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# Phlebotomy Top Gun

## Order of Draw: Do We Still Care?



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## Disclosures

- None

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## Which of the following statements describes the importance of drawing a serum tube BEFORE the K EDTA tube?

1. In the era of lyophilized anticoagulants, order of draw is no longer important
2. Contamination of serum samples with K EDTA will occur routinely if order of draw is not followed
3. During syringe collections contamination with K EDTA may rarely occur if order of draw is not followed
4. Modern lab equipment can tell the difference between K from an EDTA tube and K from the patient so order of draw is not important

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## CLSI Guidelines

- CLSI GP41, Collection of diagnostic venous blood specimens, V7, 2017
- Order of draw
  - Blood culture, citrate, serum, heparin, EDTA, sodium fluoride/K oxalate
  - Recommended for both glass (liquid additive) and plastic (lyophilized additive) tubes
  - Consider additive for tubes not listed
  - No serum clot activator tubes before citrate to avoid carry-over in coagulation results
  - No Na carry-over from Na citrate or Na heparin tubes
  - Follow tube manufacturer instructions for trace metals




## European Federation for Clinical Chemistry Pre-analytical Phases Working Group[1]

- Problems with incorrect order of draw
  - Hypernatremia due to Na citrate or Na EDTA
  - Hyperkalemia due to K EDTA contamination
  - Hypocalcemia, low MG, zinc, iron, or alk phos to due K EDTA
  - Poor coagulation due to transfer of anticoagulants
  - Clot activator transfer interfering with coagulation tests
  - Dilution effects from pouring one sample into another

## European Federation for Clinical Chemistry Pre-analytical Phases Working Group

- Three potential mechanisms of anticoagulant contamination
  - Direct transfer (pour off): Not related to order of draw, bad practice
  - Backflow during closed loop (vacutainer) collection: Data does not support that this occurs
  - Contamination by syringe needle transfer: Amount required to impact results varies by study, most likely mechanism
- Conclusion: Order of draw not important during routine closed system venipuncture
- Contamination may occur during syringe transfer
- Might as well follow order of draw all the time




## Contamination During Routine Venipuncture[2]

- 11 healthy volunteers, drawn by experienced phlebotomist
- Serum tube, EDTA tube, serum tube (BD)
- Measured EDTA, K, calcium, MG, zinc, alk phos, creatinine in first and third serum tube
- EDTA undetectable (< 0.2 mmol/L) in all serum samples
- No difference in mean K, calcium, MG, zinc, alk phos, or creatinine between first and third serum tubes

## Contamination During Routine Venipuncture[3]

- 57 outpatients attending outpatient anticoagulation clinic, 58 healthy volunteers
- Multiple experienced phlebotomists
- Outpatients: serum, Na citrate, serum
- Volunteers: serum, K EDTA, serum
- No difference in mean K, Na, calcium, MG, phosphorus between 1st and 3rd serum tubes




## Contamination Inpatient Venipuncture[4]

- One month prospective study of all samples with K > 6.0 mmol/L at one hospital
  - New Cross Hospital, Wolverhampton UK
- Sarstedt monovette serum gel tubes, Na EDTA glucose, and K EDTA coagulation tubes
- 117 samples with K > 6.0 mmol/L
  - 28 (24%) had EDTA > 0.1 mmol/L
  - 22 inpatients, 6 primary care
  - 27 patients retested with normal K second time
  - EDTA concentration correlated positively with K and negatively with calcium, zinc, MG, and alk phos

## Contamination Inpatient Venipuncture[5]

- Multi-center study of EDTA contamination in hyperkalemic (K>6.0 mmol/L) samples over 1 mo

| Lab | Tube Type | # Hyperkalmeic Specimens | # EDTA Detected | % Hyperkalemic Samples EDTA Contamination |
|---|---|---|---|---|
| 1 | Sarstedt | 300 | 20 | 6.7% |
| 2 | Sarstedt | 110 | 5 | 4.6% |
| 3 | Greiner | 200 | 3 | 1.5% |
| 4 | Greiner | 163 | 2 | 1.2% |
| 5 | BD | 140 | 7 | 5.0% |

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## Mayo Experience

- K > 6.0 mmol/L triggers suspect contamination flag
- Lab contacts care team (redraw desired)
- Lab can contact resident/fellow on call if asked to release and not comfortable doing so
- Weekly call rounds to review cases
- ~ 1/month elevated K that does not repeat on re-draw, often Ca measured off-line and low, looks like K EDTA contamination
- We think EDTA contamination is still happening, we don't know how or why

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## Conclusions Order of Draw

- Evidence suggests that K EDTA contamination does not occur during closed draws with plastic tubs (lyophilized K EDTA)
  - No backflow contamination
- In 5 UK hospitals, K EDTA contamination is seen in 2-15% of samples with abnormal K, Ca, MG, or zinc
- At Mayo we rarely see samples that look like contaminated with K EDTA
  - Don't know if collected with vacutainer or syringe
  - Could happen more often but are being redrawn
- Assumption contamination happens with syringe draws

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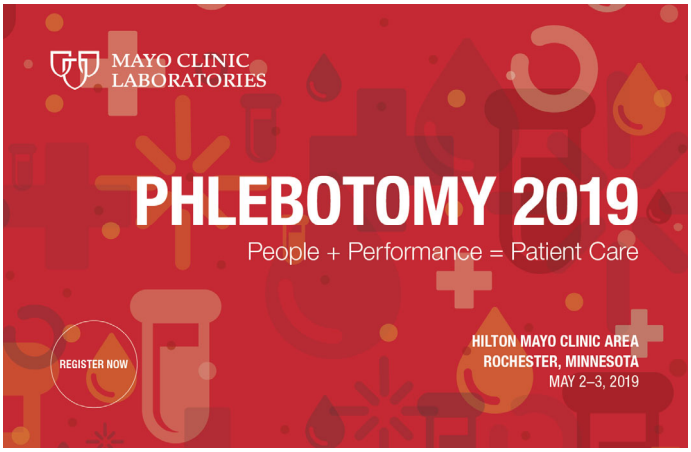


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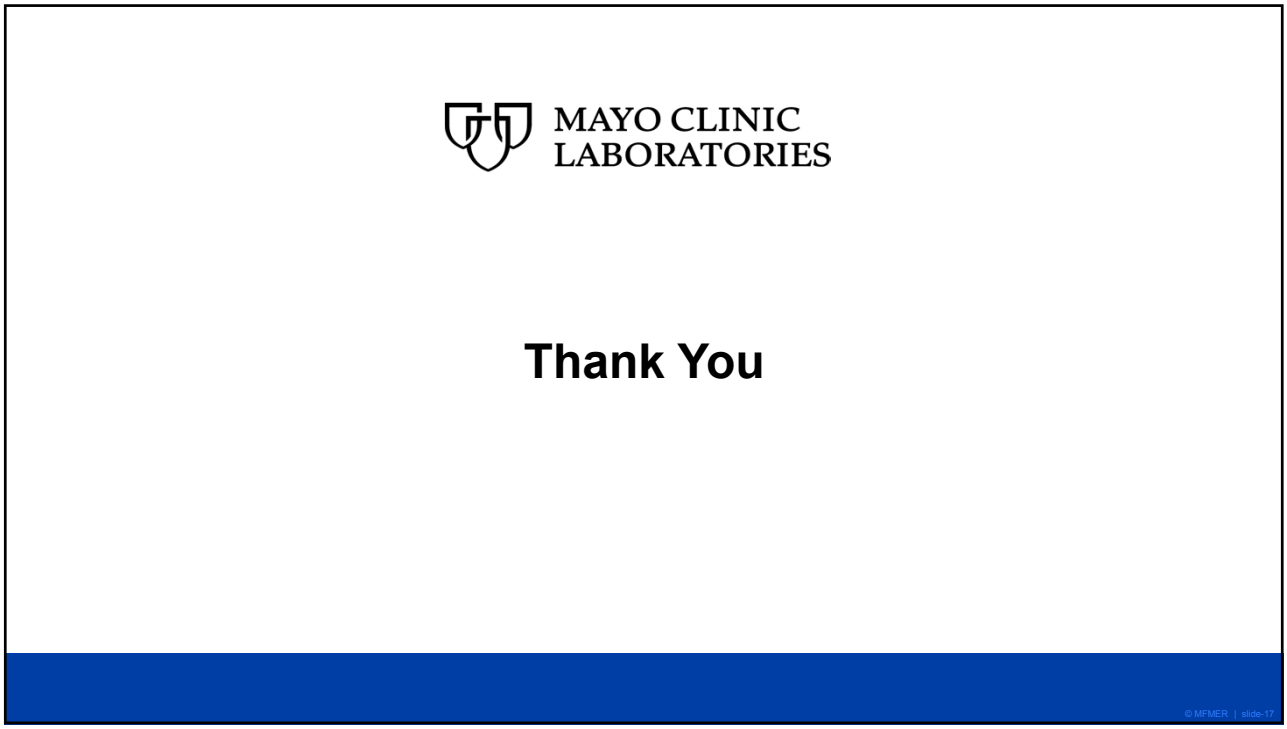
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Thank You
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