



## Quantitative Trend Analysis (2023-2025)

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The year 2023 ushered in fundamental changes to the illicit drug supply in the communities monitored by PA GROUNDHOGS. In February, we covered compositional changes to the illicit opioid supply with our trailblazing [“Adulterants” report](#). That report shed light on the presence of new adulterants [tranquilizers], cutting agents [local anesthetics], and what our chemists believe to be new fentanyl precursors/intermediaries [BTMPS] to the dope supply in Pennsylvania and New Jersey. Thanks to the tireless work of our partners at the Center for Forensic Science, Research & Education (CFSRE) our data has helped inform the harm reduction community and clinicians on new symptoms of intoxication and shed light on dangerous new side effects associated with withdrawal.

In May 2025, researchers in both [Philadelphia](#) and [Pittsburgh](#) cited PAG's work in papers on a new adulterant, medetomidine— a potent alpha 2 agonist that began to proliferate across the state in April 2024, a month before Gov. Josh Shapiro's temporary scheduling of xylazine became permanent. This research was published by the Centers for Disease Control & Prevention (CDC) and encompasses much of what we know about the extent of medetomidine adulteration and the potentially life threatening side effects of sudden discontinuation of use.

The current Quantitative Trend Analysis is a follow up to PA GROUNDHOGS' Adulterants report and presents an analysis of Drug Purity Trends for four of the nine substances PA Groundhogs currently quantifies: **fentanyl**, **methamphetamine**, **cocaine** and **xylazine**. The report covers the period from January 2023 through May 2025, and to our knowledge is the only report demonstrating trendlines in drug purity published by a community-based drug checking organization.

We have also analyzed proportional ratios of medetomidine compared to the amount of fentanyl in 292 dope samples obtained since we first discovered the adulterant in the Pittsburgh and Philadelphia drug supply in April 2024. This represents the first semi-quantitative data on the amount of medetomidine being cut with fentanyl. It's also the strongest empirical evidence we have showing a strong direct correlation between the scheduling of xylazine in Pennsylvania and the increase of medetomidine.

As the only community-based drug checking program conducting quantitative analysis, PAG is able to observe and rapidly identify fluctuations in the purity of individual components in submitted drug samples. We felt it was critical to share this data with the community of people who use drugs and other stakeholders.

### ***Methodology:***

Chemists, toxicologists and pharmacologists at the CFSRE conduct quantitative analysis using GC-MS and LC-QTOF-MS to determine the amount of an individual substance within a small sub-sampling of drug material (usually 3-5mg). This is used to calculate the percent of the drug (in its base form) contained within the sample. This calculation is known as mass-fraction, or mass-percent.

For the current report, analysts began by outputting sample data from our database, and used different analysis techniques to pull data from the appropriate fields. For instance, fentanyl purity was calculated from samples Sold As: "dope," "fentanyl," "tranq-dope," "Fent/Tranq," and "heroin." We did this to ensure the integrity of the data by weeding out samples where fentanyl presents in substances such as pressed pills, and tends to be found in lower amounts than street dope [illicit opioid supply]. For the same reason we removed methamphetamine found in small quantities in pressed Adderall pills from these calculations.

Regression analysis was used to determine whether there are statistically significant trends in the average purity of each substance over time.

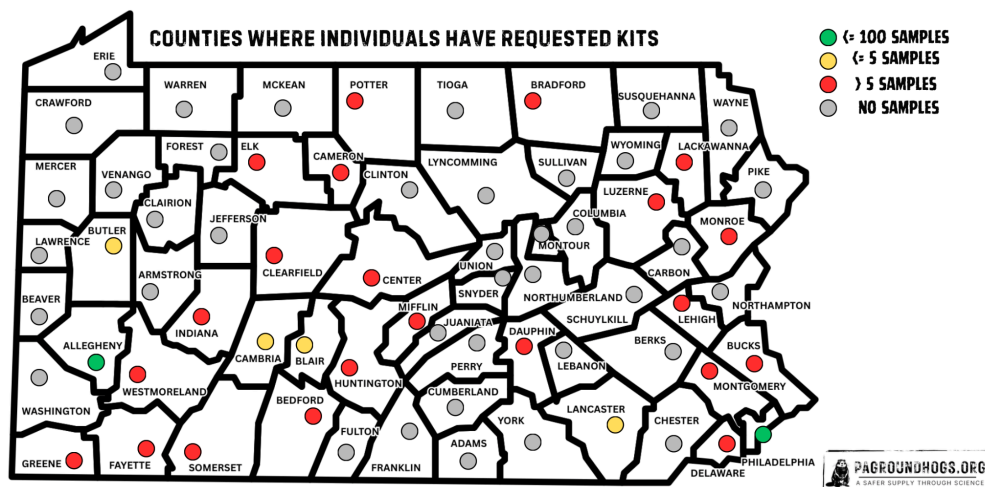
### ***Limitations:***

Our quantitative summaries are calculated using a small sub-sample of the entire drug material. Since people who use illicit opioids typically measure their dosage in “bags,” and bag weights vary even when they come from the same source, it’s difficult to determine with precision how many total milligrams of fentanyl (or a particular cut) an individual may be consuming. Likewise, there’s no way to ascertain if a sample contains hotspots due to inadequate milling. We feel it is important to note these limitations as to not mislead the public. As with all areas of scientific research, drug checking is an evolving field. However, our partners at the CFSRE are diligent in their testing and analysis techniques.

Despite these limitations, quantitative analysis is critical for revealing the trends in longitudinal data on drug purity that PA GROUNDHOGS and our partner organizations are unique in providing.

### **Where our data comes from:**

As the below map reflects, individuals or organizations from every county in Pennsylvania have ordered and received our mail-in drug checking kits, however many are still unrepresented in our dataset. This is particularly the case in rural counties. In 2025 PAG hired a rural engagement liaison who has been visiting stakeholders in Pennsylvania’s rural counties to gain insight into the unique challenges they face, provide guidance on PA’s drug checking laws and familiarize them with the GROUNDHOGS organization.



Currently, PAG’s dataset remains heavily skewed toward urban communities, including Philadelphia, Pittsburgh and Trenton, NJ.

## Key Takeaways:

Between January 2023 and May 2025 PA GROUNDHOGS and the CFSRE analyzed 1,038 drug samples and found that:

- 1.) **Methamphetamine, fentanyl, and xylazine** are all experiencing **statistically significant declines** in reported average purity since 2023.
- 2.) **Cocaine** purity has remained effectively **unchanged**, with no meaningful trend observed.
- 3.) Pennsylvania's drug market is highly volatile with purity sometimes rising and falling by wide margins month-to-month.

High volatility (large standard deviations) reflects inconsistency in the drug supply and may signal:

- Multiple supply sources with different cutting practices.
- Fluctuations in the availability of pure drug material or adulterants.
- Instability in local drug markets (e.g., raids, seizures, or distribution changes).

Market volatility in illicit drug purity — especially when **strength, composition, or adulterants change unpredictably**— has significant consequences for **consumer safety**. Market volatility creates a minefield for drug users, even those who use cautiously. It undermines harm reduction, increases overdose risk, and complicates medical response — all while staying invisible to the untrained eye.

### High Volatility + High Purity = Increased Risk

Months with **both high average purity and high volatility** are especially dangerous. Outreach teams and public health officials should consider:

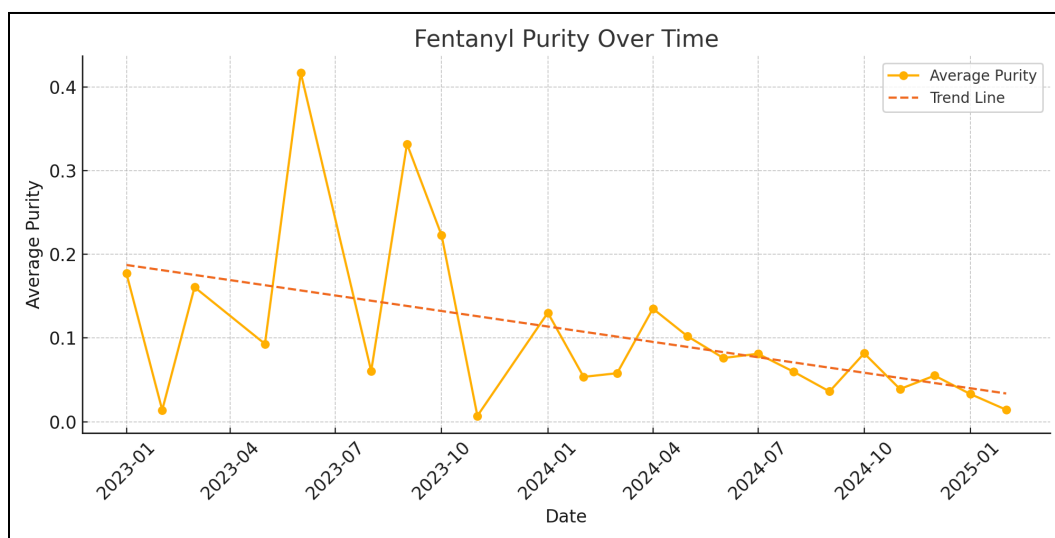
- **Targeting alerts** or naloxone distributions during months with rising volatility or purity.
- **Coordinating testing and analysis** to identify new cutting agents or contaminants.
- Monitoring correlations with overdose spikes, hospital admissions, or law enforcement activity.

## Data Insights:

### Fentanyl Purity

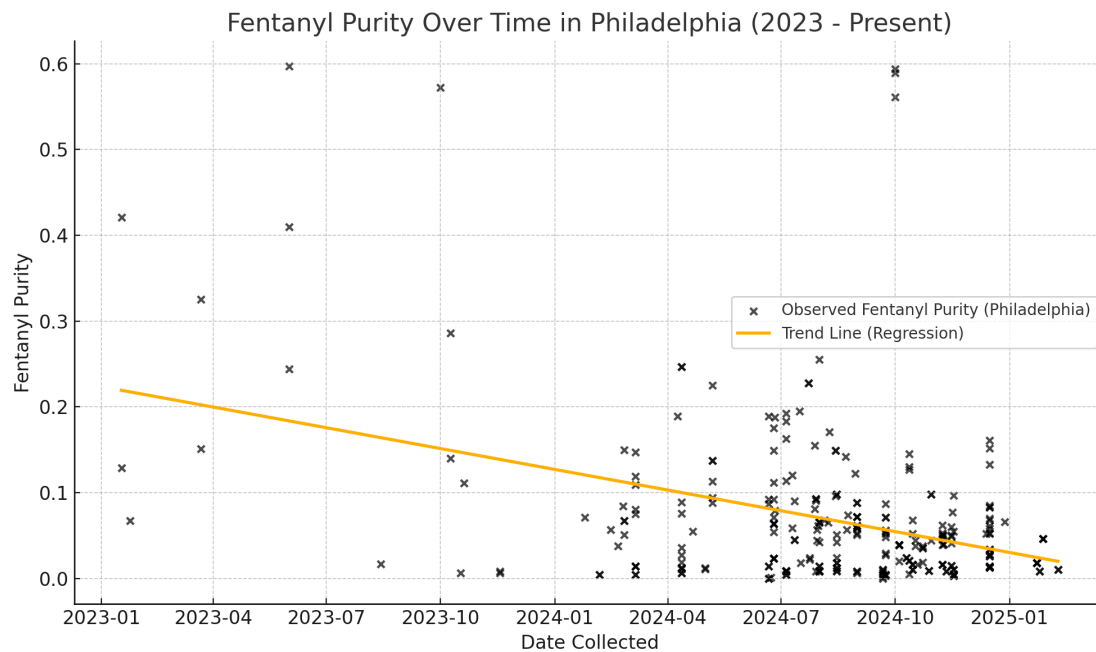
Fentanyl purity was analyzed for samples sold as 'dope', 'fentanyl', 'tranq dope', 'fent/tranq', or 'heroin'. Results indicate a statistically significant decline in fentanyl purity over time. The regression slope was  $-0.00020$  with a p-value of 0.024, and R-squared of 0.22, suggesting a modest but meaningful decrease in average purity since 2023.

Figure 1:



The decline in fentanyl purity is even more pronounced in Philadelphia, and is consistent with reports from people who use illicit opioids. People who use drugs (PWUD) whom we actively engage with to identify changes to user experience and changes to the active street supply noticed a decline in fentanyl as tranquilizers have increased in the dope supply.

Figure 2:



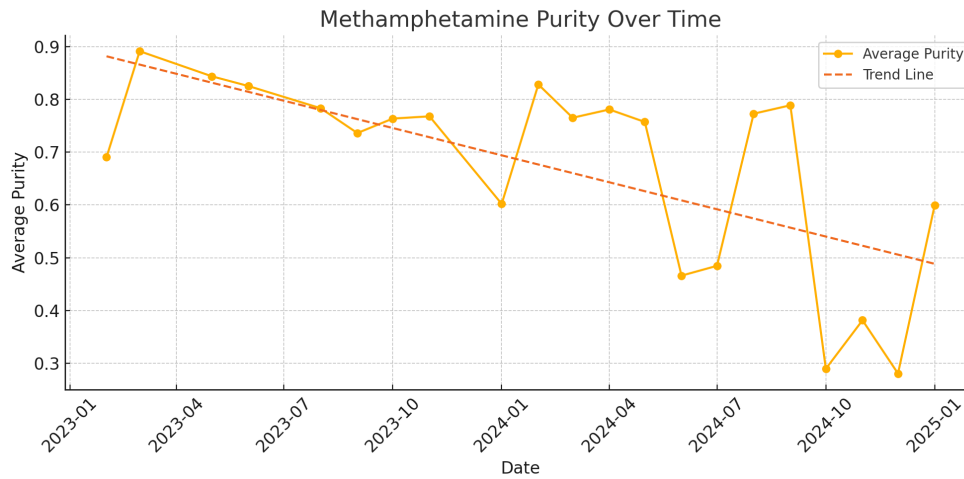
The timing of the decline also correlates with a nationwide decline in overdose fatalities, and the development of compassionate overdose reversal strategies that focus on respiration over responsiveness and rely on lower doses of naloxone. While there are different theories as to why there was a decline in nationwide fatal overdose rates, PAG believes that a ban on independent fentanyl production [enacted in October 2023](#) by the Los Chapitos faction of the Sinaloa Cartel and wider adoption of harm reduction approaches are primarily responsible for this dramatic shift. We and many others in the field will continue to monitor these trends as the landscape for PWUD and supportive services are ever changing.

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### Methamphetamine Purity

Methamphetamine purity was assessed in samples sold as 'methamphetamine'. We removed counterfeit adderall, which contain low dose percentages of methamphetamine with binders and would not adequately reflect trends in methamphetamine purity. The regression model shows a clear and statistically significant decline in purity over time. The slope was -0.00056 with a p-value of 0.001 and an R-squared of 0.43, indicating a strong downward trend in methamphetamine purity from 2023 to the present.

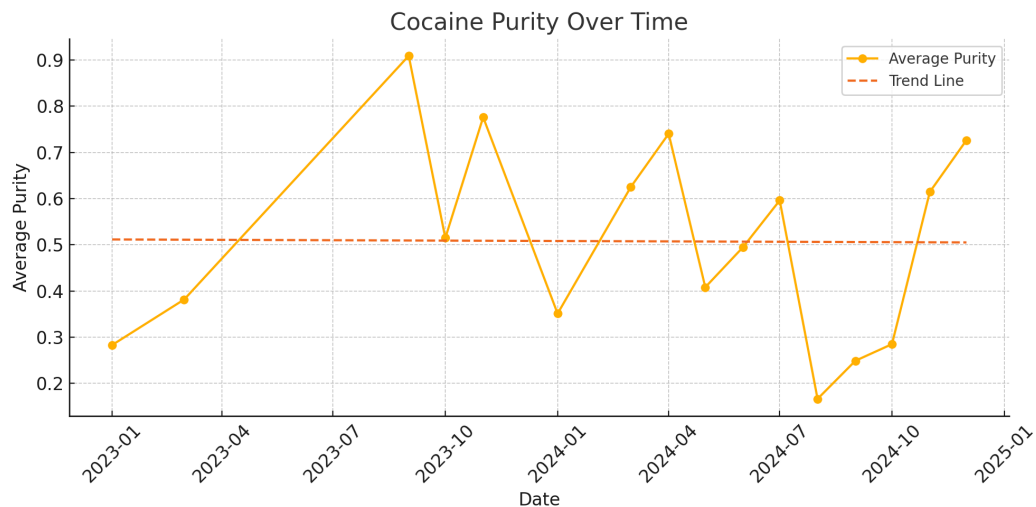
Figure 3:



## Cocaine Purity

Cocaine purity was evaluated in samples sold as 'cocaine', 'crack', or 'hard'. The analysis found no statistically significant trend in average purity. The regression slope was effectively zero ( $-0.000009$ ), with a p-value of 0.974 and an R-squared of 0.00, indicating that there was no meaningful change in *average* cocaine purity during the observed period.

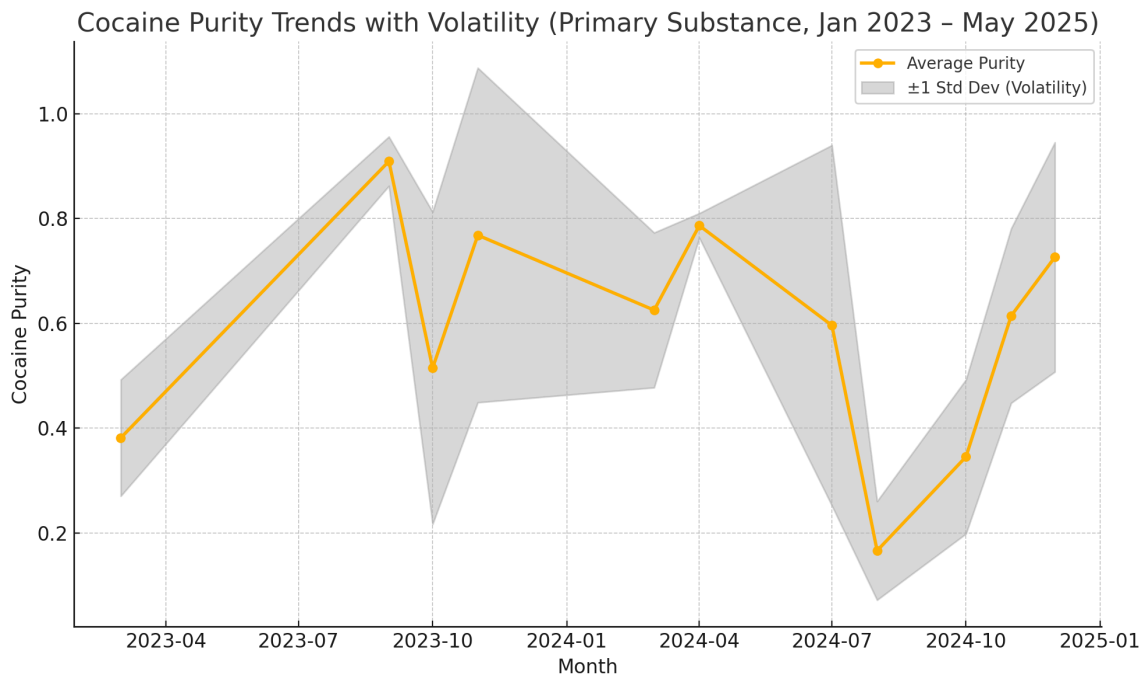
Figure 4:



However, cocaine purity fluctuates significantly over time, consistent with a volatile market.

Months with wider gray bands indicate higher risk for users, as the range between weak and strong doses widens unpredictably:

Figure 5:



Some months show sudden drops or spikes, suggesting changes in supply quality, cutting practices, or source shifts.

On average, “crack” samples had higher cocaine purity (67.9%) than those sold as powder “cocaine” (51.8%). While crack or “hard” is the same drug as powder (i.e. cocaine), powder coke is more likely to contain cuts like levamisole, lidocaine, caffeine, or dimethyl sulfone that are washed out during the process of cooking crack. The distinct differences in purity are unsurprising, but enlightening.

## Xylazine Purity

Xylazine purity remained relatively stable from 2023 to 2024, dropping sharply in 2025, likely reflecting the impact of xylazine’s scheduling in June 2024. This suggests that policy changes may have influenced supply chains, prompting dilution or substitution with other drugs, particularly medetomidine. .



Figure 7:

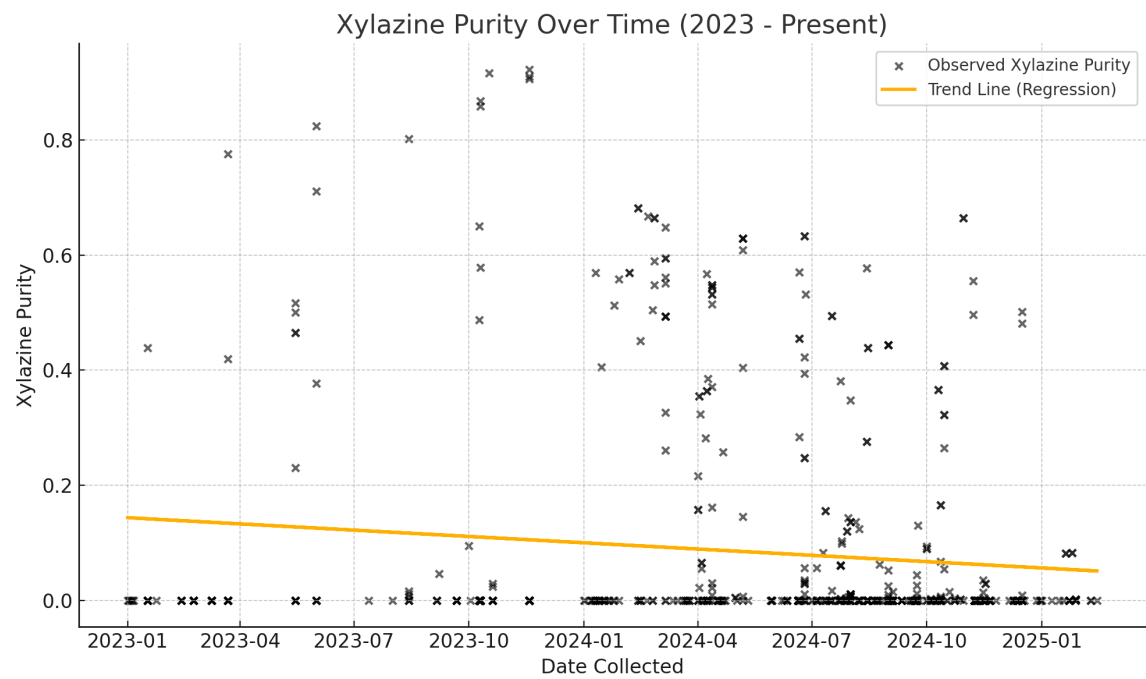
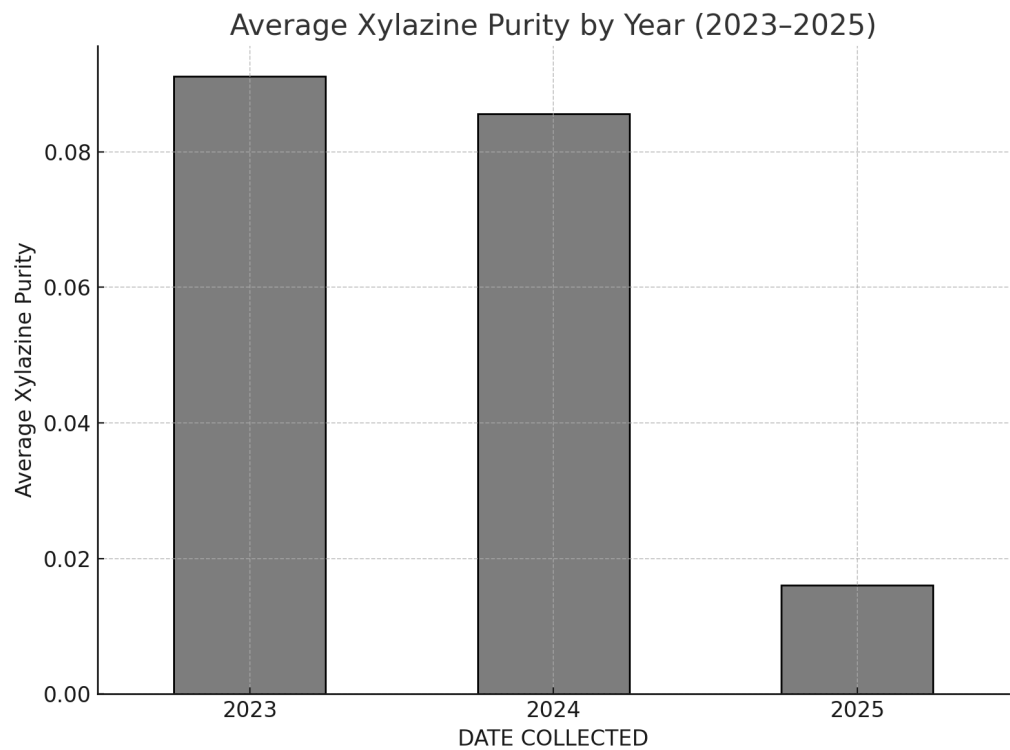


Figure 8:

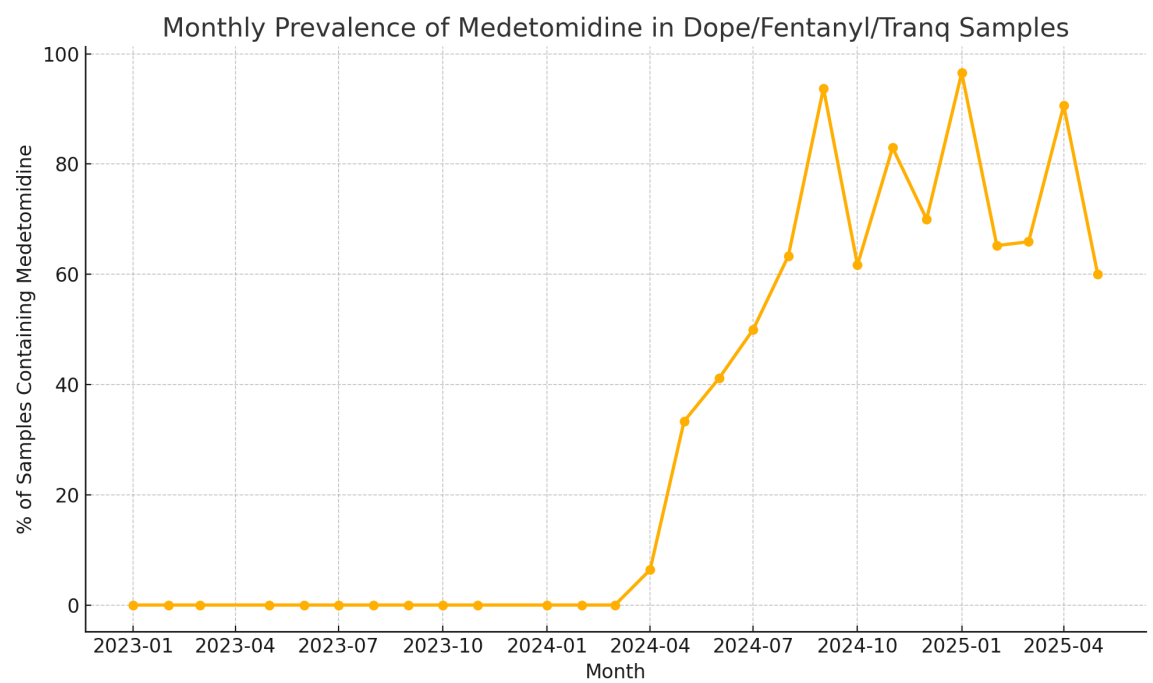


Medetomidine

General Statistics

Total Samples Analyzed: 292

Figure 9:



Impact of Medetomidine Presence on Fentanyl & Xylazine Purity

Medetomidine Presence	Avg Fentanyl Purity	Avg Xylazine Purity
Absent	10.85%	28.17%
Present	4.37%	4.35%

### **Ratios of medetomidine to Fentanyl:**

- Minimum Ratio: 0.1 (medetomidine is 10% of fentanyl)
- Maximum Ratio: 93.0 (medetomidine is 93× fentanyl)
- Mean Ratio: 4.69
- Median Ratio: 1.2
- Standard Deviation: 12.23

### **Conclusion**

While the illicit drug supply in Pennsylvania has generally declined in purity over the past two years, one could argue that high volatility and an inconsistent product have made things more dangerous and unpredictable for consumers. Meanwhile, opioid users are now facing a dual dependency as the highly potent alpha-2 agonist medetomidine has largely replaced xylazine since the latter's scheduling. Clinicians report severe withdrawal associated with medetomidine, necessitating medical intervention and frequently a stay in the ICU.

Due to the importance of keeping up with changes in the active street level drug supply PAG will continue to diligently conduct this work. We are always striving to advance this project, shortening the turn around time for results, adding new substances for quantification, and expanding our geographic reach through our new national organization Groundhogs Group. As always, we thank our community partners and the CFSRE. Without the steadfast commitment of our lab partners to the field of harm reduction our organization would not exist.

To learn more please check out our [website](#) or reach out to [info@pagroundhogs.org](mailto:info@pagroundhogs.org) for more information.

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