Simulating Strategies to Prevent Opioid Fatalities: Findings from a System Dynamics Model for the State of Connecticut

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Disclaimer

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Connecticut SD Modeling Process and Aims

We developed a System Dynamics (SD) model for Connecticut in support of a pilot study which seeks to expand access to medication for opioid use disorder (MOUD) treatment in the state and advance understanding of potential strategies to reduce opioid-related morbidity and mortality.

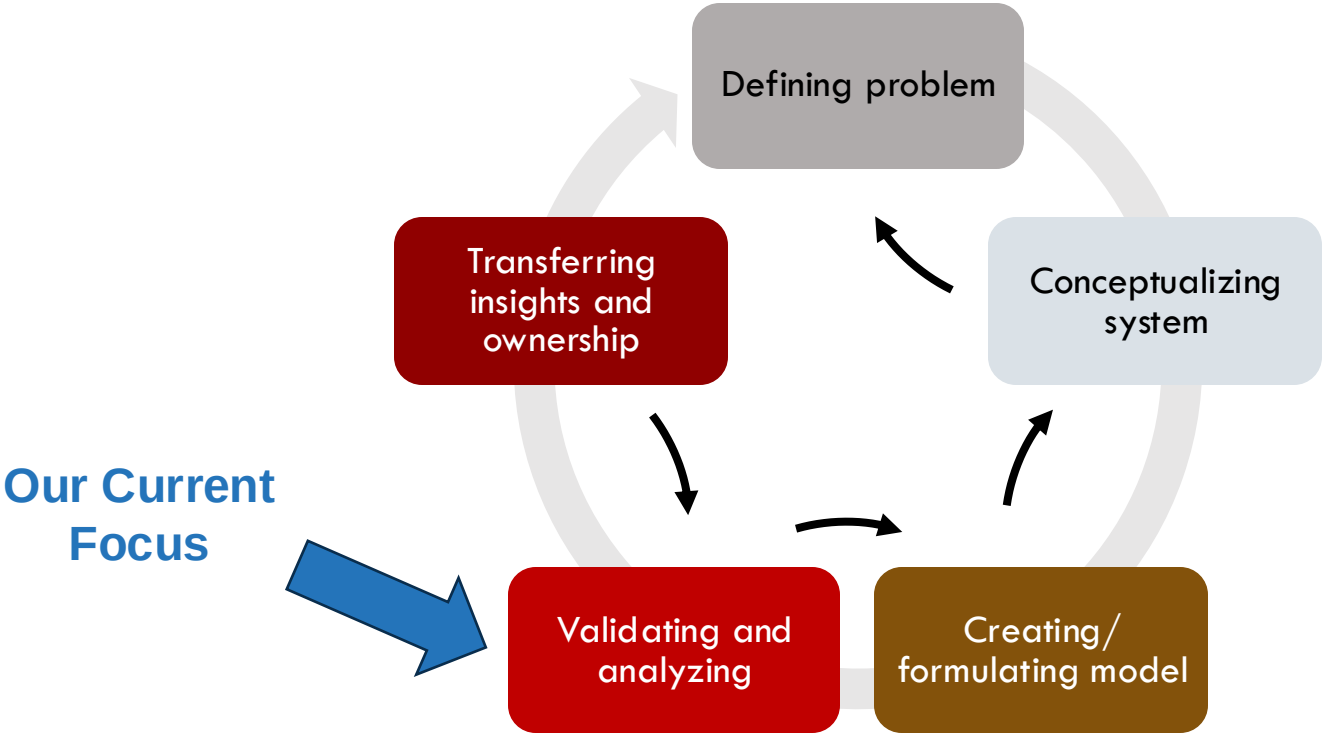
The use of SD models allows us identify the leverage points, root causes, and drivers of opioid overdose and fatality rates using model structure previously developed and validated for New York State.

Opioid Use and Overdose in Connecticut is a Complex Problem

The environment around opioid use disorder (OUD) and overdose in the State of Connecticut is rapidly changing:

- Reductions in rates of opioid overdose have been observed in the state, which had increased over 40% from 2017 to 2022 (CDC Wonder), but have shown a significant decrease in preliminary data reporting for 2023
- Treatment availability in the state is widespread but treatment program census remains largely unchanged since 2017 (as reported by CT Department of Mental Health and Addiction Services)
- Changes in the illicit drug supply have occurred, including increased detection of Xylazine and Fentanyl (Quijano, 2021)

SD Modeling is Iterative



SD allows us to:

- Synthesize and integrate multiple data sources,
- Mitigate data limitations and uncertainty
- Allow for virtual experimentation

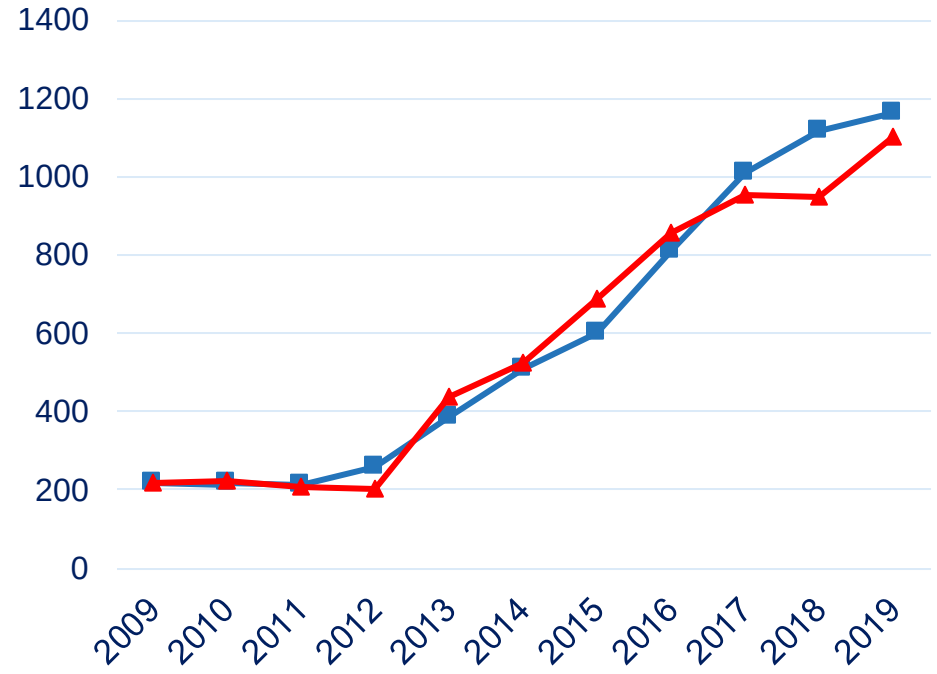
Data Obtained for Calibration

Unique data series were obtained from state agencies and institutional partners to calibrate the model to historical data.

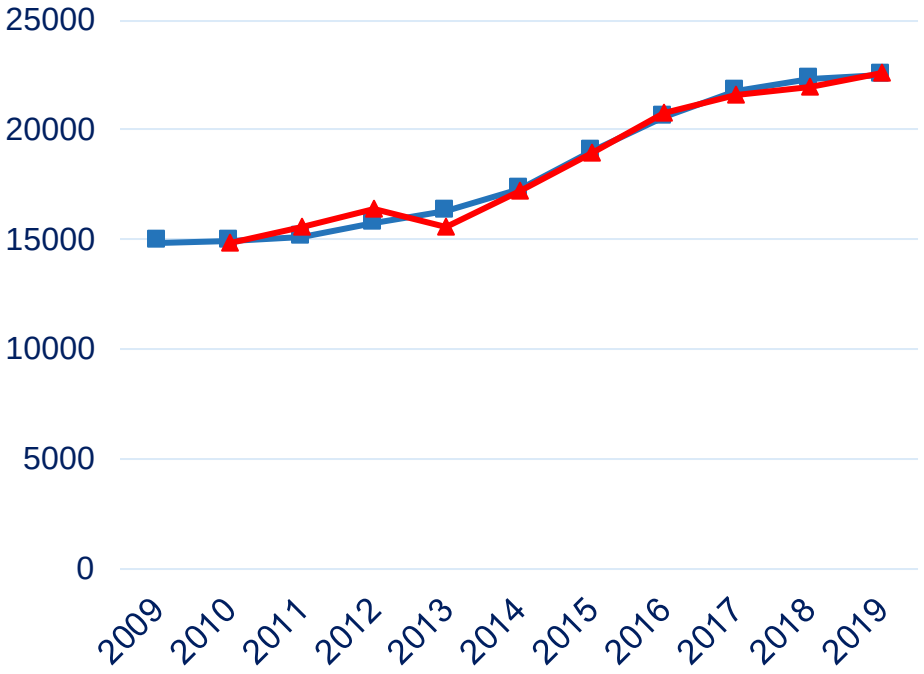
Name	Data Obtained	Years
Connecticut Office of the Chief Medical Examiner	Annual Overdose Deaths	2009-2023
Connecticut Department of Mental Health and Addiction Services	Treatment Episodes for Medication-based and behavioral treatment	2009-2022
Wake Forest Data Infrastructure Support Center (DISC)	IQVIA Retail Pharmacy Data on dispensing of opioid medications for pain and OUD, including Naloxone	2017-2022
Connecticut State Department of Public Health	Naloxone kit distributions	2016-2022
Connecticut Hospital Association	ED Visits or Hospitalizations for Opioid Overdose	2013-2019

Connecticut Base run Simulation Compared to Historical Data

Annual Opioid Overdose Deaths



Total Patients Receiving MOUD at SUD Centers



Simulation Historical Data [CT DMHAS[1]

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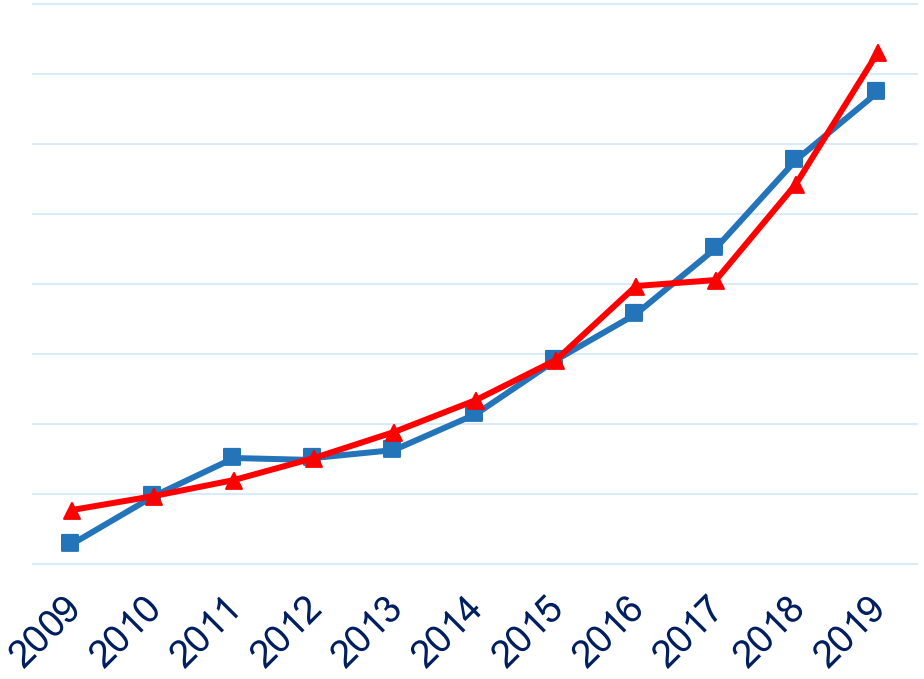
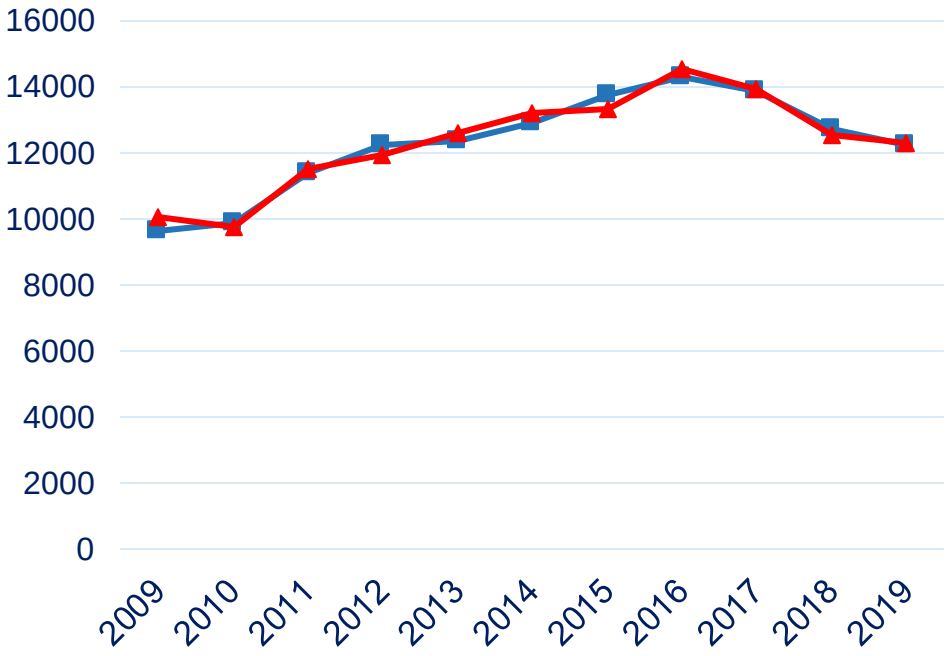
Connecticut Base run Simulation Compared to Historical Data

Total Annual Naloxone Dispensed



Annual Discharge of Patients Receiving Non-MOUD Detoxification Treatment



Simulation Historical Data [CT DMHAS]

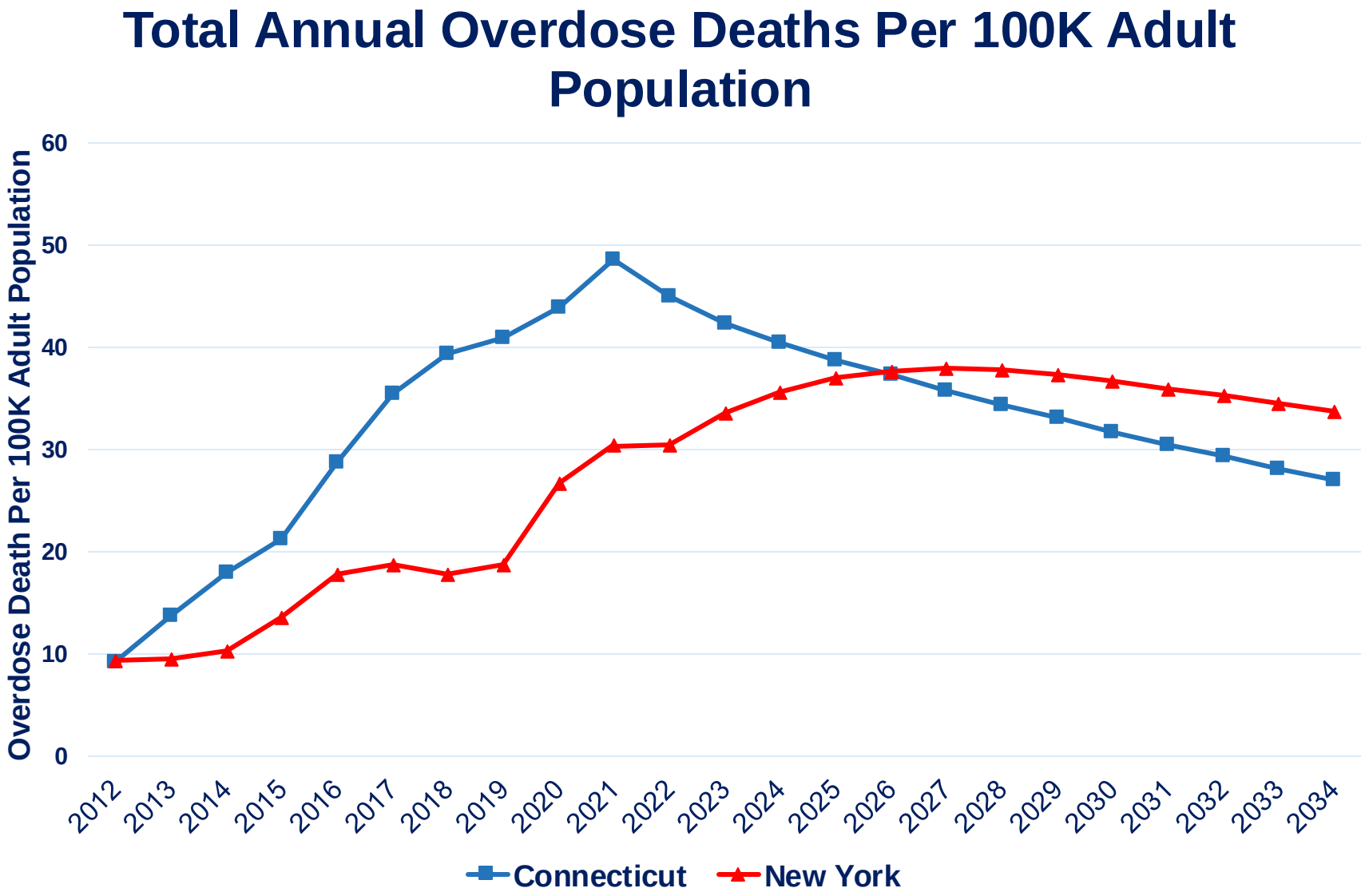
Opportunity for State-Level Comparisons

Both the NY and CT models simulate key dynamics that affect people who use opioids, including opioid supply, drug potency, treatment for opioid use disorder, and naloxone administration.

In order to explore key differences in the two states, we compared the results for Connecticut with the model SD developed previously for New York State.

This allowed us to further evaluate our modeling approach and test the generalizability of our model structure for different settings.

Comparison of Connecticut and New York:



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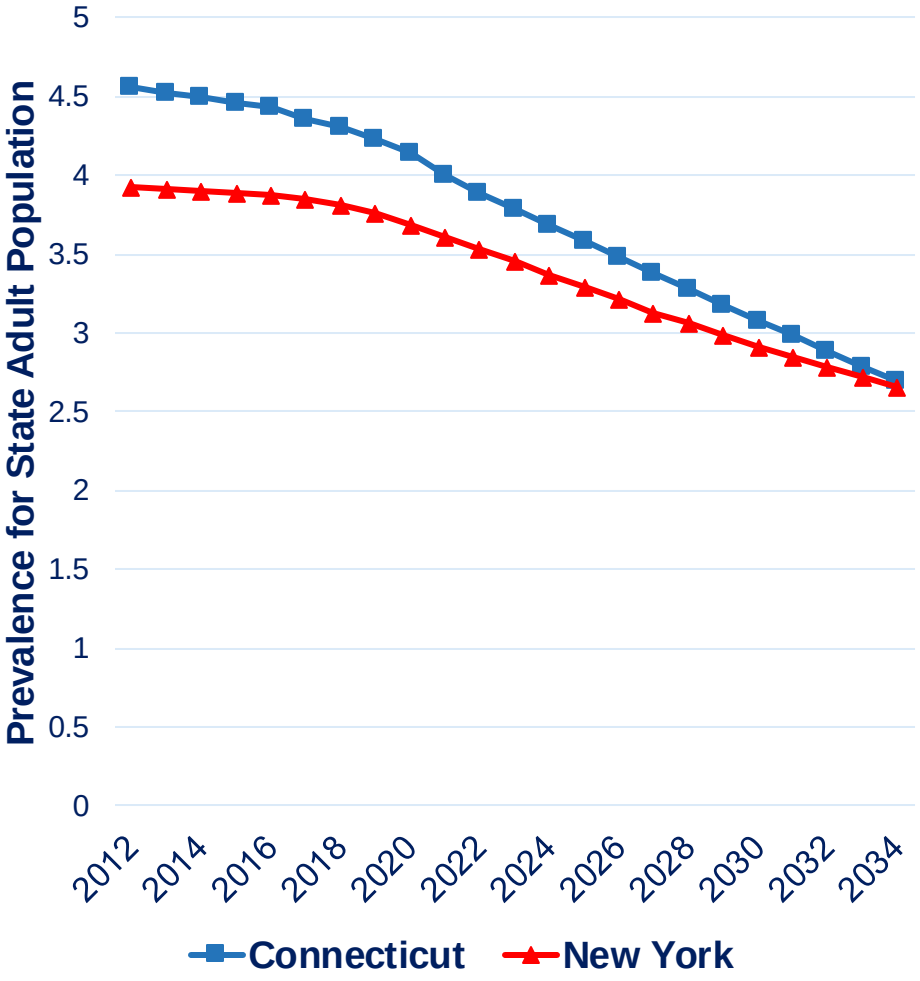
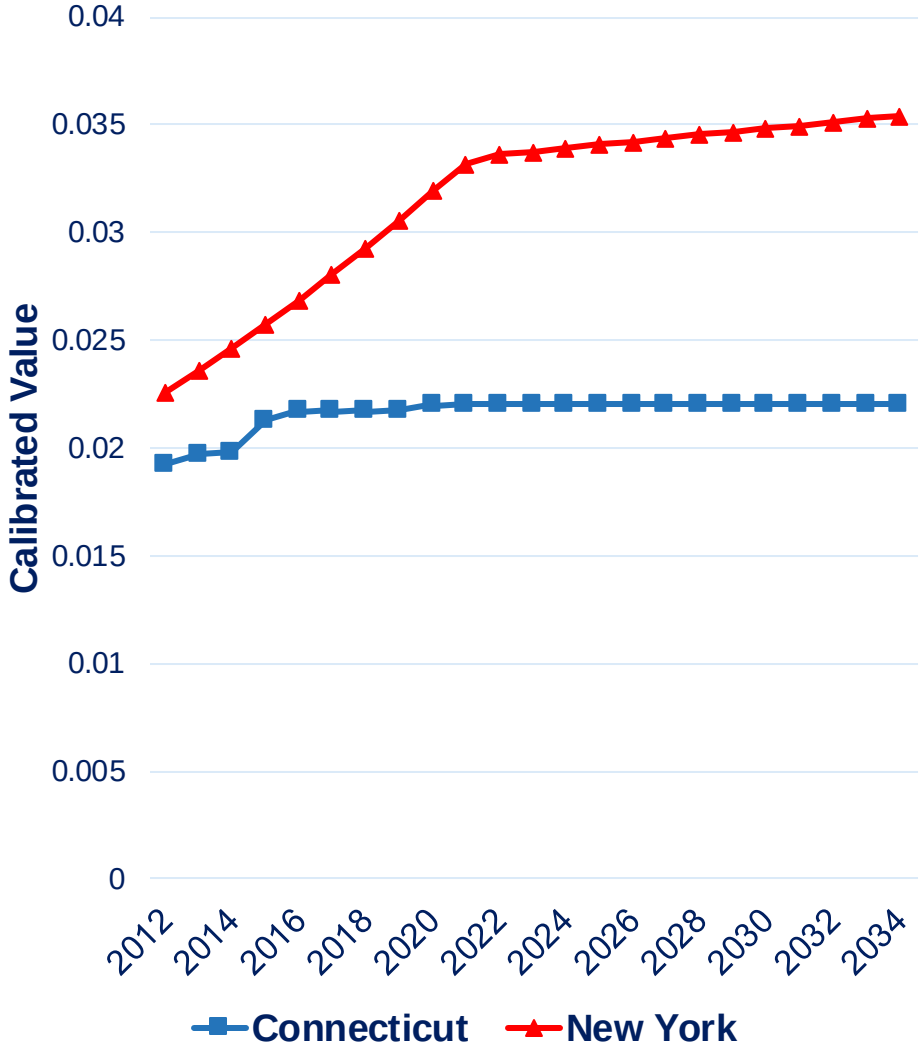
Actual OUD Prevalence Estimated



Risk of Overdose Fatality



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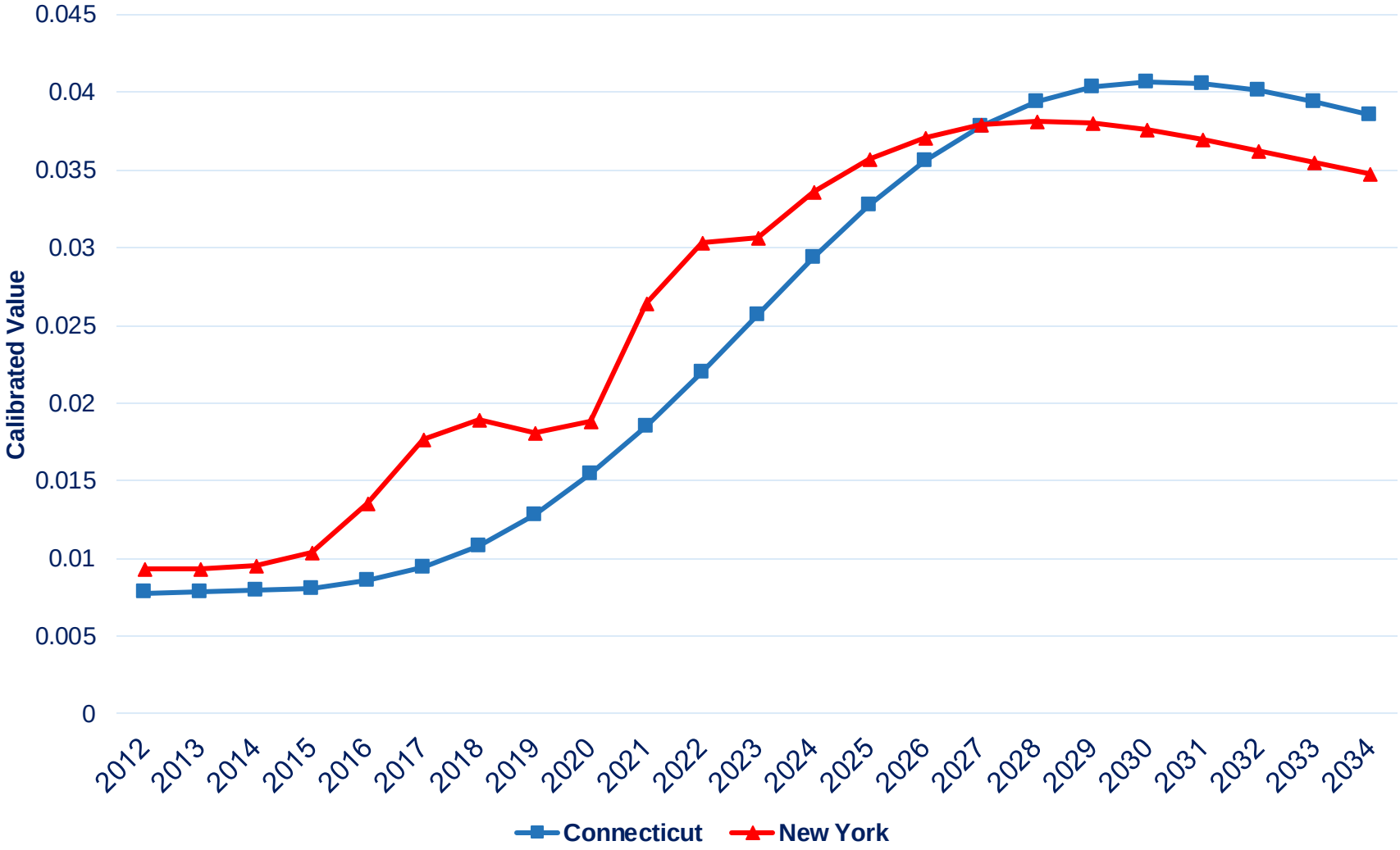
Community Awareness of Risks of Opioid Use



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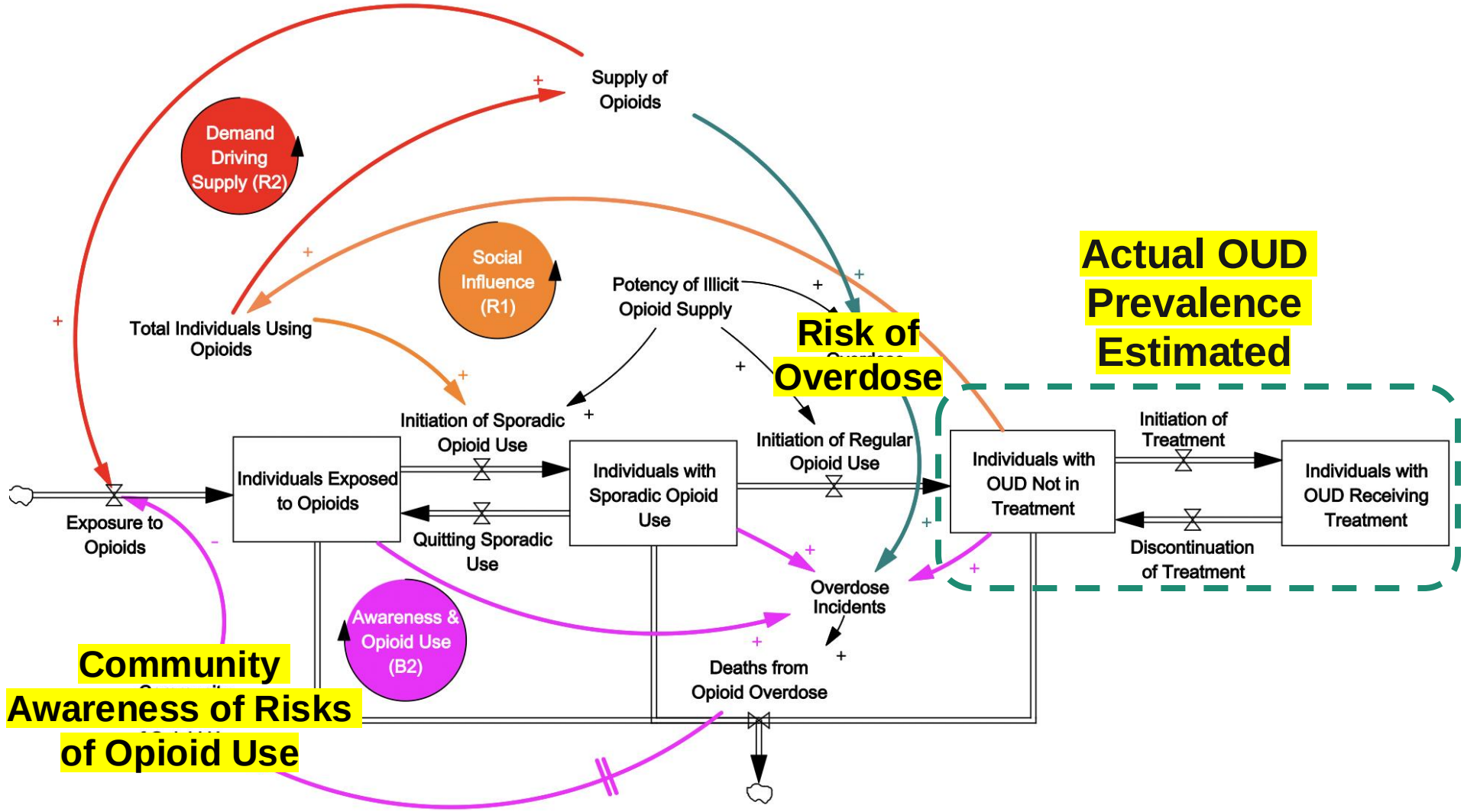
Discussion – Why are we Seeing These Differences?

The simulated trends outlined in the previous graphs describe potential scenarios for CT and NY and help illustrate the feedback loops that drive each model's behavior including the following:

- Drug supply, potency, and overdose risk
- Treatment availability
- Community awareness of the risks of opioid use

These feedback cycles give us a preliminary understanding of how each state has performed in addressing the effects of opioids, and potential sectors where the interventions may have an impact.


Supply of Opioids
Demand Driving Supply (R2)
Social Influence (R1)
Total Individuals Using Opioids
Potency of Illicit Opioid Supply
Risk of Overdose
Actual OUD Prevalence Estimated
Initiation of Sporadic Opioid Use
Initiation of Regular Opioid Use
Initiation of Treatment
Individuals Exposed to Opioids
Individuals with Sporadic Opioid Use
Individuals with OUD Not in Treatment
Individuals with OUD Receiving Treatment
Exposure to Opioids
Quitting Sporadic Use
Discontinuation of Treatment
Overdose Incidents
Awareness & Opioid Use (B2)
Deaths from Opioid Overdose
Community Awareness of Risks of Opioid Use

Discussion – Key Takeaways

- Despite similarities in prevalence of OUD and population age, the results for CT and NY are largely heterogenous
- ‘Risk of Overdose Fatality’ and ‘Effective Overdose Rate’ diverge at an increasing rate after 2020
- The proportion of the population with opioid use disorder accessing medication-based treatment (MOUD prevalence) is higher in Connecticut, providing some indication of a potential treatment gap in New York
- Feedback effects on model behavior may be delayed at different rates, e.g. change in ‘Community Awareness’ may be slower to take effect in CT than NY, creating wider gaps in model behavior over time.

Thank you!

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