Drug Checking Quantification Explained

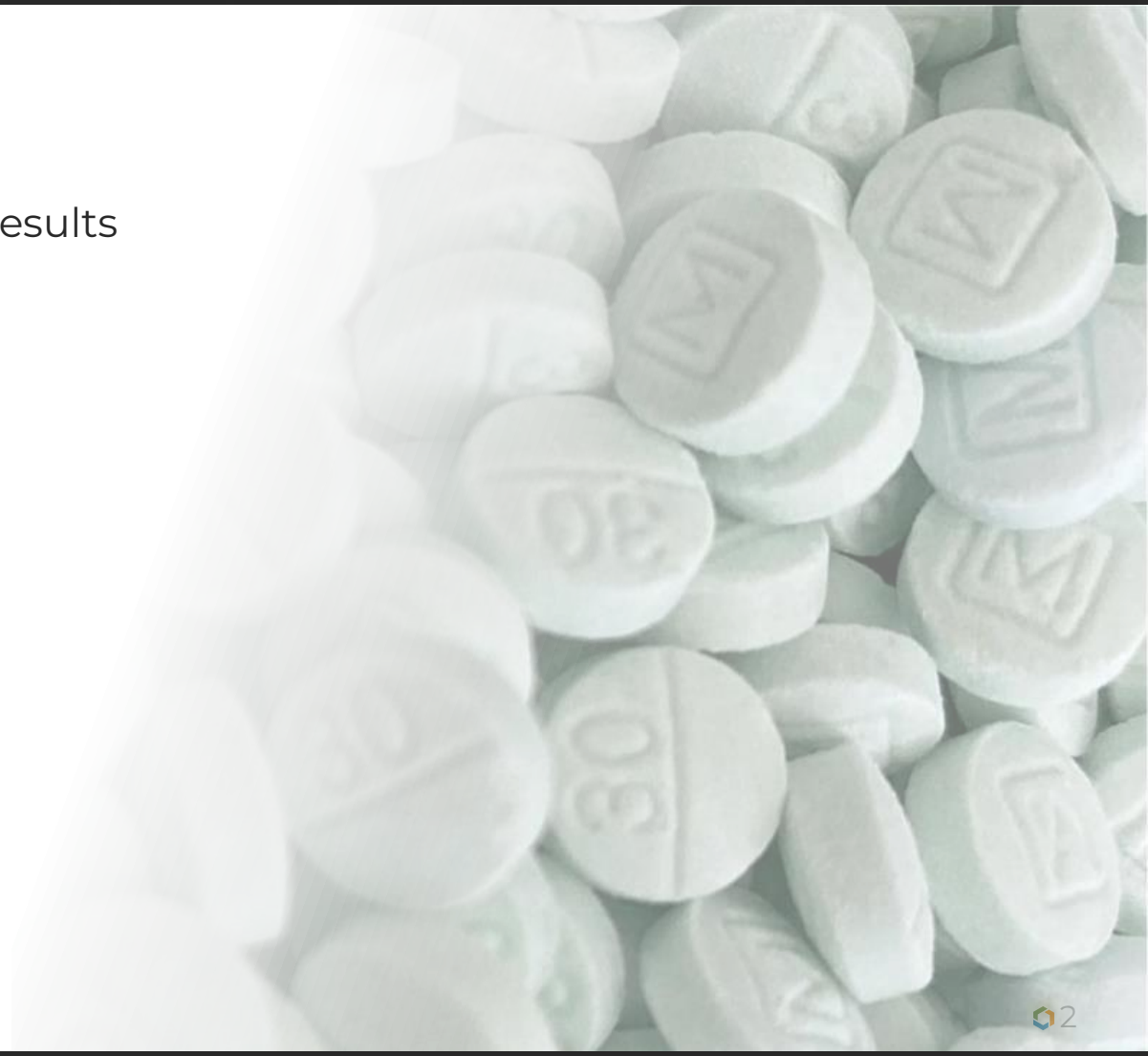
What it is, what it isn't, and important considerations

Joshua DeBord, PhD

QUANTIFICATION EXPLAINED

- What is quantification
  - Clearer understanding of composition of mixtures
  - Basis for comparing samples with similar qualitative results
  - The Basics
- What quantification is not
  - Not [necessarily] equivalent to other analyses
  - Not perfectly accurate, and why not?
  - Not a measurement of purity
  - Not Easy

Always ask the lab to explain unusual observations!



SAMPLE COMPOSITION - MIXTURES

- Quantification provides a clearer understanding of sample composition in complex sample mixtures

Sample 1

DescriptionCFSRE	One pink glassine bag containing white material		
Results	Fentanyl (1p), para-Fluorofentanyl (0.3p), Xylazine (0.4p), 4-ANPP (0.2p), BTMPS (Tinuvin 770) (trace)		
QuantMass	5.19	Data	250523AQ_DRUGQUANT_0
Quant#Summary	Fentanyl (7.1%), Xylazine (3.2%), para-Fluorofentanyl (2.5%), 4-ANPP (1.1%)		

SAMPLE COMPOSITION -

- Quantification provides a clearer understanding of sample composition when limited only to qualitative methods

Sample 1

DescriptionCFSRE	One microcentrifuge tube containing white material		
Results	Fentanyl (1p), 4-ANPP (0.1p), Phenethyl-4-ANPP (0.1p)		
QuantMass	3.81	Data	250523AQ_DRUGQUANT_0
Quant#Summary	Fentanyl (29.6%), 4-ANPP (3.2%)		

Sample 2

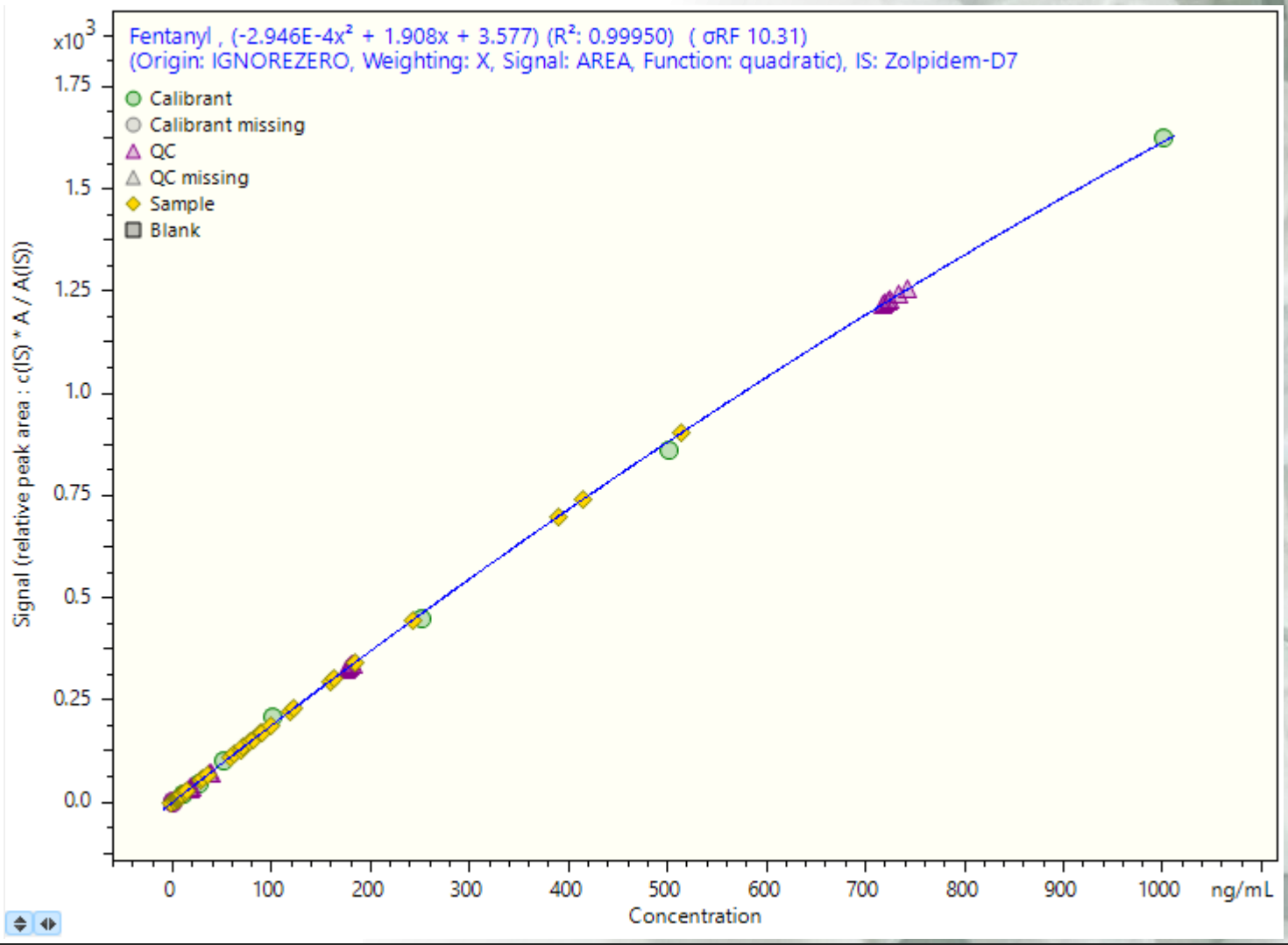
DescriptionCFSRE	One microcentrifuge tube containing white material		
Results	Fentanyl (1p), 4-ANPP (0.2p)		
QuantMass	2.94	Data	250523AQ_DRUGQUANT_0
Quant#Summary	Fentanyl (52.4%), 4-ANPP (8.3%)		

THE (VERY) BASICS

- Weigh out a sample
- 5 mg, 5.1 mg, 5.10 mg
- Precision is key!
- 5 ± 1 mg vs 5.1 ± 0.25 mg vs 5.10 ± 0.05mg
- Error 20% vs error 5% vs error 1%
- diluted to a final dilution of 1000 ng/mL
- For every 1 mg of material, we would dilute with 1,000 mL

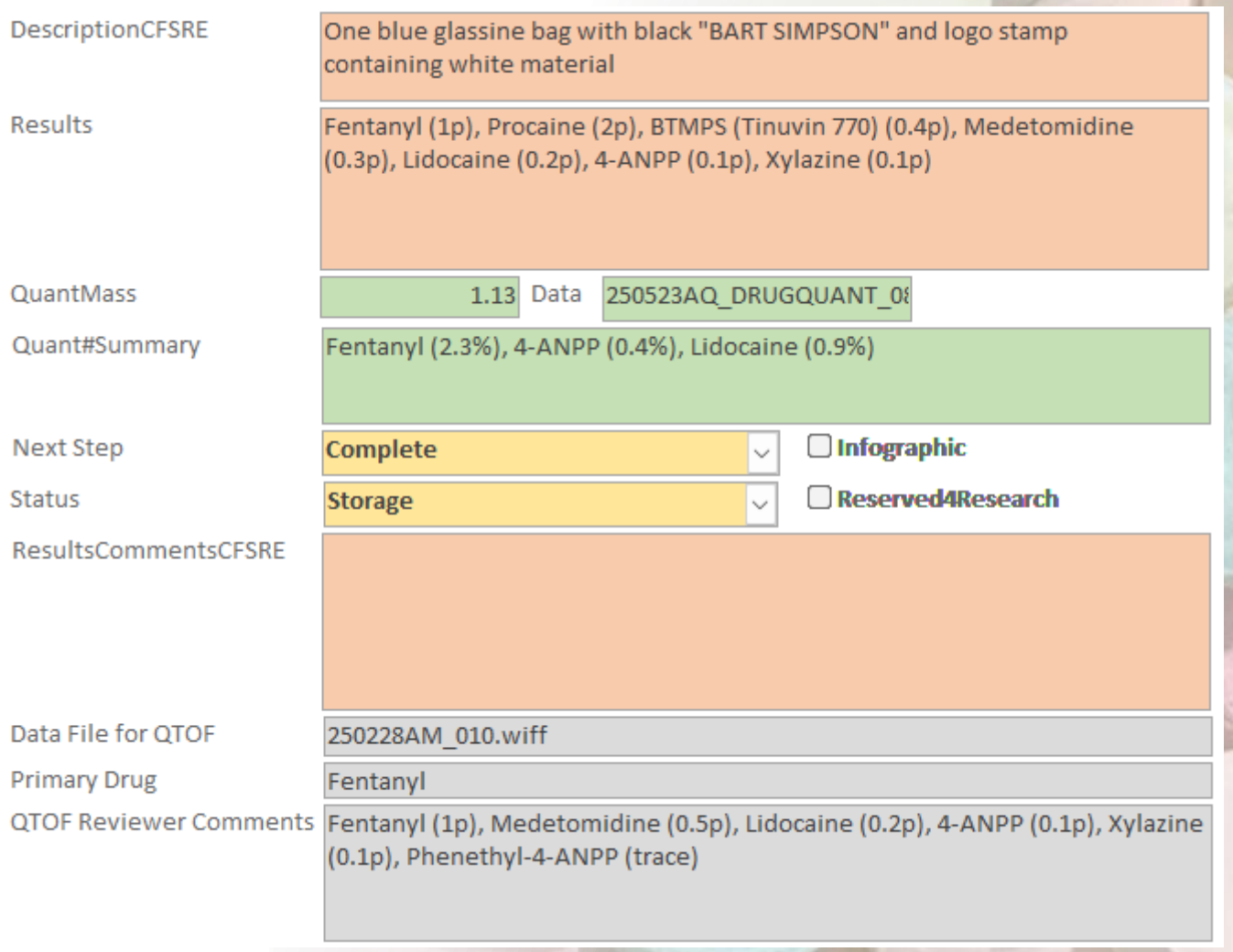
THE (VERY) BASICS

- Calibration for Fentanyl
- 10, 25, 50, 100, 250, 500, 1000 (ng/mL)
- Quality Controls
- 20, 40, 200, 800 (ng/mL)
- Quantify Samples (calculate with the mass and dilution)



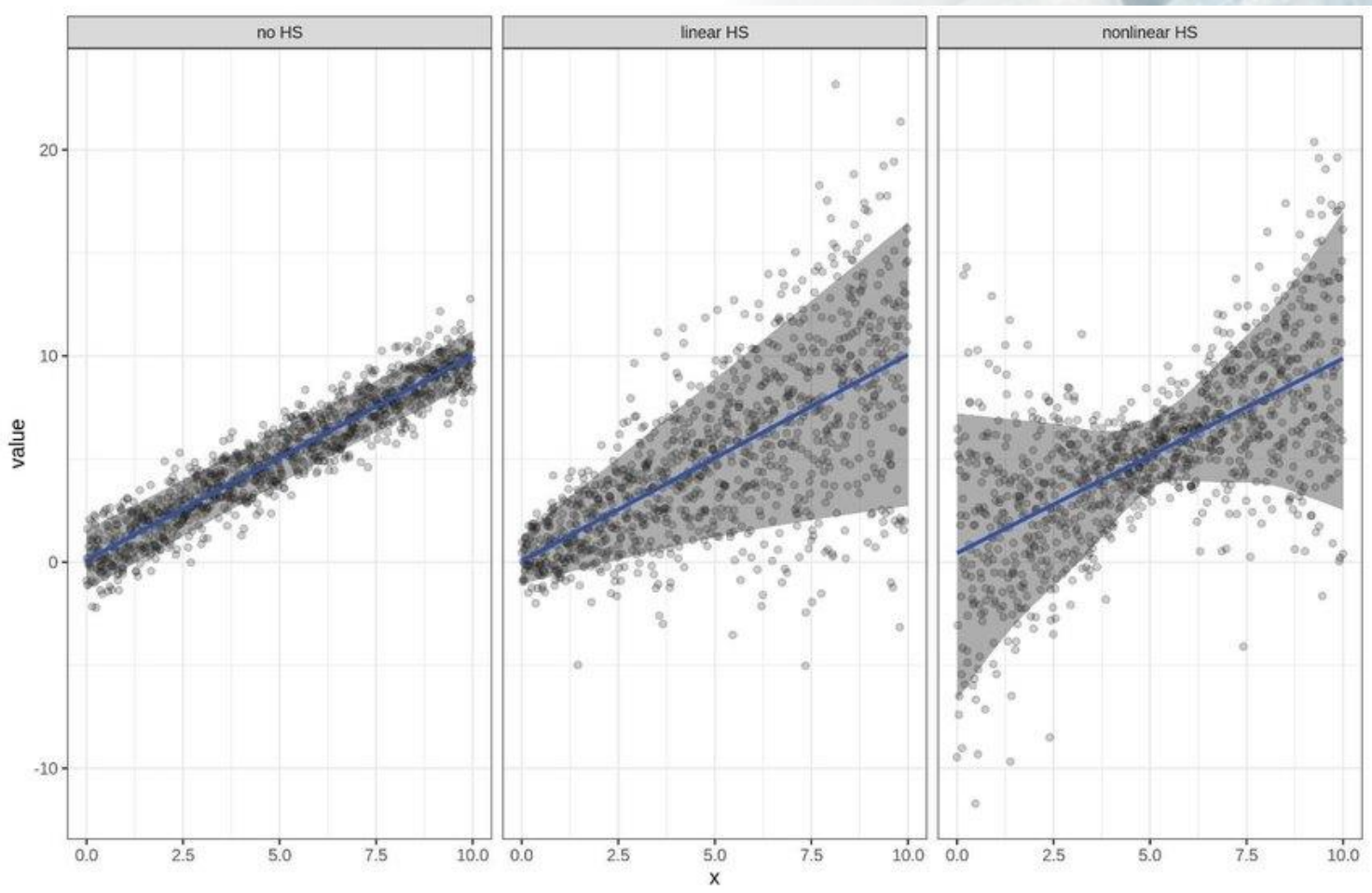
NOT EQUIVALENT TO OTHER TESTS

- Complementary / Supplementary
- Only targeted analytes can be quantified
  - Not Procaine*
  - Not BTMPS
  - Not Medetomidine*
- Signal thresholds for quantification
- Shows inconsistencies in other relative abundance analysis
  - Ex: Lido is 0.9% and not 0.4%
  - QTOF results with caution



NOT PERFECTLY ACCURATE

- Validated to within some degree of accuracy to a purchased standard
- ±10%, ±15%, ±20%
- ±20% of 5% is 5±1%
- ±20% of 70% is 70±14%
- Heteroscedasticity
  - Greater variance at higher concentration, but calibration overfits
  - Poorer instrument reproducibility and sensitivity at lower concentrations



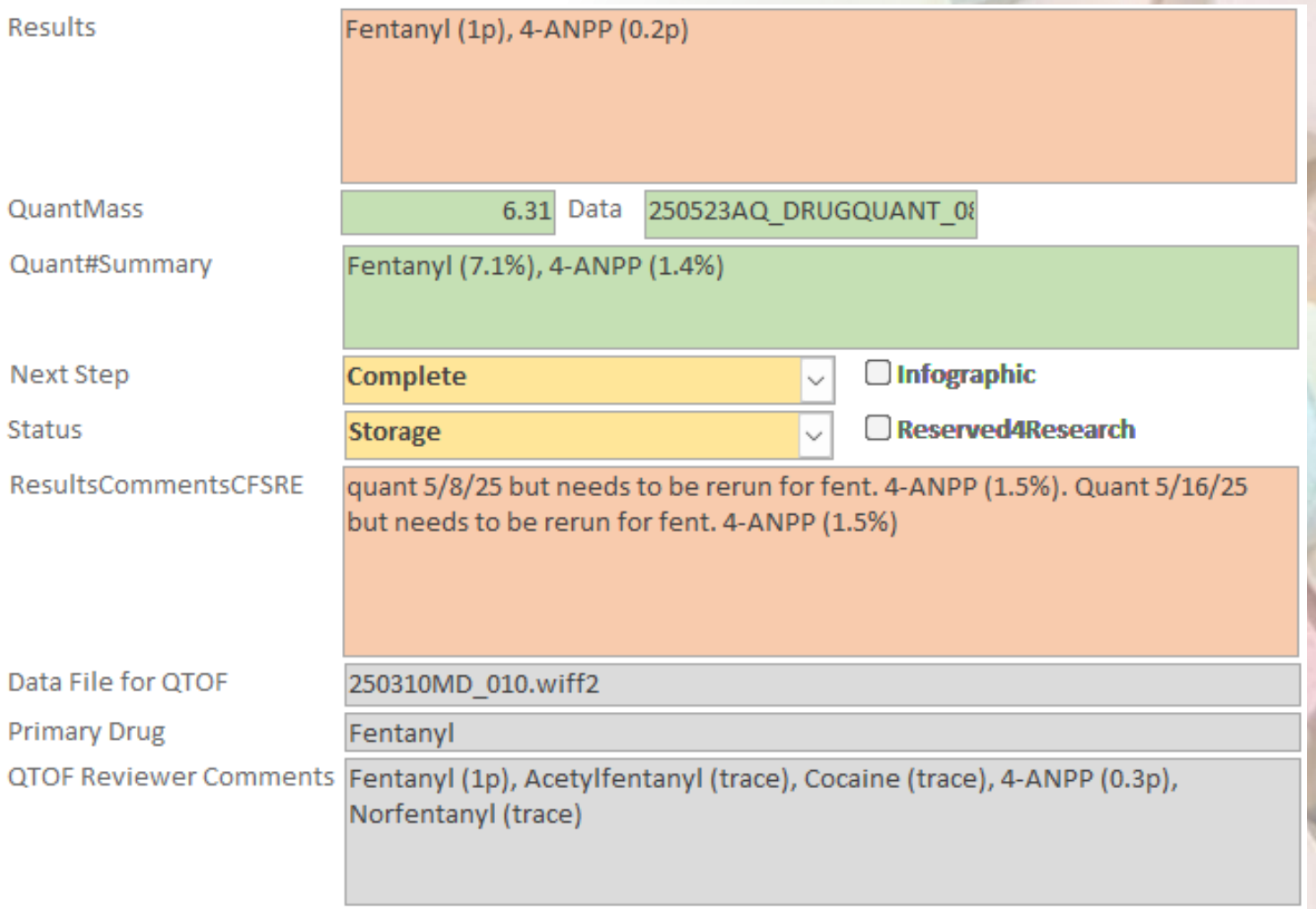
Kirkegaard, E. O. W., & Gerritsen, A. (2021). Looking for evidence of the Dunning-Kruger effect: an analysis of 2400 online test takers. OpenPsych. https://doi.org/10.26775/op.2021.08.29

NOT A PURITY DETERMINATION

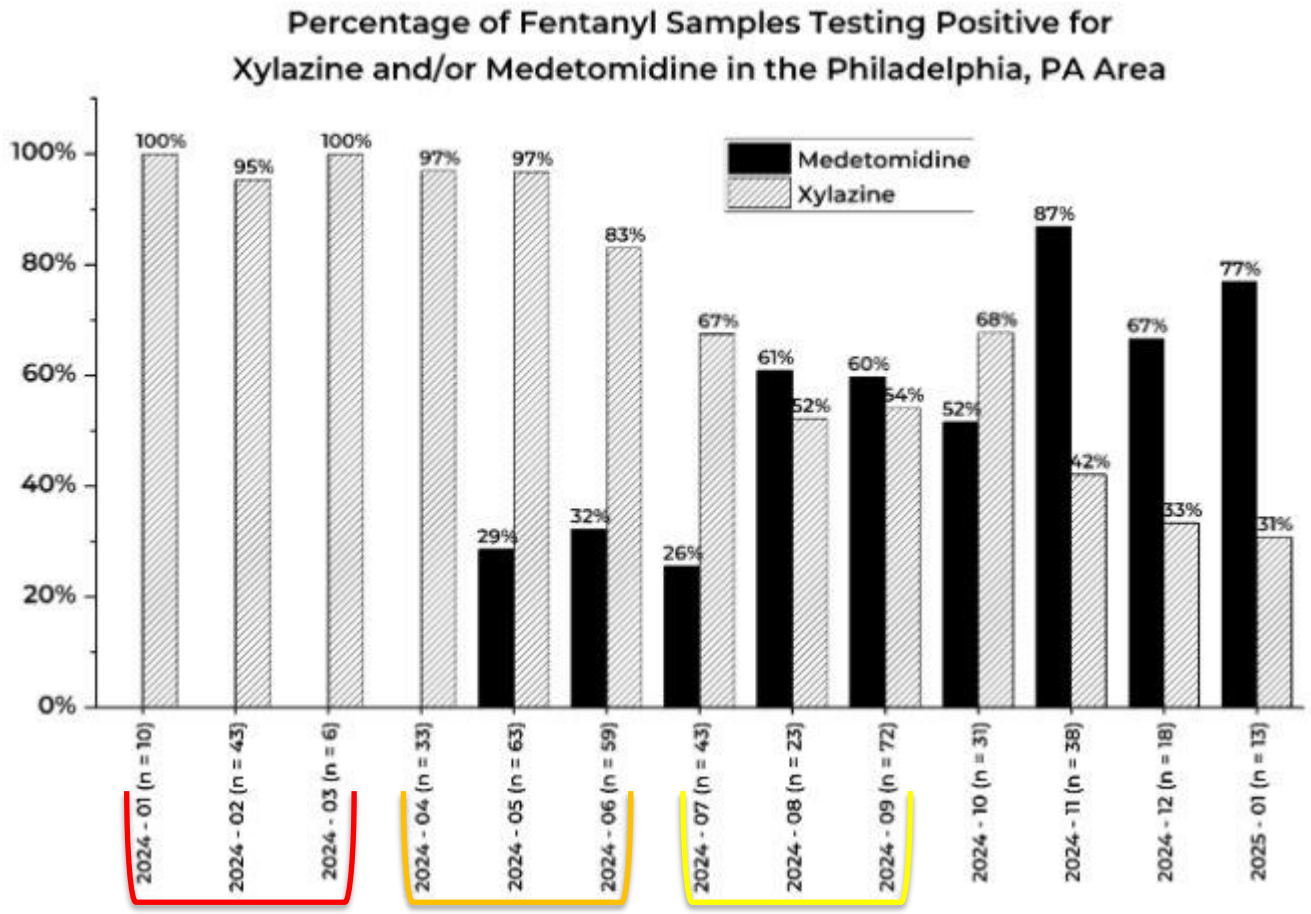
- Very high purity quantification of a single analyte
- Methods can be much more optimized and selective
- Quantification over a very narrow range
- We are interested in quantification from 0.5% - 100% (by mass)
- Mass spectrometry is very sensitive and specific, but not the most useful dynamic range for quantification
- ≥60% cocaine, high-purity methamphetamine etc.

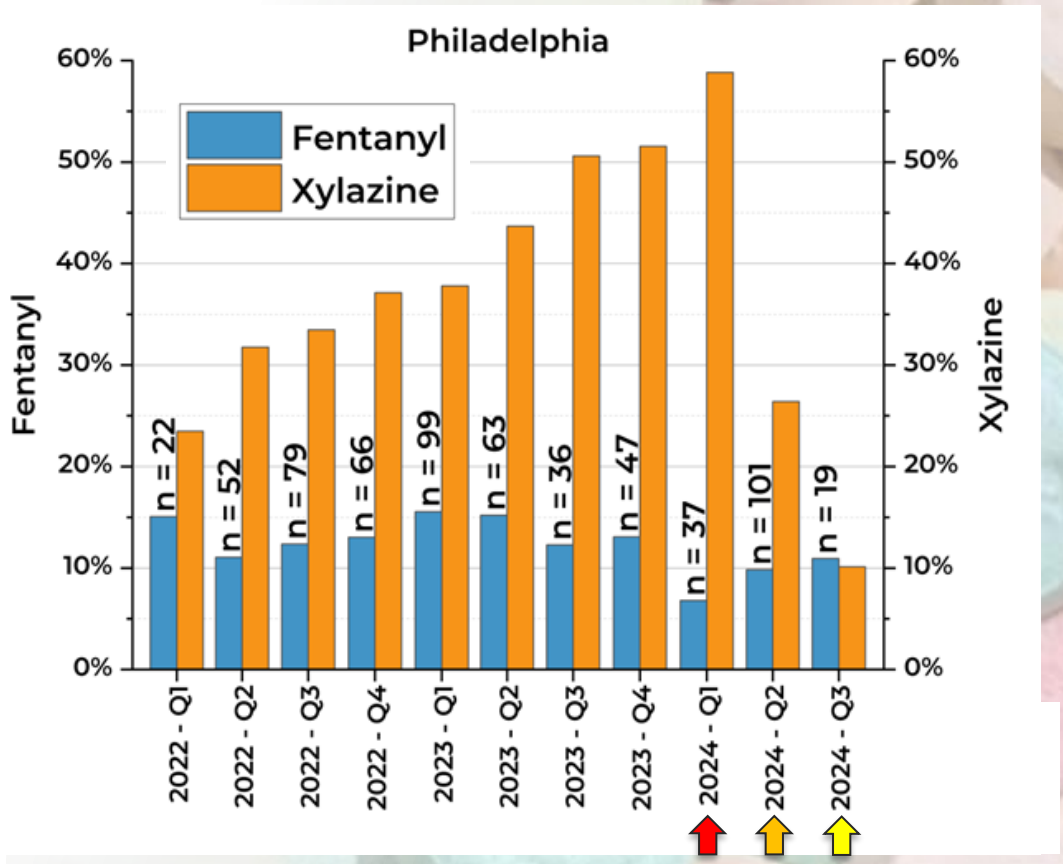
NOT EASY

- Quant method 1.0 based on GC-MS
- Detector maintenance every 6 months
- Drastically improves (but changes) the behavior of the mass spectrometer
- Fentanyl was TOO sensitive and the Calibrators were failing
- 4-ANPP passed and was consistent
- Ask questions to understand



OPIOIDS & ALPHA-2 AGONISTS (PHILADELPHIA, PA)

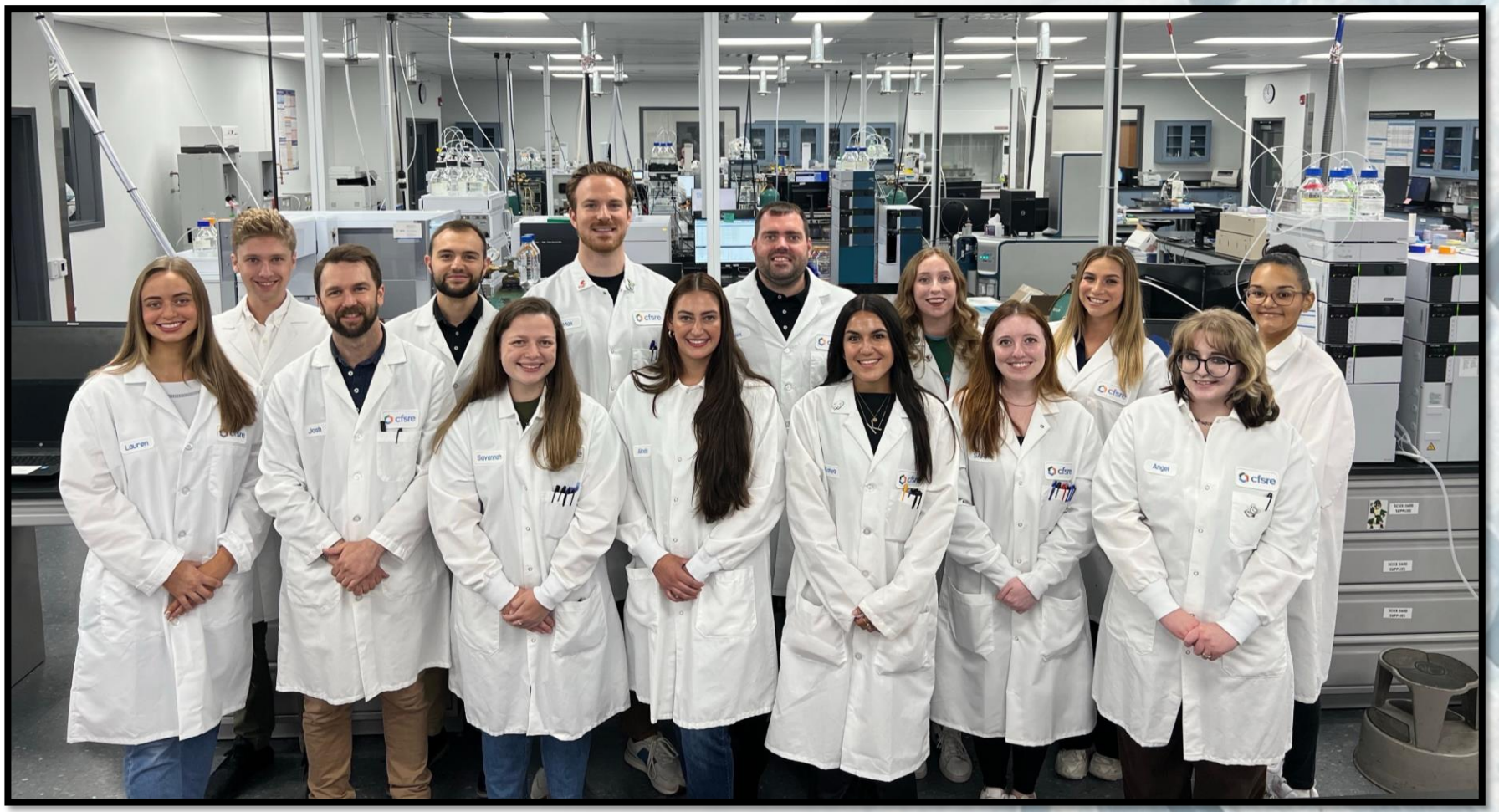




PDPH Health Alert Hospitals and behavioral health providers are reporting severe and worsening presentations of withdrawal among people who use drugs (PWUD) in Philadelphia 12/10/2024
https://hip.phila.gov/health-alerts/hospitals-and-behavioral-health-providers-are-reporting-severe-and-worsening-presentations-of-withdrawal-among-people-who-use-drugs-pwud-in-philadelphia/

ACKNOWLEDGEMENTS

- Rieders Family and CFSRE directors
- CDC
- Drug checking collaborators
- Accepting challenging casework and research opportunities
- Our amazing team at CFSRE



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Thank you! Questions?

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joshua.debord@cfsre.org

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