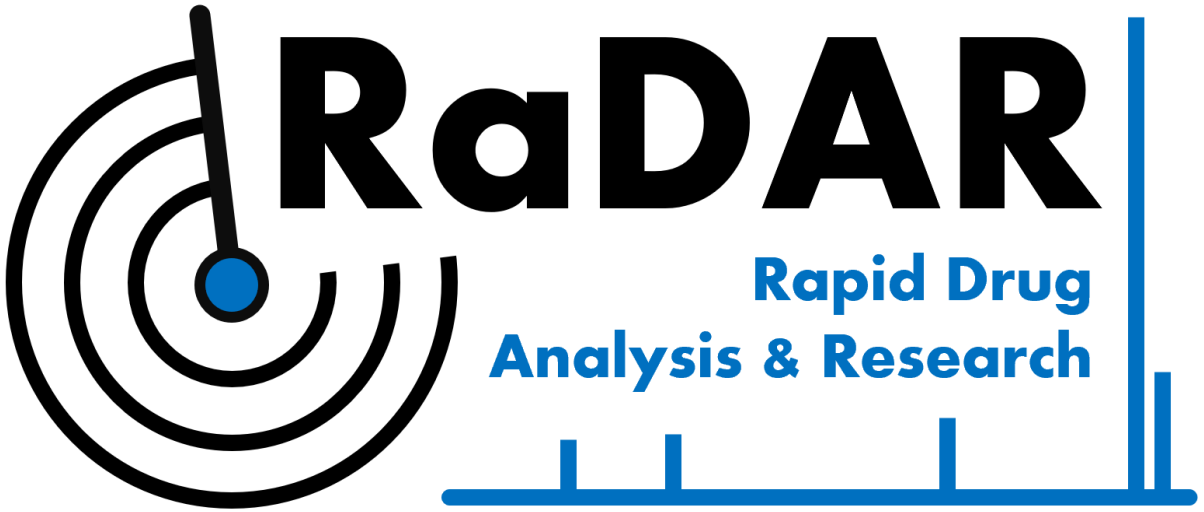

Qualitative Analysis Training

Updated: November 2024

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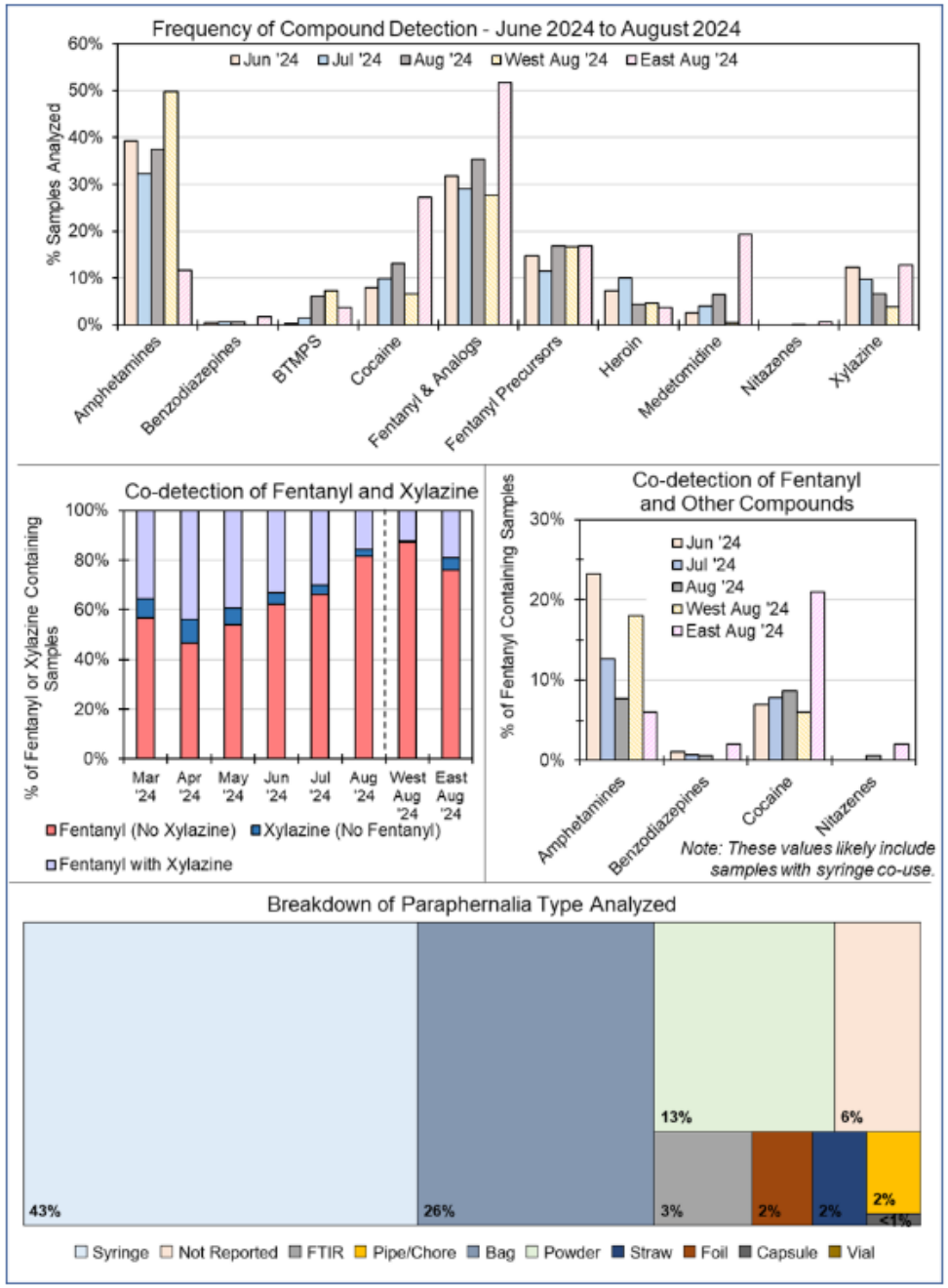
U.S. DEPARTMENT OF COMMERCE

RaDAR Background

- Pilot began in October 2021
- Expanded program in October 2022
- As of November 2024
  - 11,500+ samples analyzed
  - >60 unique sites across 14+ states
  - 100+ unique compounds identified
- Monthly newsletter for the general public
- Near real-time surveillance has:
  - Allowed agencies to better understand and anticipate changes in the drug supply
  - Deepen relationships across agencies and with the communities they serve



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RaDAR Rapid Drug Analysis & Research

How It Works

1) Paraphernalia Sampled
2) Samples Mailed to NIST
3) Samples Extracted and Analyzed by Direct Analysis in Real Time Mass Spectrometry (DART-MS)
4) Results Reported Back to Agency

Sample Collection Kits

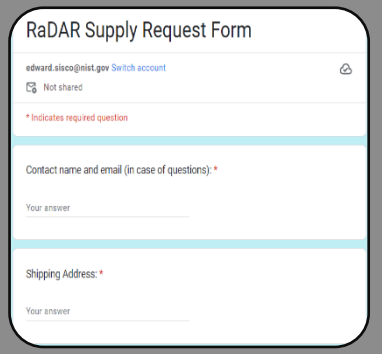
Quick reference guide for sample collection how-to's.

Barcoded sample envelopes (used for all collection media).

Wipes are shipped in a white box containing sample envelopes with wipe inside.

Swabs are shipped in a blue box containing sample envelopes and individually packaged swabs.

Used test strips are shipped in a green box containing sample envelopes.



Boxes are printed with QR Code where additional sampling materials can be requested.

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RaDAR Rapid Drug Analysis & Research

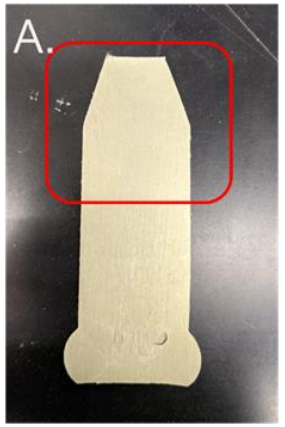
How To Sample

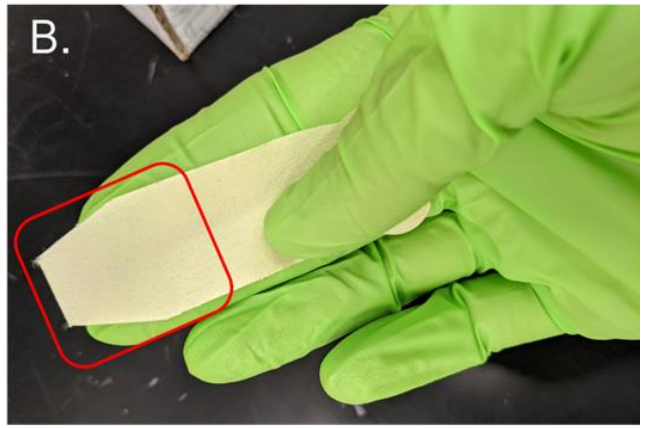
- Pressure
  - Sample with firm pressure to increase particle collection
- Area
  - Focus collection on specified area of wipe
  - Maximize coverage of surface of interest
- Direction
  - One directional sampling pattern for increased particle collection on the wipe

Using Wipes

How to Sample:

1. Wear a new pair of gloves when sampling to prevent cross contamination.
2. Remove the wipe from the sample envelope. The desired collection area on the wipe is shown below inside the red square **(A.)**.
3. Hold the wipe so that the area in the red square is under your index and middle finger **(B.)**.
4. Sample baggies, or other paraphernalia, using firm pressure (like smearing cold peanut butter) and a unidirectional motion **(C.)**.
5. When finished, return wipe to the sample envelope**.**
    a. **DO NOT lick envelope closed.** Envelopes do not need to be sealed but can be taped closed if desired.
6. Fill out the appropriate information then ship wipes to NIST for analysis.





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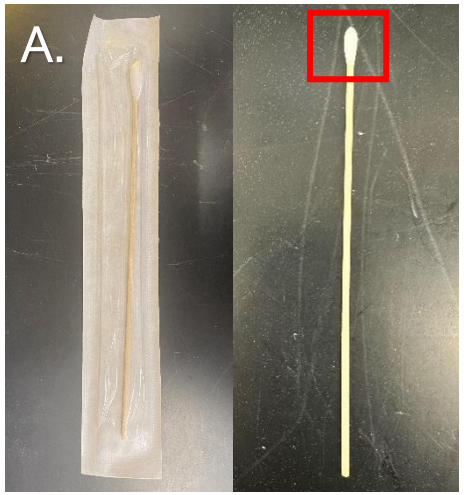
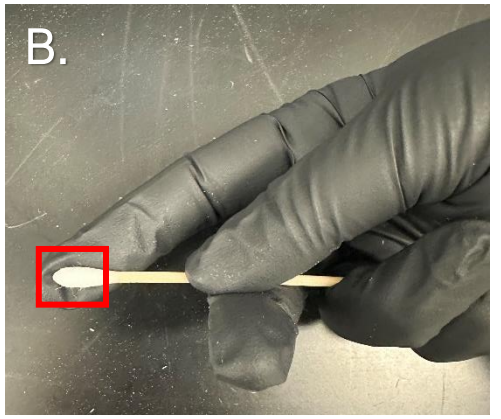
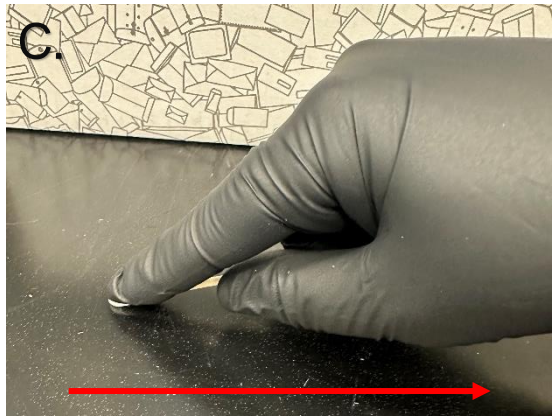
Using Swabs

How to Sample:

1. Wear a new pair of gloves when sampling to prevent cross contamination.
2. Remove the swab from the package. The desired collection area on the swab is shown below inside the red square **(A.)**.
3. Hold the swab so that the area in the red square is under your index finger **(B.)**.
4. Sample baggies, or other paraphernalia, using firm pressure (like smearing cold peanut butter) and a unidirectional motion **(C.)**.
5. When finished, place swab inside a sample envelope. Cut the stick so that the envelope will close.
    a. **DO NOT lick envelope closed.** Envelopes do not need to be sealed but can be taped closed if desired.
6. Fill out the appropriate information then ship wipes to NIST for analysis.







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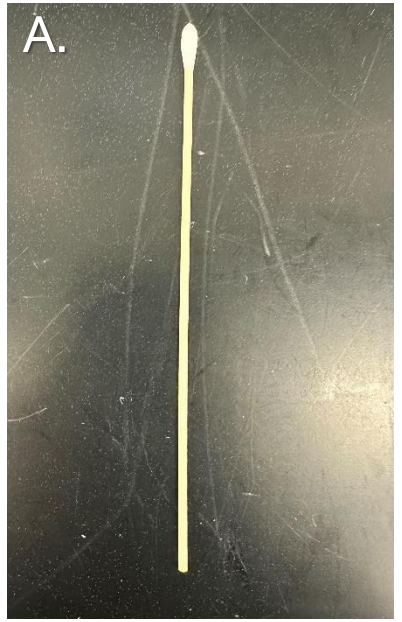
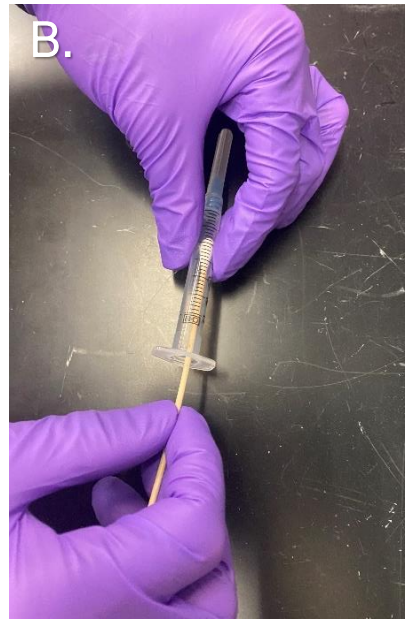
RaDAR Rapid Drug Analysis & Research

Using Swabs for Syringes

How to Sample:

1. Wear a new pair of gloves when sampling to prevent cross contamination.
2. Remove the plunger and place it in the sample envelope *(optional).*
3. Remove the swab from the package. The desired collection area on the swab is shown below inside the red square **(A.)**.
4. Sample the inside of the barrel (**B.**).
5. When finished, place swab inside the sample envelope, cut the stick to fit in the envelope.
    a. **DO NOT lick envelope closed.** Envelopes do not need to be sealed but can be taped closed if desired.
    b. DO NOT ship swabs or plungers with visible blood on them – they will not be analyzed.
6. Fill out the appropriate information and ship to NIST for analysis.





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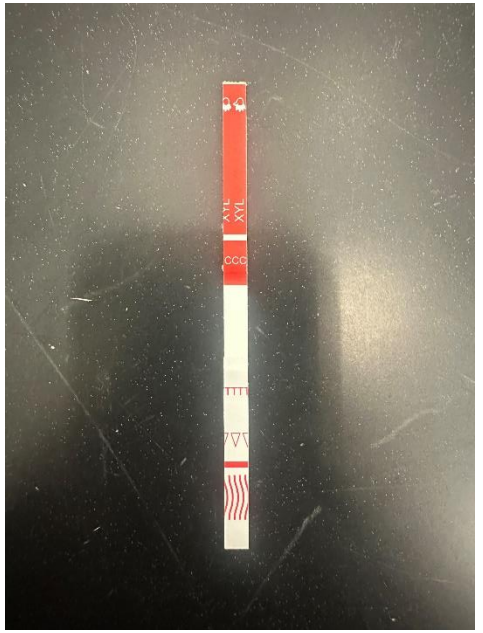
RaDAR Rapid Drug Analysis & Research

Used Test Strips

How to Sample:

1. Wear a new pair of gloves when sampling to prevent cross contamination.
2. Use test strip to test drug material according to manufacturers instructions.
    a. Minimum of 1 mg of drug material to 1 mL of water (1 mg/mL).
    b. Only test strips used on drug product, NO URINE SAMPLES.
3. When finished, allow the test strip to dry then place test strip inside the sample envelope.
    a. **DO NOT lick envelope closed.** Envelopes do not need to be sealed but can be taped closed if desired.
4. Fill out the appropriate information and ship to NIST for analysis.



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Shipping Samples

- To ship, place sample envelopes in manilla envelope, padded envelope, or box.
  - *Note: NIST does not provide mailing materials or cover shipping charges.*

- Multiple sample envelopes can be mailed together.

- Mailing address:

  National Institute of Standards and Technology
  Edward Sisco, RaDAR
  100 Bureau Drive
  Building 217, Room B253
  Gaithersburg, MD 20899

DO NOT SEND:
Paraphernalia
Drug Product
Anything with visible blood or bodily fluid

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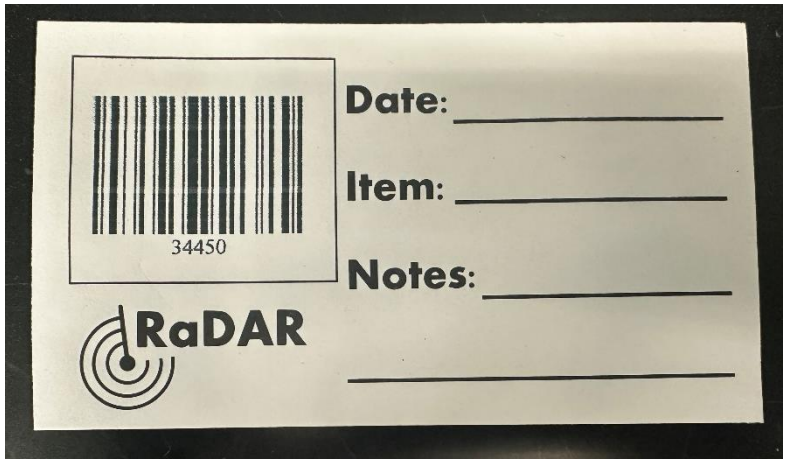
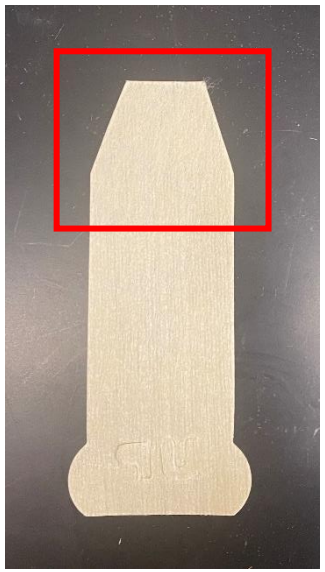
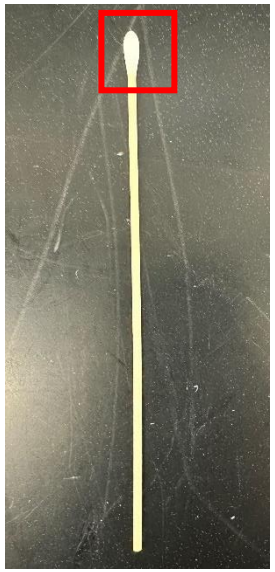
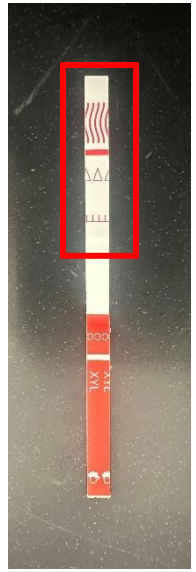
Sample Receipt & Analysis

- Intake
  - Information from envelope is recorded in database.
  - *Any personal identifiable information on envelope will not be recorded.*
- Extraction
  - Only one sampling material is analyzed.
  - Swabs, wipes, and test strips are trimmed before extraction (see right).
  - Sampling material added to vial containing solvent and internal standard.
- Analysis
  - All sample extracts are analyzed by DART-MS.
  - *Some sample extracts are also analyzed by LC-QTOF.*
- Interpretation
  - DART-MS results are searched against an in-house library of >1300 drugs, cutting agents, etc.
- Reporting
  - Results are reported back within 24-48 hours of sample receipt.
  - *The mechanism of reporting results back is agency dependent.*









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What is DART-MS?

- Instrument that provides rapid, high-fidelity chemical information about a sample.
- Uses heat to convert sample into gas and then measures the mass of all compounds in the sample.
- Better sensitivity than FTIR, Raman, and LFIs.
- Requires ~5 s for analysis.

DART-MS → Direct Analysis in Real Time Mass Spectrometry

Limitations of DART-MS

- Cannot differentiate some isomers.
- Only qualitative information is obtained.
- Cannot detect some common diluents.
  - Flour, sugar, baby powder, salt, citric acid
- May not detect all compounds in complex mixtures.
- Typically, cannot detect compounds below ≈0.5% wt.

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Confirmatory Testing

- When is confirmatory testing done?
  - Need to determine isomer identity.
  - This is the first detection of a new compound (to the program).
  - Inconclusive DART-MS results.
- How is confirmatory testing done?
  - Liquid chromatography – quadrupole time-of-flight mass spectrometry (LC-QTOF).
    - Longer, more expensive analysis that provides more definitive information.
- How long to get confirmatory testing results?
  - ≈2 weeks from DART-MS analysis *(pending availability of standards).*
  - Initial DART-MS results are immediately reported with a note there is pending confirmatory testing.
  - Once confirmatory testing complete, updated results are sent.

Reporting Results

- Results recorded at NIST uniformly but may be distributed differently.
- For sites receiving results via Google Drive or Excel, the layout below is used:

Reviewed	NIST_ID	Site_ID	Wipe_Swab	Item	Agency	Site	Collection_Date	Run_Date	Compound_1	Compound_2	Compound_3	Compound_4	Other relevant information	Confirmation Rule Outs	Notes
X	0001		Swab	Bag	A1	S25	03/13/2023	03/23/2023	Fentanyl	Heroin	Xylazine				
X	0002		Swab	Bag	A1	S25	03/13/2023	03/23/2023	4-ANPP	Fentanyl	Xylazine			RO: Methamphetamine	
X	0003		Swab	Unknown	A1	S26	03/13/2023	03/23/2023	Fentanyl	Heroin	Xylazine				
X	0004		Swab	Cooker	A1	S26	03/13/2023	03/23/2023	Acetaminophen	Fentanyl	Fluorofentanyl	Xylazine			
X	0005		Swab	Syringe	A2	S30	03/13/2023	03/23/2023	Cocaine	Medetomidine	Quinine			CC: Medetomidine	
X	0006		Wipe	Cap	A2	S30	03/17/2023	03/23/2023	Fentanyl	Quinine			BT: Xylazine		
X	0007		Wipe	Cap	A2	S30	03/17/2023	03/23/2023	Fentanyl					CP: Clindamycin	Item: Clear Cap
X	0008		Wipe	Cap	A2	S31	03/17/2023	03/23/2023	Caffeine	Medetomidine	Quinine	Xylazine	BT: Fentanyl	CC: Medetomidine	Item: Blue cap
X	0009		Wipe	Unknown	A2	S31	03/17/2023	03/23/2023	Caffeine	Fentanyl	Quinine	Xylazine			Item: “Cocaine”

- Key takeaways:
  - “NIST_ID” column corresponds to the barcode number on the sample envelope.
  - “Compound_1…” columns list the compounds identified in the sample in alphabetical order.
  - “Other Relevant Information” column lists compounds that may be present at very low levels in the sample (BT).
  - “Confirmation Rule Out” column is used to inform you if the sample is pending additional testing.
    - Yellow cells = additional testing is pending.
    - Purple cells = additional testing is complete.

- There is a 1-page document available that provides additional information on what data is in every column of the results spreadsheet.

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Please reach out with questions & suggestions!

RaDAR@nist.gov

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