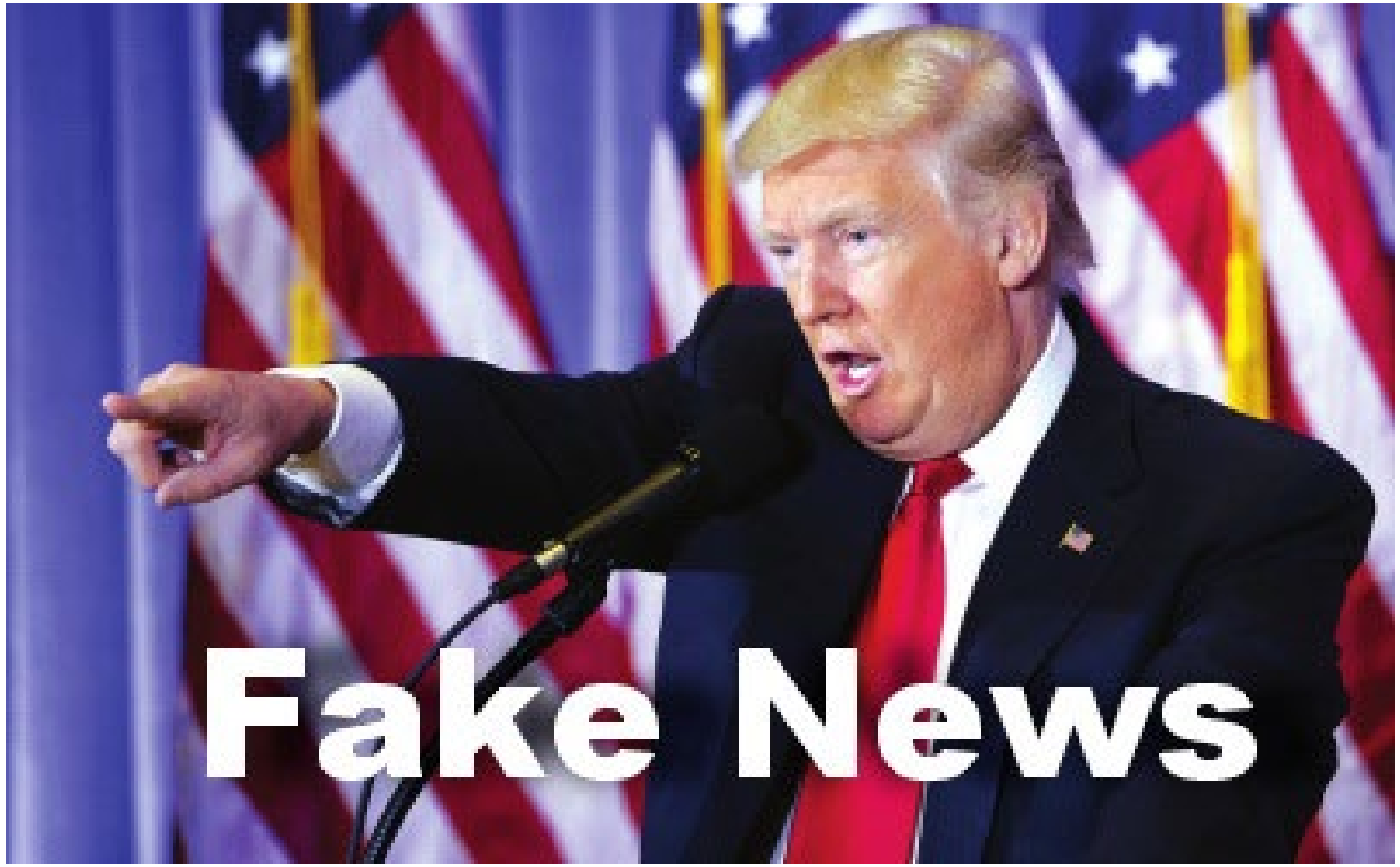
- Sodium Lactate Compound (Hartmann's, Ringer's) – Balanced Crystalloid
  - Na^+ 131
  - Cl^- 111
  - K^+ 5
  - Ca^{2+} 2
  - Lactate 29
  - pH 6

- Normal biochemistry
  - Na^+ 135-145
  - Cl^- 100-110
  - K^+ 3.5-5
  - Ca^{2+} 2.2-2.6
  - HCO_3 22-26
  - pH 7.35-7.45

Mythbusting?

- You can't use Hartmann's in Sepsis!
  - Why?
- Coz it's got lactate, innit

Mythbusting?



Mythbusting?

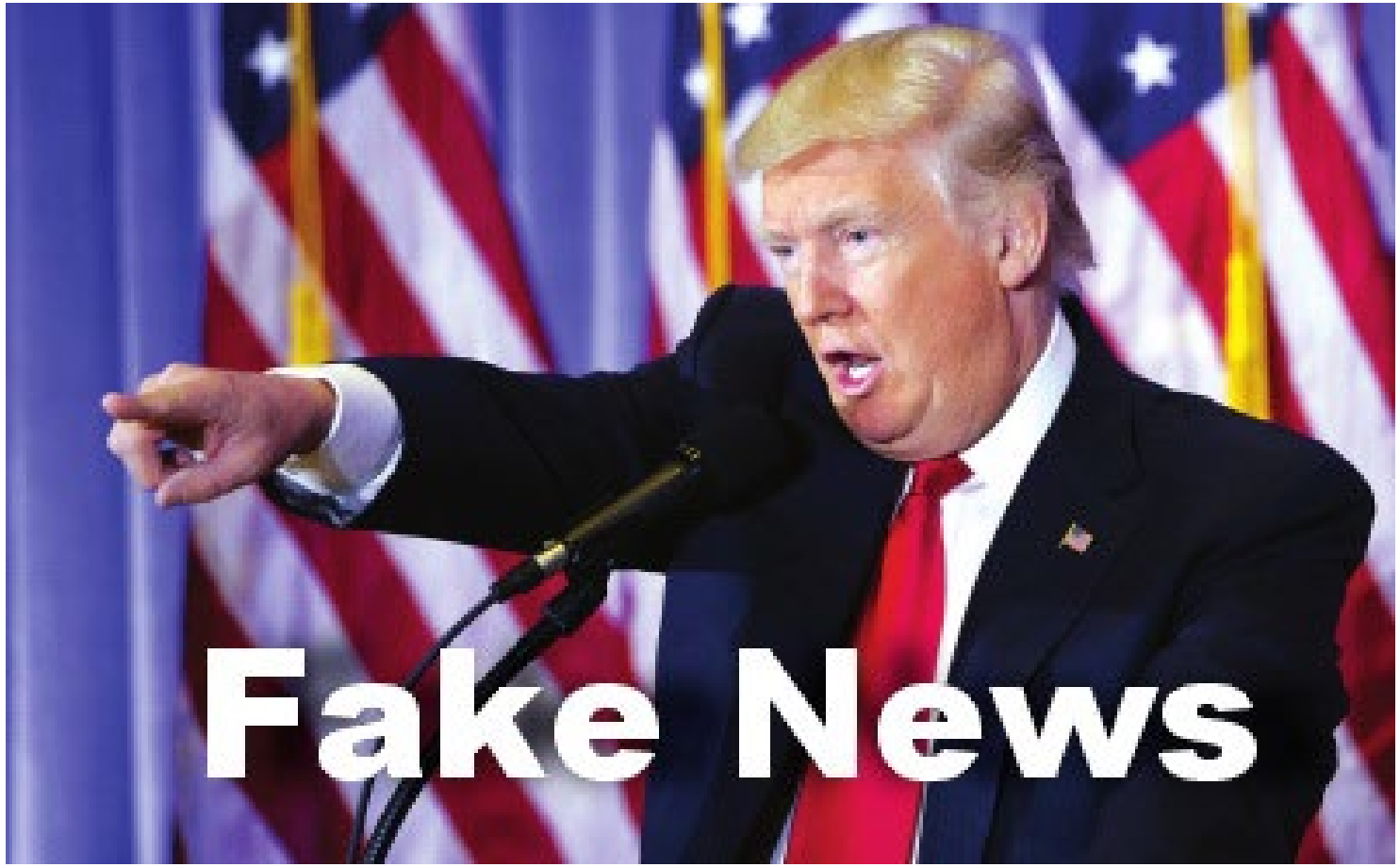
- Lactate does not automatically become Lactic Acid
- Lactate undergoes gluconeogenesis and oxidisation:
  - Gluconeogenesis = Pyruvate
  - Oxidisation = HCO^3 (& CO^2)

- Lactate metabolism results in pH buffering
- Studies have not shown any outcome difference vs NS
- Hyperchloraemic acidosis from NS more harmful?

Mythbusting?

- You can't use Hartmann's in DKA!
  - Why?
- Coz JRCALC used to say innit…

Mythbusting?



Mythbusting?

- Contentious issue!
- Hesitation stems again from Lactate worsening acidaemia

- Two studies:
  - Self *et al.* (2020) – 172 adults
  - Yung *et al.* (2017) – 77 children
- Both suggest benefit in severe DKA

- Current guidelines:
  - Recommend NS, but acknowledge the risk of NAGMA
  - Do not contra-indicate Hartmann's

Let's Talk Head Injuries

- Studies support NS over Hartmann's in traumatic brain injury
- In TBI swelling (oedema) of the brain contributes to raised ICP
- Cerebral Perfusion Pressure is key!
  - CPP = MAP – ICP
  - We cannot measure ICP
  - But if MAP is rising, you can assume it is because ICP is too
  - The body raises MAP to preserve CPP
  - When it can no longer overcome ICP, secondary brain injury occurs
  - This is why the threshold for fluids is higher in head injuries

- Cerebral oedema is extravascular fluid
- If we introduce an intravascular osmotic agent, we will reduce that oedema
- NS has 154 mmol of Na^+ – this is mildly osmotic (normal = 135-145)

Hypertonic Saline

- Hypertonic Saline exhibits much greater osmotic force
  - 2.7% Saline contains 462 mmol of Na^+
    - 0.9% contains 154
    - Plasma contains 135-145
  - 5% Saline contains 855

- 2.7% is the most common
  - Also available in 3% & 5%
  - 5% is growing in popularity

- As yet, there doesn't seem to be an 'ideal' concentration
  - A recent study has suggested 5% had improved outcomes vs 2.7%
  - A recent systematic review has shown significant benefits over Mannitol
  - Although nobody has compared to placebo?

- Indicated for TBI with clinical evidence of significantly raised ICP – think Cushing's Triad
- Dose: **3ml/kg** slow infusion – currently for all strengths (up to 5%)
  - Do not connect the bag to the cannula – draw up the required amount and administer by syringe

Cold vs Warm

- Why wouldn't you give warm?
  - Wall *et al.* (2018): greater increase in MAP with warm fluid per volume

- Less effect on core temperature
  - And thus coagulopathy
  - Better tolerated (less shivering etc)

- Limitations
  - When did you last see a fluid warmer on an ambulance?
  - Can fluids be stored in a warmer until expiry date?
  - Power supply issues

Glucose

- Not a resuscitative fluid
- Available in 5% and 10% (most common)
  - 10% used in pre-hospital care

- 10% typically only used for hypoglycaemia
  - Also indicated in prolonged paediatric arrests
- 5% has many uses:
  - Mixed with NS as a maintenance fluid
  - Mixed with Insulin for DKA and Hyperkalaemia
  - Mixed with Sodium Bicarbonate in PALS

- Adult dose for hypoglycaemia: **10g/100ml** (10%)
- Repeat every **5 minutes** (as required)
- Max Dose: **30g/300ml** (10%)

- Paediatric dose: **2ml/kg** (10%) (200mg/kg)

Next Session

Prehospital Care Series | Episode 2 | Prehospital Bloods

Tuesday 26th August 2025

19:30 London

Zoom registration will shortly be open through our website and Facebook page
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CPD certificates will be available soon – please keep an eye on our website and Facebook page

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If you do not want to take part in the Q&A then please feel free to leave and we hope to see you again next week!

Any Questions?

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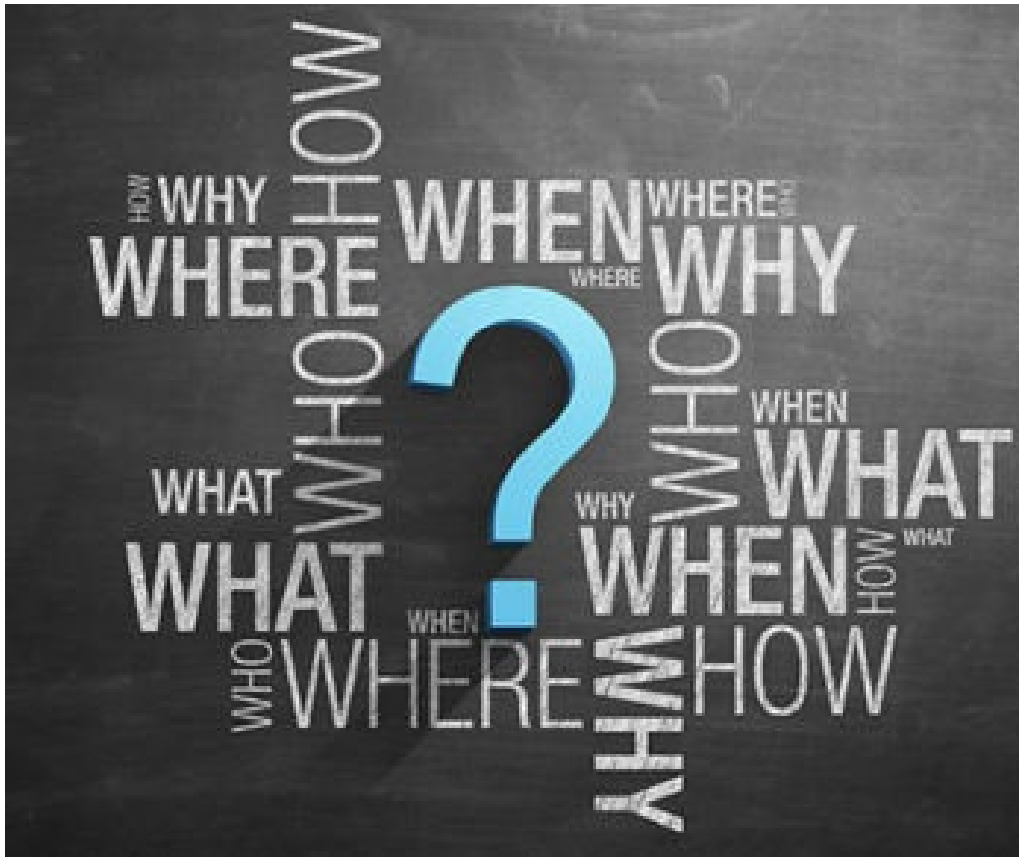

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