Health: Drug Overdose in USA

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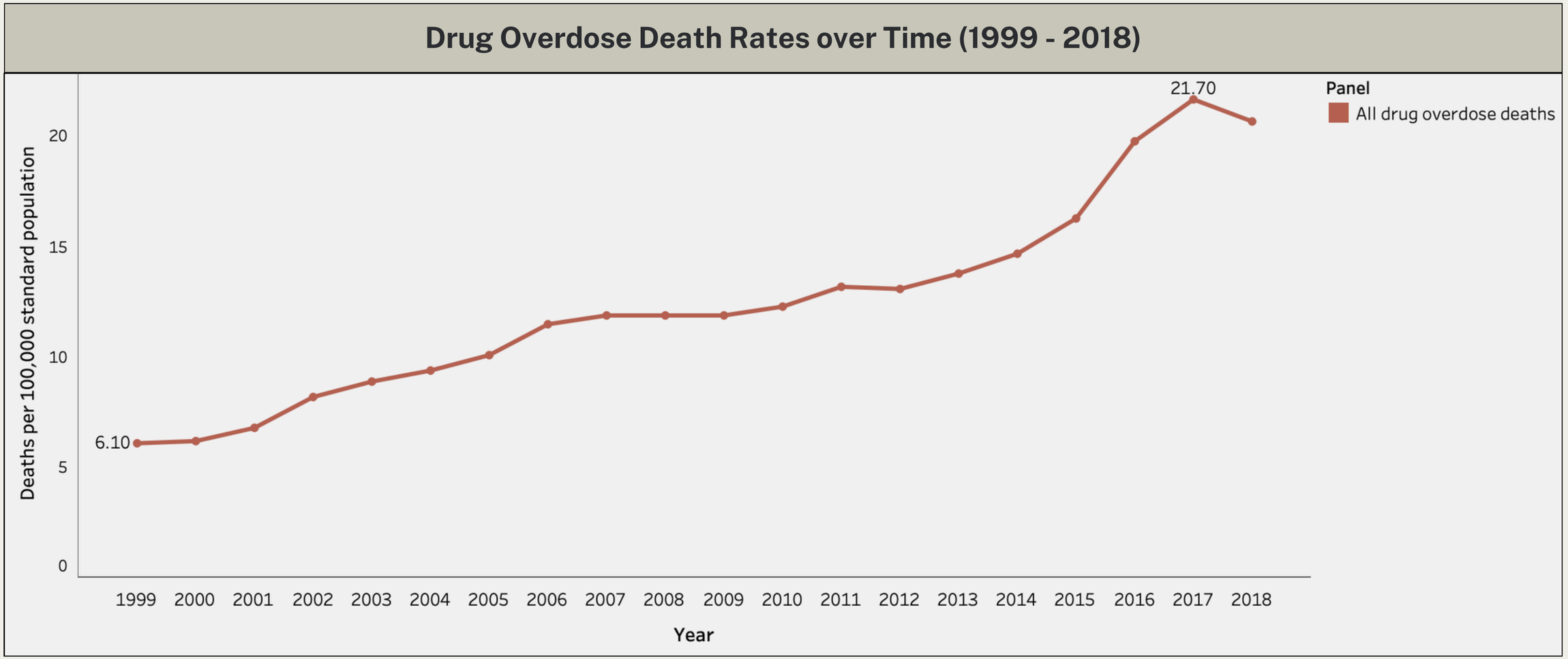
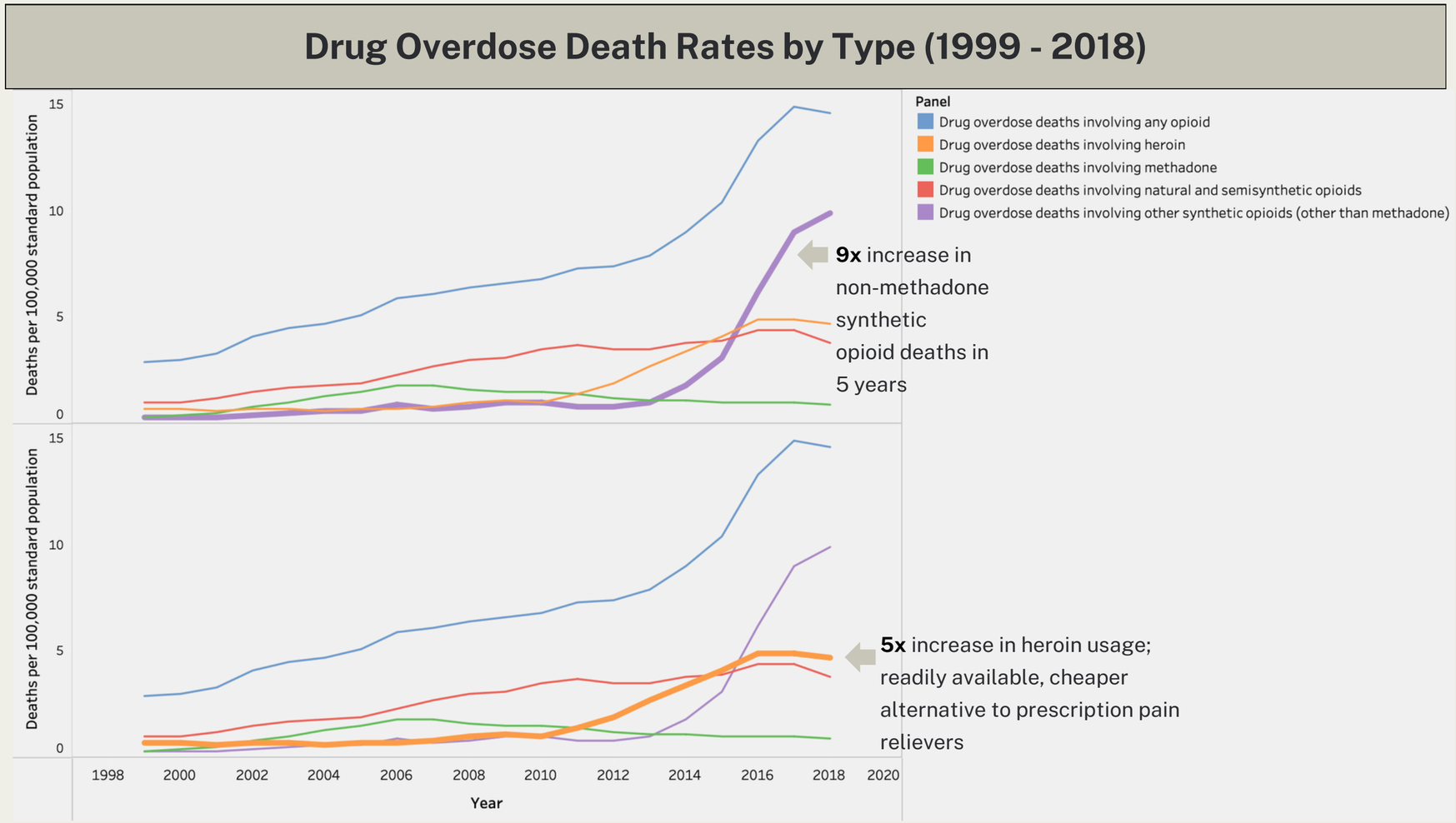
DRUG OVERDOSE IS ON THE RISE...



Overall, deaths due to drug overdose have increased **250%** over the last two decades

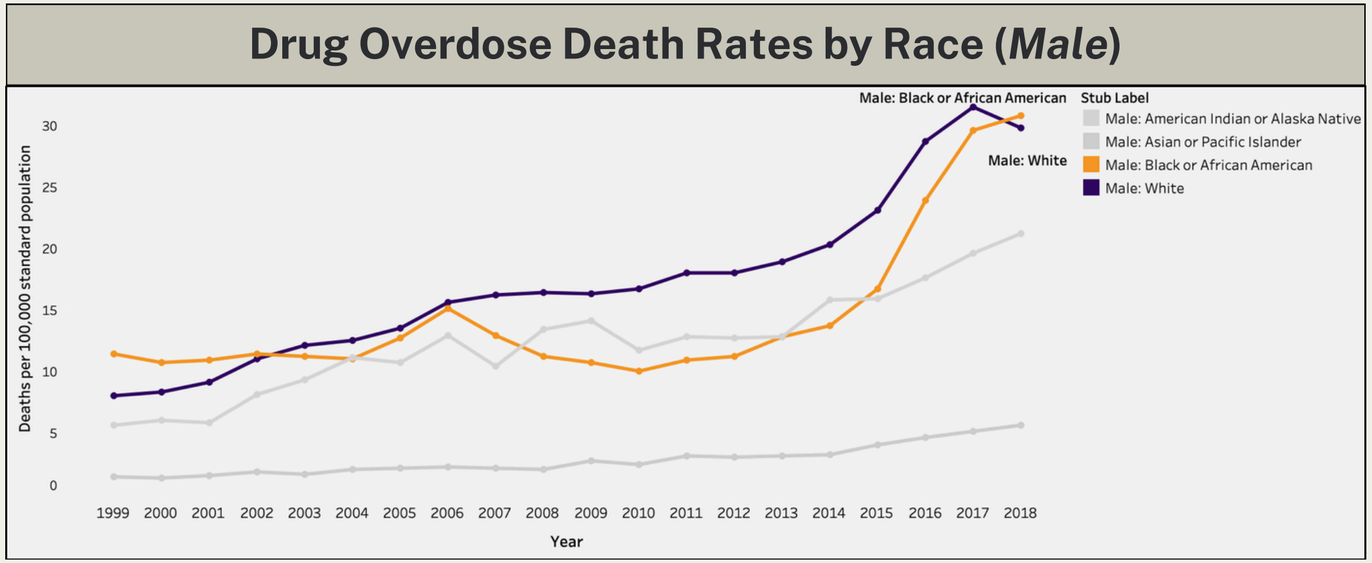
SYNTHETIC OPIOIDS ARE THE KILLER!

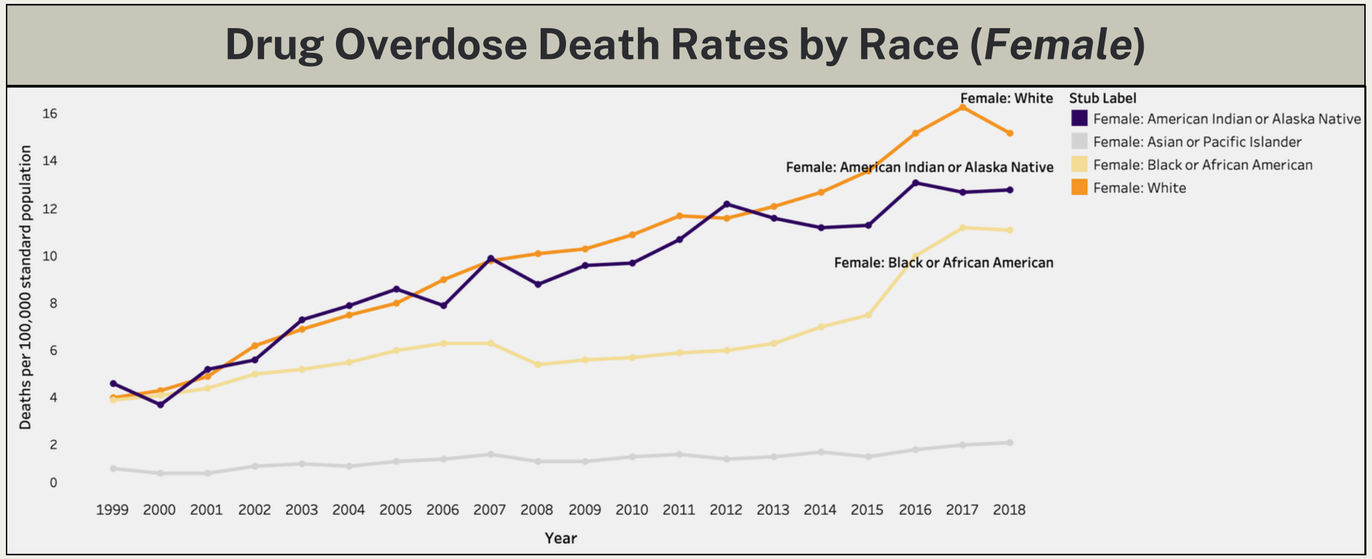


Synthetic opioids other than methadone (primarily **fentanyl**) have seen a sharp increase since 2013

Deaths due to **heroin** rose rapidly from 2010 to 2016

WHICH RACE AND SEX IS AT HIGHEST RISK?





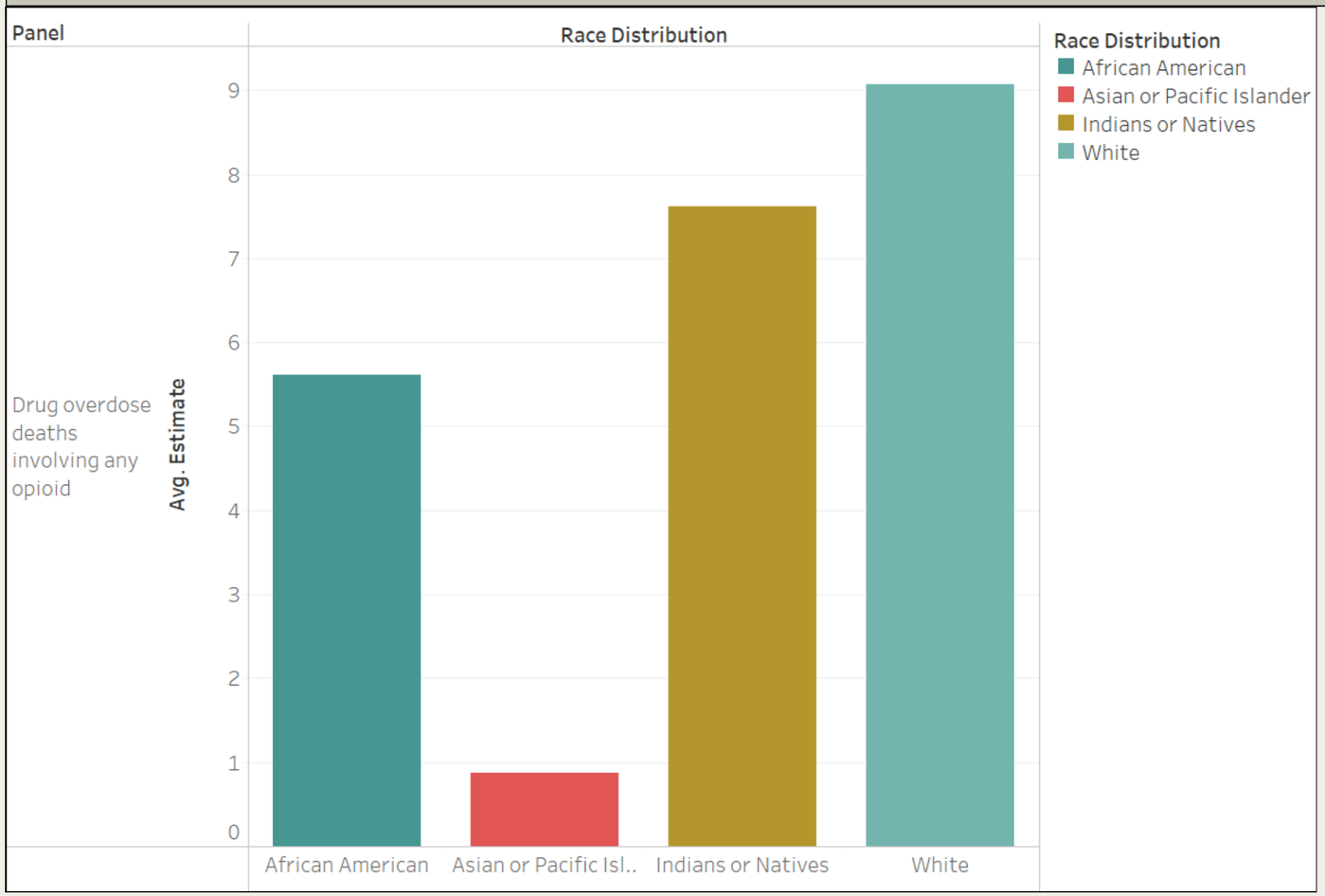
Black or African American males are at highest risk of death due to drug overdose, followed closely by **White** males

In case of females, **White** females are at highest risk of death due to drug overdose, followed by **American Indian or Alaska natives**

Asian or Pacific islanders are significantly less likely to die due to drug overdose for both males and females

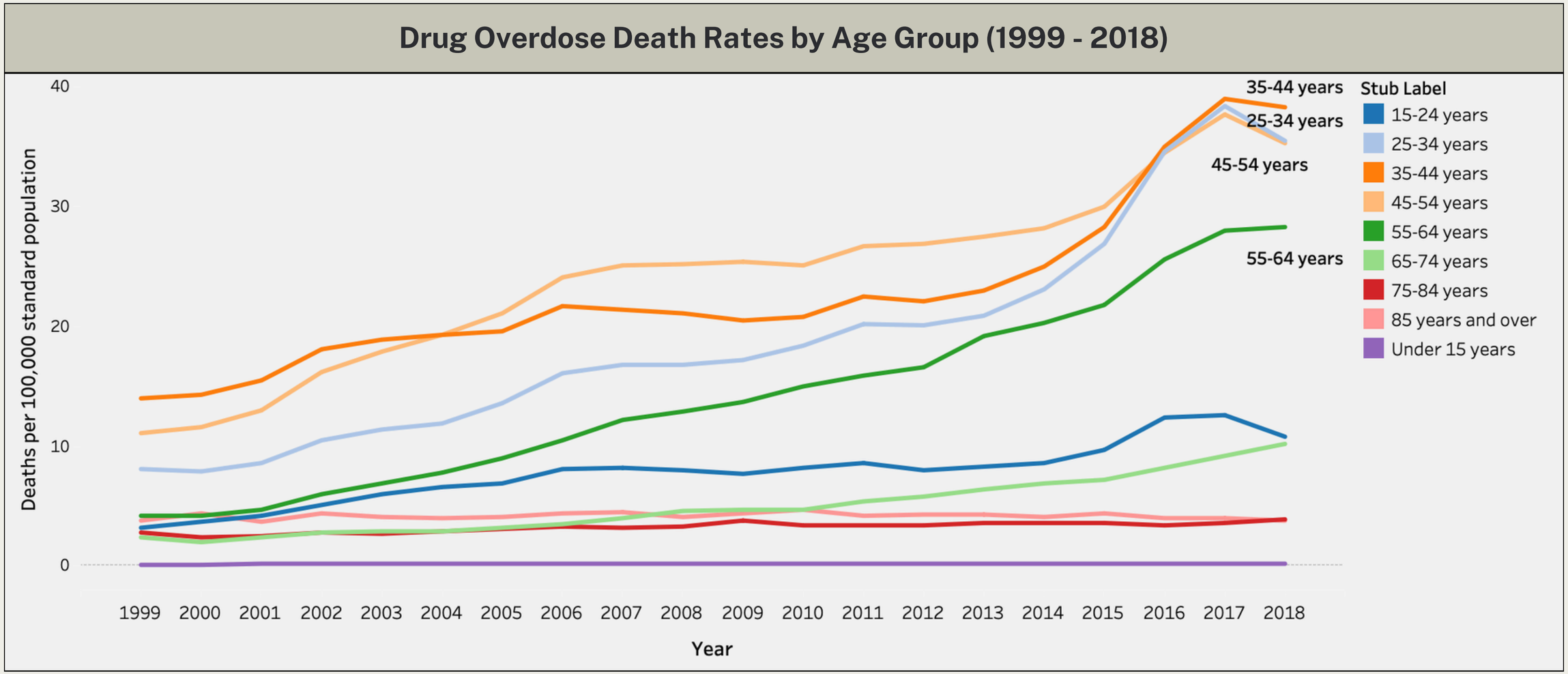
WHICH RACE AND SEX IS AT HIGHEST RISK?

Drug Overdose Death Rates by Race (1999 - 2018)



A trend we can see with respect age is that White people are impacted the most by Opioid drugs with an estimate of **9.07%**. Socioeconomic factors and the prescription **Opioid epidemic** are some of the major contributors to this stat (Cicero & Ellis, 2017).

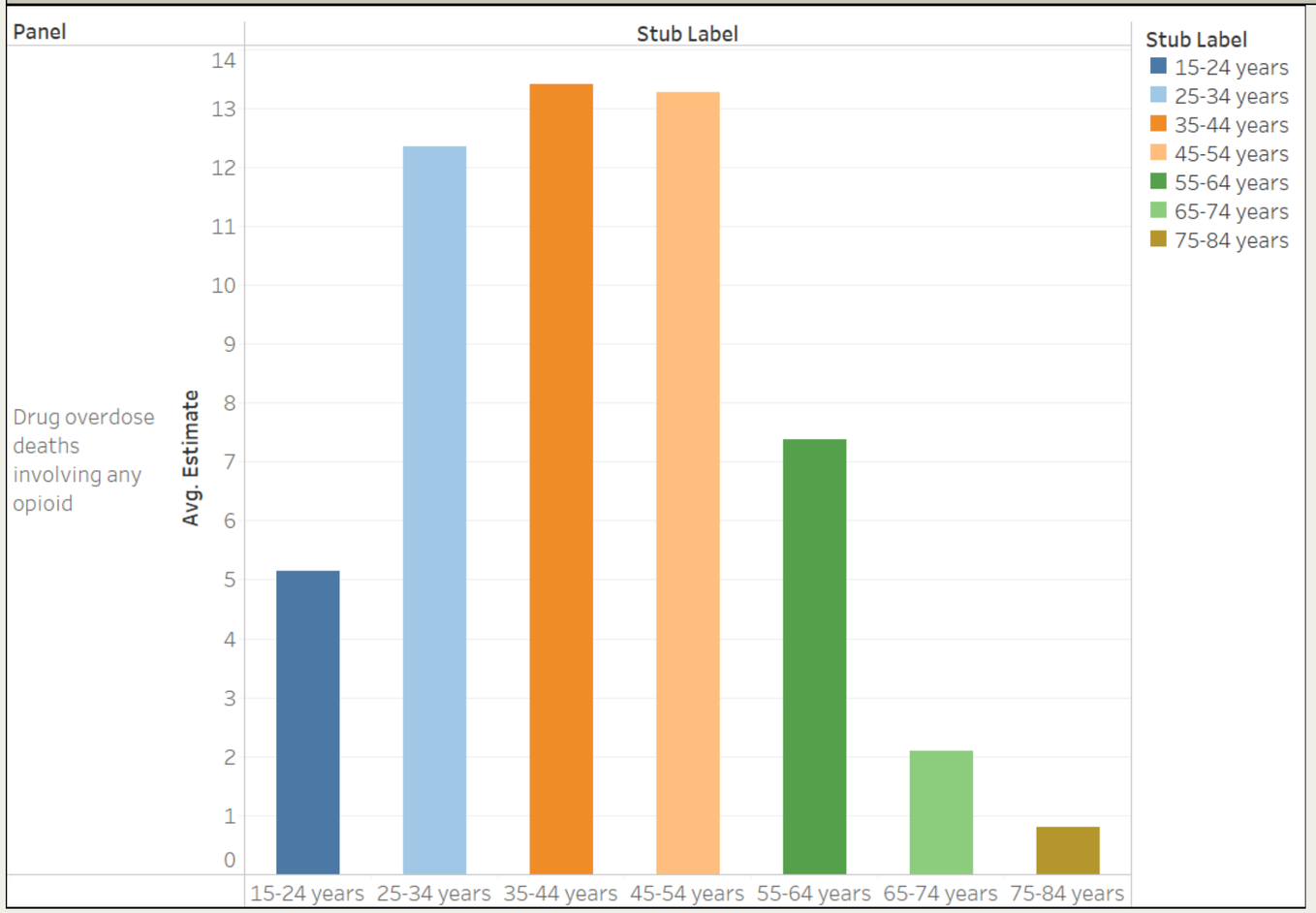
IS AGE A FACTOR FOR OVERDOSE DEATHS?



Individuals with ages ranging from **25-54 years** have significantly higher death rates compared to other age groups, with a **10% avg YOY increase**

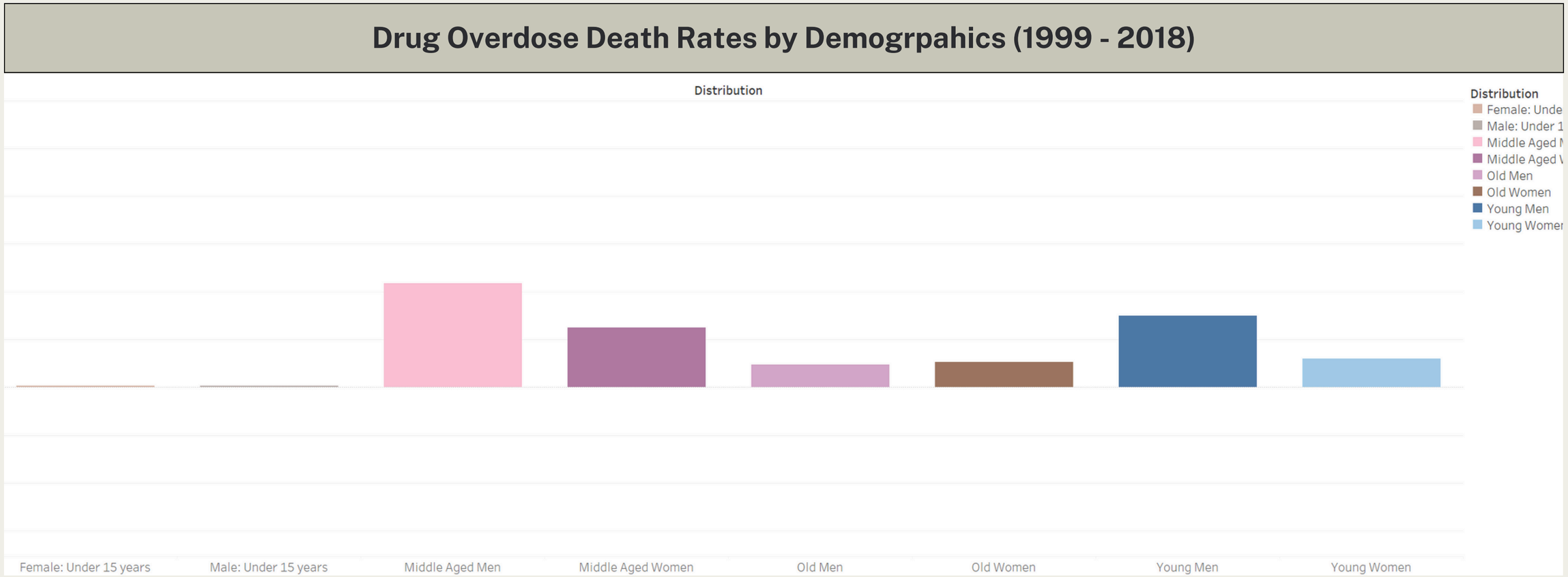
IS AGE A FACTOR FOR OVERDOSE DEATHS?

Drug Overdose Death Rates by Age Group (1999 - 2018)



The age group most affected by Opioids are the middle aged group of 35-44 years of age with an estimate of **13.40%**. Factors in interplay here including access to money through various types of income and their own personal network.

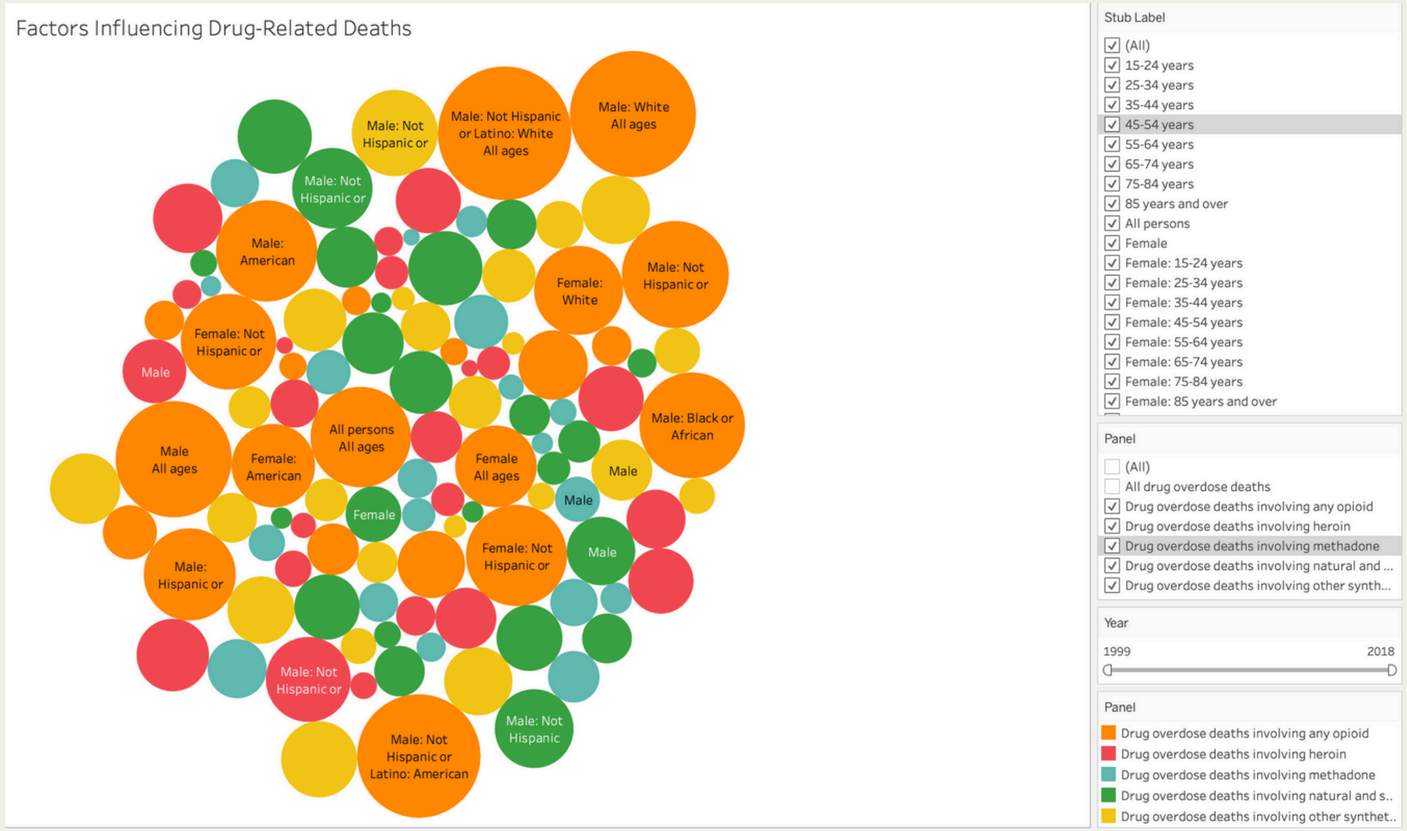
WHO DOES DRUG OD AFFECT THE MOST?



Middle aged men are the most susceptible to death by drug overdose with an estimate of **10.85%**. There are multiple factors why this can be **social stressors** and **chronic loneliness** (Choi & Lee, 2022). There is also a ground for underestimation of risk of exposure to hard drugs in the society for middle aged men where younger men are considered more venturesome.

FACTORS AFFECING DRUG OVERDOSE DEATHS

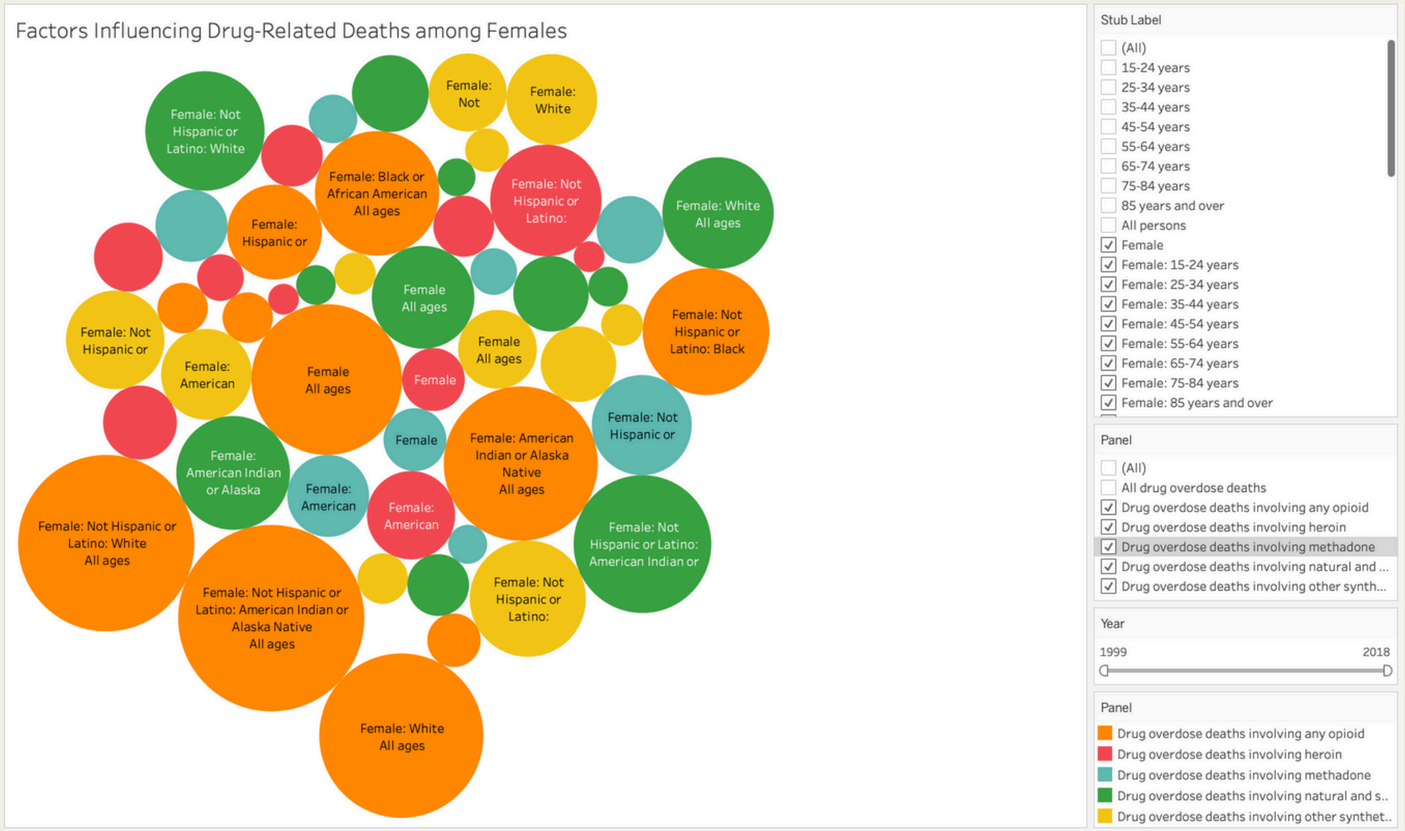
Major Factors Affecting Drug OD Deaths (1999 - 2018)



By leveraging factors such as Age, Sex, and Race, we notice higher death rate averages in **Males: Not Hispanic or Latino: White** in the age group **35-44 years** due to drug OD, especially **Opioids.**

FACTORS AFFECING DRUG OVERDOSE DEATHS

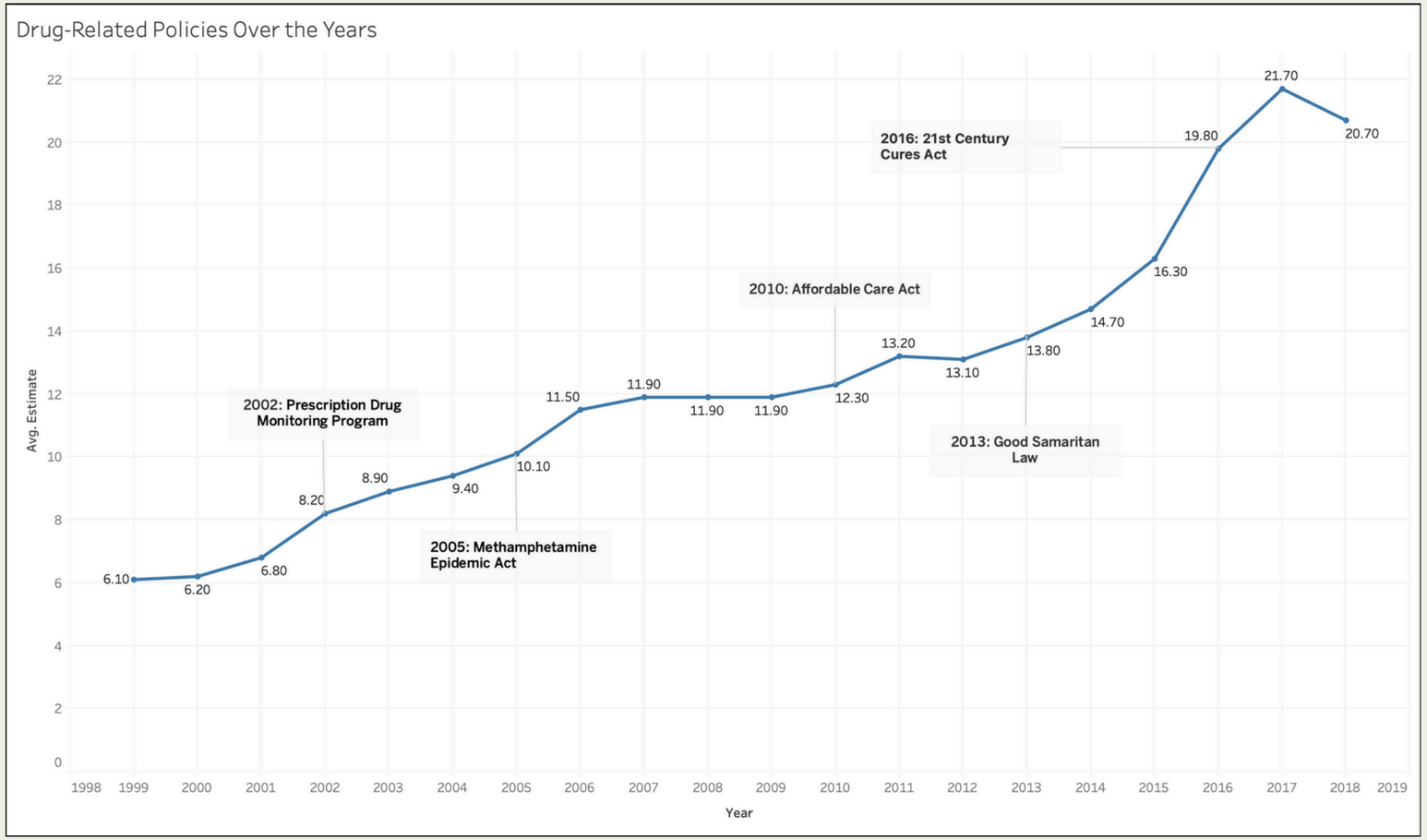
Major Factors Affecting Drug OD Deaths amonsgt Females (1999 - 2018)



However, for Females, the higher average deaths fall between the age group of **45-54 years** and females who are **not Hispanic or Latino: American Indian or Alaskan Native**, who are also victims to Opioid overdose.

WHAT ROLE DO POLICIES HAVE TO PLAY?

Timeline of Drug-Related Policies over the Years

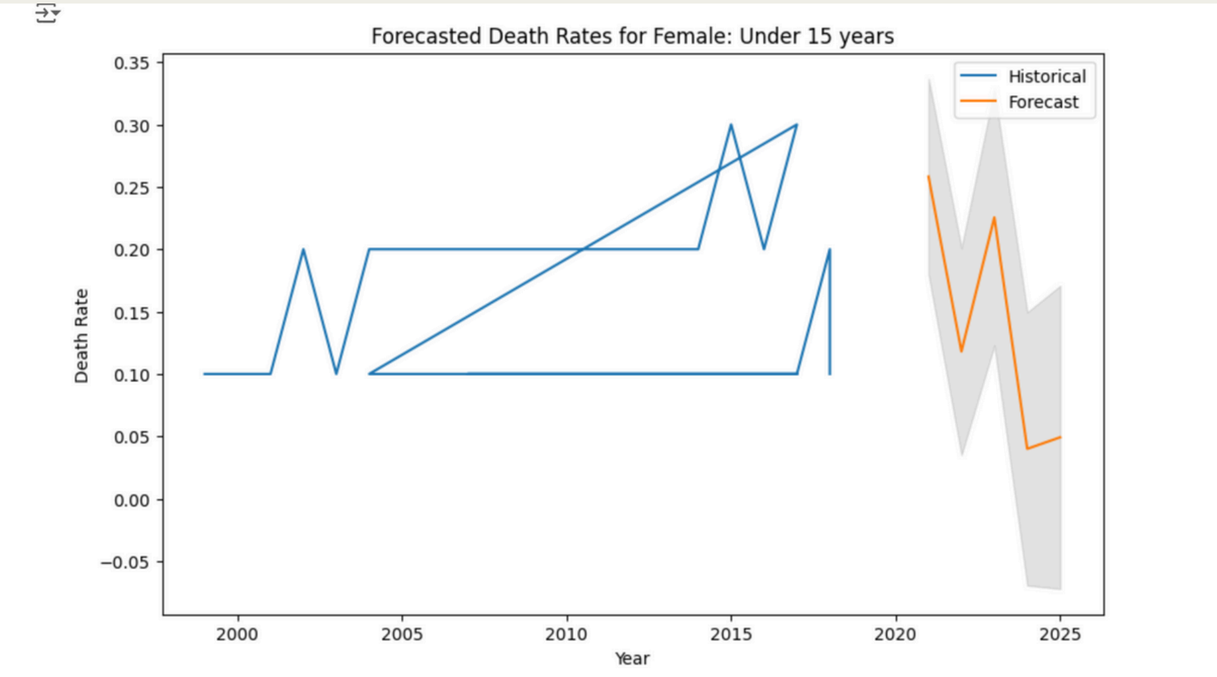


Based on various drug-related policies introduced over the last two decades, we found these policies relevant to causing sudden spikes (increase and decrease) in drug overdose deaths per 100,000 standard population.

FORECASTING FUTURE DEATH RATES

Forecasted Death Rate for Females under 15 years

The model generates some interesting forecasts when we use SARIMAX for forecasting the ESTIMATE variable by grouping the data according to each demographic group. The data was forecasted for 2020 through 2025. Let us look at these graphs and the insights:

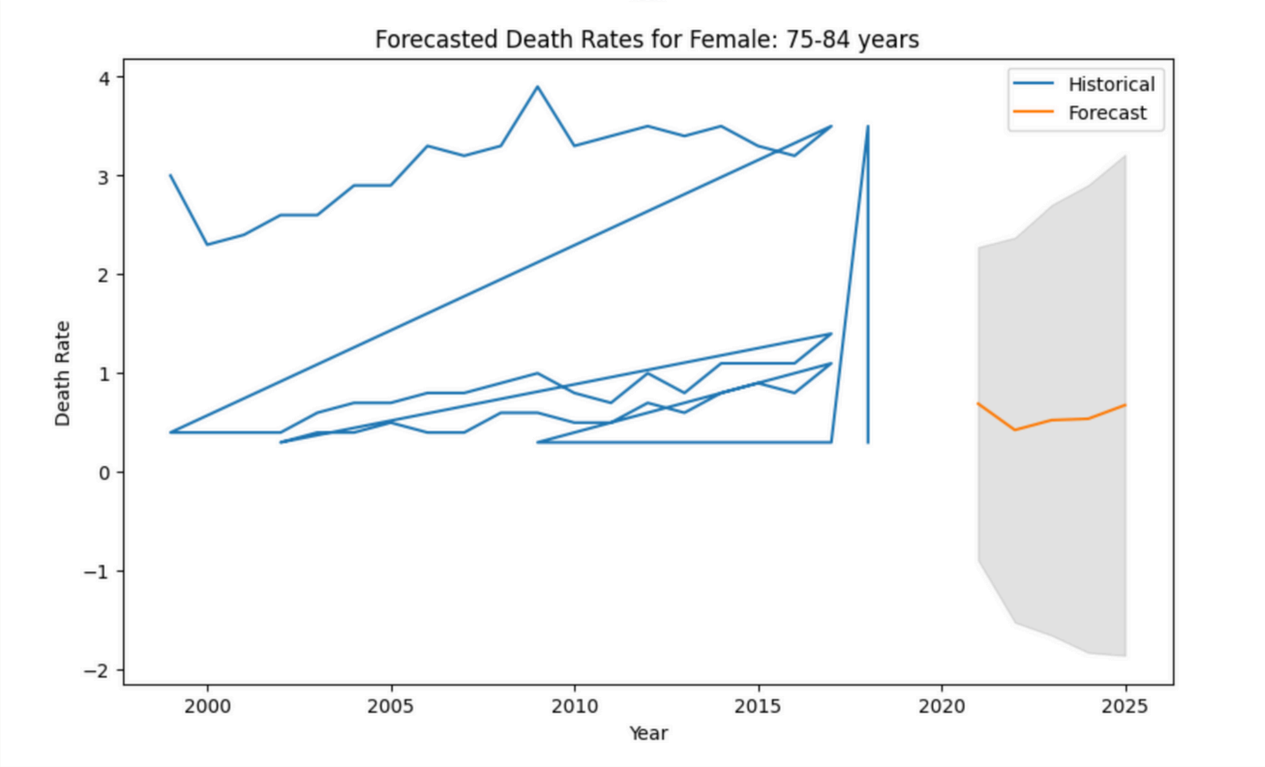


We can see that the forecast predicts the rate to follow a downward trend with a sudden increase in 2022 before going down again.

We can compare this with the data from these years to see if how accurate our predictions are.

CREATING A CONCERN METRIC

Forecasted Death Rate for Females under 15 years



We can see that our model predicts the deaths for females aged between 75-84 years of age to follow an increasing pattern.

This indicates a concerning factor for the government for that particular group.

The government can use the predictions from this forecast model as the metric for identifying which groups are at risk.

USING ML MODELS TO PREDICT DEATH RATES

Model Performances

We implemented Machine Learning to predict the estimated death rates according to input features like age, sex, demographic group and drug type.

The model which we used was Random Forest and XGBoost Regressor. For the one with RFR, we implemented cross validation as well. Unexpectedly, the model having cross validation and grid search (the random forest) did not outperform the XGBoost Model.

Model Performance of the RF Regressor

```
Mean Squared Error on Test Set: 0.8600580420922549
R-squared on Test Set: 0.9803573438554029
Predicted values: [29.603   1.1215  7.795  ...  9.073
Actual values: [30.   1.2  8.  ...  9.2  4.9  2.9]
```

Model Performance for XGBoost

```
Mean Squared Error: 0.6680555911548113
R-squared: 0.9835815243678683
Predicted values: [2.9496555e+01 1.9709074e+00 8.5574255e+00 ... 4.4600625e+00 4.4157432e-
 1.3998526e+01]
Actual values: [30.   1.2  8.  ...  4.4  0.1 14.7]
```

REFERENCES

All Citations

1. Choi, Hye-Sueng & Lee, Jong-Eun. (2022). Factors Affecting Depression in Middle-Aged and Elderly Men Living Alone: A Cross-Sectional Path Analysis Model. doi: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8864270/
2. Cicero, T & Ellis M. (2017). The prescription opioid epidemic: a review of qualitative studies on the progression from initial use to abuse. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5741109/