
Substance Use Data to Action: Development of the City of Phoenix Opioid Overdose Alert System Methodology and Program Framework

2025 AzPHA Annual Conference

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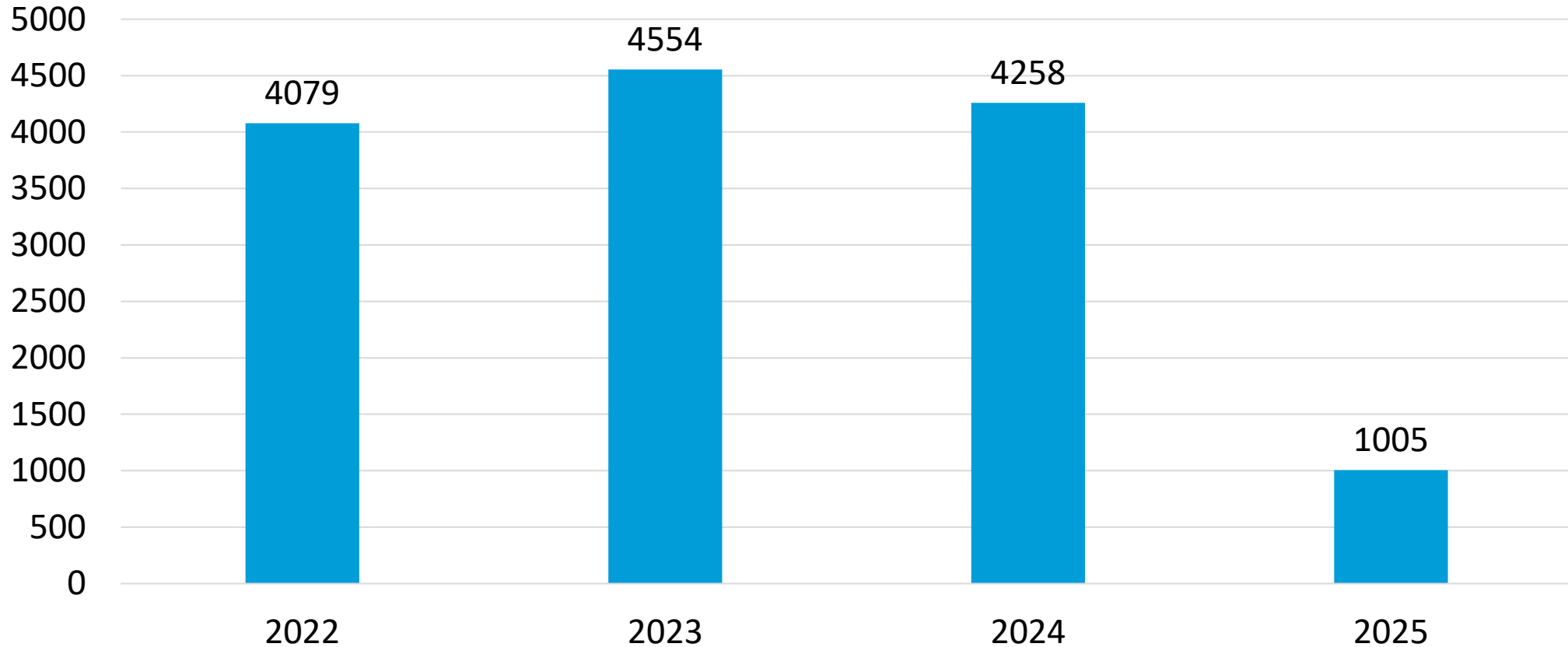
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Agenda

1. Overview of Phoenix Opioid Overdose Data
2. Development of the Phoenix Opioid Overdose Alert System
3. Alert Methodology Performance Evaluation
4. Future Overdose Alert Program Planning

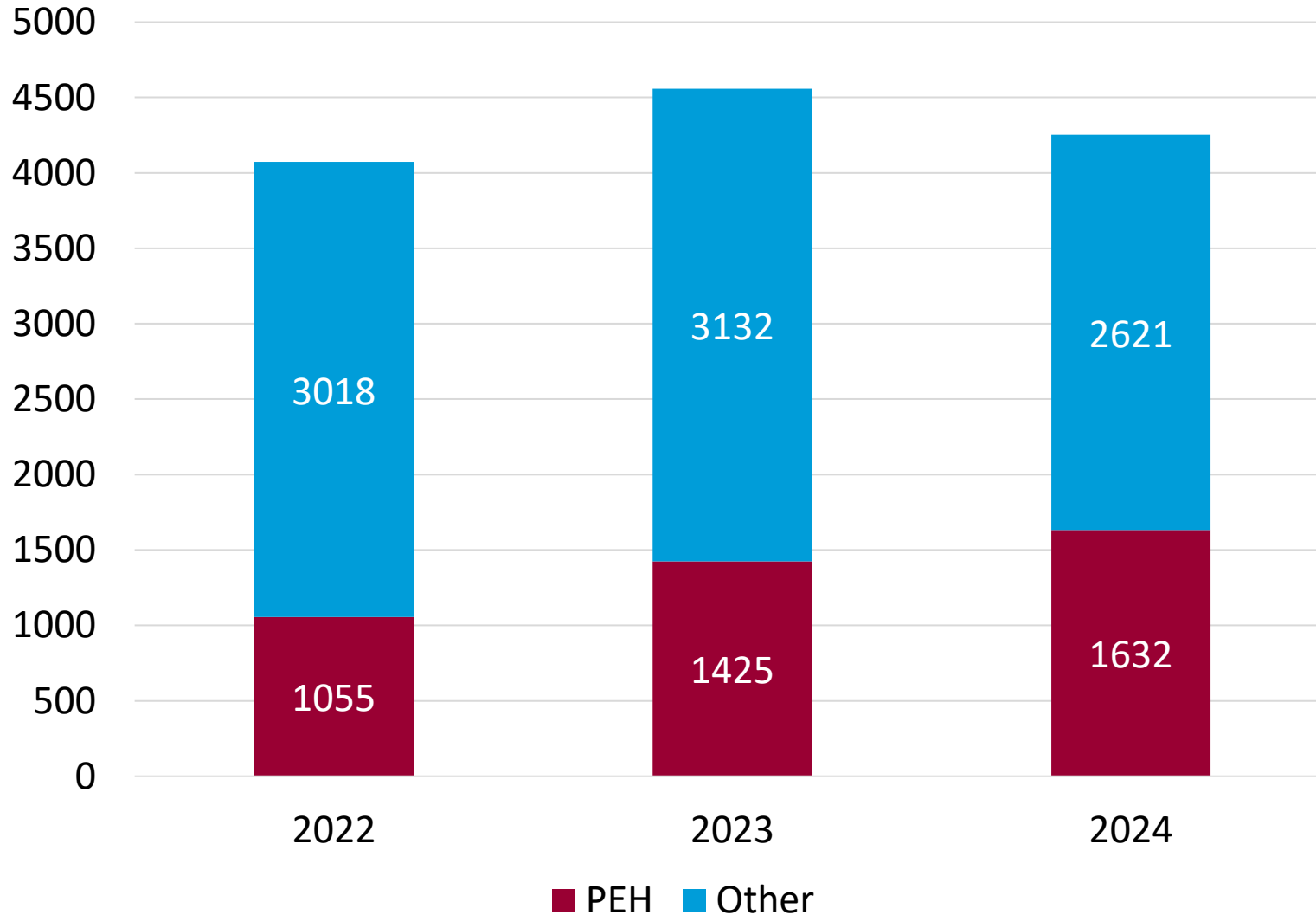
Overview of Phoenix Opioid Overdose Data

Suspected Opioid Overdoses in Phoenix

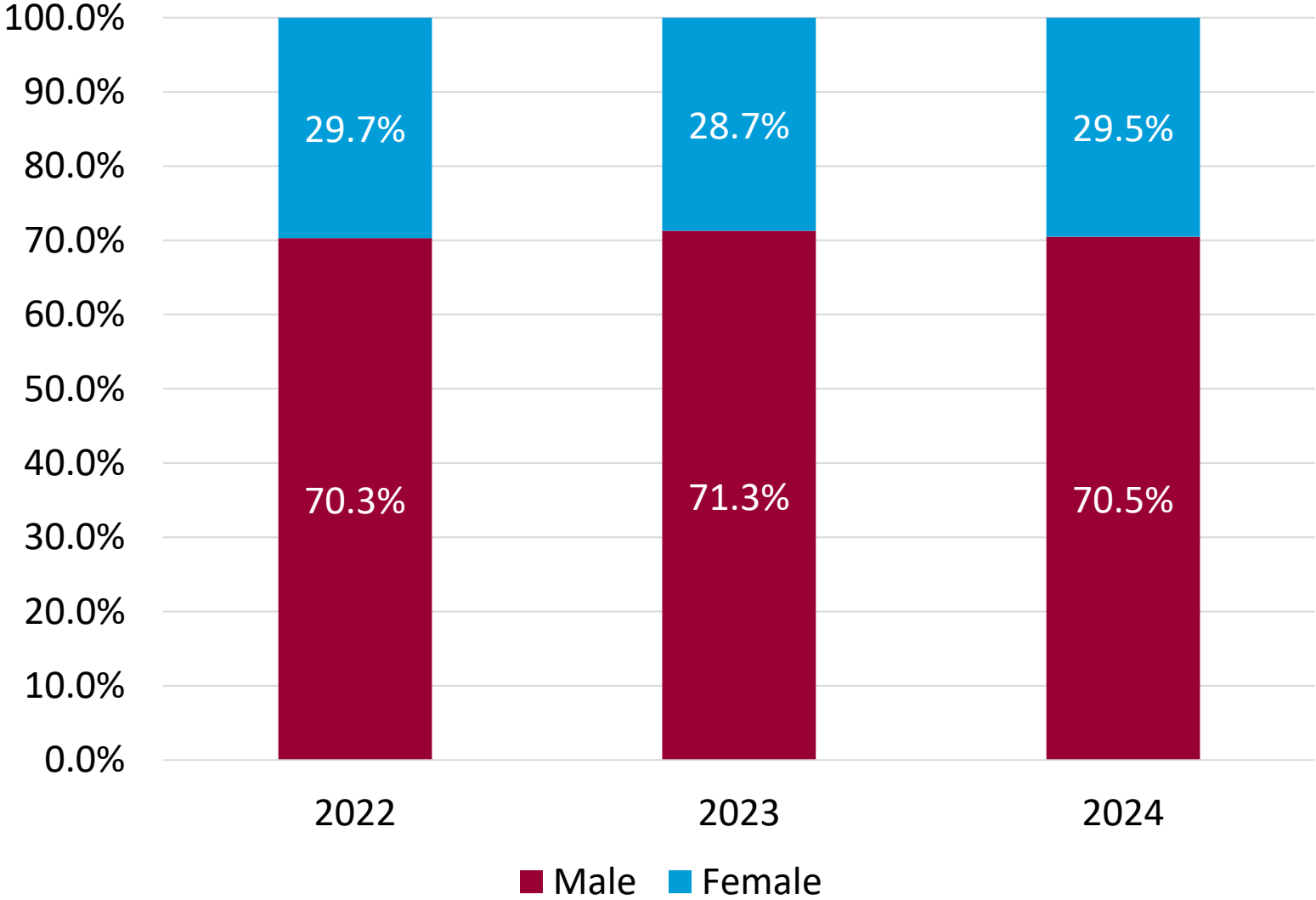


**A suspected opioid overdose is defined as any case where naloxone was administered by Phoenix Fire Emergency Medical Services (EMS) and the patient showed signs of improvement or response. The data presented in this section is sourced from Electronic Patient Care Records (EPCR) utilized by Phoenix Fire EMS.*

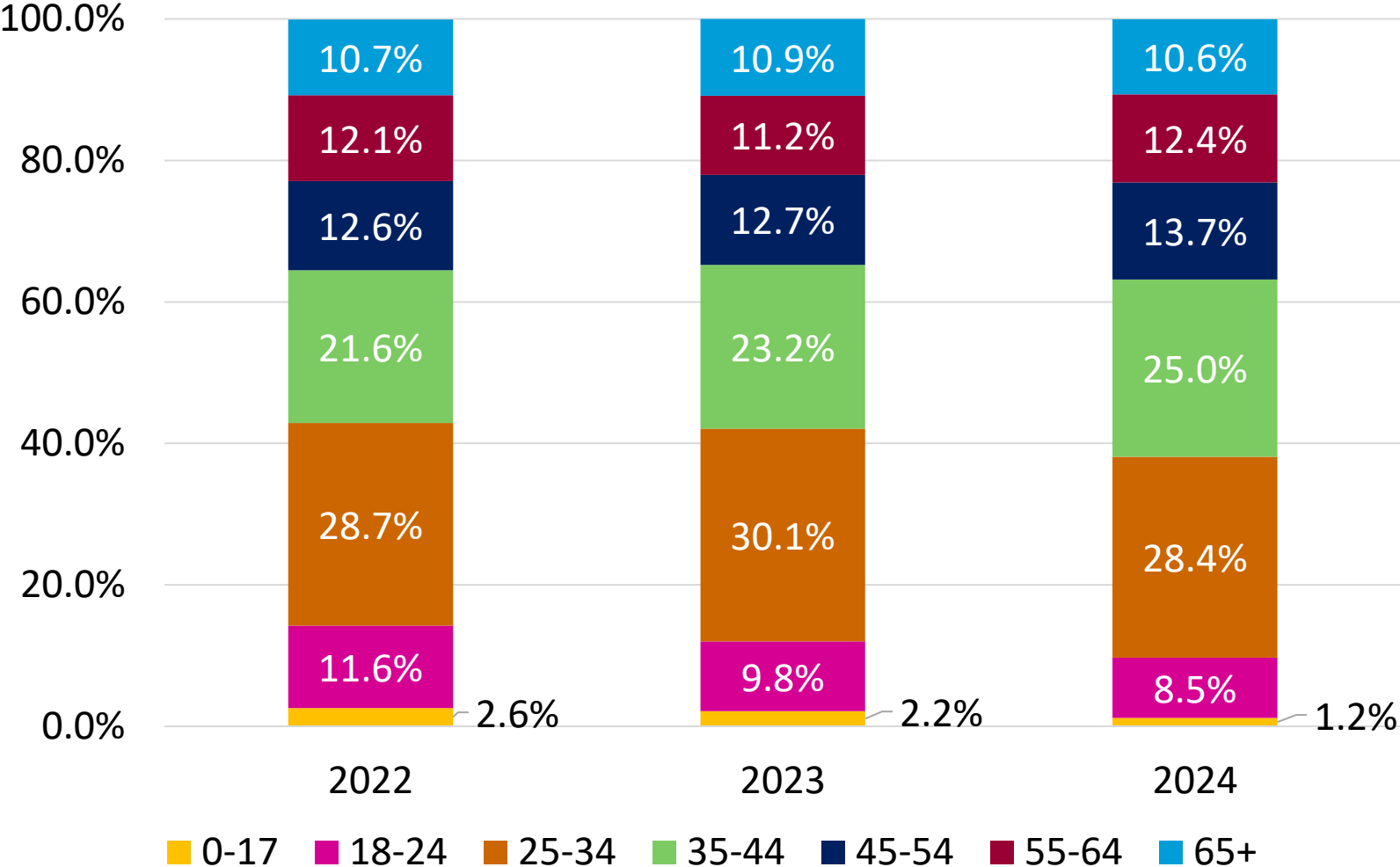
Suspected Opioid Overdoses by Housing Status



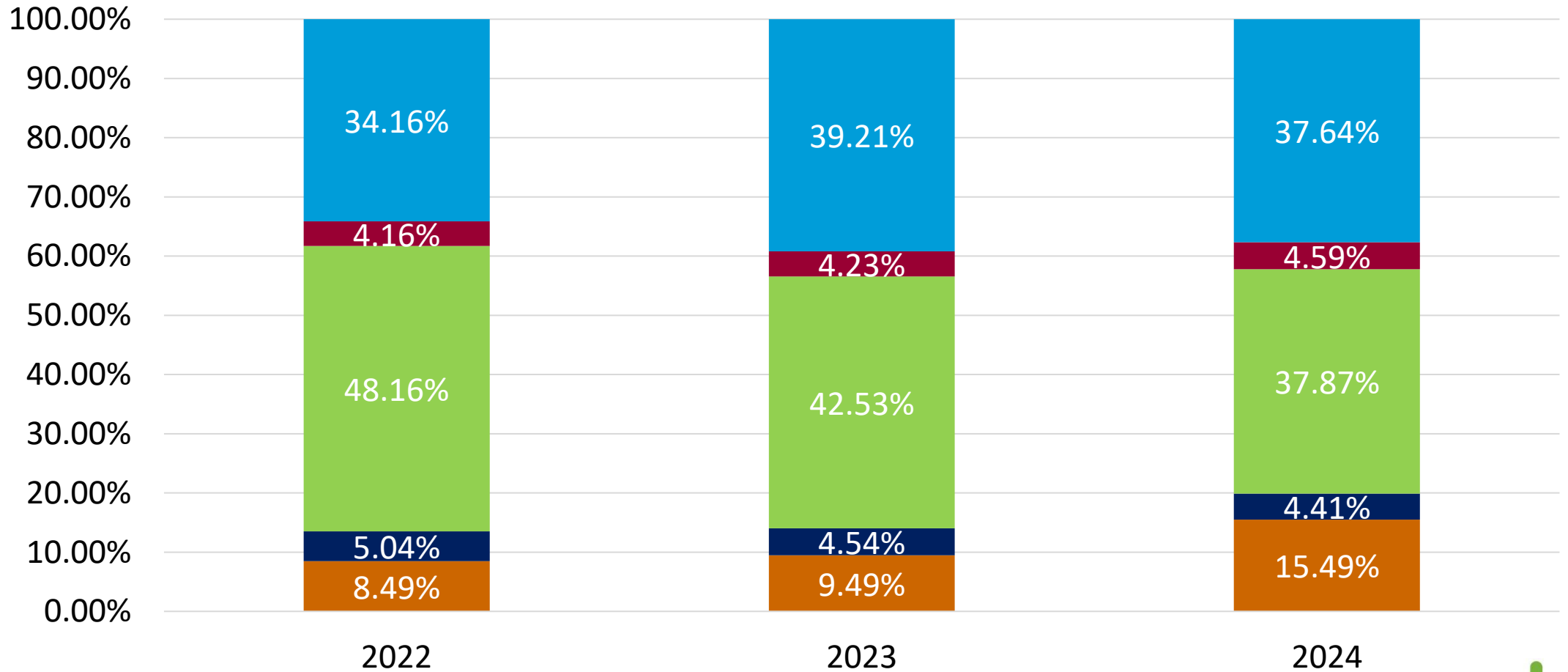
Suspected Opioid Overdoses by Gender



Suspected Opioid Overdoses by Age



Suspected Opioid Overdoses by Location Type



Data Surveillance and Monitoring

- We have access to real-time data on suspected opioid overdoses thanks to a partnership between Phoenix Fire, Phoenix PD, and the Office of Public Health.
- Through this partnership, we were able to build and publish the city's first-ever Phoenix Substance Use and Overdose Dashboard.
 - The dashboard is available to the public for anyone to use.
- In addition to data on suspected opioid overdoses, the dashboard features:
 - overdose fatality data provided by the Maricopa County Department of Public Health from the Office of the Medical Examiner
 - data on naloxone administration prior to EMS arrival (Phoenix Fire EMS)
 - data on the distribution of City of Phoenix Opioid Overdose Reversal (Narcan) Kits

Phoenix Substance Use & Overdose Dashboard

The Phoenix Substance Use and Overdose Dashboard (PSUOD) is an opioid and substance use surveillance system that monitors and shares data and local trends around suspected opioid overdoses and fatal overdoses across the City of Phoenix. It also features key statistics on the City's naloxone program.

The PSUOD is a city wide-endeavor and collaboration between the Office of Public Health, Phoenix Police Department, and Phoenix Fire Department. Support for the dashboard is provided by City of Phoenix Information Technology Services (ITS).

The development of the PSUOD was funded by the Opioid Settlement funds received by the City of Phoenix to combat the City's opioid overdose crisis through the One Arizona Agreement. For more information on the One Arizona Agreement and the settlement funds please click [here](#).



Suspected Overdoses



Fatal Overdoses



Naloxone Information

Development of the Phoenix Opioid Overdose Alert System

Opioid Overdose Surveillance

- **Public health surveillance** is the ongoing collection, analysis and interpretation of data.
- The EMS data housed in the PSUOD allows us to provide real-time assessment of suspected opioid overdose rates across Phoenix, prompting development of an Opioid Overdose Alert System (OOAS).
- This OOAS will allow us to **recognize** and **respond** to spikes in opioid overdoses across Phoenix.

Opioid Overdose
Surveillance

Detection of Opioid
Overdose Spikes

Tailored and
Targeted Response

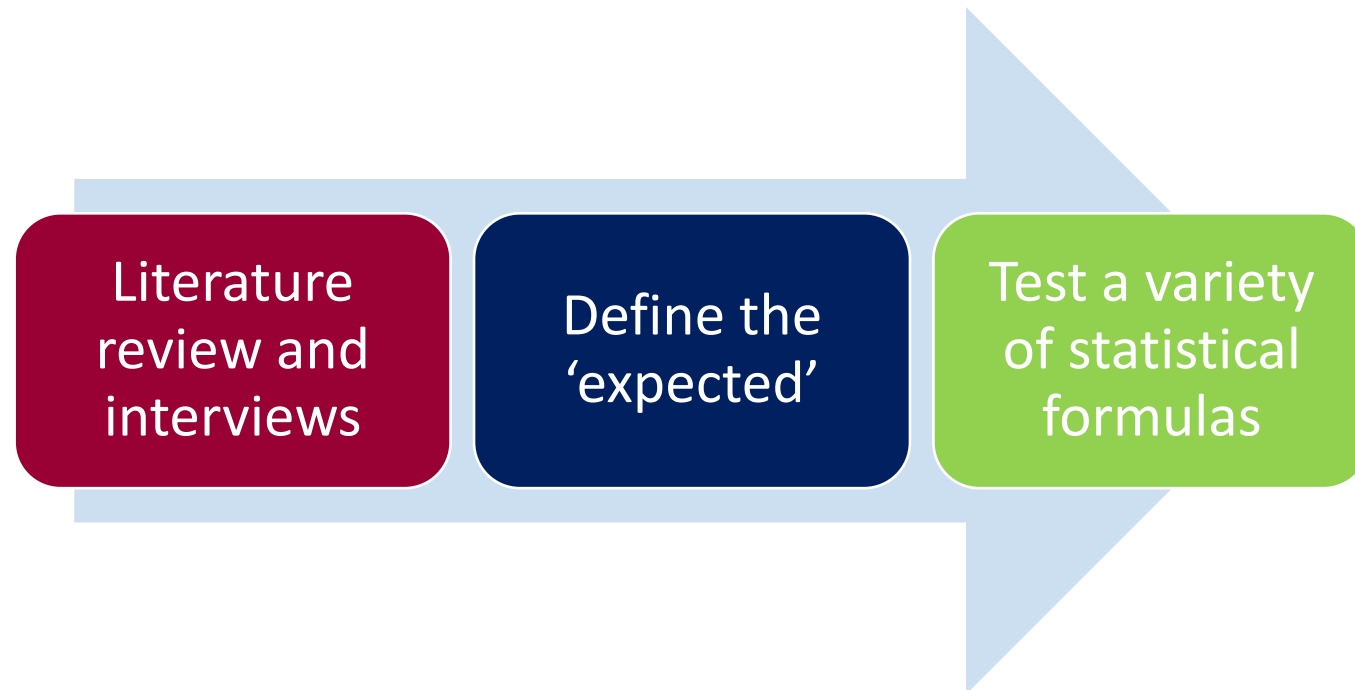
What Constitutes a Spike in Opioid Overdoses?

- A spike is a significant deviation from the rate of opioid overdoses that are expected.



How Should Spikes in Opioid Overdoses be Measured?

- To make this determination, we took a three-step approach:



Preliminary Review of Alert Methodologies

- In addition to reviewing the literature, we conducted an in-depth review of alert methodologies in six states: Pennsylvania, Michigan, Rhode Island, Utah, Montgomery County, Ohio, and Nevada.
- We concluded that there was no gold standard.
- Methodology is up to the discretion of public health officials.



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Preliminary Review of Alert Methodologies

- Other finding based on these reviews were:

Location

Different
Substances

Spikes vs
Sustained
High Rates

Seasonality

Algorithms

Determining Expected Opioid Overdose Rates

- We had to determine an approximate number of yearly alerts that would be actionable but not overwhelming.
- These alerts also needed to account for the seasonality of Phoenix.



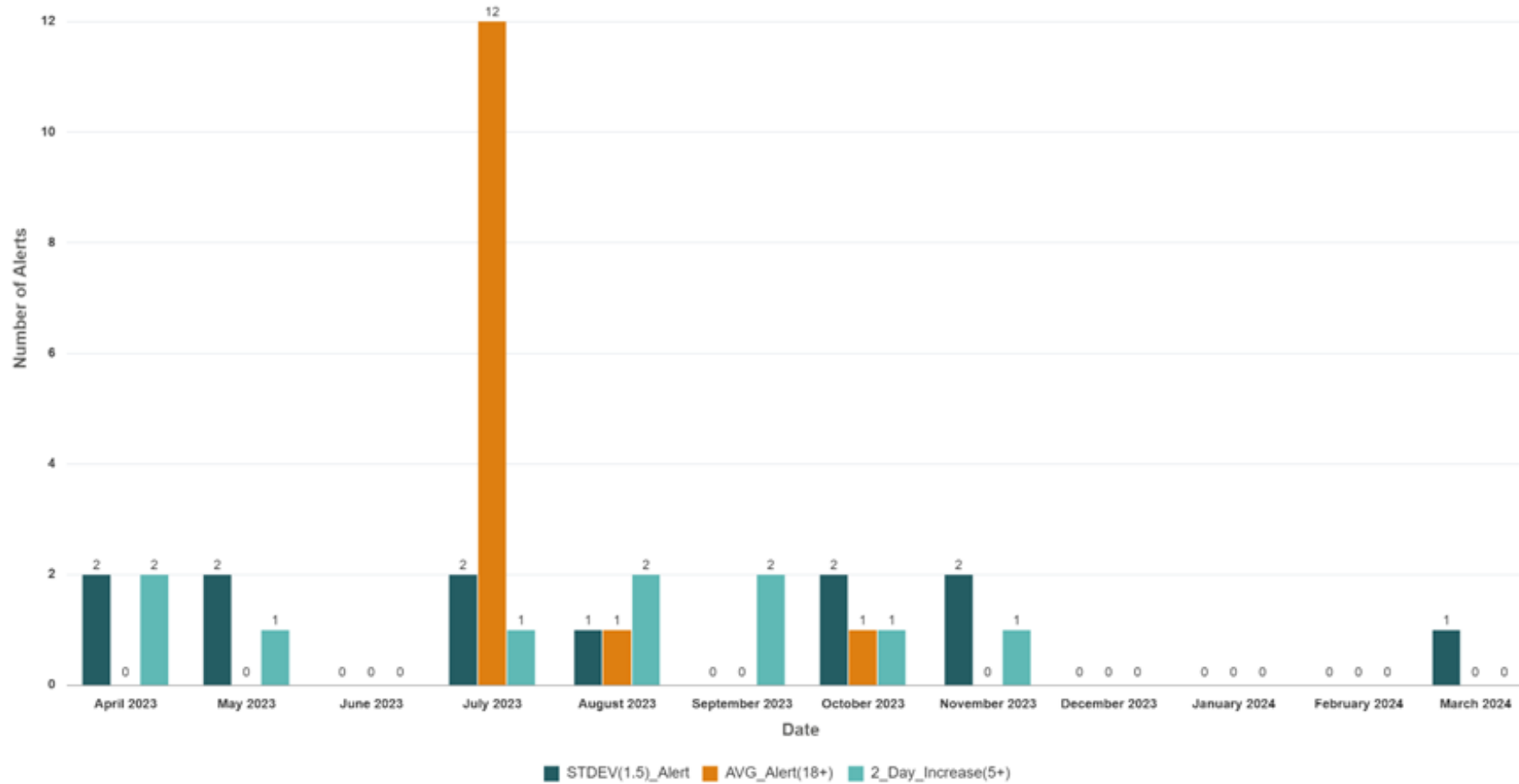
Statistical Alert Methodology Testing

- We tested a variety of statistical methods to define and identify spikes using data from the past two years.
- There were three possible methods that came to the fore: standard deviation, average threshold, and daily increase.
- Each method was tested with several thresholds to determine the ideal sensitivity so alerts would be meaningful and actionable.

Statistical Alert Methodology Testing

Method	Description	Recommendation
Standard Deviation	<p>Measures whether the current number of suspected opioid overdoses exceeds the defined number of standard deviations based on a rolling 2-week average.</p> <ul style="list-style-type: none"> •The standard deviation is the calculation of how far the data strays from the average. The greater number of standard deviations the more significant the alert is. 	<p>Based on historical data, the recommended number of standard deviations is 1.5. This would have triggered approximately 12 alerts in the past 12 months.</p>
Average Threshold	<p>Looks at the average number of suspected opioid overdoses in a 3-day period and triggers an alert when this threshold is surpassed.</p>	<p>Based on historical data, the recommended threshold is a 3-day average of 18 or more suspected opioid overdoses to trigger an alert.</p> <p>This method could also be used as color-coded stages. Recommendations for colors:</p> <ul style="list-style-type: none"> •Green: Below 15 •Orange: 15 to 17.99 •Red: 18 or above
Daily Increase	<p>Looks at the change from the previous 2-day average to the current 2-day average.</p> <ul style="list-style-type: none"> •The 2-day average is used to reduce single-day anomalies from causing alerts. 	<p>Based on historical data, the recommendation to trigger an alert is an increase of 5 or more</p>

Statistical Alert Methodology Testing



Statistical Alert Methodology Testing

- The team then examined whether it would be best to use a single method or multiple methods to identify alerts.
- If only one method was to be used, the Standard Deviation method would be recommended because
 - 1) it is the most consistent with the alerts produced by the other two methods and
 - 2) it will trigger with both individual spikes and clusters of high-overdose days.
 - 3) Due to the observed seasonal spikes in Phoenix the average threshold would trigger disproportionately during summer months while the daily increase would not detect consistent increases over time.
- However, when using only a single method, there would likely be issues detecting certain individual spikes while the 2-week rolling average caught up to seasonal or pattern changes.

Statistical Alert Methodology Selection

Green Level

- **No threat** is detected; opioid overdose levels are either at or below what is expected for that location and time period.

Orange Level

- A **moderate threat** has been detected
- Indicated by a spike of **1.5 Standard Deviations** above the 2-week rolling average

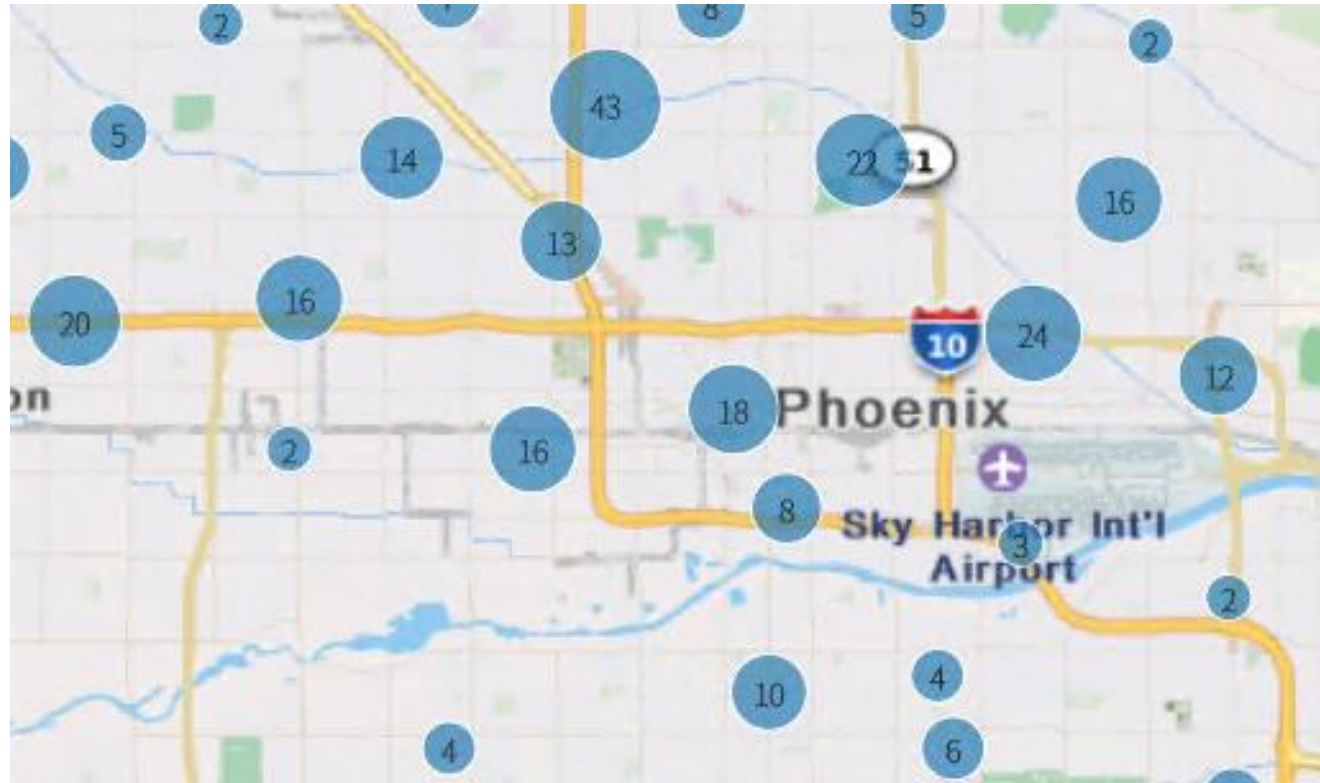
Red Level

- A **high-level threat** has been detected
- Indicated by either:
 - A spike of **2 Standard Deviations** above the 2-week rolling average
 - Or the standard deviation exceeds a threshold of 1.5 and
 - 1) 4 or more police precincts also exceed 1.5 standard deviations or
 - 2) the 2-day change indicates an increase of 5 or more suspected overdoses

Cluster Detection and Monitoring

- An overdose cluster is a high number of overdoses in a select area. In Phoenix, we are defining this area as 1500 feet, which is the maximum city block length.
- Clusters manually examined retroactively every 30-days and typically represent 2.5-5% of the total suspected overdose population.
- Clusters may or may not be associated with spikes.
- While we cannot act on them in real-time, cluster detection and monitoring will inform our public health response in tandem with spike detection and response processes.

Cluster Mapping Examples



Opioid Overdose Alert System Technology

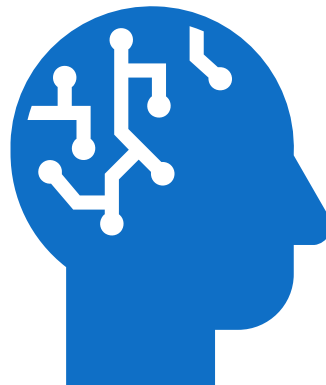
- The data and current algorithms are currently housed in an Oracle database and use Oracle SQL to run.
- The visuals for the current alert system live on our private, internal dashboard which is in Oracle Business Intelligence.
 - This allows for one space where the team and approved stakeholders can reference the current alert status as well as capabilities to email alerts to the team directly.



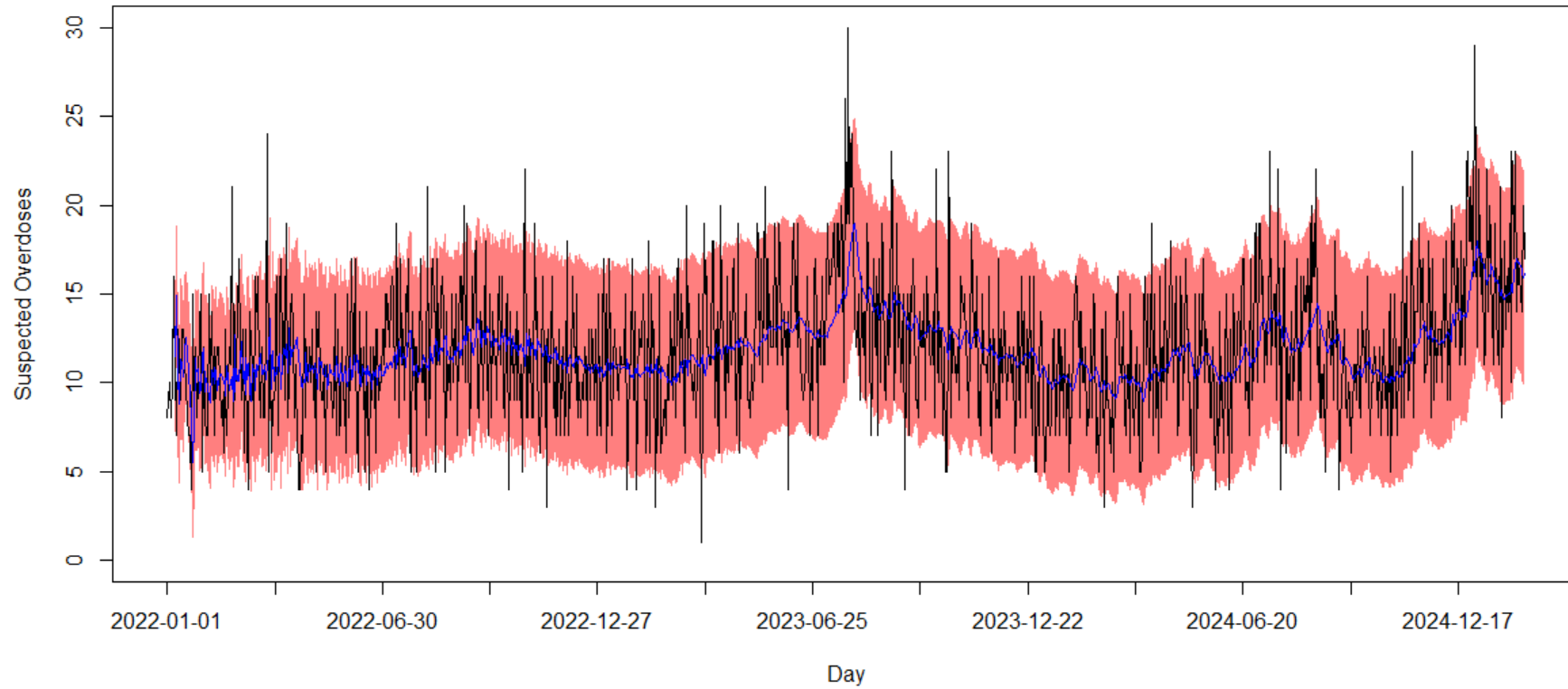
Alert Methodology Performance Evaluation

Rethinking the Approach

- We decided to go back to first principles: What are we really looking for?
 - Excursions at a large scale from general history: long-term averages (order of a year)
 - Excursions at a finer scale from recent history: short-term averages (order of a week to a month)
 - Large changes from day to day: one-day difference averages (unclear time-scale)
 - Unexpected excursions from a predictive model: ARIMA model predictions



ARIMA(1,1,3) Prediction Method



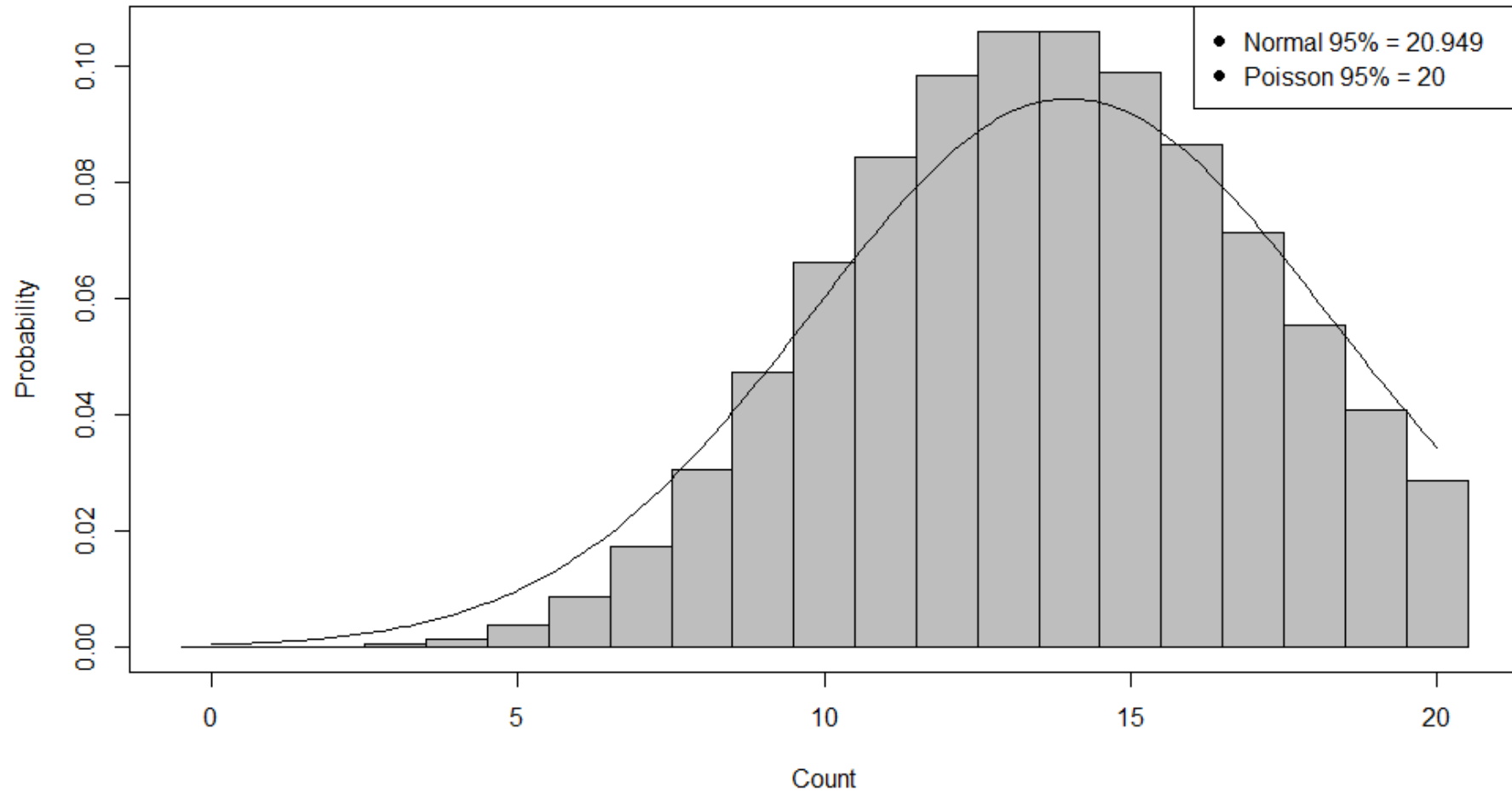
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 - Unexpected excursions from a predictive model: ARIMA model predictions
- None of these by themselves were raising alerts every time they looked necessary. Each raised some unique alerts.
- But first, a side-bar about using averages, standard deviations, and normal distribution theory ...

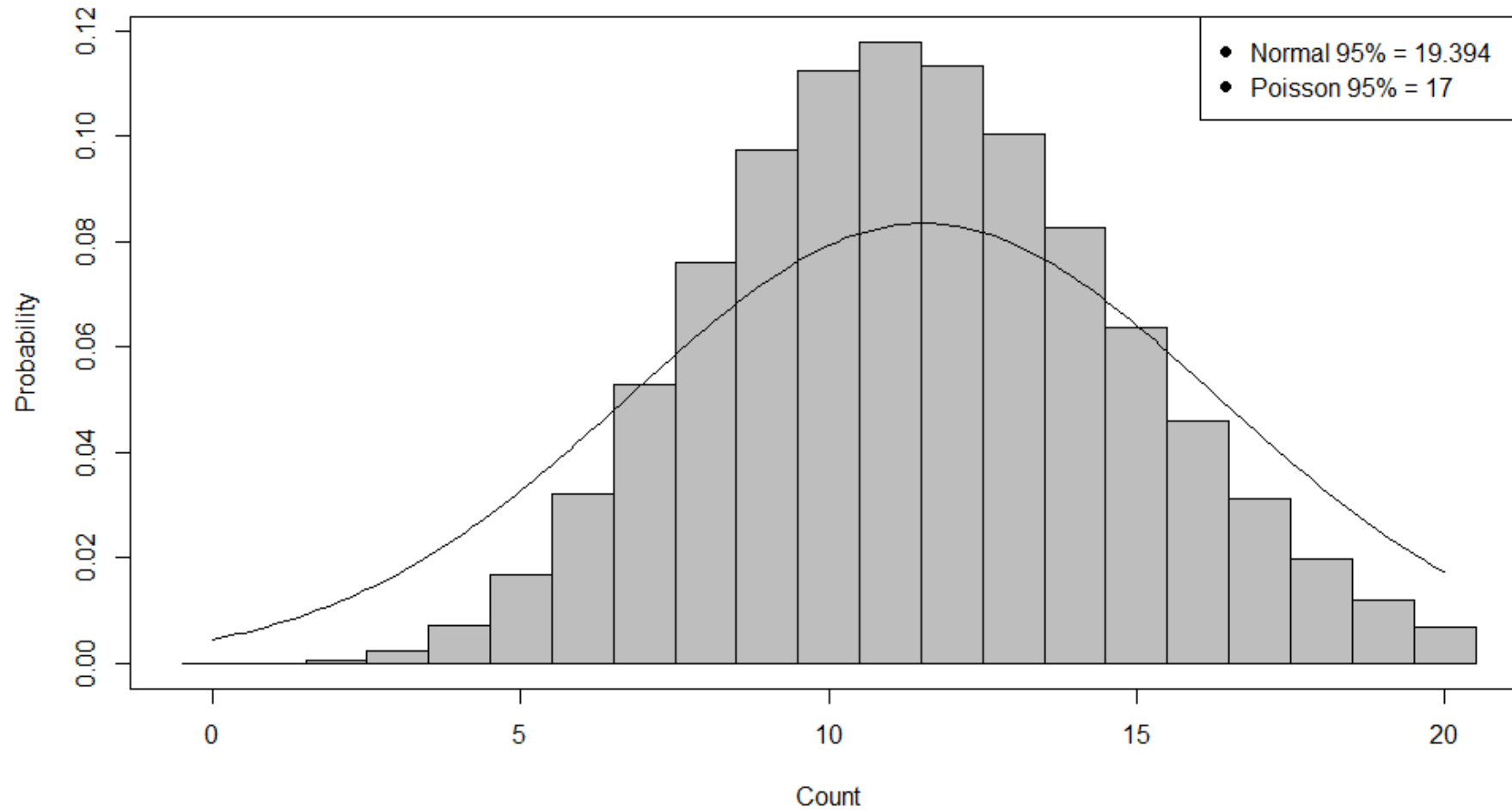
Normal versus Poisson Distribution

- Using the average and a multiple of standard deviation is based on Normal distribution theory: continuous numbers from negative infinity to positive infinity
- Number of overdoses is a COUNT: strictly integers, no negative numbers
 - We can think of overdoses as the result of the number of people who are using the given drug on a given day (likely changing) with a probability that each will overdose on that day (likely changing). Like spinning a wheel for each person and hoping the unlucky number doesn't come up.
 - This is modeled as a POISSON Distribution, not Normal.
 - Mathematical property: the standard deviation is related to the mean count over repeated trials instead of changing based on how different the counts are.
 - We want this: we don't want to ignore big changes when there have been lots of fluctuations, we probably want to be just as sensitive.
 - Some example differences ...

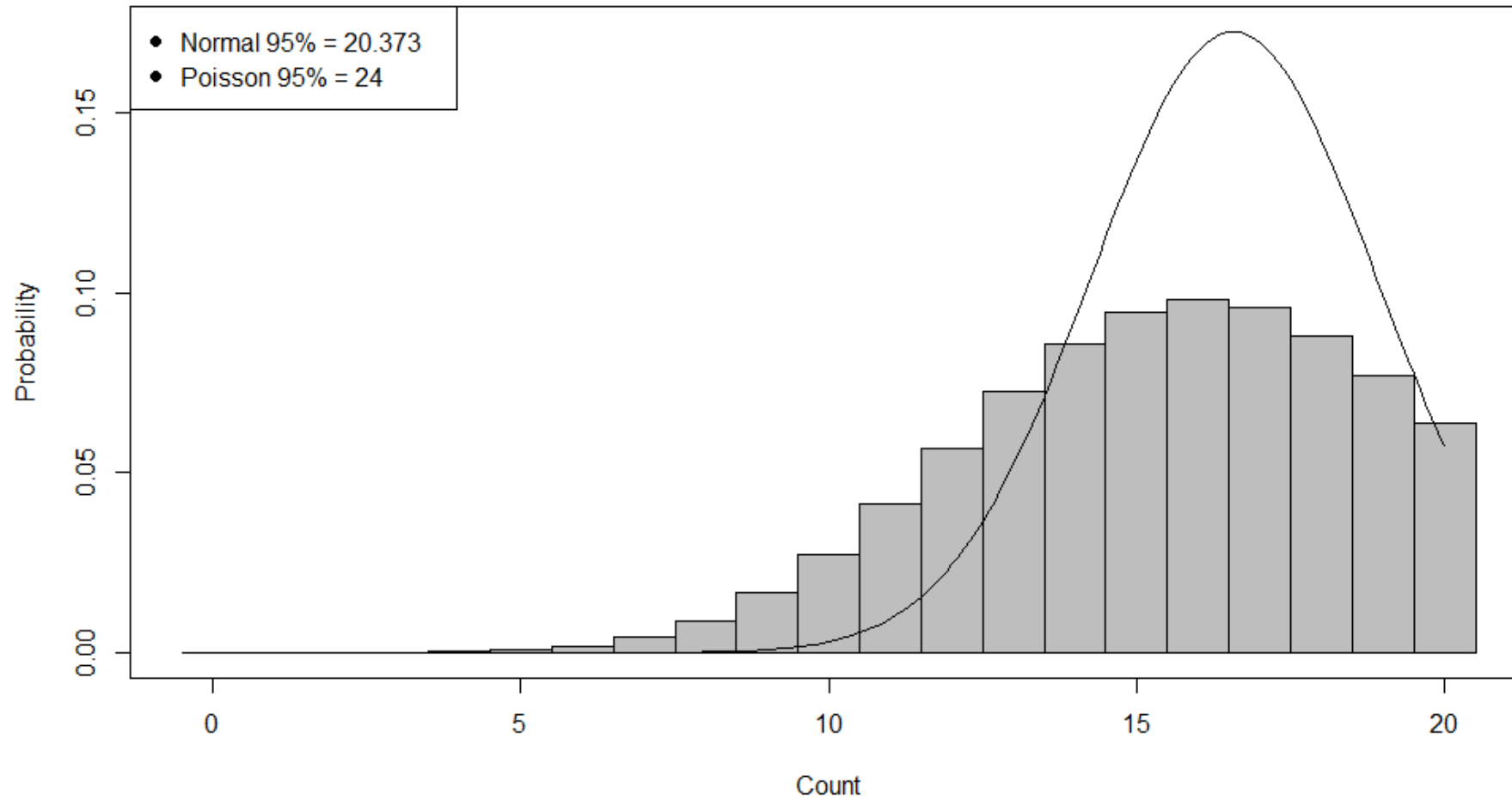
Normal vs. Poisson, 14 Day Average, Mean = 14



Normal vs. Poisson, 14 Day Average, Mean = 11.533



Normal vs. Poisson, 14 Day Average, Mean = 16.571



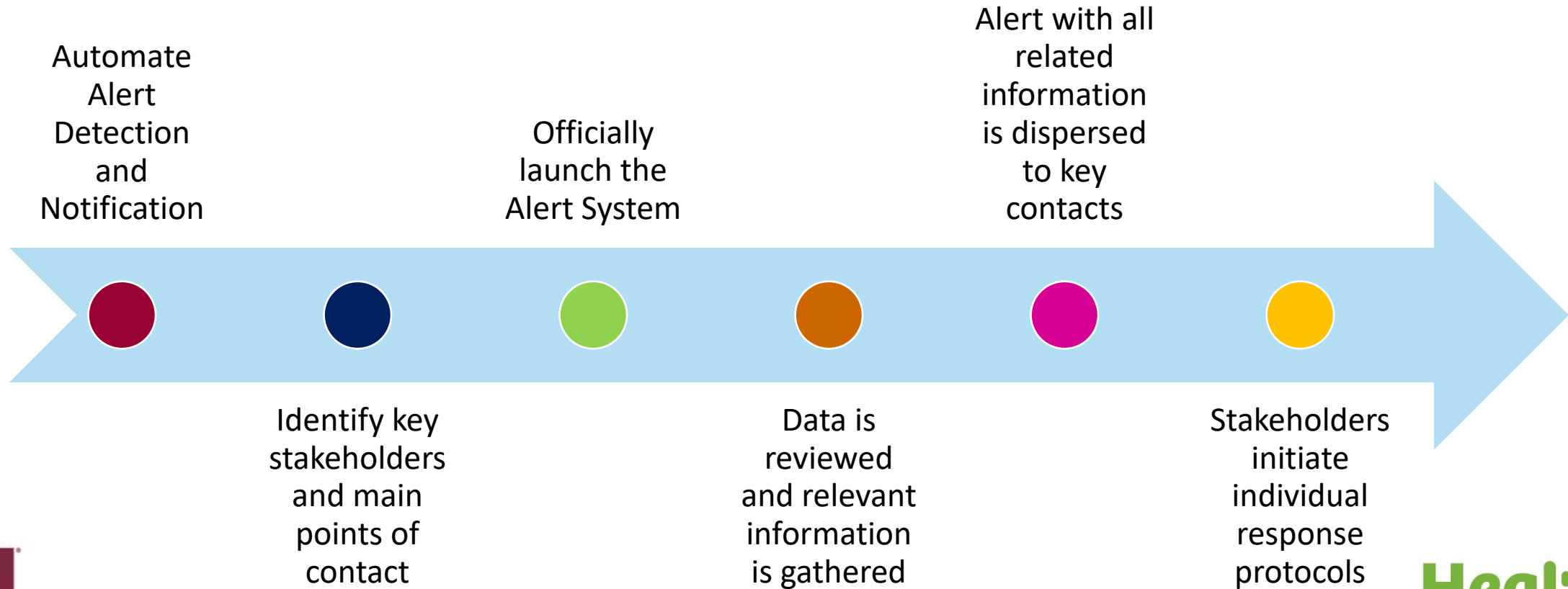
Rethinking the Approach, Continued

- With this issue fixed, we still had no one metric that worked by itself
- The obvious answer: combine the algorithms and give each a vote on whether or not it was an alert day.
- This not only produces excellent results, given past data, but also allowed us to create a CONFIGURABLE tool.
 - We can change the sensitivity via the expected number of excursions (statistical p-value cutoff) for each algorithm. Longer term tend to do better with less sensitive settings (big excursions).
 - We can change the weight of the vote each algorithm gets. For example, longer-term excursions are more important (because they are big excursions and more theoretically worrisome).
 - We can change the number of votes required for each alert level.



Future Overdose Alert Program Planning

Future Planning: Alert Protocol



Future Planning: Putting Data to Action

- Deploy trained outreach staff from the Community Assistance Program and Office of Homeless Solutions to hotpots.
 - Narcan kits
 - Connections to treatment
 - Referrals to services
- Establishing new naloxone distribution centers in targeted areas.
- Sharing alert information with community partners.
- Increase prevention initiatives in key areas.
- Ability to analyze shifts in overdose patterns overtime and tailor responses to particular populations to increase effectiveness.



Any Questions?

Extra Slide 1: Comparison of Old and New Methods

Method	Unique Counts	Total Count	
		2024	
Current StDev Method		4	19
Updated StDev Method		6	26
Weighted Poisson Method		8	28