

# **The Use of Rapid Immunoassay Drug Screens at Autopsy: Triage or Trouble?**



**Hannah Coltrain, MS, PA (ASCP)<sup>CM</sup>**

DeKalb County Medical Examiner's Office

Forensic Medicine Associates, Inc.



## Disclosure Statement

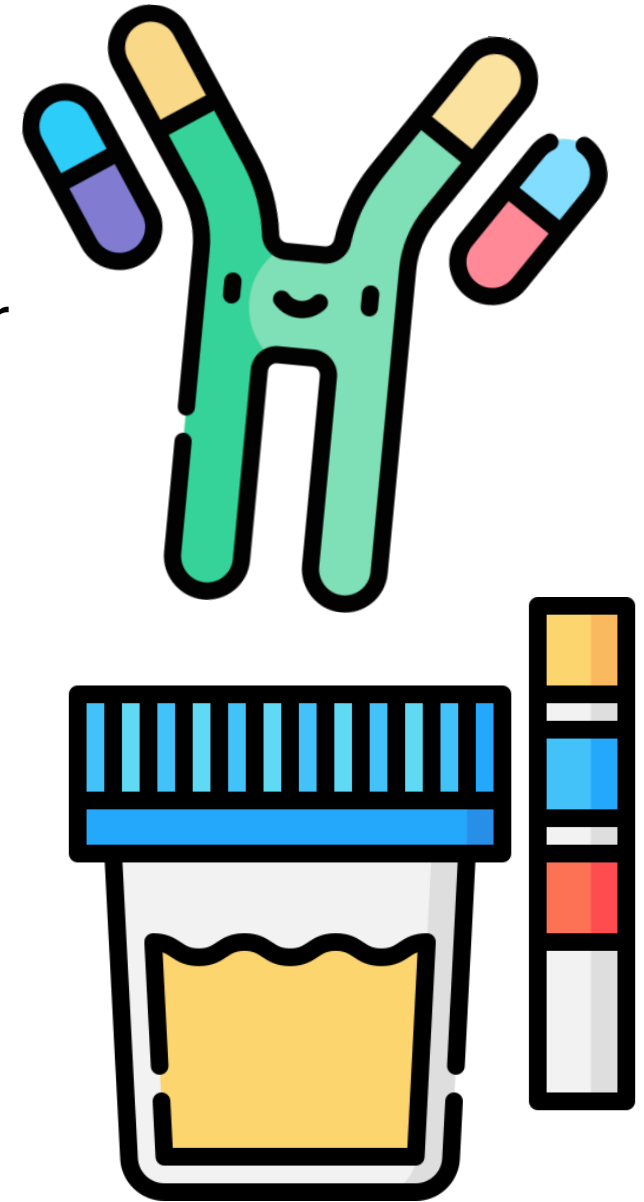
The author has no personal financial relationship or conflict of interest with the commercial interests of the products and services discussed within this presentation.

# Objectives

- Understand the basic mechanism of rapid immunoassay drug screens.
- Identify reasons why rapid drug screens are used within medicolegal death investigation systems.
- Review the evolving use of rapid drug screens in the forensic pathology setting as a factor of triaging the extent of postmortem examinations.
- Describe the limitations of interpretation provided by rapid immunoassay screening results compared to a confirmatory test.

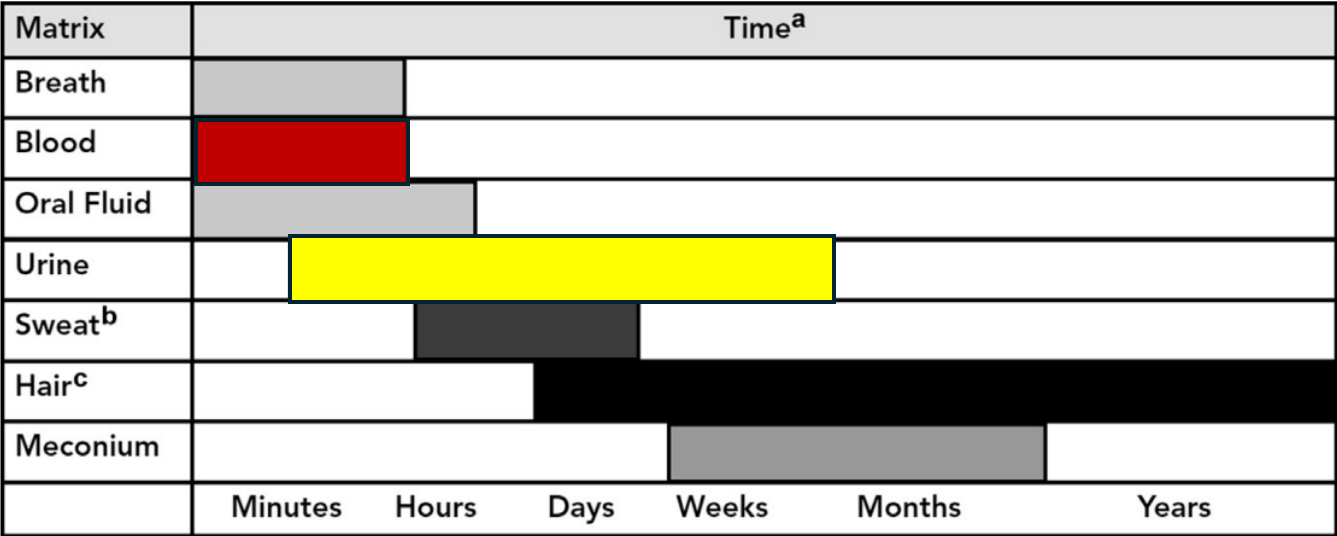
# Urine Drug Screen (UDS) Rapid Immunoassays

- Immunoassays use **antibodies** to detect drugs and/or their metabolites in a liquid sample
  - Usually urine or saliva
- **Antibody** = a protein that binds a specific antigen
- **Antigen** = the substance of interest in a sample
- **Detection window** = the range of time a drug can be found within a specimen
  - Urine samples often have *longer* detection windows
  - Affected by drug characteristics + patient factors



| Screening Test                                                                                                                                                                                                                                                                                     | Confirmatory Test                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>- Preliminary testing</li><li>- Qualitative only (presumptive)</li><li>- Fast results</li><li>- Lower cost</li><li>- Higher sensitivity</li><li>- Lower specificity</li></ul> <p>Example:</p> <ul style="list-style-type: none"><li>• Immunoassays</li></ul> | <ul style="list-style-type: none"><li>- Quantitative testing following a positive screen result</li><li>- High specificity</li><li>- Longer turnaround time</li><li>- Higher cost</li></ul> <p>Examples:</p> <ul style="list-style-type: none"><li>• GC/MS</li><li>• LC/MS</li></ul> |

**Drug Detection Windows per Biological Sample**

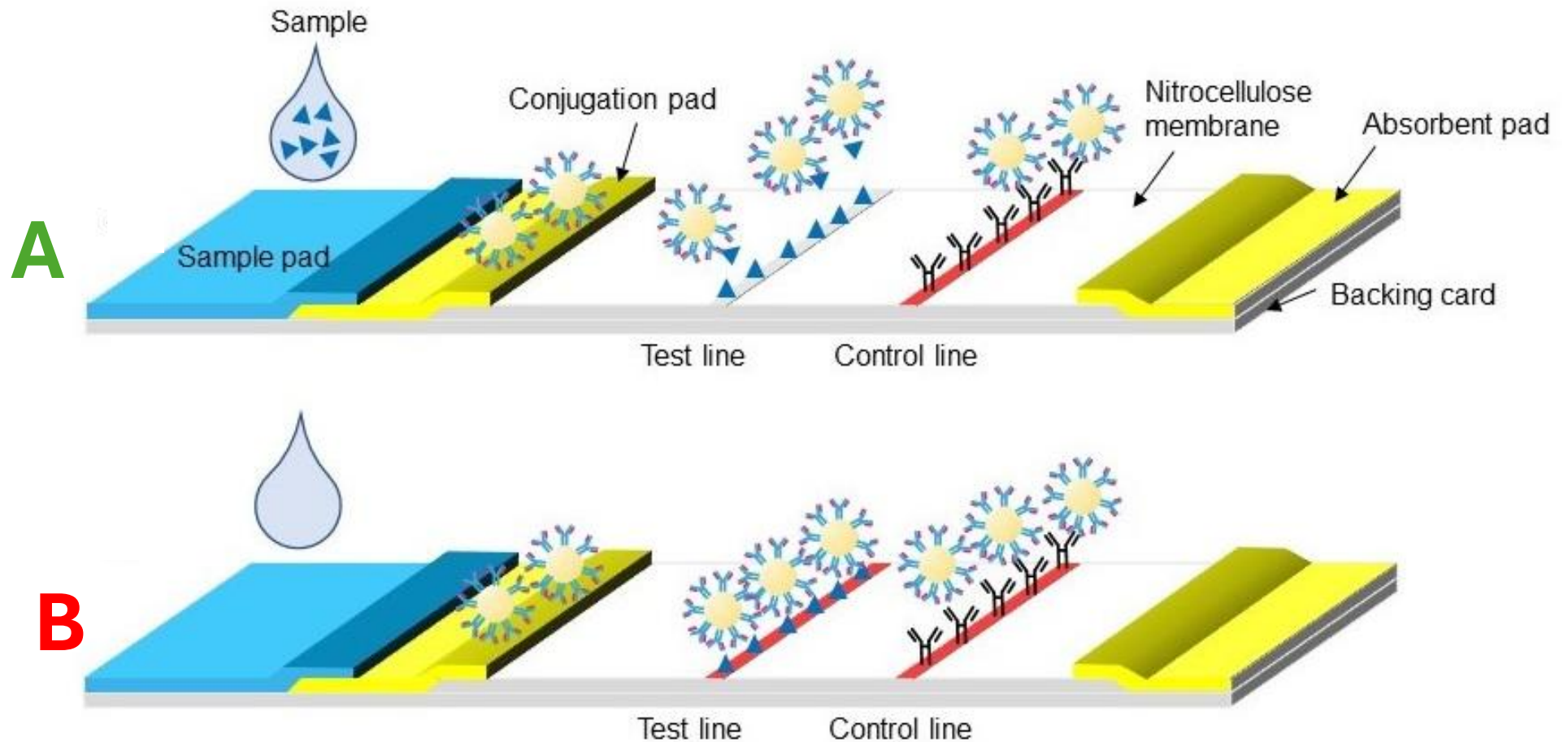


**Fig. 1.** Drug detection times for different biological specimens used in drug testing. <sup>a</sup> Very broad estimates that also depend on the substance, the amount and frequency of the substance taken, and other factors previously listed. <sup>b</sup> As long as the patch is worn, usually 7 days. <sup>c</sup> Seven to 10 days after use to the time passed to grow the length of hair but may be limited to 6 months' hair growth. However, most laboratories analyze the amount of hair equivalent to 3 months' hair growth. (From Substance Abuse and Mental Health Services Administration. Clinical drug testing in primary care. Technical assistance publication [TAP] 32. Rockville (MD): 2012. HHS publication No. [SMA] 12-4668.)

**Image source:** Child Adolesc Psychiatr Clin N Am. 2016 July ; 25(3): 549–565. doi:10.1016/j.chc.2016.02.005.

# Lateral Flow Immunoassays

- Uses competitive binding principles

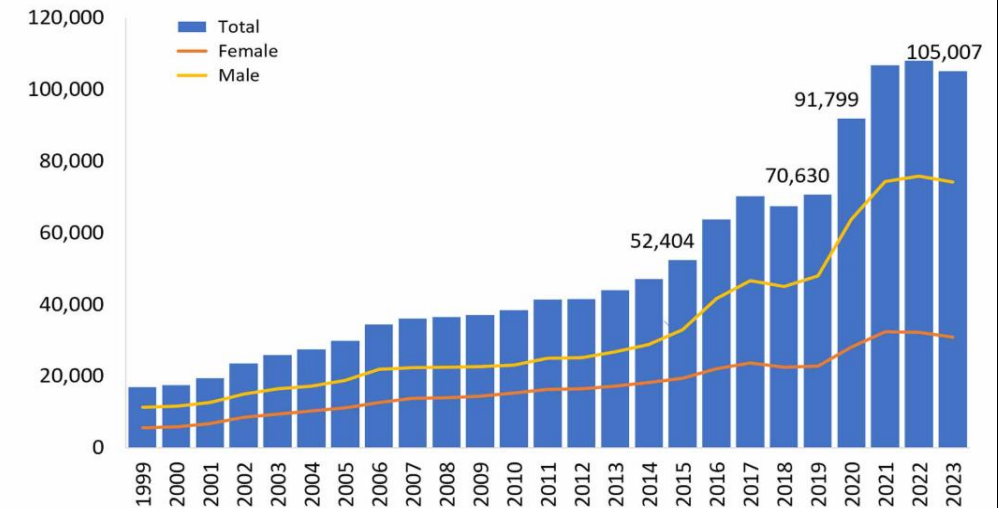


# Rapid Drug Screens in Death Investigation

- High OD mortality strains the ME/C systems
- UDS Limitations
  1. Qualitative data ONLY!
  2. Subjective interpretation of visual results
  3. Cut-off levels of detection may be higher than desired for a forensic investigation
  4. Cross-reactivity within drug categories
    - High sensitivity, low specificity
  5. Urine screen results do NOT reflect perimortem drug levels in blood



Figure 1. U.S. Overdose Deaths\* by Sex, 1999-2023



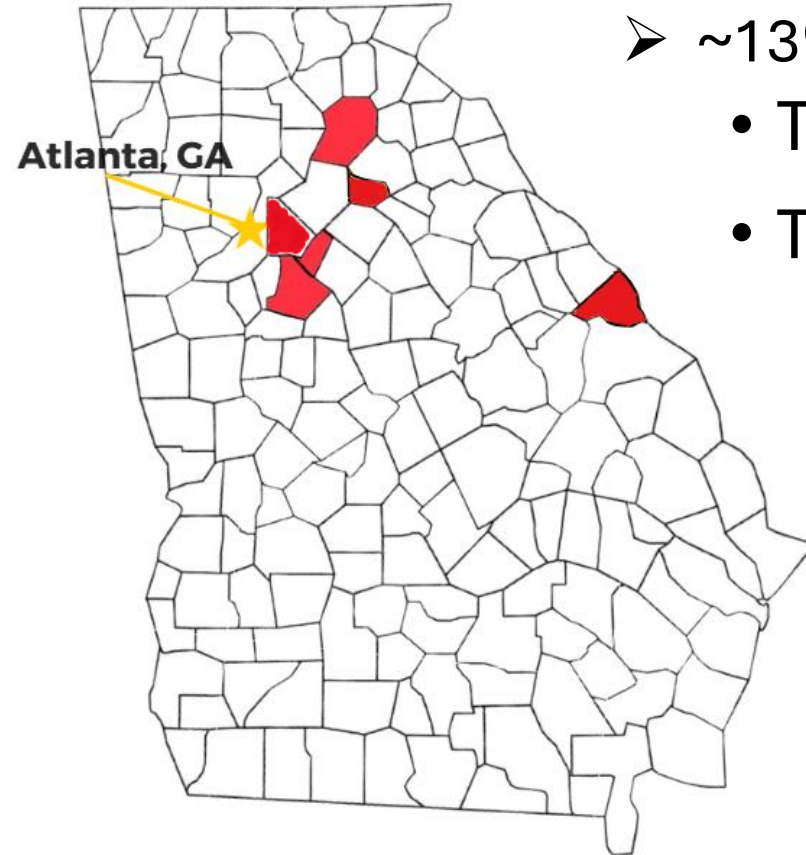
\*Includes deaths with underlying causes of unintentional drug poisoning (X40–X44), suicide drug poisoning (X60–X64), homicide drug poisoning (X85), or drug poisoning of undetermined intent (Y10–Y14), as coded in the International Classification of Diseases, 10th Revision. Source: Centers for Disease Control and Prevention, National Center for Health Statistics. Multiple Cause of Death 1999-2023 on CDC WONDER Online Database, released 1/2025.

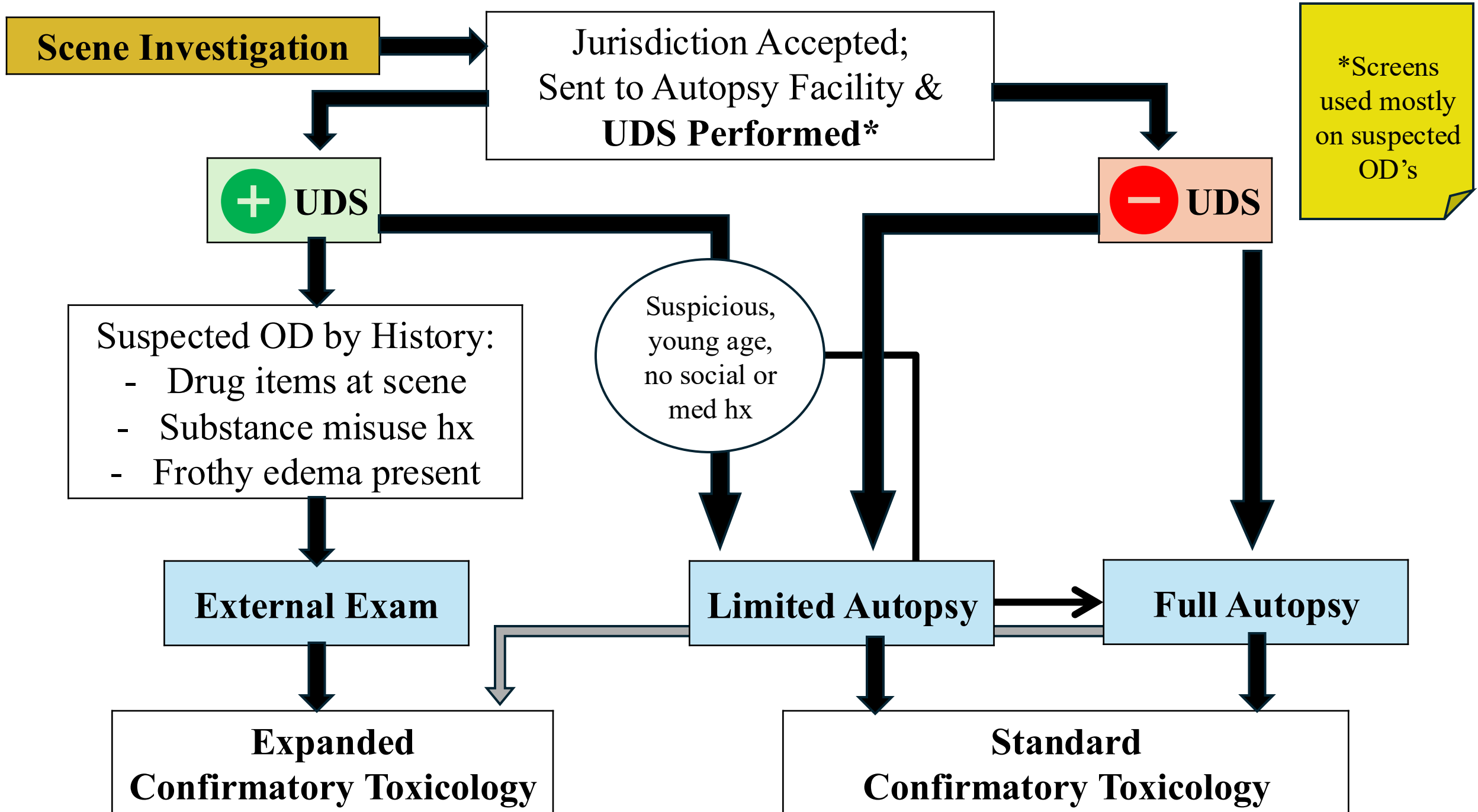


# DeKalb County ME's Overdose Trends (2019-2024)



- Combined state population served: **1,396,154**
  - ME and Coroner counties (4 ME's, 155 Coroners)
  - ~13% total state population
- Total cases sent to autopsy facility: **7,886**
- Total certified drug-related fatalities: **1,730** (22%)
  - Outsourced toxicology services have varied panels
  - Confirmatory testing on **all** cases
    - GC/MS, LC/MS, LC/TOF-MS
  - OD Data is uploaded to State Unintentional Drug Overdose Reporting System (SUDORS)

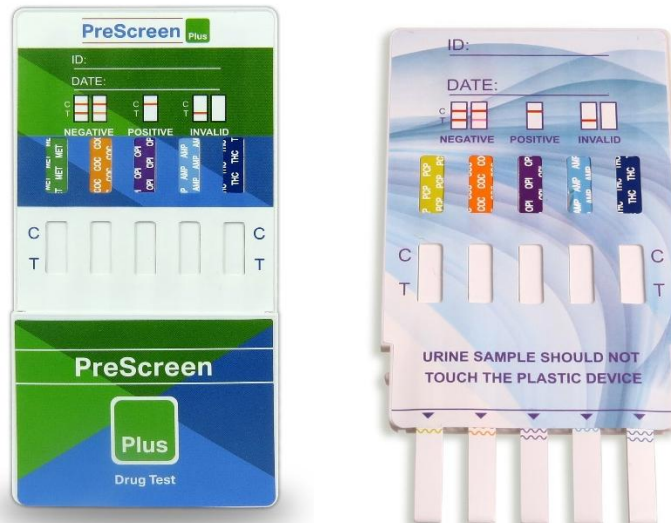




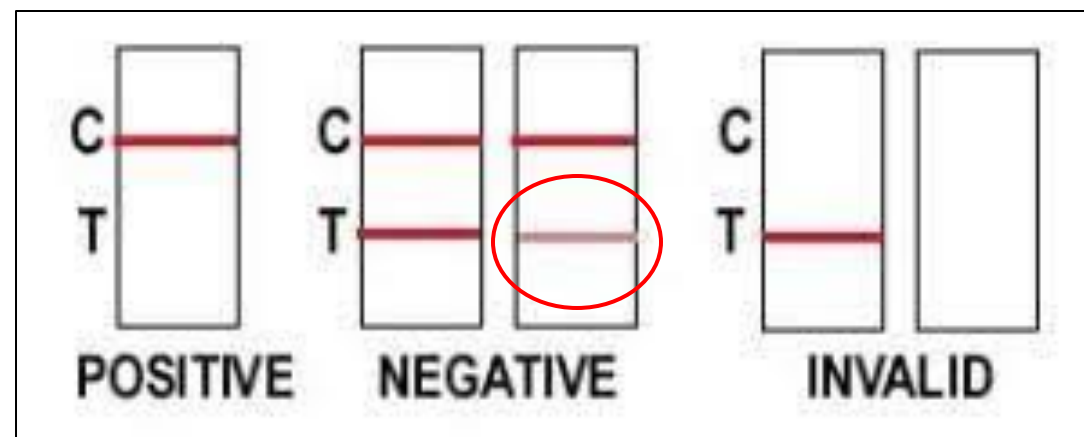
# UDS Cards Used at the DCMEO

## PreScreen Plus Test Dip Card & Healgen Multi-Drug Urine Test Dip Card

- Up to 6 analytes:
  - COC (Cocaine)
  - MET (Methamphetamine)
  - AMP (Amphetamine)
  - OPI (Opiates)
  - BZO (Benzodiazepines)
  - THC (Marijuana)



## Single Panel FEN (Fentanyl)



## UDS Card Analytical Specificity

|            |                                                                                                                                                                                                                                   |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>COC</b> | Cocaine HCl, Benzoylecgonine (BZE), Cocaethylene                                                                                                                                                                                  |
| <b>FEN</b> | Fentanyl, Norfentanyl, Buspirone                                                                                                                                                                                                  |
| <b>OPI</b> | Morphine, 6-MAM, Codeine, Ethylmorphine, Diacetylmorphine (Heroin), Hydromorphone, Hydrocodone, Oxycodone, Thebaine                                                                                                               |
| <b>MET</b> | D-methamphetamine, MDEA, MDMA (ecstasy), Novocaine, Trimethobenzamide, Ranitidine, Chloroquine, Ephedrine, Fenfuramine, P-hydroxymethamphetamine                                                                                  |
| <b>AMP</b> | D-amphetamine, Amphetamine sulfate, Phentermine, 4-Hydroxyamphetamine HCl, L-amphetamine, Ephedrine, MDMA, MDE                                                                                                                    |
| <b>BZO</b> | Alprazolam, Bromazepam, Chlordiazepoxide HCl, Clobazam, Clonazepam, Clorazepate dipotassium, Delorazepam, Desakylflurazepam, Diazepam, Estazolam, Flunitrazepam, Lorazepam, Midazolam, Nitrazepam, Oxazepam, Temazepam, Triazolam |

# Retrospective Study Methods

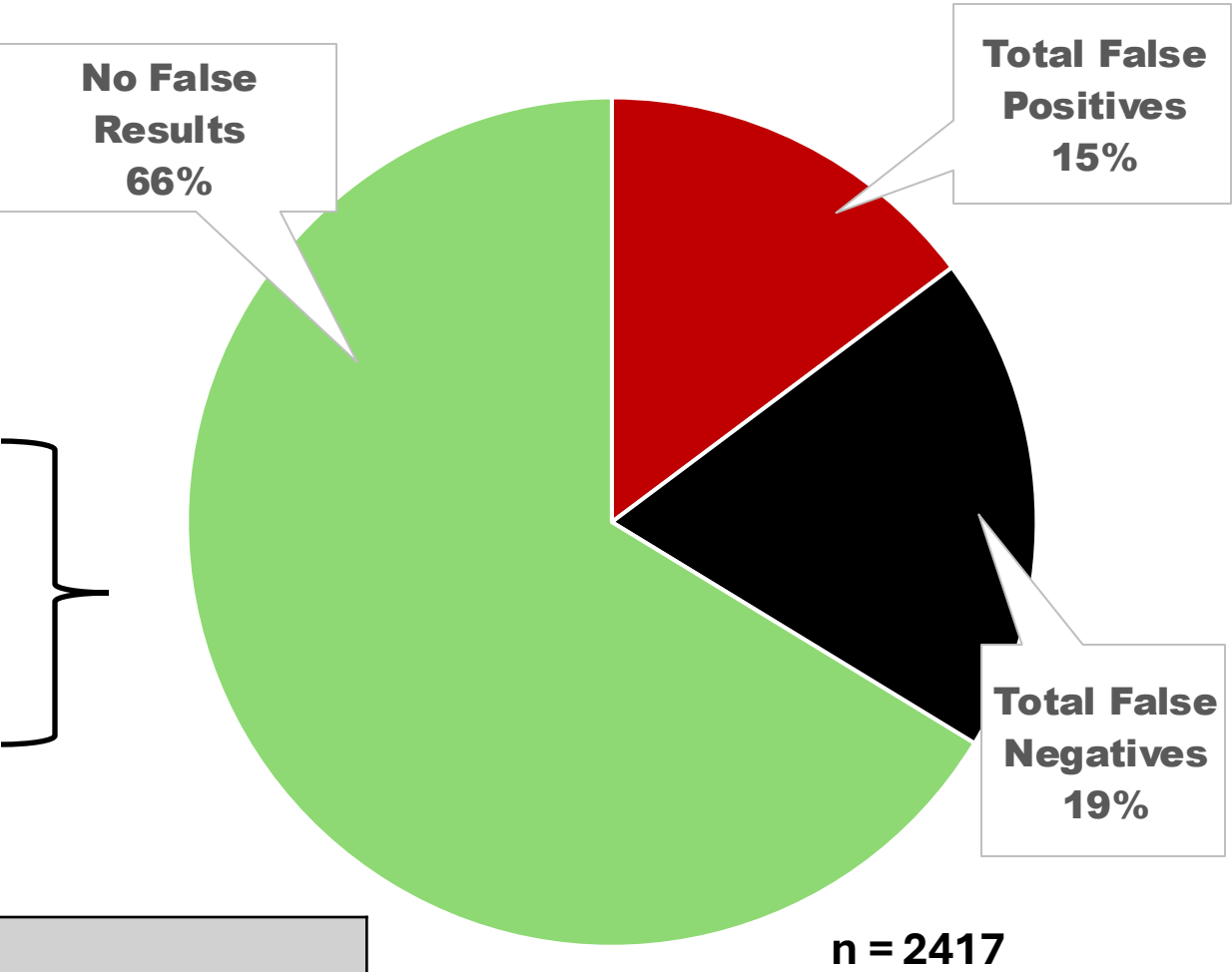
- MDI Log Advanced Search
  - 2019 – first year *routinely* utilizing UDS's and MDI Log
  - Six-year review: 2019-2024
- Inclusion criteria
  - Photo of the UDS card available
  - Cases with quantitative results
- Data Study Variables
  - Drugs screened for at autopsy + their UDS results
    - THC excluded
  - Specimen matrix used for screening
  - Confirmatory **blood** toxicology results
  - False positive results
  - False negative results

| Types of UDS Results                                                                                                                  |                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>True Positive</b> <ul style="list-style-type: none"><li>- Both the screen AND the final toxicology detected a drug</li></ul>       | <b>False Positive</b>  <ul style="list-style-type: none"><li>- Drug screen was positive</li><li>- NO drug was found in the final toxicology</li></ul> |
| <b>True Negative</b> <ul style="list-style-type: none"><li>- Both the screen AND the final toxicology did NOT detect a drug</li></ul> | <b>False Negative</b> <ul style="list-style-type: none"><li>- Drug screen was negative</li><li>- The drug IS present in the final toxicology</li></ul>                                                                                   |

|        |                   |                   |                       | UDS Results |     |     |     |     |      | Quantitative Blood Results (ng/mL) |     |      |     |     |      |                  |                  |
|--------|-------------------|-------------------|-----------------------|-------------|-----|-----|-----|-----|------|------------------------------------|-----|------|-----|-----|------|------------------|------------------|
| Case # | Drug Related COD? | Autopsy Procedure | Screening Matrix      | Bzo         | Coc | Met | Amp | Opi | Fent | Bzo                                | Coc | Met  | Amp | Opi | Fent | False + Present? | False - Present? |
|        | Y                 | F = full          | U = Urine             | -           | 0   | 0   | 0   | 0   | 1    | 0                                  | 0   | 0    | 0   | 0   | 0    | Y                | N                |
|        | Y                 | F = full          | U = Urine             | -           | 0   | 1   | 1   | 0   | 0    | 0                                  | 0   | 56   | 20  | 0   | 10   | N                | Y                |
|        | Y                 | F = full          | U = Urine             | -           | 0   | 0   | 0   | 0   | 1    | 0                                  | 0   | 0    | 0   | 0   | 7.7  | N                | N                |
|        | Y                 | F = full          | U = Urine             | -           | 1   | 0   | 0   | 0   | 1    | 0                                  | 120 | 0    | 0   | 0   | 25   | N                | N                |
|        | N                 | F = full          | U = Urine             | -           | 0   | 0   | 0   | 0   | 0    | 0                                  | 0   | 0    | 0   | 0   | 0    | N                | N                |
|        | N                 | F = full          | P = pericardial fluid | -           | 0   | 0   | 2   | 0   | 0    | 0                                  | 0   | 0    | 0   | 0   | 0    | N                | N                |
|        | Y                 | E = external      | X = unknown/other     | -           | 1   | 0   | 0   | 0   | 0    | 0                                  | 0   | 0    | 0   | 0   | 0    | N                | N                |
|        | Y                 | F = full          | S = blood serum       | -           | 1   | 0   | 0   | 0   | 0    | 0                                  | 43  | 0    | 0   | 0   | 0    | N                | N                |
|        | Y                 | L = limited       | U = Urine             | -           | 1   | 0   | 0   | 0   | 0    | 0                                  | 0   | 0    | 0   | 0   | 0    | N                | N                |
|        | N                 | L = limited       | S = blood serum       | -           | 0   | 0   | 0   | 0   | 0    | 0                                  | 0   | 0    | 0   | 0   | 0    | N                | N                |
|        | N                 | E = external      | U = Urine             | -           | 0   | 0   | 0   | 0   | 1    | 0                                  | 0   | 0    | 0   | 0   | 0    | Y                | N                |
|        | N                 | E = external      | X = unknown/other     | -           | 0   | 1   | 0   | 0   | 1    | 0                                  | 0   | 1200 | 66  | 0   | 0    | Y                | Y                |
|        | Y                 | L = limited       | U = Urine             | -           | 1   | 0   | 0   | 0   | 0    | 0                                  | 270 | 21   | 0   | 0   | 30   | N                | Y                |
|        | N                 | F = full          | U = Urine             | -           | 0   | 0   | 0   | 0   | 0    | 0                                  | 0   | 0    | 0   | 0   | 0    | N                | N                |
|        | Y                 | F = full          | U = Urine             | -           | 1   | 1   | 1   | 0   | 1    | 0                                  | 11  | 5000 | 230 | 0   | 9.5  | N                | N                |
|        | Y                 | E = external      | U = Urine             | -           | 1   | 0   | 0   | 0   | 0    | 0                                  | 13  | 18   | 0   | 0   | 0    | N                | Y                |

# Results (1)

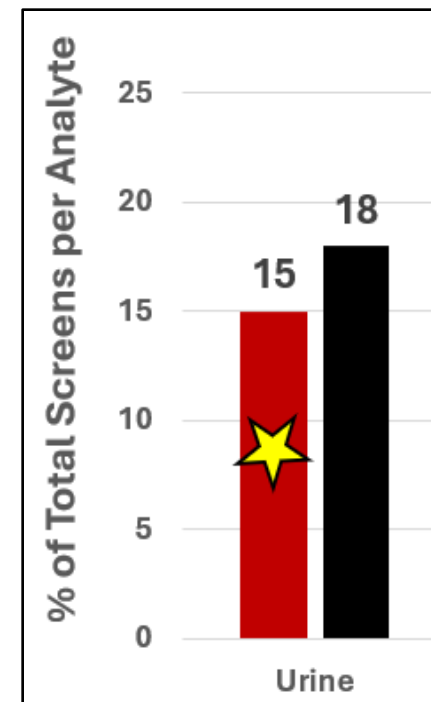
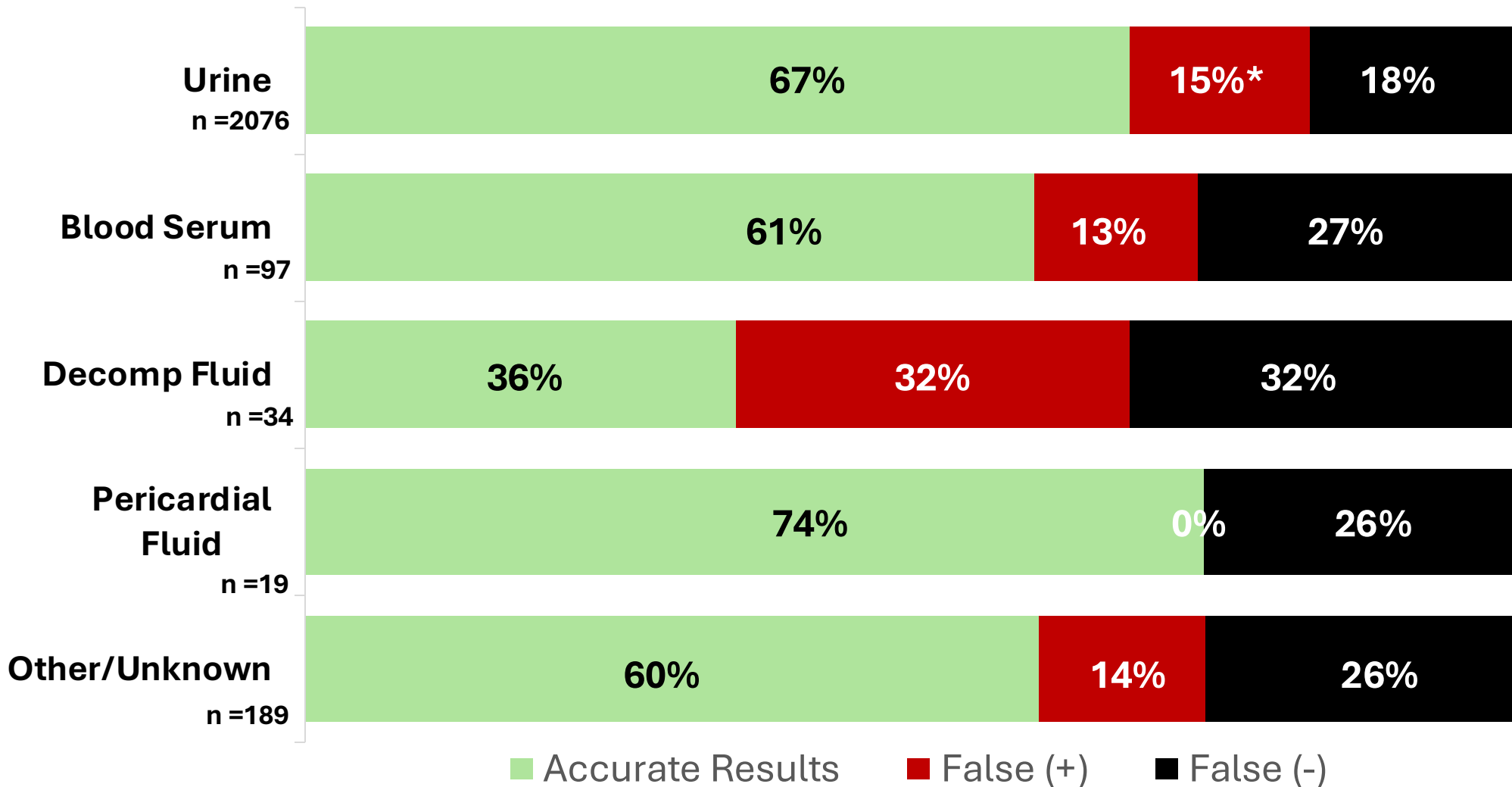
| Total UDS Cases at the DCMEO (2019-2024)       |             |
|------------------------------------------------|-------------|
| Total Cases sent to DCMEO                      | 7886        |
| Total # UDS Cards Utilized                     | 2810        |
| Total # UDS Cards with Confirmatory Toxicology | <u>2417</u> |
| # False Positives                              | 351         |
| # False Negatives                              | 458         |



| UDS Cards Used Per Year |      |      |      |      |      |
|-------------------------|------|------|------|------|------|
| 2019                    | 2020 | 2021 | 2022 | 2023 | 2024 |
| 153                     | 492  | 550  | 544  | 538  | 533  |

# Results (2)

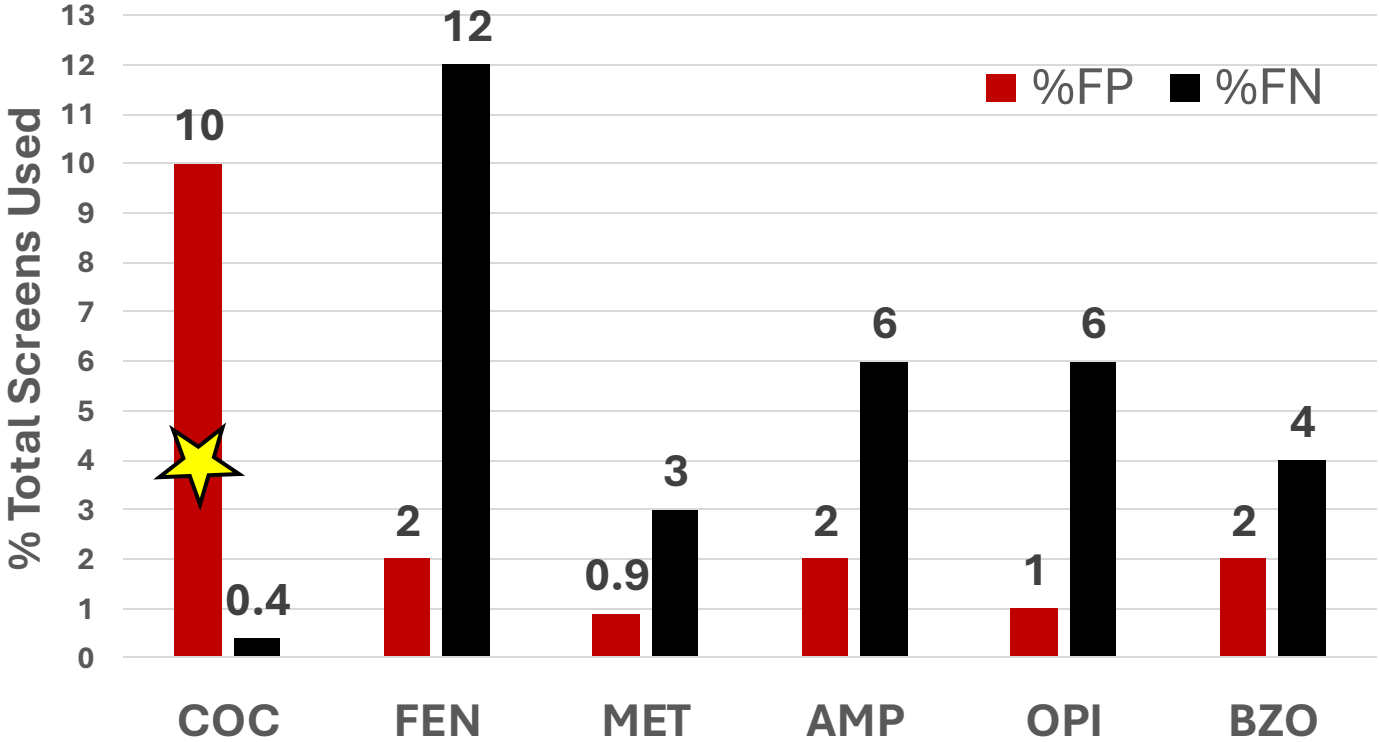
## All UDS Results per Screening Matrix (2019-2024)



\*9% when correcting  
for presence of  
benzoylecgonine  
(BZE)

# Results (3)

| Analytes Screened by UDS Cards (2019-2024) |                |                 |                 | Analytes Screened by UDS Cards (2019-2024) |                |                 |                 |
|--------------------------------------------|----------------|-----------------|-----------------|--------------------------------------------|----------------|-----------------|-----------------|
| Analyte                                    | Total UDS Used | False Positives | False Negatives | Analyte                                    | Total UDS Used | False Positives | False Negatives |
| Cocaine                                    | 2396           | 245*            | 9               | Amphetamine                                | 2389           | 54              | 138             |
| Fentanyl                                   | 1827           | 33              | 223             | Opiates                                    | 2387           | 32              | 155             |
| Methamphetamine                            | 1269           | 12              | 41              | Benzodiazepine                             | 1140           | 26              | 42              |



\*4% when correcting  
for presence of  
benzoylecgonine  
(BZE)

# Discussion

- In this study, the high rate of uncertainty across all UDS cards compared to final toxicology results was significant (34%), emphasizing their use as a **preliminary** tool in medicolegal death investigations.
- Marketed drug screen cards are compliant with federal cutoff levels which were designed to combat drug use in the workplace.
  - Fentanyl immunoassay efficacy highly questionable given these results
    - New DHHS Initial Test Cutoff (January 2025) = 1.0 ng/mL
- Similar Studies:
  - Arndt et al (2024) – *Assessment of urine drug screen utility at autopsy to predict laboratory postmortem blood toxicology*
  - Gates et al (2014) – *Evaluating the Utility of Dipstick Drug Screens as a Postmortem Triage Modality*

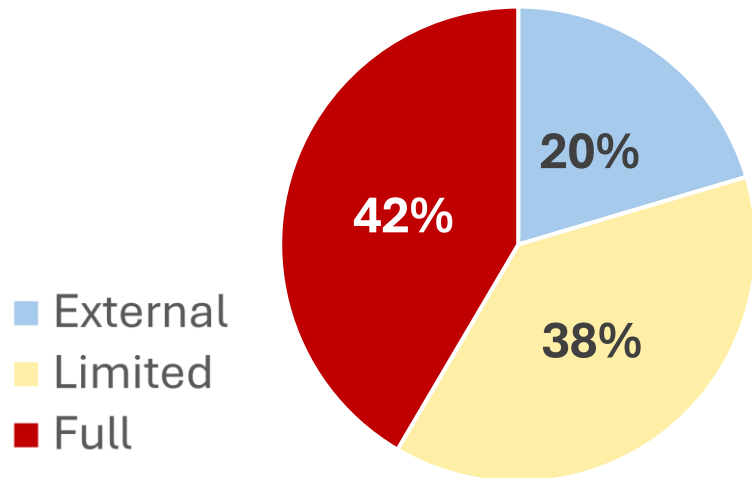
| PreScreen Plus UDS<br>Cut-Off Levels |                          |
|--------------------------------------|--------------------------|
| Analyte                              | Cut-Off Level<br>(ng/mL) |
| COC                                  | 150 - 300                |
| FEN                                  | 300                      |
| OPI                                  | 2,000                    |
| MET                                  | 1,000                    |
| AMP                                  | 500 - 1,000              |
| BZO                                  | 300                      |

# Discussion

- Of the total dataset evaluated with confirmatory toxicology, there were **1283 (53%)** in which the immediate COD involved acute drug intoxication
  - The most implicated drugs were **cocaine** and **fentanyl**

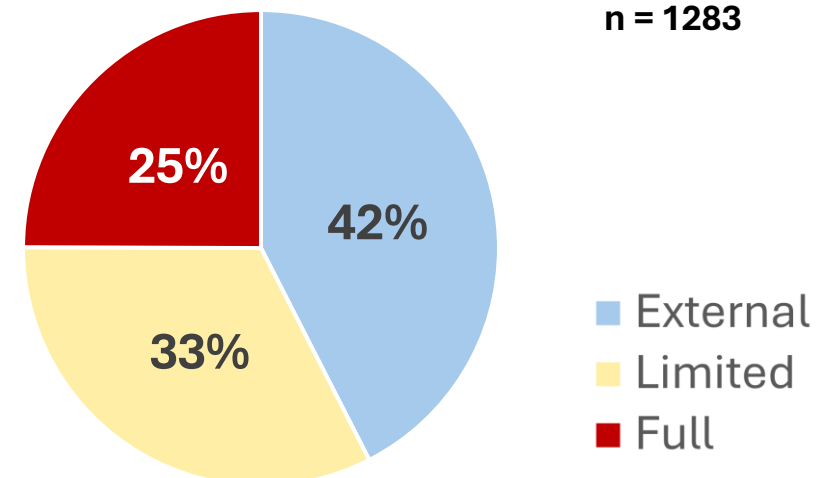
| Non-Drug OD Examinations (2019-2024) |     |
|--------------------------------------|-----|
| External                             | 230 |
| Limited                              | 429 |
| Full                                 | 468 |

n = 1127



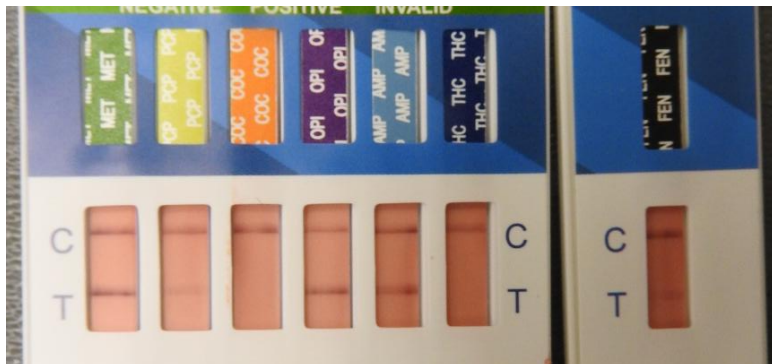
| Acute Drug OD Examinations (2019-2024) |     |
|----------------------------------------|-----|
| External                               | 545 |
| Limited                                | 418 |
| Full                                   | 320 |

n = 1283



# Discussion

- Retrospective Study Limitations
  - Subjectivity of digital photograph interpretation
  - Screened sample condition was not assessed
    - Assumes no contamination during procurement
    - Compositional changes not assessed
  - Time interval to interpretation not considered
  - Lot differences/variance between screens
    - Ex: FEN cutoff levels between brands, MOP300 vs. MOP2000



- Rapid drug screens are affected by many different factors!
- Interpret with high discretion.
- Always confirm!

# Conclusion & Key Points



- Rapid immunoassays can be a cost-effective *preliminary tool* for triaging cases amongst a national forensic workforce shortage.
- Understanding the limitations of rapid drug screen immunoassays is essential before integration within a medicolegal death investigation.
- Within a sample of 2417 postmortem cases at the DCMEO comparing rapid drug screen results with final blood results, approximately **34% of screens presented some type of false result.**
- **Positive rapid drug screen results should be confirmed** with traditional toxicology methods (GC or LC Mass Spec) on blood specimens to infer an acute intoxication fatality.

# Acknowledgements

- DeKalb County Medical Examiner's Office (DCMEO)
- Forensic Medicine Associates, Inc (FMA)
- Dr. Gerald Gowitt
  - Chief Medical Examiner of the DCMEO
  - CEO of FMA
- Public Health Interns & Consultants:
  - Rocky, Gift, and Leslie



# References & Further Reading

- Arndt C, Huestis MA, Jarvis HC, et al. Assessment of urine drug screen utility at autopsy to predict laboratory postmortem blood toxicology. *Journal of Forensic Sciences*. 2024;69(5):1815-1825. doi: 10.1111/1556-4029.15561
- Department of Health and Human Services. Mandatory Guidelines for Federal Workplace Drug Testing Programs – Authorized Testing Panels. *Federal Register*. 90(10):4662-4668. FR Doc. 2025-00425
- Davis GG, Cadwallader AB, Flinger CL, et al. Recommendations for the Investigation, Diagnosis, and Certification of Deaths Related to Opioid and Other Drugs. National Association of Medical Examiners (NAME) Scientific Position Papers. 2019
- Gates JP, Khan-Gates J, Wagner M, Cina SJ. Evaluating the utility of dipstick drug screens as a postmortem triage modality. *Academic Forensic Pathology*. 2014;4(4):520-523. doi:10.23907/2014.067
- Hancock A, McLemore J, Russell G. False-Positive Rate for Suspected Drug-Related Deaths Following Full Autopsy. *American Journal of Forensic Medicine and Pathology*. 2024;45(3): 189-192. doi:10.1097/PAF.0000000000000936
- Moller K, et al. Urine Drug Screening: Practical Guide for Clinicians. *Mayo Clinic Proceedings*. 2008;83(1): 66-76.
- Shute R, Bollinger K, Tucker M, et al. Use of rapid toxicology screening tools in medical examiner/coroner offices. *Forensic Technology Center of Excellence In-Brief*. 2021.
- Sunstrom M, Pelander A, Okanpera I. Comparison between drug screening by immunoassay and ultra-high performance liquid chromatography/high-resolution time-of-flight mass spectrometry in post-mortem urine. *Drug Testing and Analysis*. 2015;7:420-427. doi:10.1002/dta.1683

# Thank you!

DCMEO LinkTree



**Email/Phone:**

hlcoltrain@dekalbcountyga.gov  
office@forensicmedicine.co  
tel: (404) 508-3507