WHEN & WHEN NOT TO REPORT RESULTS

A discussion on result correlation and troubleshooting when results may be questionable

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- Note:
  - I do not have any conflicts of interest to disclose in regards to this presentation.

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- Objectives
  - *Upon completion of this course you shall be able to……..*

1. Evaluate the impact and importance of reporting accurate results.
2. List steps to take when investigating questionable results.
3. Describe pre-analytical and analytical errors that may produce questionable results.
4. Validate the accuracy of laboratory results based on sample assessment, previous results, and basic correlation of analytes.

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- Quality and accurate results are imperative
- Laboratories contain both highly specialized equipment and highly trained staff
- ~70% of patient care relies on laboratory testing
- **What do we do when questionable results arise?**

https://www.acla.com/the-power-of-knowing/

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- Start with doing your homework!
- With good training and practice, this "homework" will become second nature
- Begin with these guidelines:
  - 1. Evaluate the sample
  - 2. Review previous results if possible
  - 3. Correlate with other lab values
  - 4. Is the analyte is functioning properly
    - Troubleshoot instrument

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Evaluating the sample:

1. Was the correct tube drawn
2. Was tube properly filled
3. What was the mode of collection
4. Was tube centrifuged properly (if required)
5. Is sample clotted or fibrin present
6. Once spun does there seem to be an abnormal volume of plasma/serum present
   -could suggest a diluted sample
   - in coag could suggest an adjusted tube is needed
7. Is there another acceptable tube available

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- **DO NOT REPORT RESULTS ON:**
  - Clotted coag or hematology
  - Hemolyzed K
  - Underfilled coag (blue top) tube
  - Inappropriate sample type
  - Improperly transported sample
  - Unlabeled or mislabeled samples (unless deemed irretrievable)
- **Refer to your SOP's and package inserts**

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- Reviewing previous results
  1. Helps gauge result stability over time
     - Be cautious – patient status can change rapidly
  2. May indicate instrument issue

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- Basic Correlation
  - Chemistry Panels
    - Group results together → look for appropriate patterns
      - Electrolytes, Ca & Phos, Creat & BUN, Alb & Total Protein, Glucose & CO2
      - Anion Gap - measure of positively and negatively charged ions (acidity)
        - What do I do with a negative value?
  - Hematology
    - HCT → 3x hgb
    - Platelets → same picture on the slide?
    - WBC → Review of slide correlate with instrument counts?
  - Coagulation
    - Do results make sense with medication
- Is a diagnosis available?

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Na K Cl	**Electrolytes – Nerve/Muscle Function & Acid Base Balance**
CO2 Glu	**Diabetes**
Ca	**Nerve/Muscle/Heart Function & Bones & Hemostasis**
Cre BUN	**Kidney**
Alb TP AST ALT ALK Tbili	**Liver Function**

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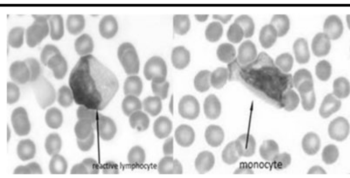

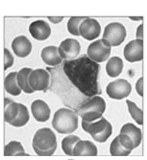

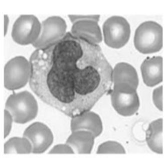

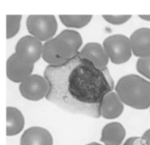

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https://www.r

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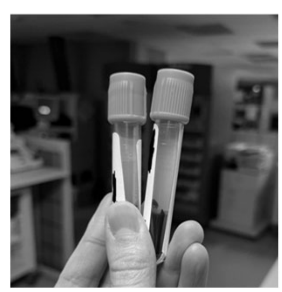

https://www.reddit.com

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- Evaluate if the analyte is functioning properly
  - Was QC performed and acceptable
  - Visual check of functional parts of the instrument
  - Any aspiration errors due low reagent

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- Flags to help assess possible questionable results
  - Delta checks
  - Indices (HIL)
  - Instrument error flags
  - Critical values
- Technologist must use these tools available to decide if results are reasonable to report.

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- Delta Checks
  - Measurement of quality
  - Comparison of two sets of results within a defined time period and a defined allowable difference
  - Originally set as a tool to detect tube/patient misidentification
  - All delta checks must be investigated

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- Examples for delta flagging:
  - Ok to report results if:
    - Drop in hemoglobin/HCT after surgery or have been admitted and given fluids
    - Increase in RBC, Hgb, and HCT after giving RBCs or platelets increasing with platelet transfusion
    - Renal disease patients can have creatinine and BUN increases and decreases depending on dialysis treatment
  - Do not report results if:
    - Critical high potassium and critical low calcium - order of draw incorrect
    - Incorrect patient drawn
    - Compromised or contaminated samples

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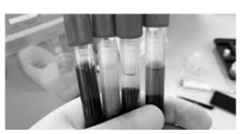
- Indices (HIL) = describes integrity of the sample
  - H = Hemolysis
    - RBC destruction releasing cell contents
    - Cyanokit medication
  - I = Icterus
    - Increased bilirubin seen with liver damage, gall stones, pancreatic cancer
    - Orange/brown coloration of plasma
    - Interferes either spectrally or reactively with the chemical makeup of the reagent (Cre, CK, Chol)
  - L = Lipemia
    - Excess lipids in plasma
    - Causes light scatter problems
    - Spectrophotometric testing principle



https://cyanokit.com/treatment-with-cyanokit.html

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- Can we correct the samples with HIL error flagging?
  - ANSWER: YES & NO

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- Troubleshooting Hemolysis
  - Recollection helps determine if in-vitro or in-vivo
    - Examples of in-vitro vs in-vivo
      - In vivo- rare
- Tests highly affected by hemolysis:
  - K, LDH, Liver Enzymes, Folate
  - Why?

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- Troubleshooting Icterus
  - Very difficult as this is a result of the disease process
  - May be present until liver heals

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- Troubleshooting Lipemia
  - Ultracentrifuge sample
    - ~13,000 rpms
  - Ensure CO2 and lipid results (Chol, Trig, HDL) are completed prior to ultra centrifugation
    - Why?

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- Other Instrument Error Flags
  - Absorbance Errors – value too high or interfering substance
  - Reaction Check Failures
    - Refer to online instrument manual to help explain error flags

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- Critical values
  - Values that are considered life threatening

K 6.5 mEq/L !!

  - **Do not report values even verbally if result is questionable**
  - Take steps to determine validity of result **1st!**
    - Review sample integrity
    - Correlate with other lab values
    - Repeat testing if appropriate

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- Contacting the patients care team
  - Complete "homework" first
  - Phone call
    - Opportunity for open dialogue & clear communication
    - Example of appropriate vs not
  - Speak with caring confidence
  - Obtain information from RN or provider to complete the puzzle
  - Safely report result or recollect
  - ***If recollection is decided, check with the other departments first!**

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- ALWAYS ask yourself:
  - What is the impact to the patient if these results are reported?
  - What is the impact if I don't?

  - According to the American Clinical Laboratory Association (ACLA):
    - 7 billion clinical lab tests performed in US yearly
    - Clinical laboratory tests [thus Medical Laboratory Professionals] have an immeasurable impact on diagnostic and treatment decisions made by health care providers.

https://www.acla.com/value-of-lab-testing/

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CASE STUDIES

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- **Case Study #1**
- **Patient collected in Urgent Care clinic for routine lab work. The following results were reported:**

WBC	7.8
RBC	4.55
Hgb	8.5
Hct	44.3
MCV	97.4
MCH	18.7
MCHC	19.2

- **Patient was discharged. Provider then ordered iron studies to be collected with another CBC. Patient returned next day. Results on this sample:**

WBC	9.3	Fe	100 mcg/dL
RBC	4.49	TIBC	300 mcg/dL
Hgb	14.4	% Sat	40%
Hct	43.4	Ferr	205 ng/mL
MCV	96.7		
MCH	32.1		
MCHC	33.2		

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- What Happened???
- Clinic called questioning both sets of results
  - Further investigation revealed:
    - The original CBC was not repeated and no slide made on initial day of testing
    - The hgb/hct do not match x3
    - Indices are grossly abnormal.
    - Original tube was still available and run again.
      - Noted the volume in the tube was very low. Repeat run in open mode & matched results of second collection
      - Initial run in closed mode - volume in the tube was just enough to not trigger an aspiration error.
  - Additional testing would have been avoided if the original sample was assessed properly. The patient was credited for the additional venipuncture and testing that was not needed.

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- **Case Study #2**
- A blood collection on patient BR was performed by the nurse during a dialysis visit. A blue top tube for a PTINR was sent to lab for testing.
- Prior to running, sample was checked for clots and tube fill was acceptable.
- Results reported from the instrument are as follows:
  - PT = no result
  - INR = >

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- Troubleshooting the sample:
  - 1. Repeat testing
    - Results were identical to the first run
    - Noted other samples were running without issue, QC performed earlier was within range
  - 2. Review patient record to verify medication (Coumadin) or other clues on patient condition
    - Discovered dialysis RN performed a courtesy draw for the Anticoagulation Clinic
    - Possible this could be a valid result?
  - 3. Technologist questioned whether it could be a contaminated sample and called dialysis
    - RN stated the patient was doing well but did forget the patient needed a blood collection prior to beginning dialysis so they decided to collect the tube mid cycle
    - Tech then placed an order for a redraw
    - Reviewing tube post centrifugation may have also helped (plasma to cell ratio); look for bubbles

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- **Case Study #3**
- Patient RS presents to the family medicine clinic for a routine physical. A CBC sample is collected and sent to the lab. Results are as follows:

WBC	6.82	[10^3/uL]		
RBC	1.87 *	[10^6/uL]		
HGB	9.7 *	[g/dL]		
HCT	18.7 *	[%]		
MCV	100.0 *	[fL]		
MCH	51.9 *	[pg]		
MCHC	51.9 *	[g/dL]		
PLT	318 *	[10^3/uL]		
RDW-SD	55.1	[fL]		
RDW-CV	16.8	[%]		
MPV	9.9	[fL]		
NEUT&	4.62	[10^3/uL]	67.8	[%]
LYMPH	1.38	[10^3/uL]	20.2	[%]
MONO	0.56	[10^3/uL]	8.2	[%]
EO	0.21	[10^3/uL]	3.1	[%]
BASO	0.03	[10^3/uL]	0.4	[%]
IG	0.02	[10^3/uL]	0.3	[%]
NRBC	0.00	[10^3/uL]	0.0	[/100WBC]

RBC Agglutination?
Turbidity/HGB Interf?

THOUGHTS?

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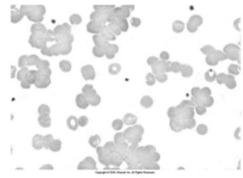
- Tech reviewed the CBC as well as the peripheral smear.



Next steps?

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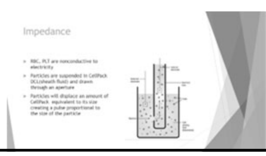
NEW RESULTS:

WBC	7.73	[10^3/uL]		
RBC	3.29	[10^6/uL]		
HGB	9.9	[g/dL]		
HCT	30.7	[%]		
MCV	93.3	[fL]		
MCH	30.1	[pg]		
MCHC	32.2	[g/dL]		
PLT	316	[10^3/uL]		
RDW-SD	53.2	[fL]		
RDW-CV	15.7	[%]		
MPV	9.9	[fL]		
NEUT&	5.21	[10^3/uL]	67.3	[%]
LYMPH	1.49	[10^3/uL]	19.3	[%]
MONO	0.63	[10^3/uL]	8.2	[%]
EO	0.34	[10^3/uL]	4.4	[%]
BASO	0.04	[10^3/uL]	0.5	[%]
IG	0.02	[10^3/uL]	0.3	[%]
NRBC	0.00	[10^3/uL]	0.0	[/100WBC]



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- **Case Study #4**
  - Patient SW had the following results on their 1st and 2nd timed draws of the day:

Draw #1			Draw #2	
Sodium	137 mEq/L		Sodium	137 mEq/L
Potassium	6.0 mEq/L		Potassium	4.9 mEq/L
Chloride	99 mEq/L		Chloride	99 mEq/L
Total Co2	24 mEq/L		Total Co2	24 mEq/L
Glucose	125 mg/dl		Glucose	130 mg/dl
Creatinine	1.2 mg/dl		Creatinine	1.2 mg/dl
BUN	20 mg/dl		BUN	21 mg/dl
Calcium	5.5 mg/dl		Calcium	9.8 mg/dl

  - What preanalytical variable might explain the differences in the two sets of results?

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- Answer: Tubes were collected in the incorrect order
  - EDTA was drawn before the LiHep
  - K2 EDTA is the anticoagulant – drives K levels up
  - EDTA's job is to chelate Ca – does the same in the contaminated tube
  - **NOTE:** this collection error may not always result in critical values!

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- **Case Study #5**
  - Patient SC, a 68 year old male presents to Urgent Care with nausea, vomiting and a burning sensation in his chest lasting 2 days. Patient history include notes of hypertension, tobacco use disorder and Type 2 diabetes. Renal panel and troponin testing were ordered.

Test	Result
Na	132 ⇩
K	3.4 ⇩
Cl-	87 ⇩
CO2	33 ⇧
Glu	301 ⇧
Cre	1.08
BUN	19
Ca	13.4 ▲△
Phos	4.1
Alb	4.2
hsTrop	21

Should these values be reported?

Thoughts?

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- Results are as follows:

Test	Result
Na	132 ⇩
K	3.4 ⇩
Cl-	87 ⇩
CO2	33 ⇧
Glu	301 ⇧
Cre	1.08
BUN	19
Ca	13.4 ▲△
Phos	4.1
Alb	4.2 ▽
hsTrop	21

- Tech noted abnormal values, critical & delta checks
- No evidence of MI
- Performed results review
- -no previous issues with Ca or electrolytes

- Care team contacted and decided on recollect due to questionable results. Provider also requested a PTH.

Test	Result
PTH	13 ⇩

- Recollect came back with nearly identical values
- Glucose and electrolytes explained?
- What can cause an elevate PTH? PTH results expected?

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- Patient Diagnosis
  - Symptomatic severe hypercalcemia due to oral ingestion of excessive TUMS
  - Mil-Alkali Syndrome
  - GERD
  - Hypokalemia secondary to vomiting

- Upon investigation – all values are explained

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- **Case Study #6**
  - Patient GG, a 56 year old female inpatient had a Renal Profile and lactic acid were drawn during am labs. Both the renal and lactic samples were a unit collect from an IV.
  - Yesterdays results also provided

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	Current AM Results	Yesterday's Results
NA	138	132
K	4.1	4.8
Cl-	97	93
CO2	28	27
Glu	120	79
Cre	3.2 △	6.0
BUN	15 △	39
Ca	8.7	9.0
ALB	3.1	3.4
Phos	2.7	3.5
Lact	1.0	5.7 ▲

△ = Delta Check

▲ = Critical value

Thoughts???

RENAL PANEL:
NA, K, CL, CO2 – SIMILAR
GLUCOSE – MAY NOT BE FASTING, FLUCTUATES
CA, ALB, PHOS – SIMILAR

MOST CONCERNING: CRE, BUN, LACT

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- **Case Study #7**
  - Patient LP, a 15-year-old female, sees her physician for a routine check-up after which the doctor writes a lab order for a PHEN. LP is drawn by our lab and a Phenobarbital level is run. The result is less than the lowest detectable level.
    - Would you report the < than value?

YES	NO	MAYBE

Yes - get it off my pending list – it's a race to clean everything up and I am a winner!

No - There is definitely something wrong there is no way this is correct

Maybe – I should look into this a little more
Your "homework" findings help you answer yes or no

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- **Case Study # 8**
  - Patient JT was being seen for a routine checkup at the clinic. The patient was drawn for a basic panel at 4:55 pm. The courier was arriving in 5 minutes so lab staff quickly packing listed the sample to be delivered to Fargo. Sample arrived at 10:00pm.
  - Results are as follows:

Test	Result
Na	135
K	4.2
Cl-	100
CO2	25
Glu	60 ▼
Cre	1.0
BUN	20
Ca	8.6

  - Thoughts?
  - What would you do 1st?
  - Call critical <20 minutes

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THANK YOU!

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