

Opioid Crisis and Mortality in the U.S. : When Quick Fixes Make Things Worse

Opioid Use Disorder Crisis in the United States
(actual data)

PROBLEM DEFINITION



Since the **late 1990s**, the U.S. has faced a growing opioid crisis driven by:

- Aggressive pharmaceutical marketing
- Widespread overprescription

In the 2010s, as legal access decreased:

- Many users transitioned to **illicit opioids** like heroin and fentanyl
- The crisis **intensified**, increasing health and social burdens

Despite public policy and healthcare interventions:

- The number of people with **Opioid Use Disorder (OUD)** remains **critically high**

By 2025, an estimated **6 million people** are living with OUD

Without **structural reforms** and **long-term investment** in:

- Treatment infrastructure
- Prevention and education

→ The number could exceed **10 million** by **2045**

Target (2045):

Reduce the OUD population to **below 3 million**

ACTORS

PROBLEM OWNER

US.GOVERNMENT

VICTIM 1

US.GOVERNMENT

VICTIM 2

Citizens

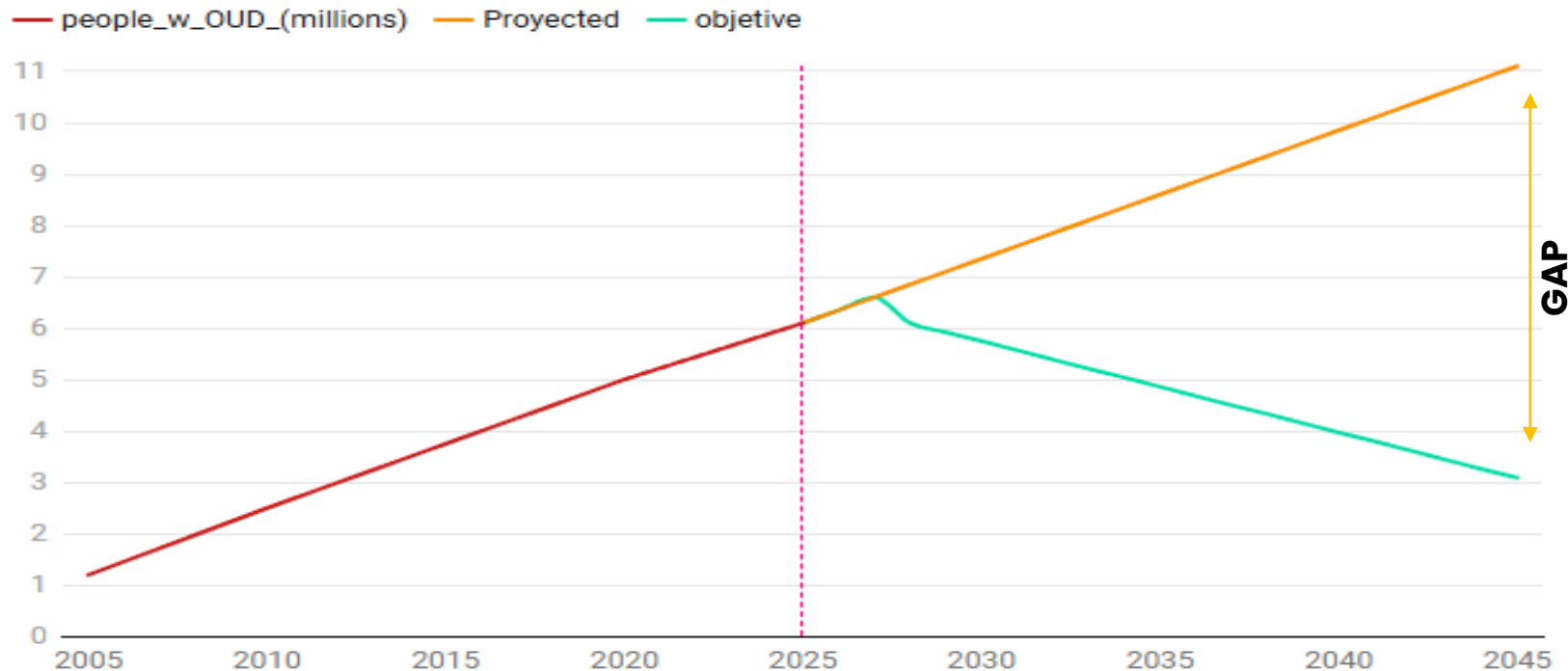


REFERENCE MODE – MAIN VARIABLE

People with Opioid Use Disorder (OUD) in the U.S.

TIME HORIZON: 20 years

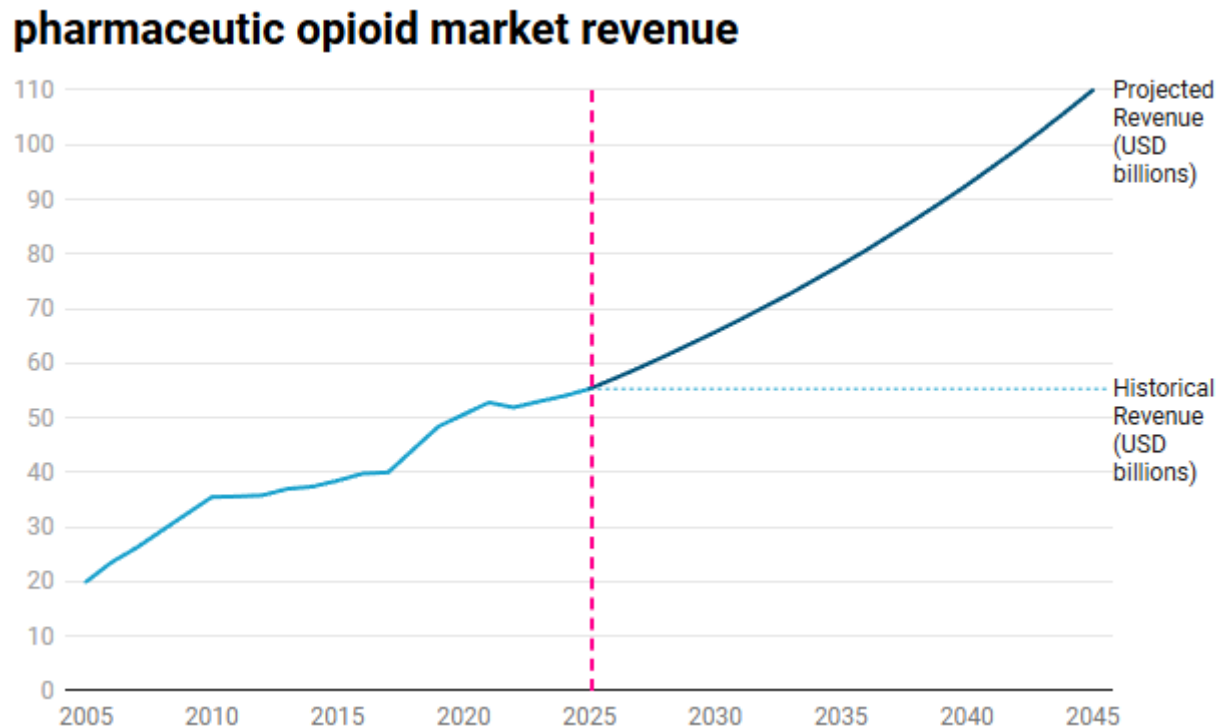
People with Opioid Use Disorder (OUD) in U.S



REFERENCE MODE – SECONDARY VARIABLE

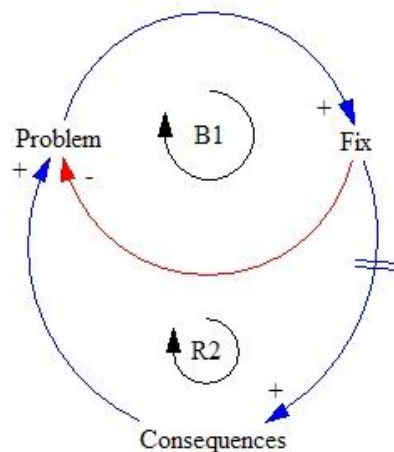
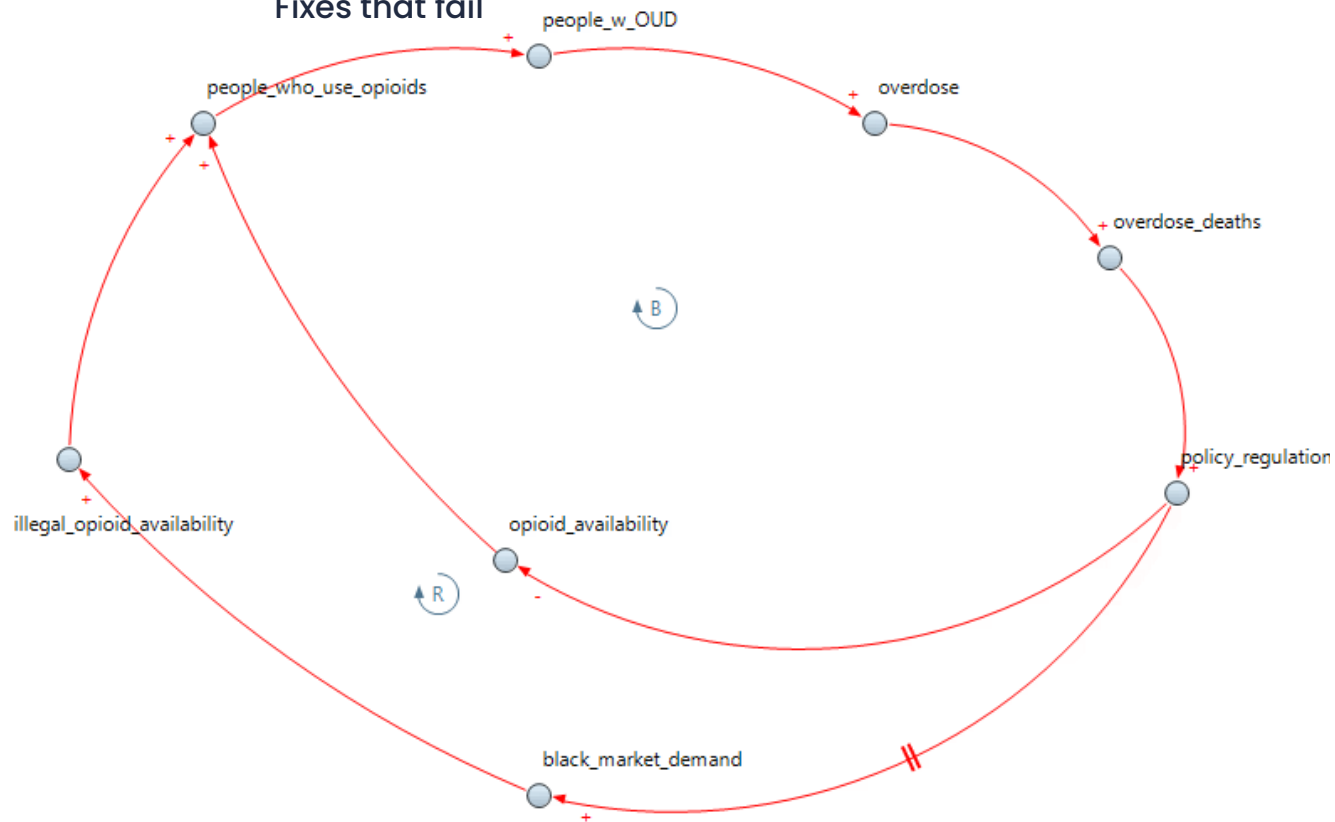
PHARMACEUTICAL INDUSTRY

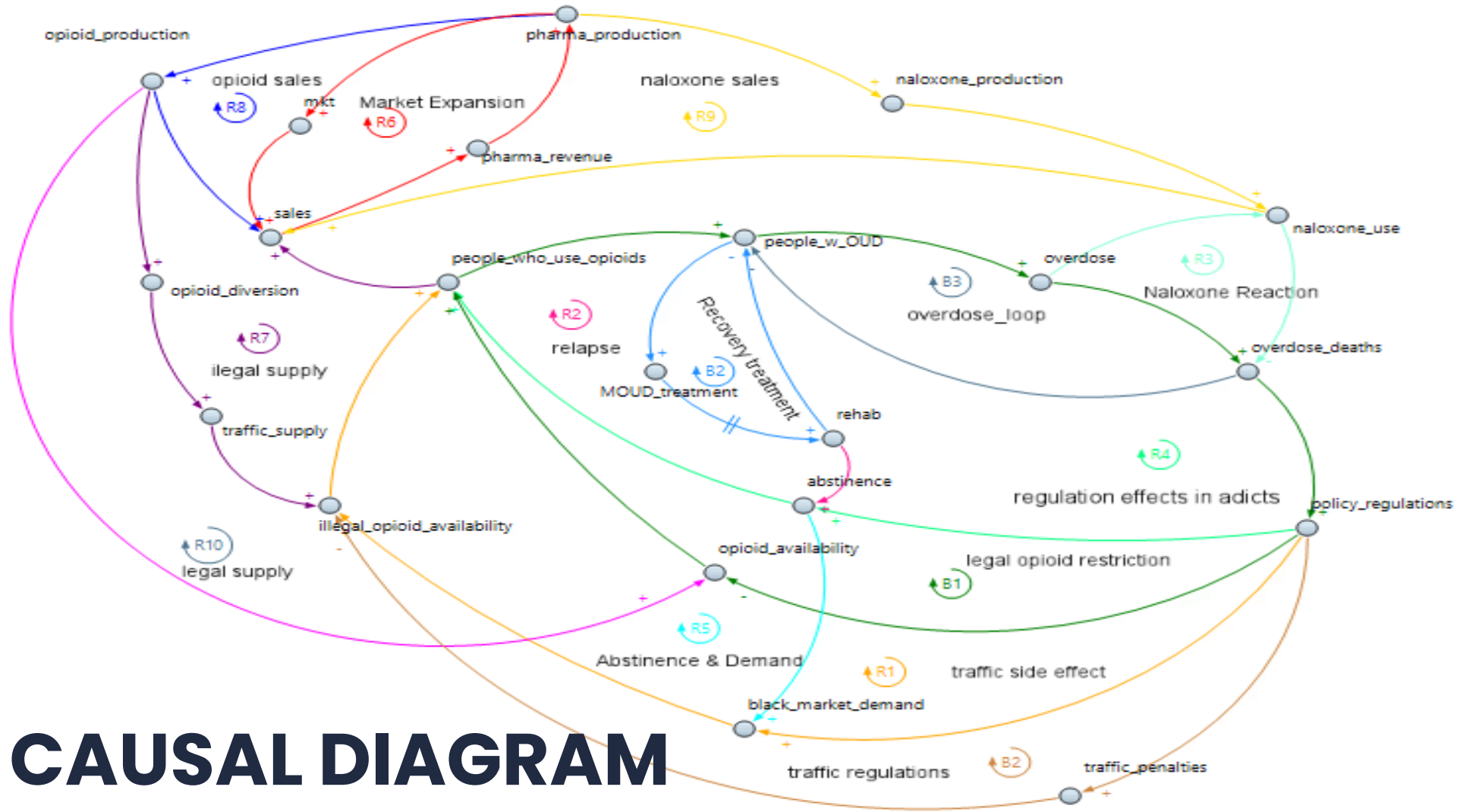
REVENUE



ARCHETYPE:

Fixes that fail





Loops On detail

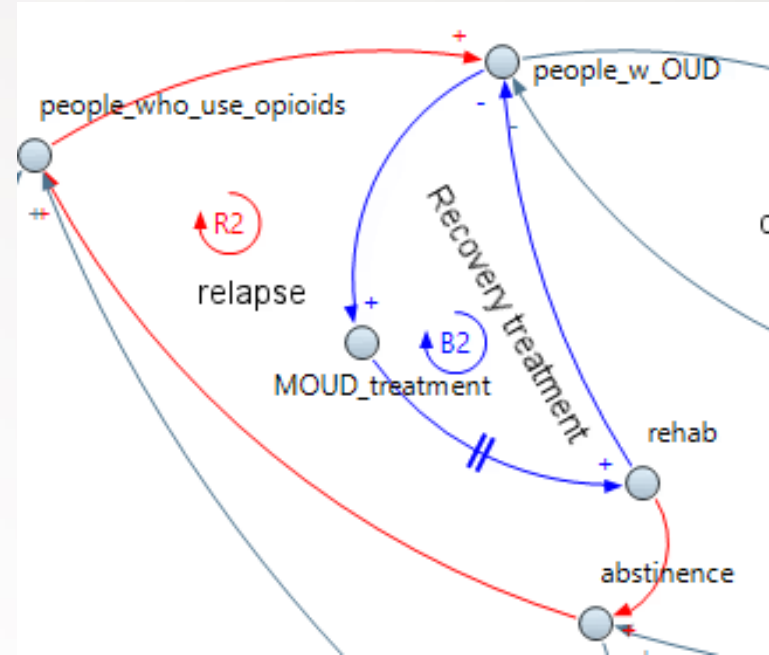
Sector: Recovery & Relapse Dynamics

•R – Relapse Loop

- More people with OUD → higher risk of relapse.
- Relapse increases the number of people who use opioids.
- This reinforces a cycle of use and re-addiction.

•B – Recovery Treatment Loop

- More people with OUD → more demand for MOUD treatment.
- MOUD increases rehab
- rehab decreases the OUD population, balancing the system.



Loops On detail

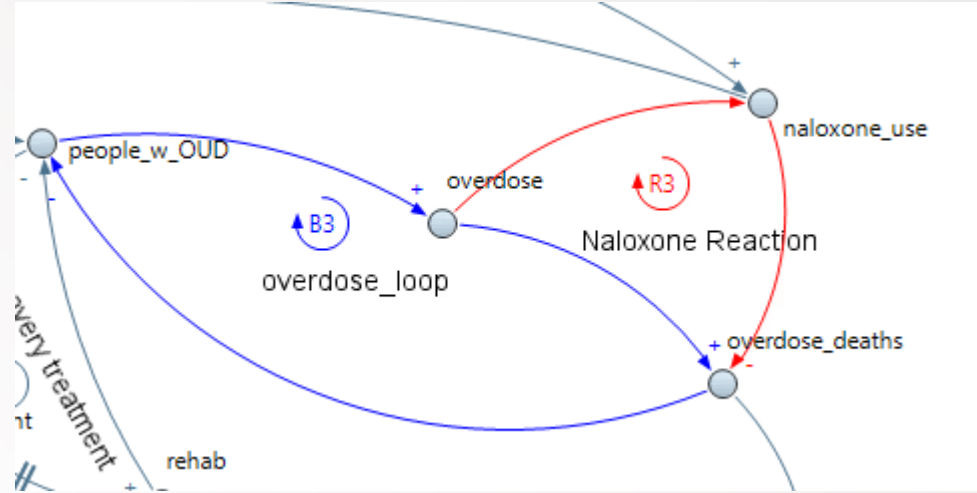
Sector: Overdose Response

•B – Overdose Loop

- More people with OUD → more overdoses.
- Overdose deaths reduce the stock of OUD.
- This loop limits growth through mortality.

•R – Naloxone Reaction

- Overdoses trigger naloxone use.
- Naloxone saves lives.
- Survivors remain in the system, reinforcing demand.



Loops On detail

Sector: Policy & Regulation Feedback

R – Regulation Effects in Addicts

- Overdose deaths trigger public pressure.
- Policymakers respond with new regulations.
- Policies affect opioid access and behavior.

B – Legal Opioid Restriction

- Regulations reduce legal opioid availability.
- Lower availability reduces consumption.

R – Traffic Side Effect

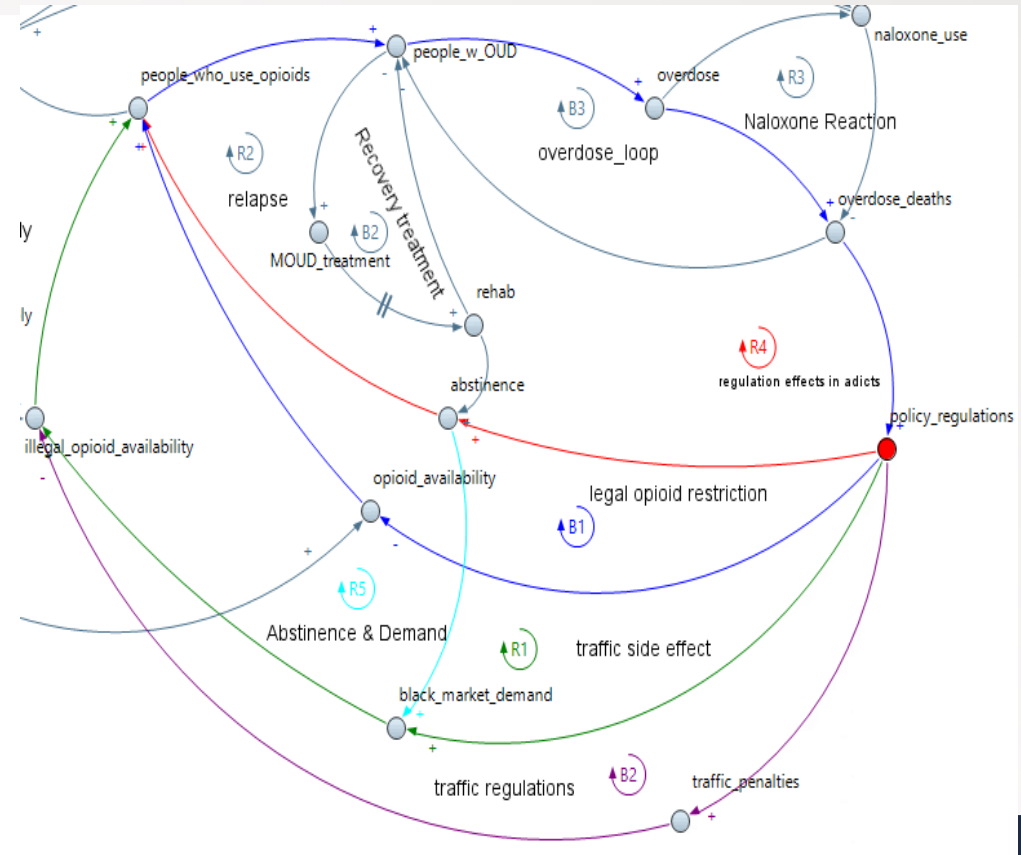
- Restrictions push users to illegal markets.
- Black market demand increases illegal supply.

R – Abstinence & Demand

- higher abstinence increases overall opioid demand.
- Demand feeds back into availability.

B – Traffic Regulation

- More regulations lead to tougher trafficking penalties.
- Penalties reduce illegal supply over time.



Loops On detail

Sector: Pharma & Supply System

R – Market Expansion

- Pharma income increases marketing.
- Marketing boosts opioid sales.
- More sales → more income → more marketing.

R – Legal Supply

- Increased production boosts legal opioid availability.
- More legal supply increases consumption.
- Consumption justifies further production.

R – Market Expansion

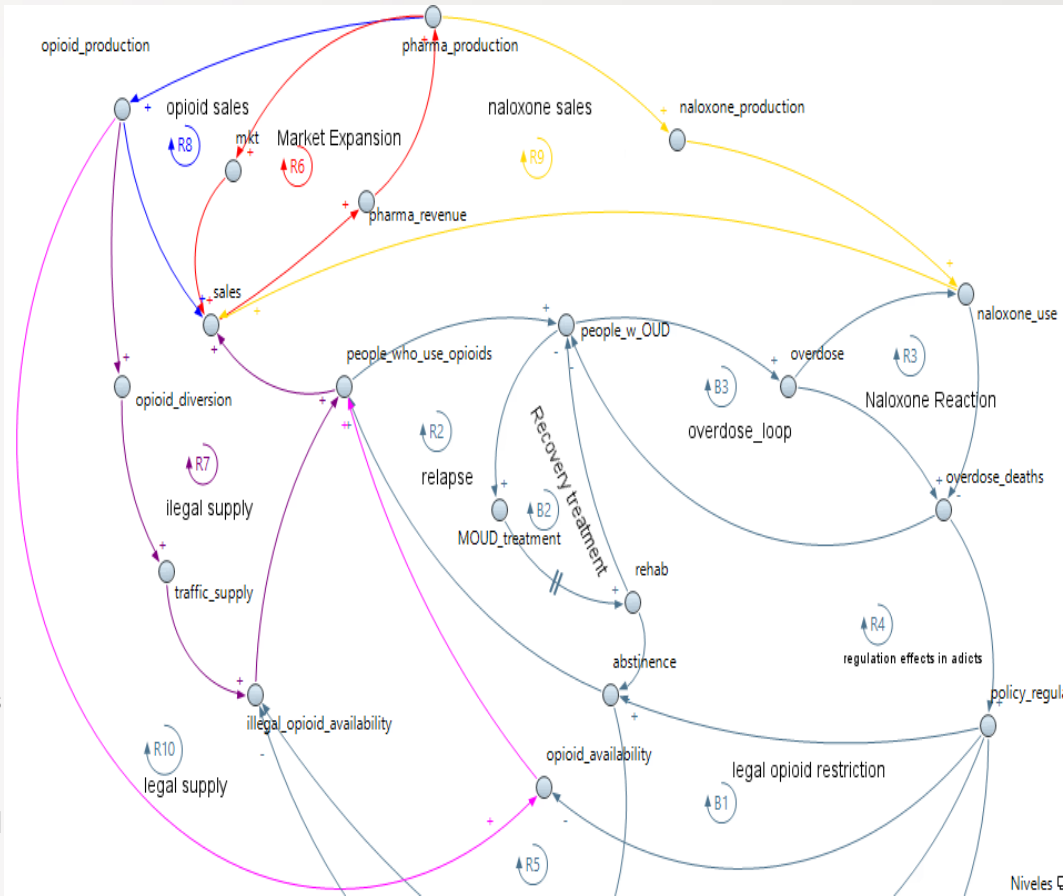
- Pharma income increases marketing.
- Marketing boosts opioid sales.
- More sales → more income → more marketing.

R – Pharma Revenue

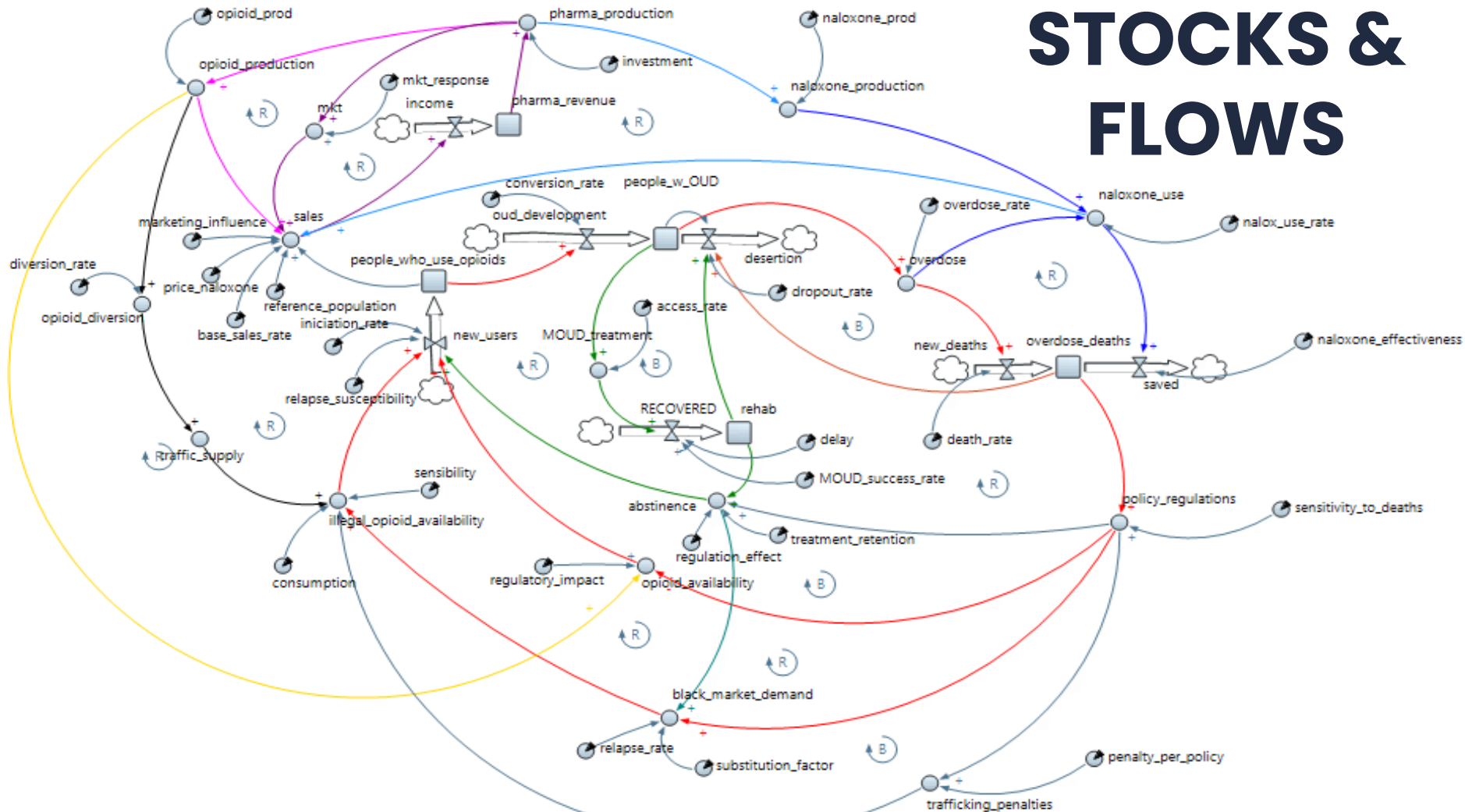
- More sales generate higher revenue.
- Revenue drives more production.
- Production supports more sales.

R – Illegal Supply

- Some legal opioids are diverted.
- This feeds the illegal market.
- Illegal availability reinforces opioid use.



STOCKS & FLOWS



Units

Element	Type	Unit	Description
rehab	Stock	People	People currently in MOUD treatment
recovered	Flow	People/Month	Flow of individuals successfully treated
overdose_deaths	Stock	People	Cumulative overdose deaths
new_deaths	Flow	People/Month	Flow of overdose deaths per month
saved	Flow	People/Month	People saved by naloxone per month
people_who_use_opioids	Stock	People	People currently using opioids
new_users	Flow	People/Month	New people initiating opioid use
people_w_OUD	Stock	People	People diagnosed with OUD
oud_development	Flow	People/Month	People developing OUD
desertion	Flow	People/Month	Dropout from MOUD treatment
pharma_revenue	Stock	USD	Accumulated revenue of pharmaceutical companies
income	Flow	USD/Month	Monthly pharmaceutical income

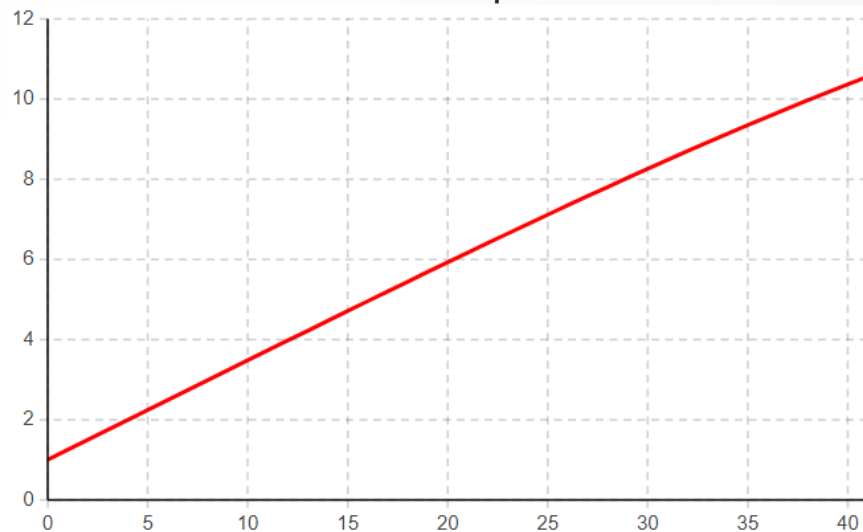
GOLDEN RULES

1. A stock can only be modified by flows ✓
2. All loops include at least one stock ✓
3. Flow units = Stock units / time ✓
4. Same number of loops in the causal loop diagram and the stock & flow diagram
Causal loops = 10 = S&F loops ✓



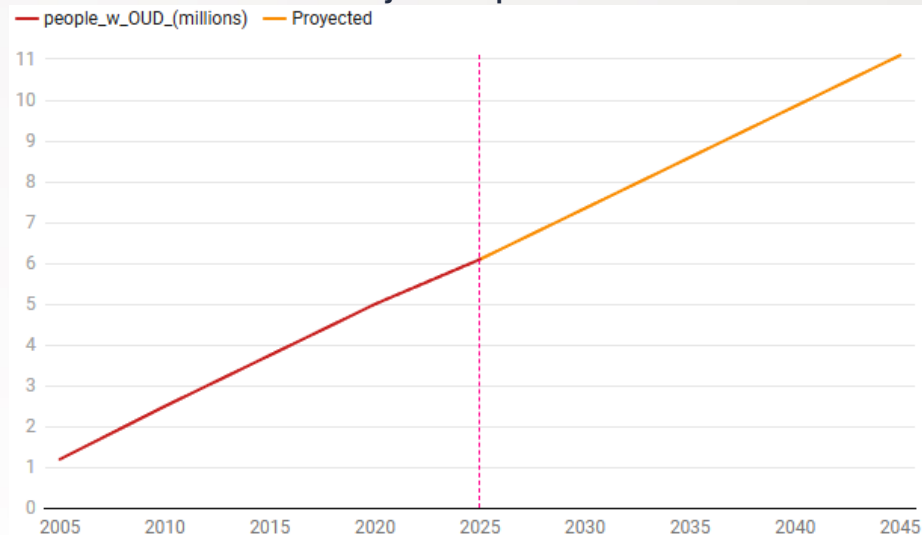
ANYLOGIC MODEL VERIFICATION

Simulated plot

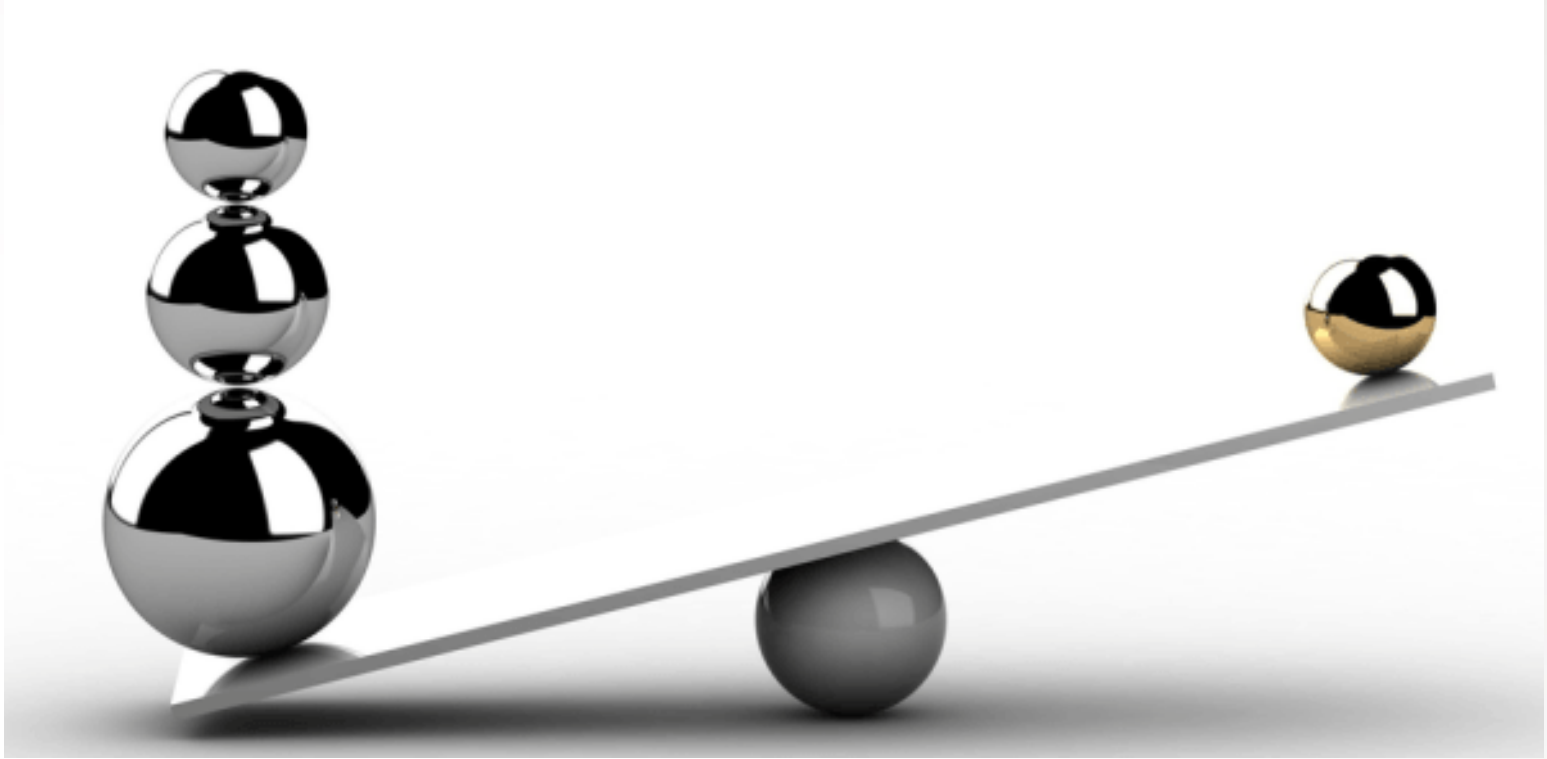


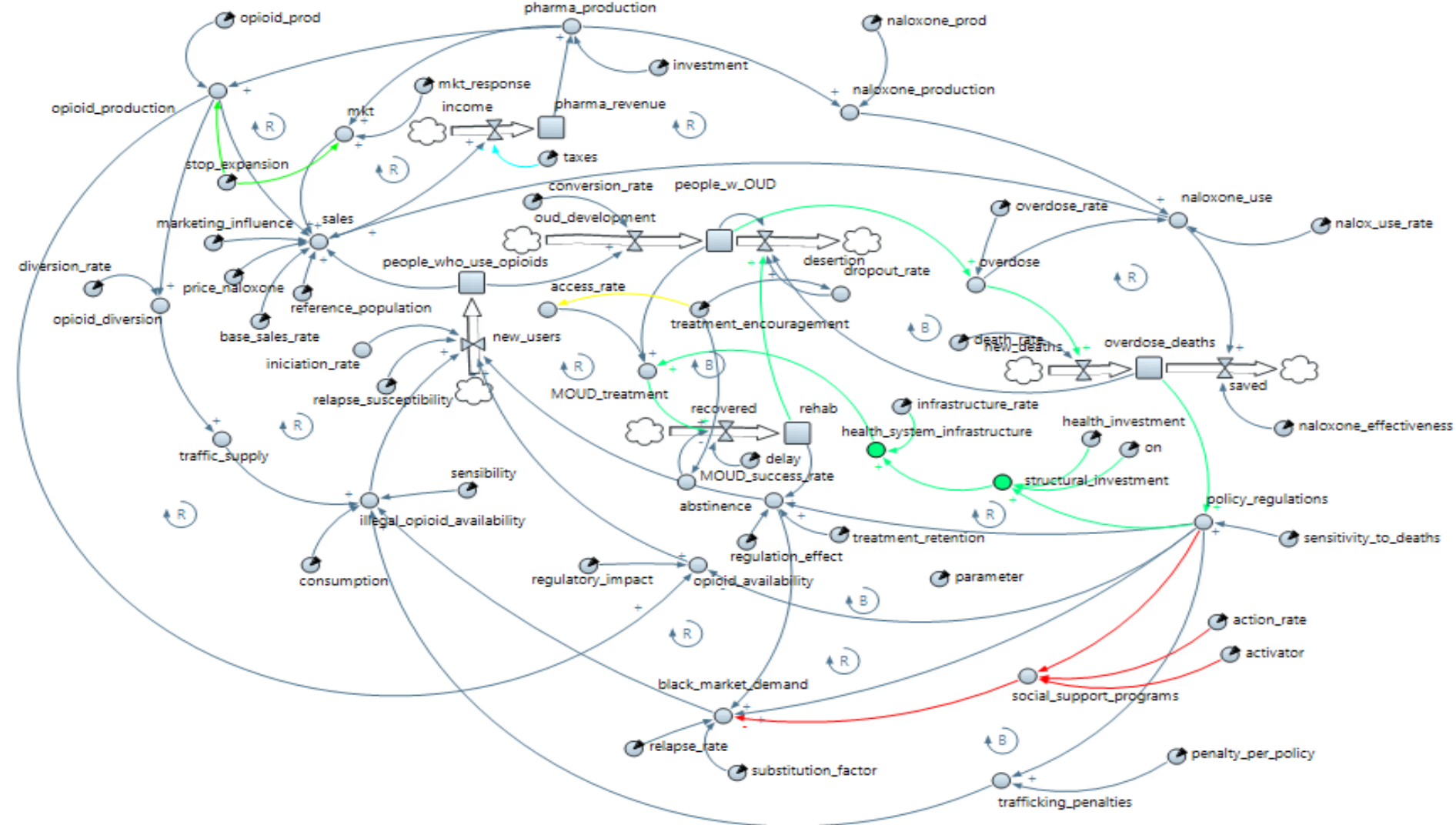
● people with oud

Projected plot



LEVERAGE



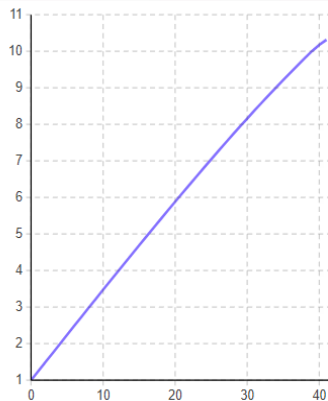


LEVERAGE EFFECTS

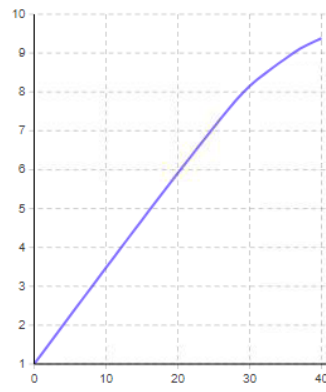
Levers	Investment in structural treatment	Treatment encouragement policy	Side effect control of restrictions	Pharma taxes	Stop market expansion
Grade of leverage	7. Boosting positive feedback loops.	9: Parameters	8. Regulation of negative feedback loops	4. The rules of the system	4. The rules of the system
Effects	5	7.63	9.7	10.2	9.3

LEVERS PLATES (INDIVUALS)

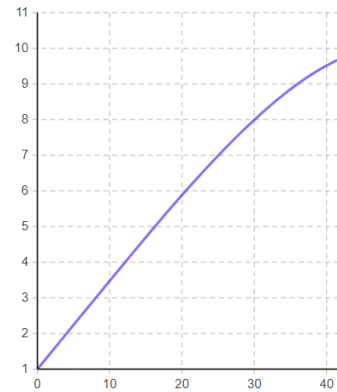
- ☐ investment in structural treatment
- ☐ stop market expansion
- ☐ stop the traffic
- ☐ side effect control of restrictions
- ☒ pharma taxes



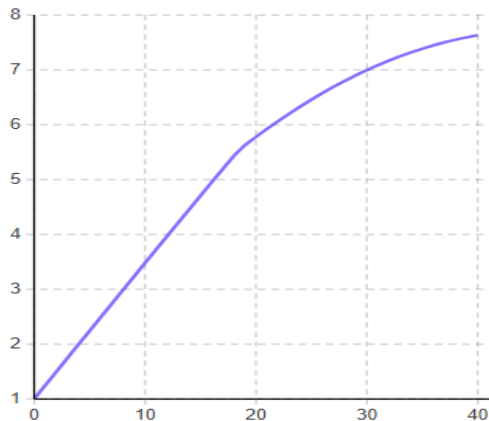
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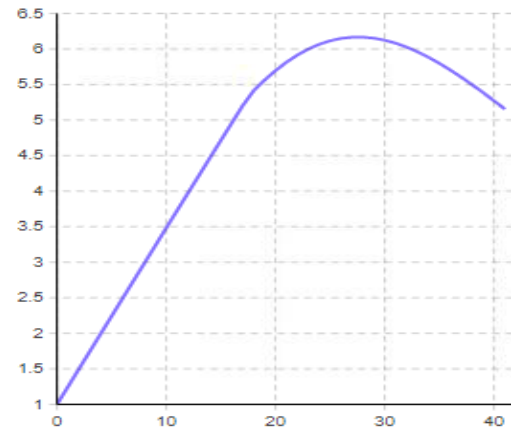
- ☐ investment in structural treatment
- ☐ stop market expansion
- ☐ stop the traffic
- ☒ side effect control of restrictions
- ☐ pharma taxes



- ☐ investment in structural treatment
- ☐ stop market expansion
- ☒ treatment_encouragement_policy
- ☐ side effect control of restrictions
- ☐ pharma taxes



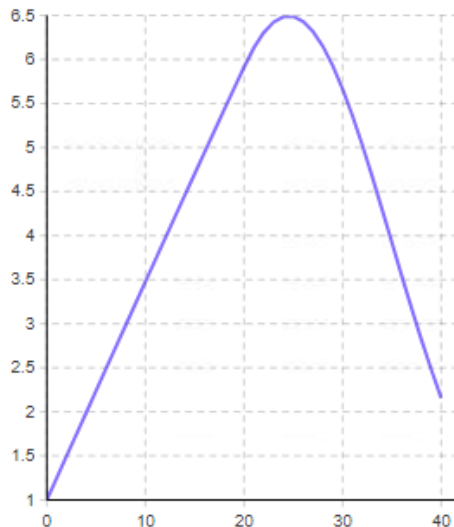
- ☒ investment in structural treatment
- ☐ stop market expansion
- ☐ stop the traffic
- ☐ side effect control of restrictions
- ☐ pharma taxes



Suggested Combination:

- ☒ investment in structural treatment
- ☐ stop market expansion
- ☒ treatment_encouragement_policy
- ☒ side effect control of restrictions
- ☐ pharma taxes

RESULTS:
2.4M PERSONS W
OUD in 20 years



✓ Investment in Structural Treatment

Strengthens the healthcare system infrastructure, improving MOUD treatment effectiveness and enabling a higher long-term recovery rate.

✓ Treatment Encouragement Policy

Represents campaigns and incentives that promote treatment-seeking behavior (e.g., awareness, stigma reduction, economic support), leading to higher access, lower dropout, and greater retention in treatment programs.

✓ Side Effect Control of Restrictions

Addresses unintended consequences of strict policies (such as diversion to black markets), helping to reduce relapse rates and stabilize the transition away from opioid use.

Thanks!