

# **Finding Values in the Science of Policy Modeling**

A Case Study of Modeling the  
Pharmaceutical Opioid Epidemic

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# Chronic Pain

- ▶ Increasingly Common in the United States



29 million sufferers, 1999–2002

*Hardt et al., 2008*

Chronic pain **diagnoses** are becoming increasingly common in the United States.

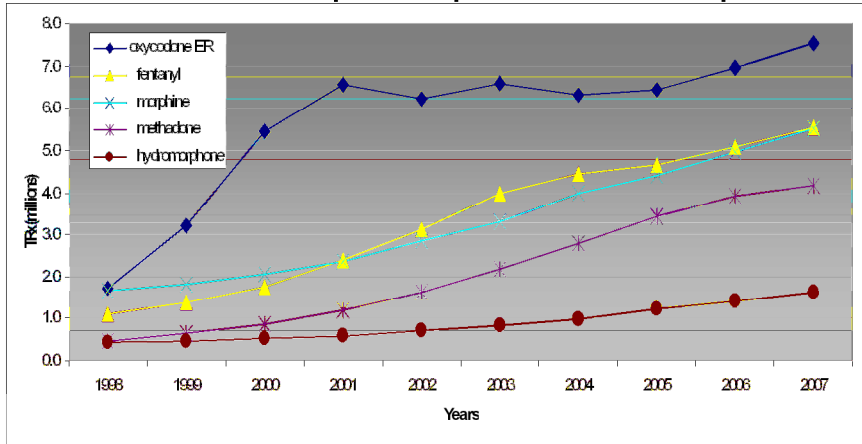
Typically it is defined as having pain for more than 90 days.

Data from the U.S. Census and the National Health and Nutrition Examination Survey suggest that 29 million individuals suffered from chronic pain between 1999 and 2002.

This makes it the leading cause of disability in the United States.

# Pharmaceutical Opioids

Number of Prescriptions dispensed for selected Opioids



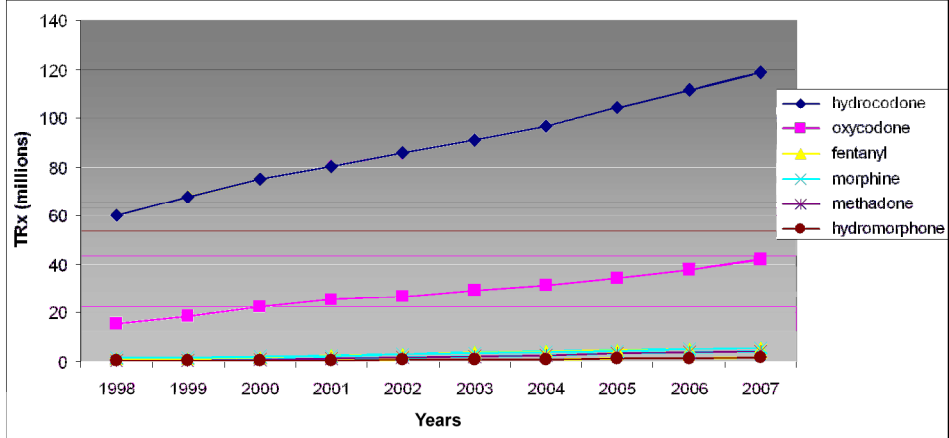
\*excludes hydrocodone and oxycodone

*See Governale, 2008*

Pharmaceutical Opioids have been found to be more effective at ameliorating pain than alternative medications (Furlan et al., 2006), so they have been prescribed increasingly more.

# Pharmaceutical Opioids

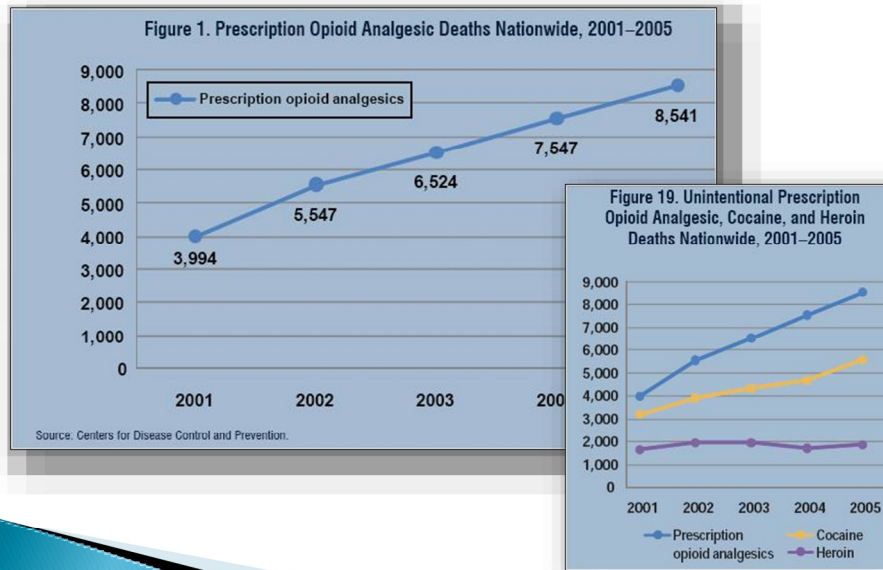
Number of Prescriptions dispensed for selected Opioids



\*includes hydrocodone and oxycodone

*See Governale, 2008*

# Adverse Outcomes



The rate of opioid overdose in the US increased by more than threefold between 1999 and 2006, and by more than fivefold among youth aged 15-24 (Warner et al., 2010).

In 2005 opioid overdose deaths outnumbered heroin and cocaine deaths, *combined* (CDC).

## System Dynamics

- ▶ Computer simulation of dynamic interactions between a set of elements
- ▶ Uses differential equations
- ▶ Replicates system behavior “on its own”
- ▶ Ideal for studying complex, dynamic systems
- ▶ Useful for informing public policies

*See Sterman, 2000, 2006*

The idea for this project was to build the model of the opioid system and then test out several alternative policy interventions on it.

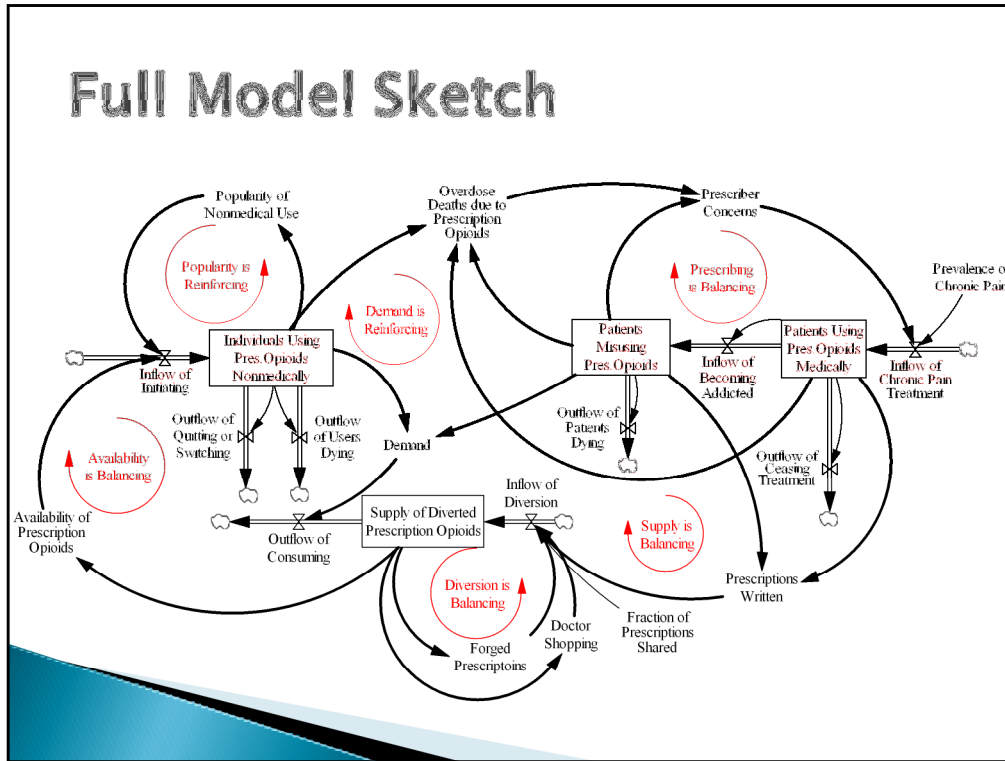
## Research Team

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- ▶ Jack Homer,  
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- ▶ Aaron Gilson,  
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**Modeling Team**

**Expert Panel**

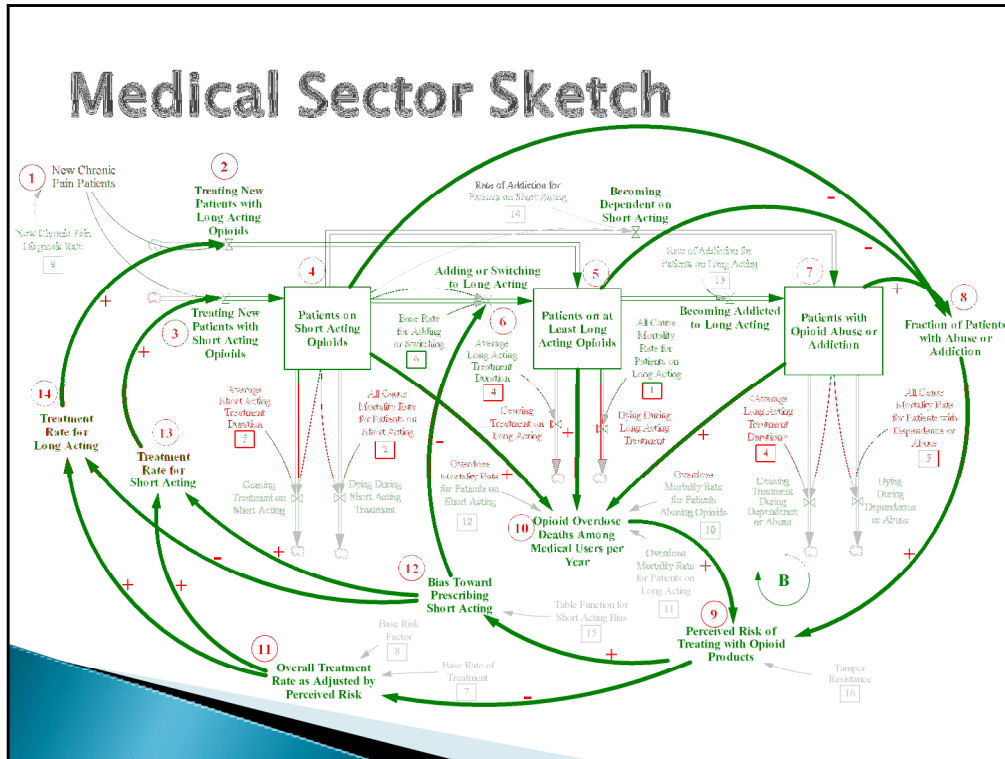
Funded Under Contract from Purdue Pharma L.P.



Model includes Medical Sector, Nonmedical Sector, and Diversion Sector.

The idea was to test out alternative policy interventions to see what will be most effective at reducing opioid overdose deaths.

We don't totally have the nonmedical and diversion sectors working right now, but we can still test policies on the medical sector to find out what impact they would have on prescribers and chronic pain patients.



### The "Story" of the Medical Sector:

- Patients come in, and some fraction of them are treated with either long acting or short acting
- Some percentage of them develop abuse or addiction
- Some percentage of those with abuse or addiction suffer overdose deaths
- Doctors are aware of the number of patients with abuse, addiction, or overdoses
- When they perceive this fraction to be high, they prescribe fewer opioids, and safer kinds
- When they perceive this fraction to be low, they prescribe more opioids

This feedback loop is *balancing*, meaning that it finds an equilibrium over time where there aren't too many people suffering adverse consequences. The prescribers' sense of risk keeps the system "in check."

## Model Testing (V&V)

- ▶ Reproducing reference data
- ▶ Analyzing parameter sensitivity

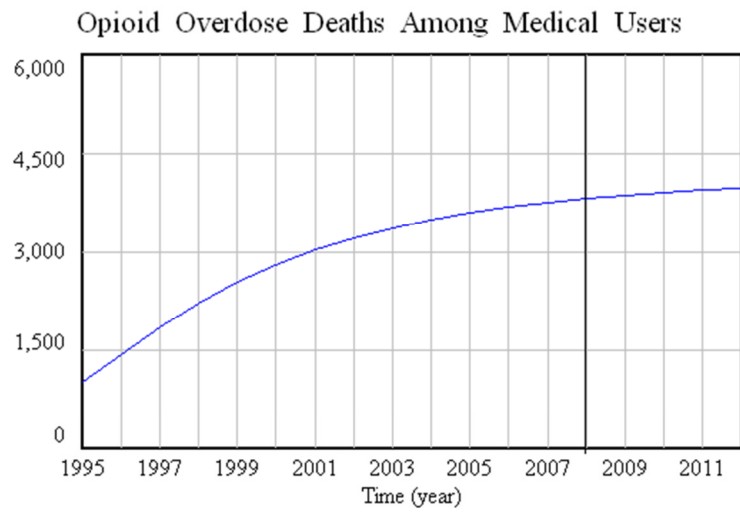
## Limitations

- ▶ Excludes acute pain
- ▶ Assumes all pain patients are legitimate
- ▶ Causal relationships assumed:



- ▶ Weak support for some parameter values
- ▶ Excludes alternative treatments for pain

## Baseline behavior



We don't have good reference behavior data for this – it is a rough estimate.

## Interventions

- ▶ Tamper Resistant Formulations
- ▶ Prescriber Education
- ▶ Patient Education

### INTERVENTION ONE

In this simulation, all pharmaceutical opioids become twice as tamper resistant. This halves the rate at which patients develop abuse or addiction. But also reduces the rate at which physicians perceive opioid prescribing as risky.

### INTERVENTION TWO

This simulation simply doubled the physicians sense of risk in prescribing opioids. This reduces rates of treatment with opioids (by half), and also reduces the percentage of patients who develop abuse or addiction (by half) because doctors are more careful who they prescribe to.

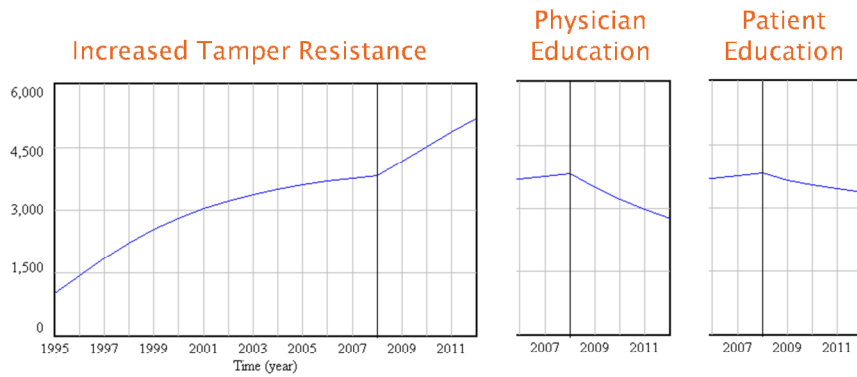
### INTERVENTION THREE

In this simulation the only thing that was changed is patients' rate of developing abuse and addiction. (What if there were an intervention that could convince or educate people so as not to develop abuse or addiction?)

This is a picture of the baseline model behavior without any interventions.

# Results

## Total Opioid Overdose Deaths Among Medical Users



Tamper Resistance leads to an increase in the number of deaths. This is because physicians become very relaxed about prescribing when they are assured that the prescriptions are tamper resistant. There is still a smaller percentage of patients dying, but there are way more patients total, resulting in a net increase.

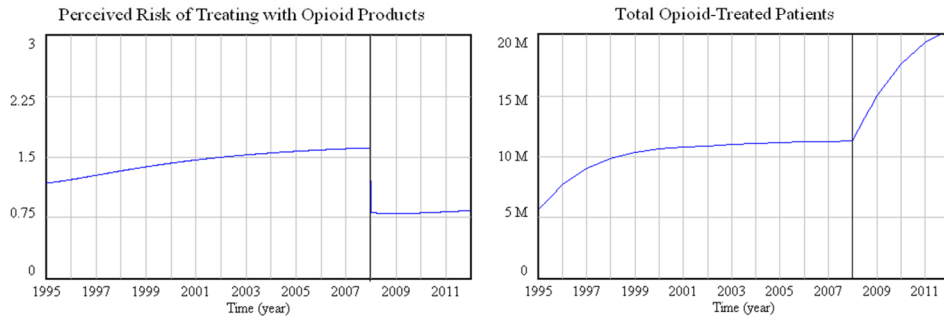
Physician Education led to a reduction in the number of deaths, as would be expected when physicians are prescribing fewer people and more selectively.

Patient Education also led to reduced deaths, but to a lesser degree since the total number of patients remained very close to baseline.

So the total number of patients seems to be an important contributing factor in these results. So Wayne also looked at the number of deaths per 10,000 patients.

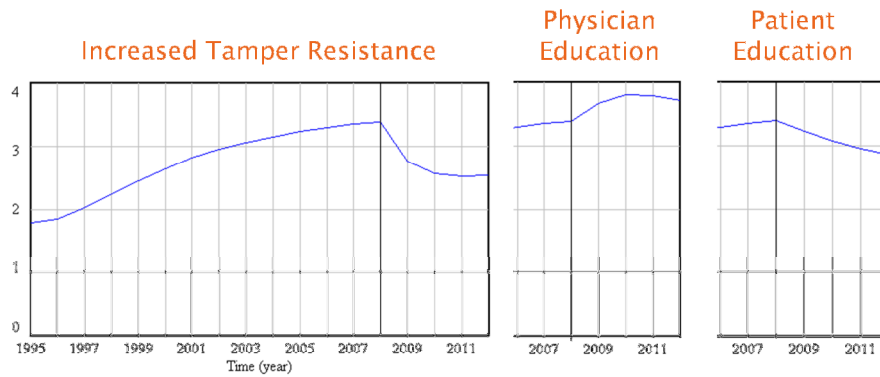
# Results

## Decreased Perceived Risk Leads to Increased Treatment



# Results

## Number Opioid Overdose Deaths *Among 10,000* Medical Users



The results of the interventions look really different when using this metric. They all go in opposite directions.

Increased tamper resistance led to a *decrease* this time, in the number of deaths per 10,000. And patient education also led to a decrease, although less dramatic.

Physician education increased the fraction of deaths because physicians' increased risk caused them to treat way fewer people. Even though less prescribing led to a smaller number of deaths overall, it did not decrease the fraction of patients who suffer overdose deaths.

## Discussion

### What Should a Policy Do?

- ▶ Reduce the total number of deaths  
-or-
- ▶ Reduce the fraction of deaths among treated

Does pain relief for a large number of people  
justify the death of a small portion?

Implies the question of whether or not Undertreatment is as serious of an issue as Overdose Deaths.

## Implicit Values

- ▶ Pain sufferers deserve relief.
- ▶ Relief via pain killers is a human right.
- ▶ “Addicts” should not take drugs.
- ▶ Society should prevent drug abuse.

*See Bell & Salmon, 2009*

Individuals who suffer from chronic pain deserve the opportunity to find relief from this pain with the use of pain medications. But to genuinely suffer from chronic pain you need a valid diagnoses from a medical practitioner. If you do not have this, you have no business taking pain killers.

On the other hand, non-patients should not take drugs. Getting high is unethical. It harms the self and others.

This collection of values puts a lot of pressure on prescribers to differentiate between “good” pain patients and the “bad” drug addicts. It is not uncontested. Bell and Salmon (2009) have a nice discussion of the undertreatment problems associated with this issue.

## Questions

- ▶ Who decides (and how do we decide) which metric is better?
- ▶ Does modeling help us to grapple with these value-based questions?
- ▶ Should you have values and assumptions “resolved” before building a model like this?

## References

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