



Children's Hospital Boston  
Informatics Program

Harvard-MIT Division of  
Health Sciences and Technology



# The Use of Addiction Center Data to Assess Abuse of Prescription Opioids

John Brownstein, PhD

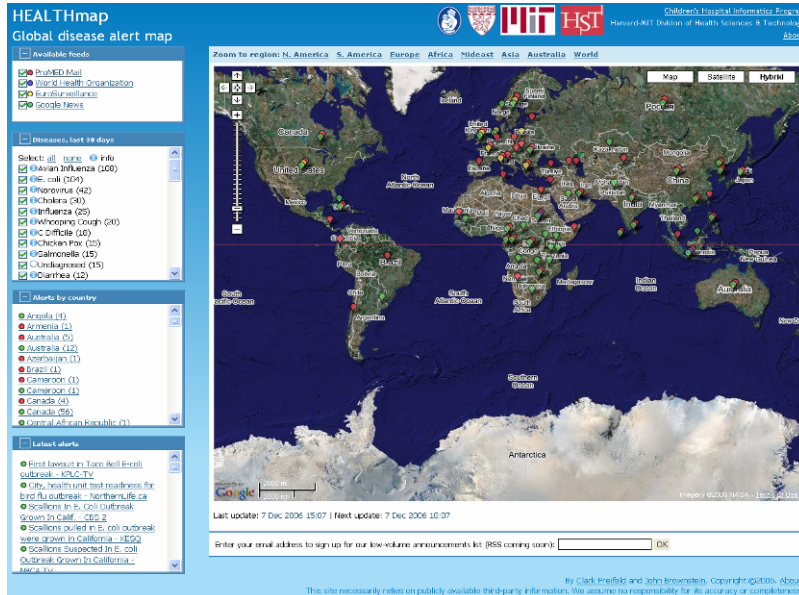
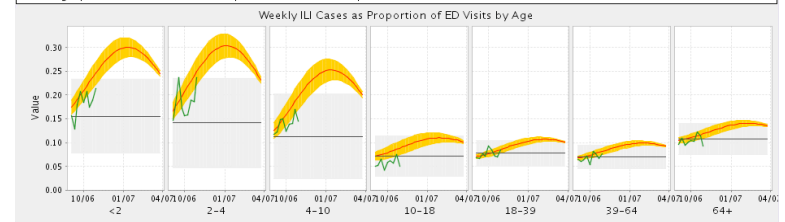
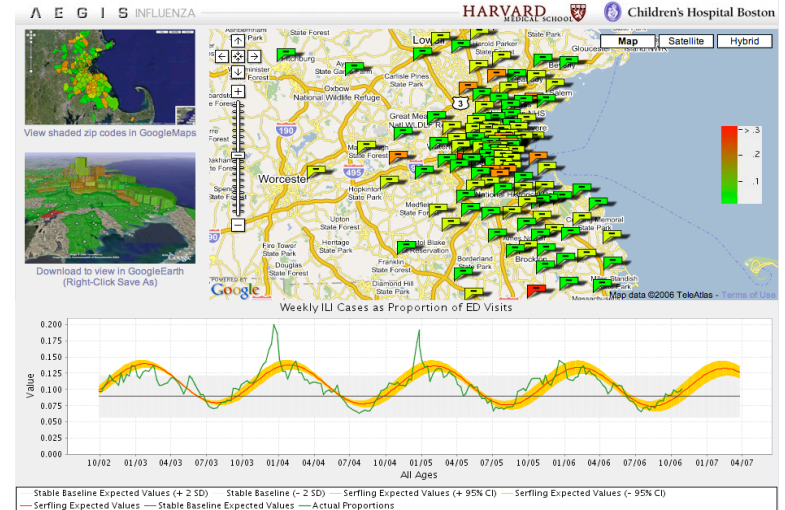
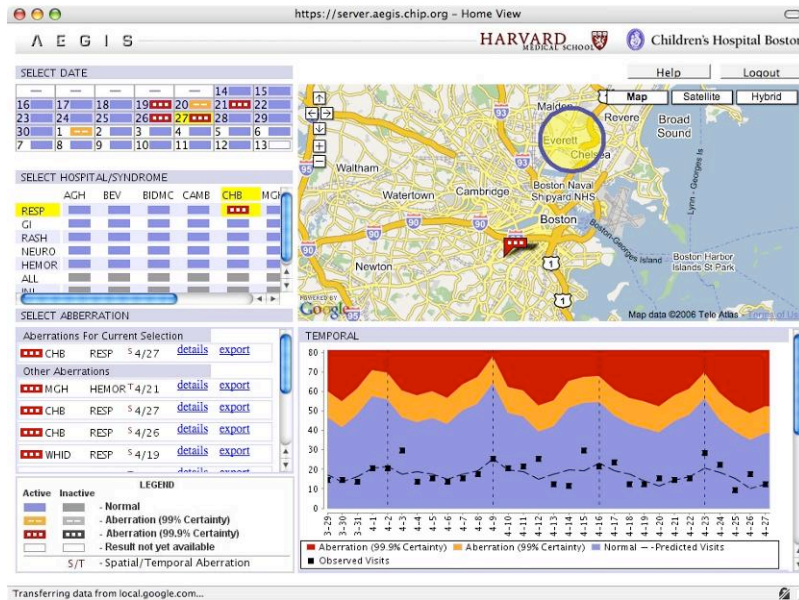
Children's Hospital Boston, Harvard Medical School



HealthMap  
Global Disease Alert Map



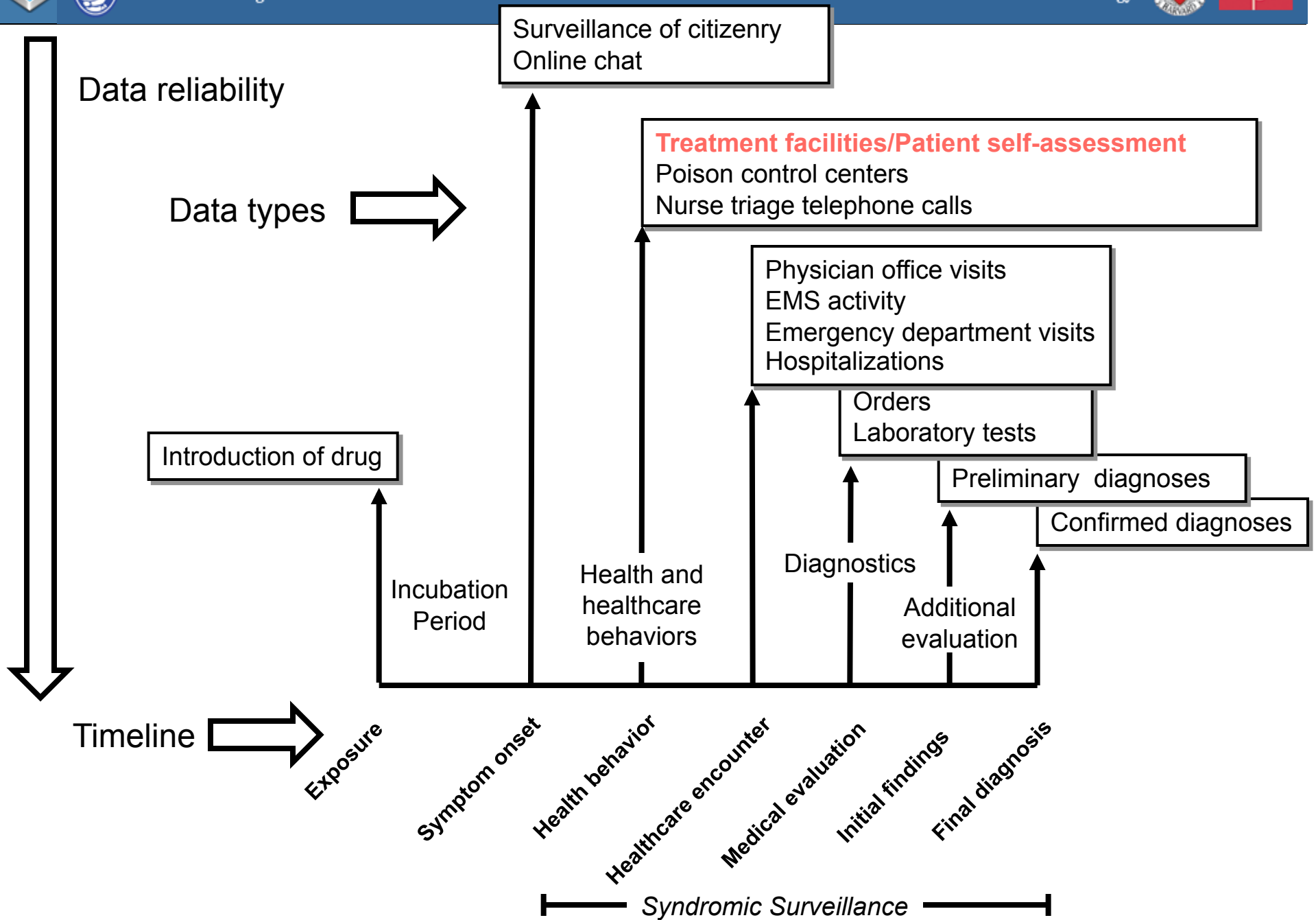
# Real-time Population Health Monitoring





## Goals of opioid surveillance

- Early and reliable detection of drug abuse epidemics
- Characterization of size, spread, and tempo of drug epidemic once detected
- Monitoring of abuse trends/shifts
- (Repurposing data for observational studies)





## Addiction Center/Treatment facility Data

- Broad/comprehensive geographic coverage
- Real-world abuse
- Most vulnerable to abuse of newly introduced opioids
- Possible sentinel population of early adopters
- Assessment part of required clinical flow at substance abuse center intake
- Window into one of the most severe public health impacts



# **ASI-MV<sup>®</sup> Connect**

## **(Addiction Severity Index – Multimedia Version Connect)**

- Developed and tested over the past 10 years with support from NIDA and industry by Inflexxion, Inc.
- Client self-administered assessment with audio and video to engage user
- Consistent standard for assessment & outcomes, generates immediate client severity ratings and detailed reports for decision support
- Allows collection of real-time prospective data on drug abuse
- Product specific on over 50 brand and generic opioids, with pictures and street names (stimulants to be added, 2009)

Welcome to the  
Addiction  
Severity Index.

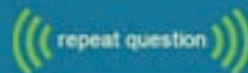


ASI-MV  
CONNECT

NEXT →



If you have taken OxyContin® or oxycodone ER (extended-release) in the past 30 days please select the appropriate boxes.



Remember to only select the boxes if you recognize the picture of the medication you used.

These medications are also called OC, Ox, Oxy, Oxy IR, Blue, Hillbilly heroin, Kicker, Oxycotton, 40's (40mg tablet), 80's (80mg tablet).



OxyContin®



oxycodone ER



oxycodone ER

other extended release  
oxycodone not shown

None

← BACK

NEXT →





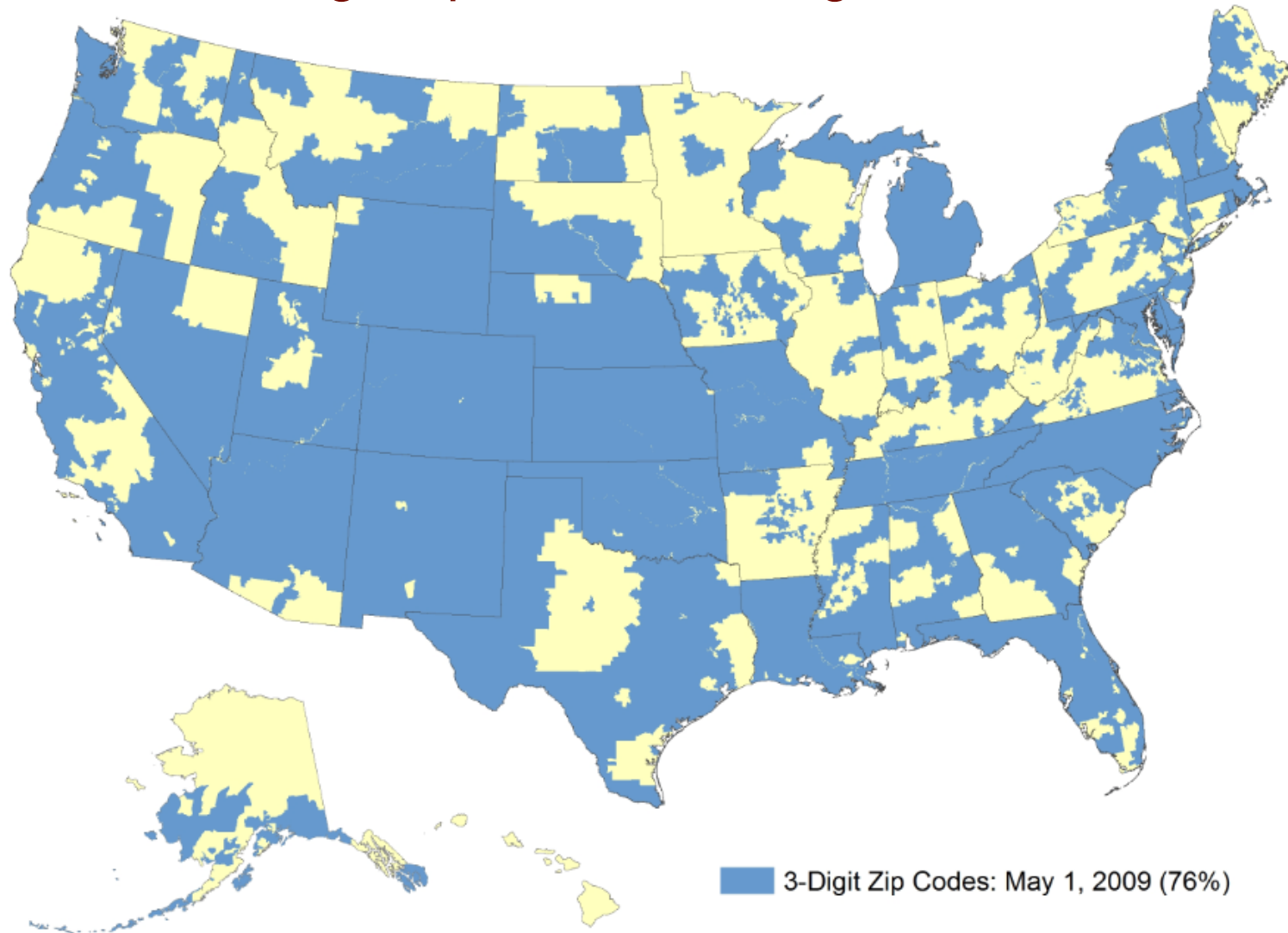
# ASI-MV<sup>®</sup> Connect Network

- Over 90,000 cases in the current database
- Over 1600 new cases added per week / 320 cases per working day
- Almost 500 sites around the country
- Network increasing at the rate of 5 new sites per week
- One state fully represented and others coming on board
  - New Mexico fully represented; Missouri joining Network this summer (beginning with approximately 100 sites), Vermont and Massachusetts to implement pilot program



# ASI-MV<sup>®</sup> Connect Network

## Patient Home 3-Digit Zip-Code Coverage





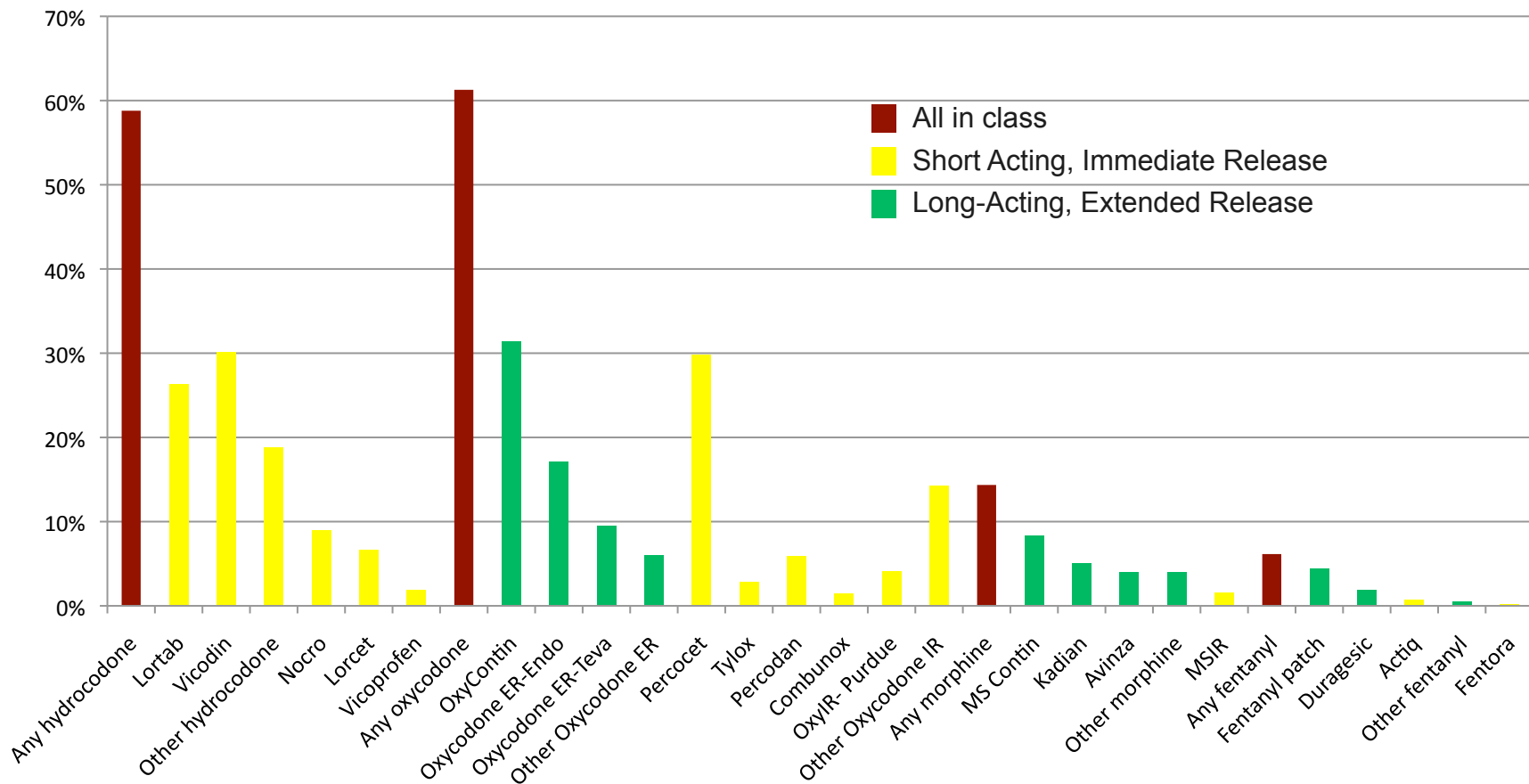
## Demographic Characteristics of Treatment Center Population

	<b>Total ASI-MV Connect Population (N = 91,619)</b>	<b>Opioid-Abusing Population (N = 8,981)</b>
<b>U.S. Census Region</b>		
Northeast	3.5%	7.2%
South	30.1%	36.9%
West	52.9%	40.0%
Midwest	13.5%	15.9%
<b>Race</b>		
Caucasian	52.5%	67.3%
African American	13.5%	6.8%
Hispanic/Latino	26.2%	20.3%
Other	7.8%	5.6%
<b>Age</b>		
Mean	34.7 years	32.8 years
Range	12-87 years	14-78 years
<b>Gender</b>		
Male	63.2%	56.2%
Female	36.8%	43.8%
<b>Chronic Pain Problem</b>	<b>31.0%</b>	<b>53.1%</b>
<b>Required to Enter Substance Abuse Treatment by Criminal Justice System</b>	<b>52.4%</b>	<b>24.4%</b>



# ASI-MV<sup>®</sup> Connect Data

## Relative Rates of Specific Products Used by Patients Who Indicate Non-medical Use of Prescription Opioid

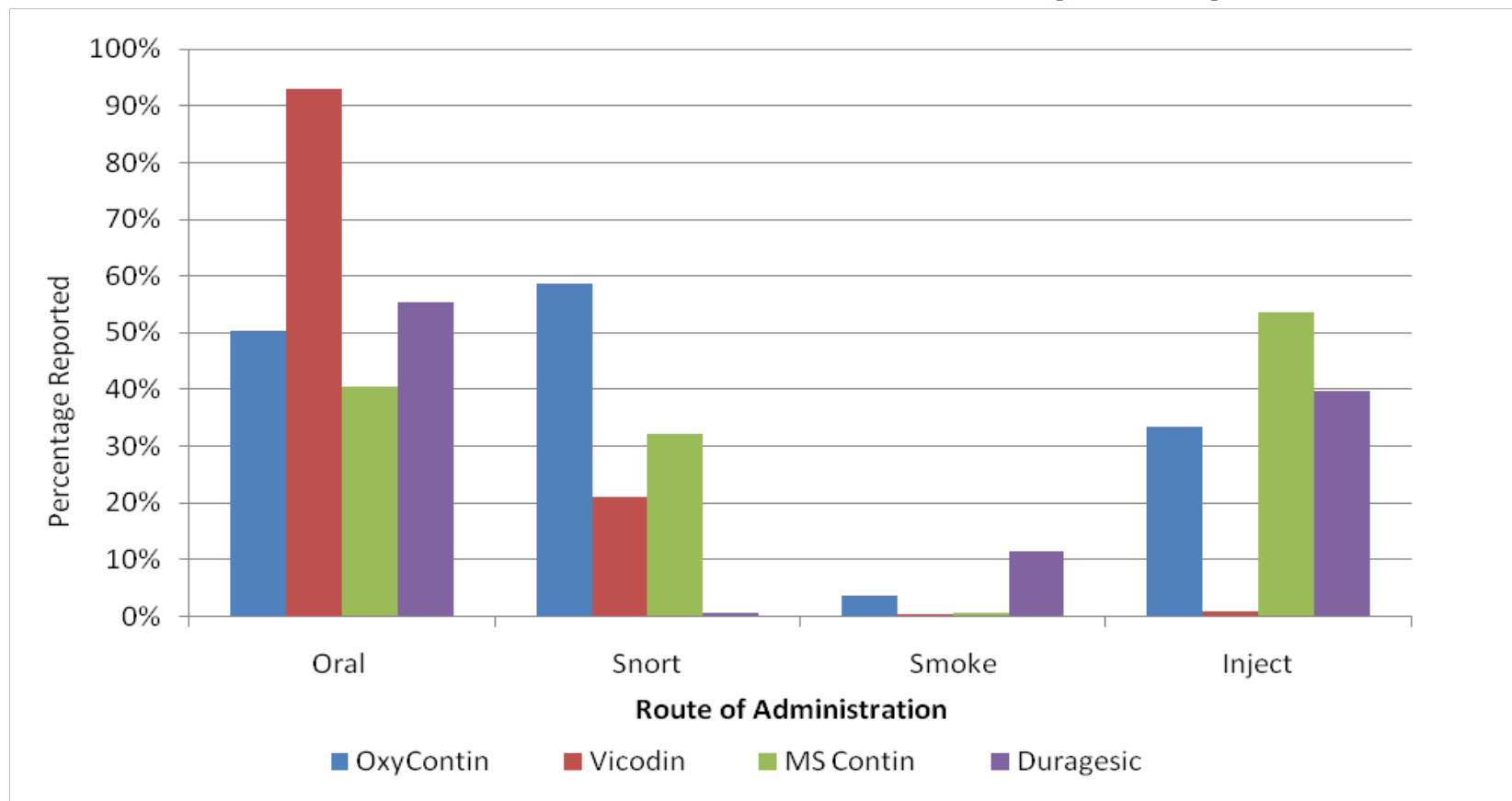


N = 8,981 patients, any illicit use past 30 days



# ASI-MV<sup>®</sup> Connect Data

## Routes of Administration for Specific Products Used by Patients Who Indicate Non-medical Use of Prescription Opioid

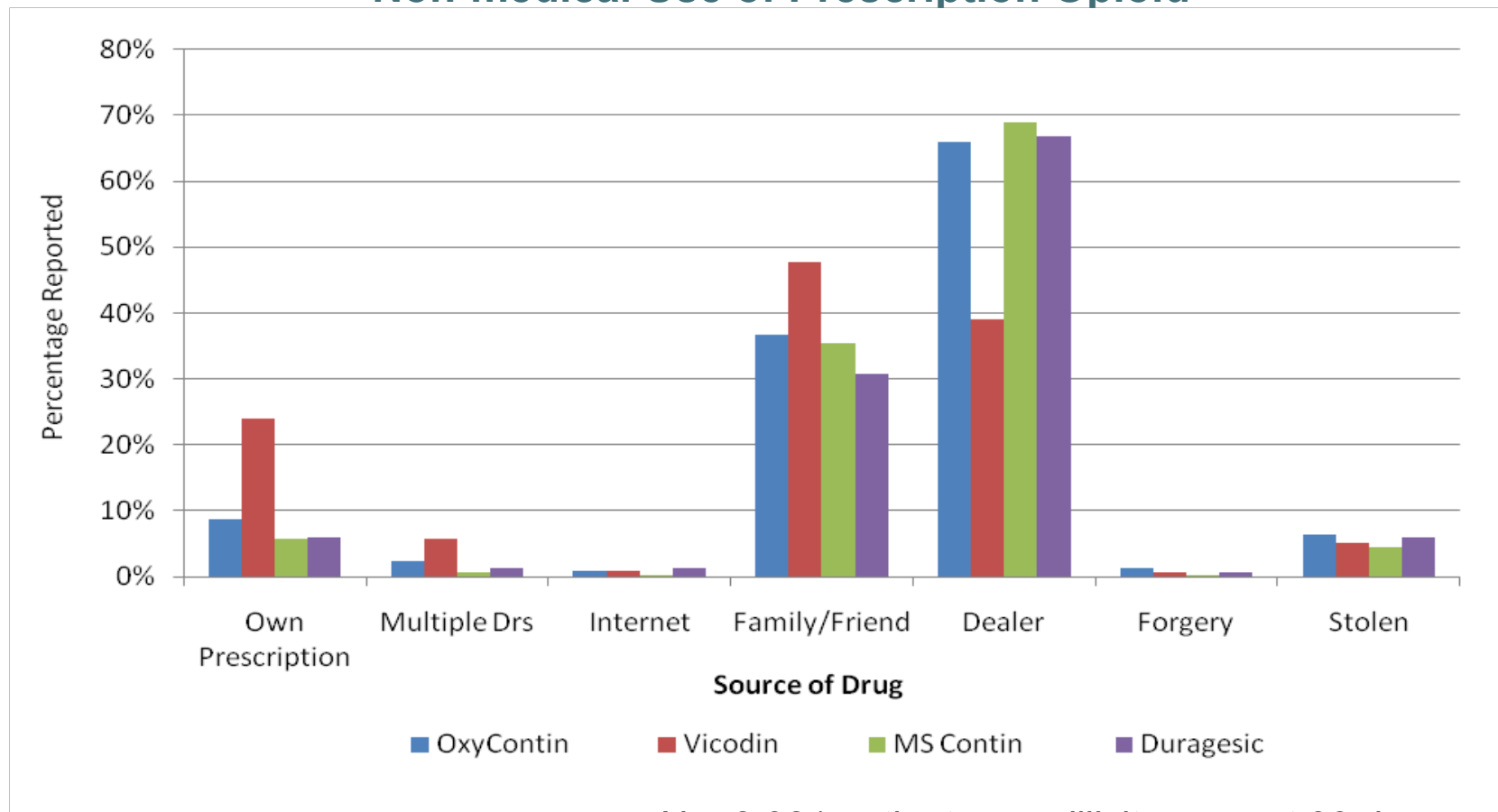


N = 8,981 patients, any illicit use past 30 days



# ASI-MV<sup>®</sup> Connect Data

## Source of Specific Products Used by Patients Who Indicate Non-medical Use of Prescription Opioid

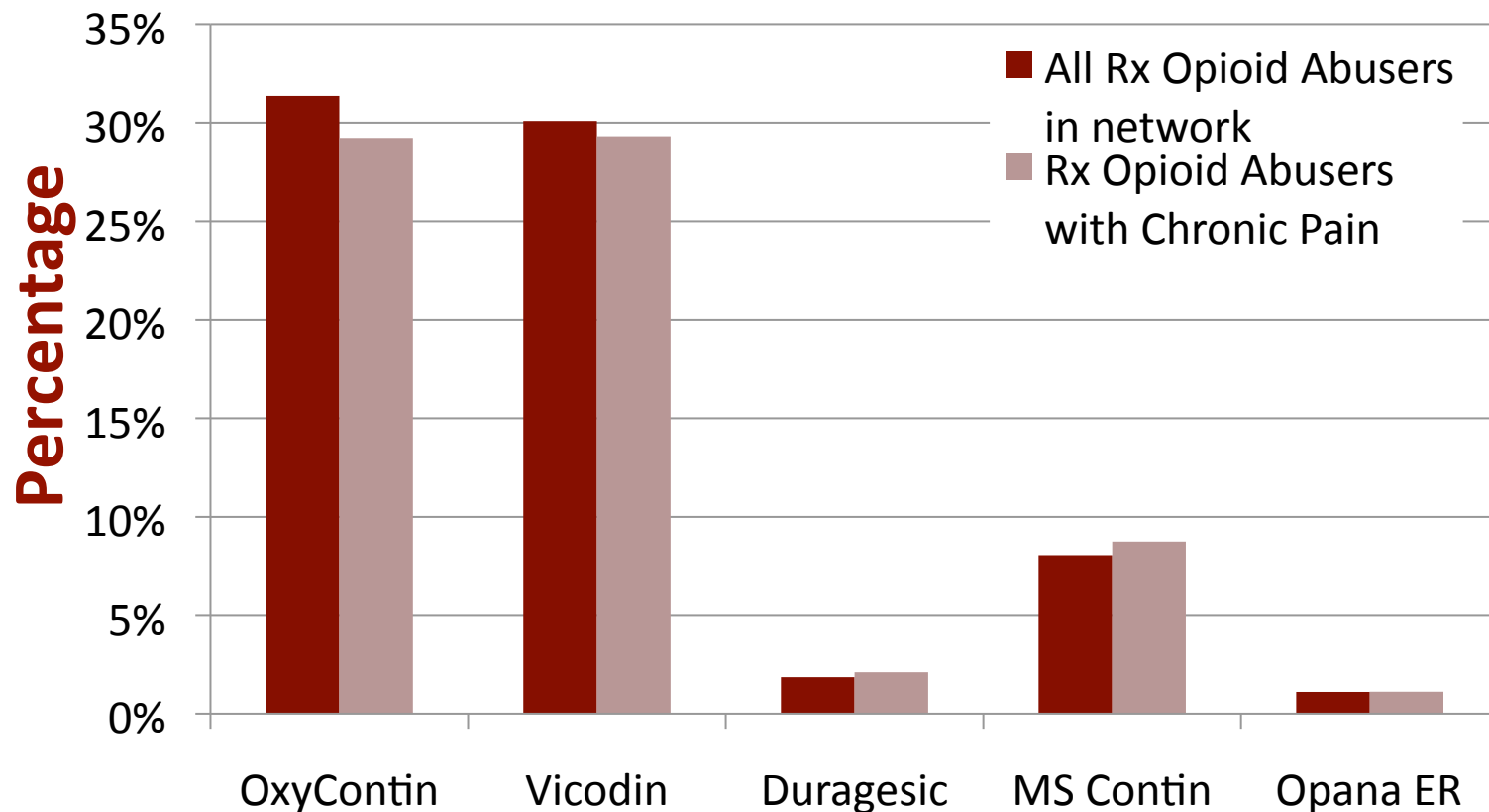


N = 8,981 patients, any illicit use past 30 days



# ASI-MV Connect<sup>®</sup> Data

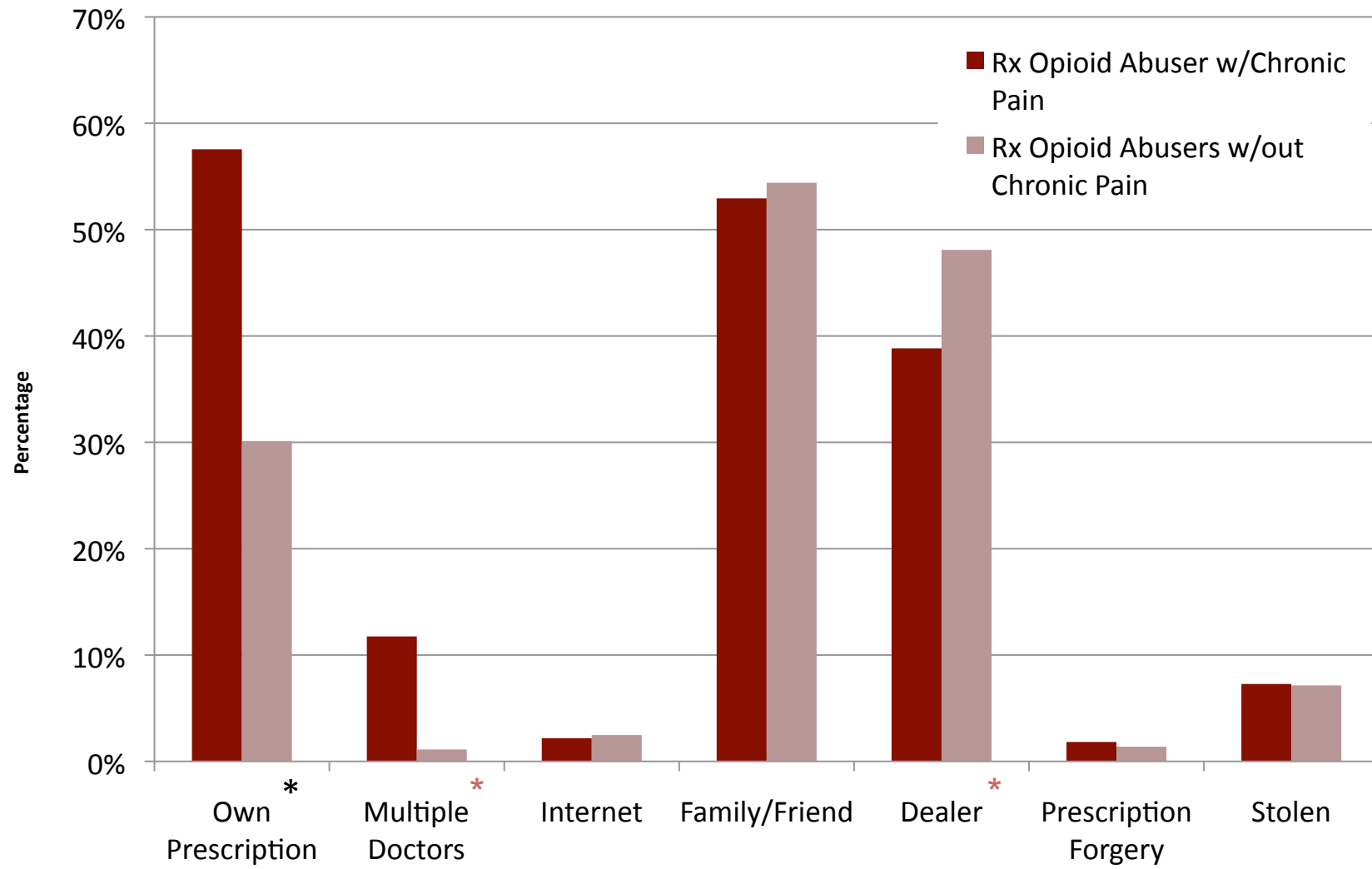
Product-specific Prescription Opioid Abuse for All Opioid Abusers  
(n=8,981) and Opioid Abusers with Chronic Pain (n=4,766)





## ASI-MV Connect<sup>®</sup> Data

Source of Drug Reported by Opioid Abusers with and without Chronic Pain (n=8,981)

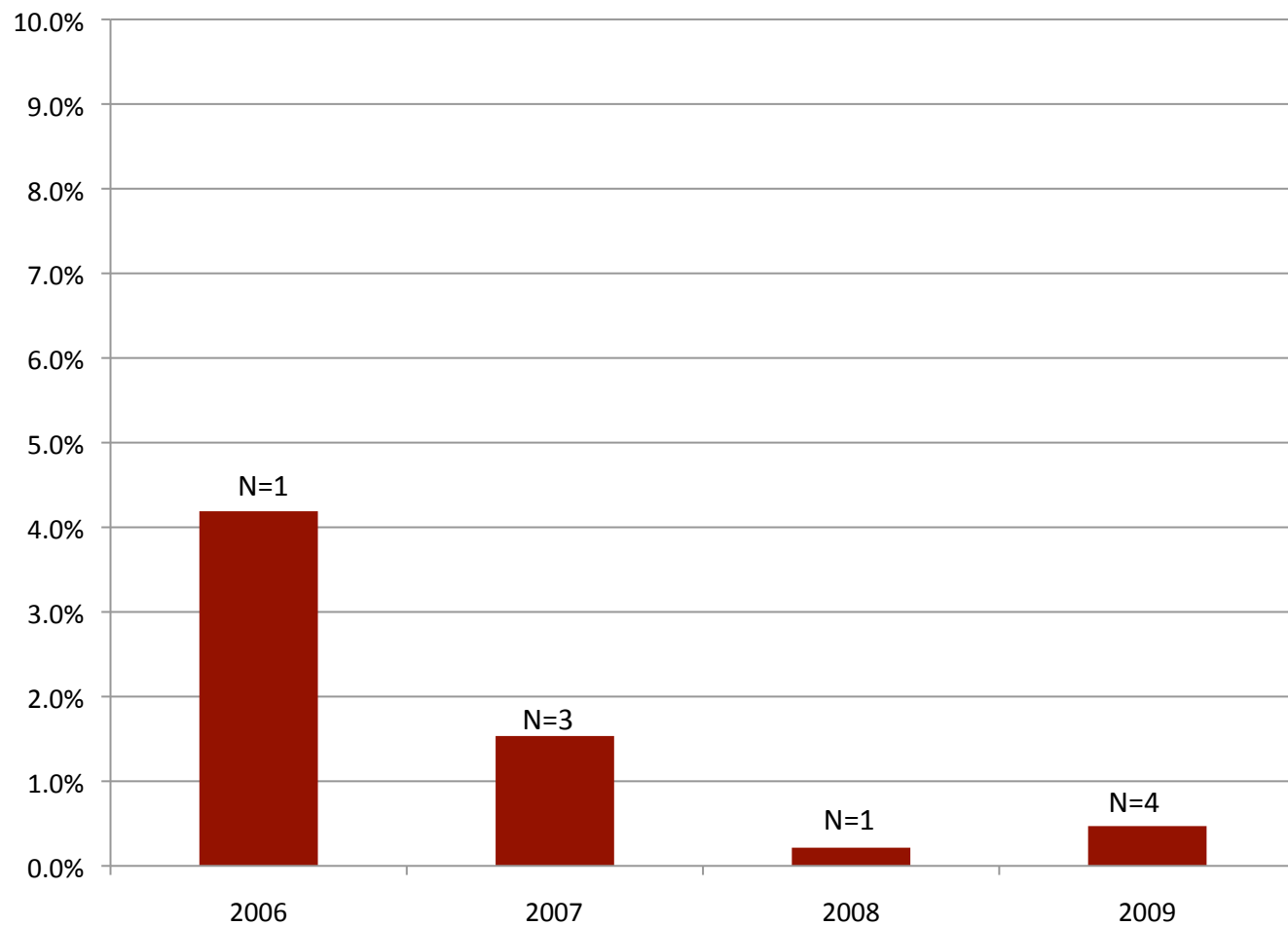


\* statistically significant  $p < 0.001$





## Reported Use of "Entrol" in ASI-MV<sup>®</sup> Connect Substance Abuse Treatment Population





# ASI-MV<sup>®</sup> Connect CHAT<sup>™</sup>

ASI-MV ADOLESCENT // A COMPREHENSIVE HEALTH ASSESSMENT TOOL FOR TEENS





# Comprehensive Health Assessment for Teens (CHAT™)

## A Clinical Assessment Tool to Measure Severity of Addiction Among Adolescents

- Funded through NIDA
- Targeted for adolescents (ages 13 -18)
- Web-based virtual interview – uses ASI-MV Connect® technology
- Designed for use in treatment centers and juvenile justice centers
- Engaging, teen-friendly with audio and video prompts for users with learning and literacy difficulties
- >50 Pilot Sites already signed up at Launch



## Comprehensive Health Assessment for Teens (CHAT™)

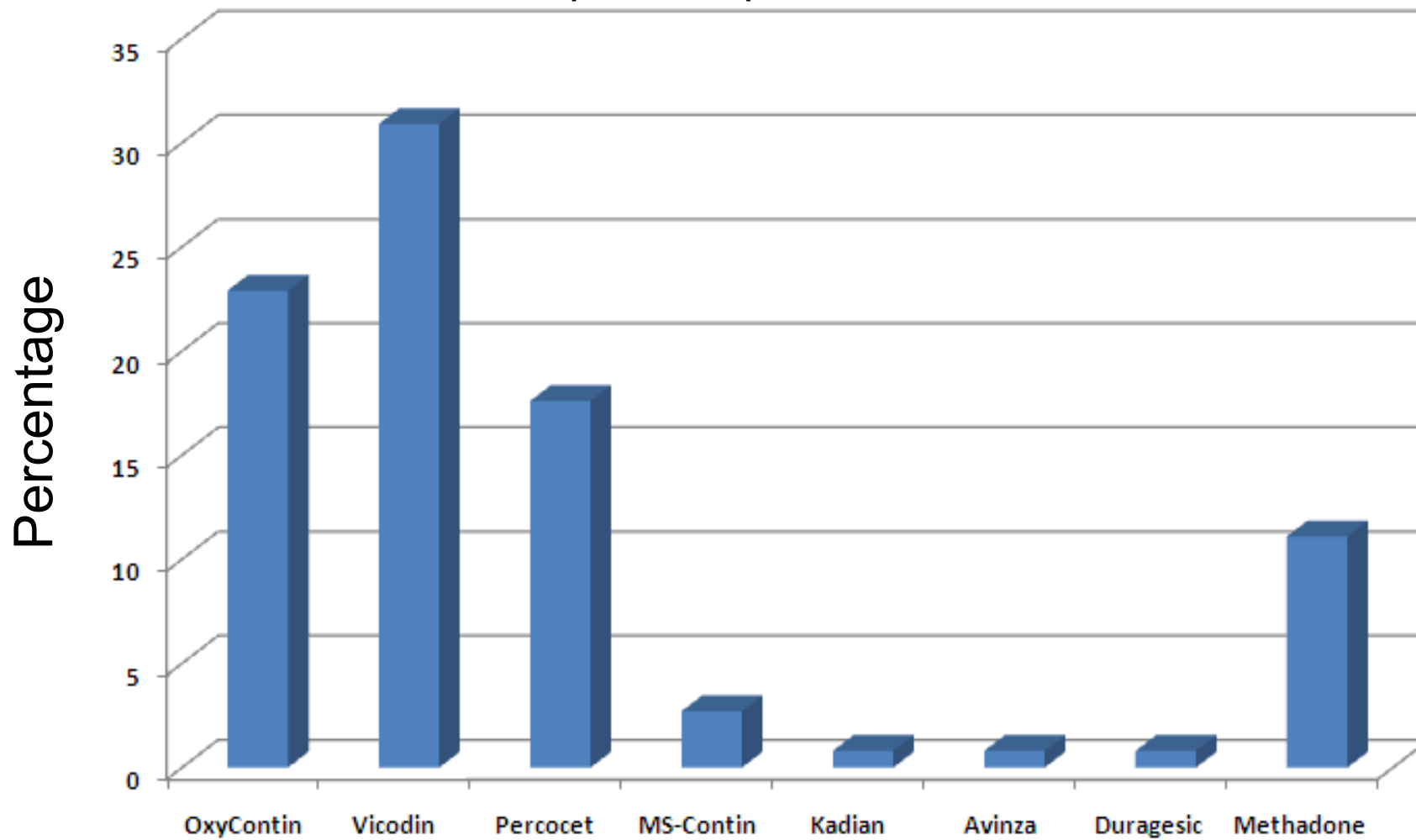
- Collects information on factors related to addiction in five areas
  - **SELF:** Personality Factors (Who you are and what you like)
  - **HEALTH:** Physical and Emotional
  - **PEOPLE:** Friends, Family, and Relationships
  - **DAY:** School, Work, Leisure, and Legal Issues
  - **USE:** Drugs and Alcohol Use
- Product specific information on abuse of prescription stimulants and opioids ( including route of administration and source of drug)



# CHAT™ Adolescent Pilot Data

Specific Opioids Misused

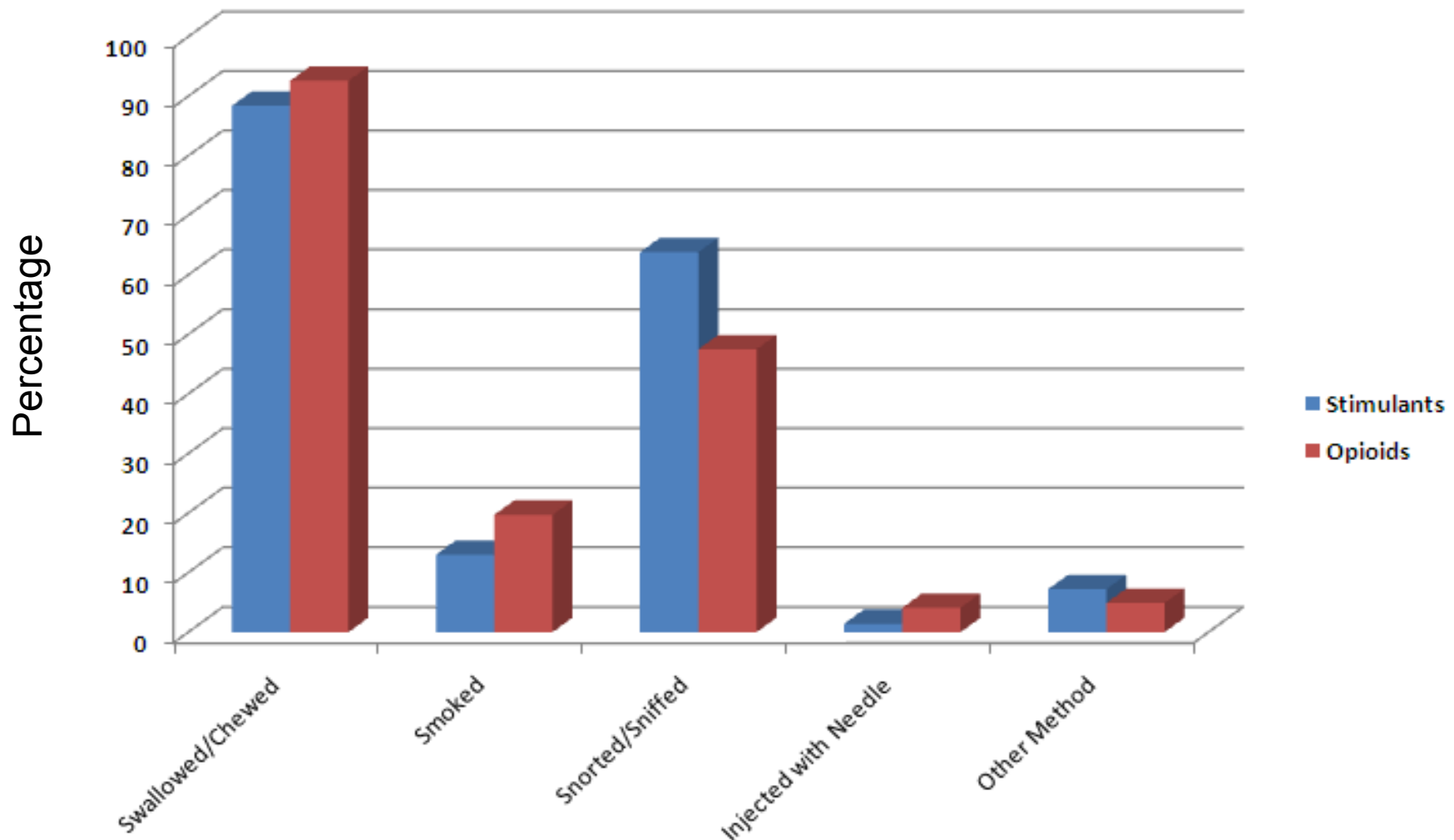
N = 262





# CHAT™ Adolescent Pilot Data

Route of Administration Reported for Adolescents  
Who Misused Stimulants *and* Opioids N = 262

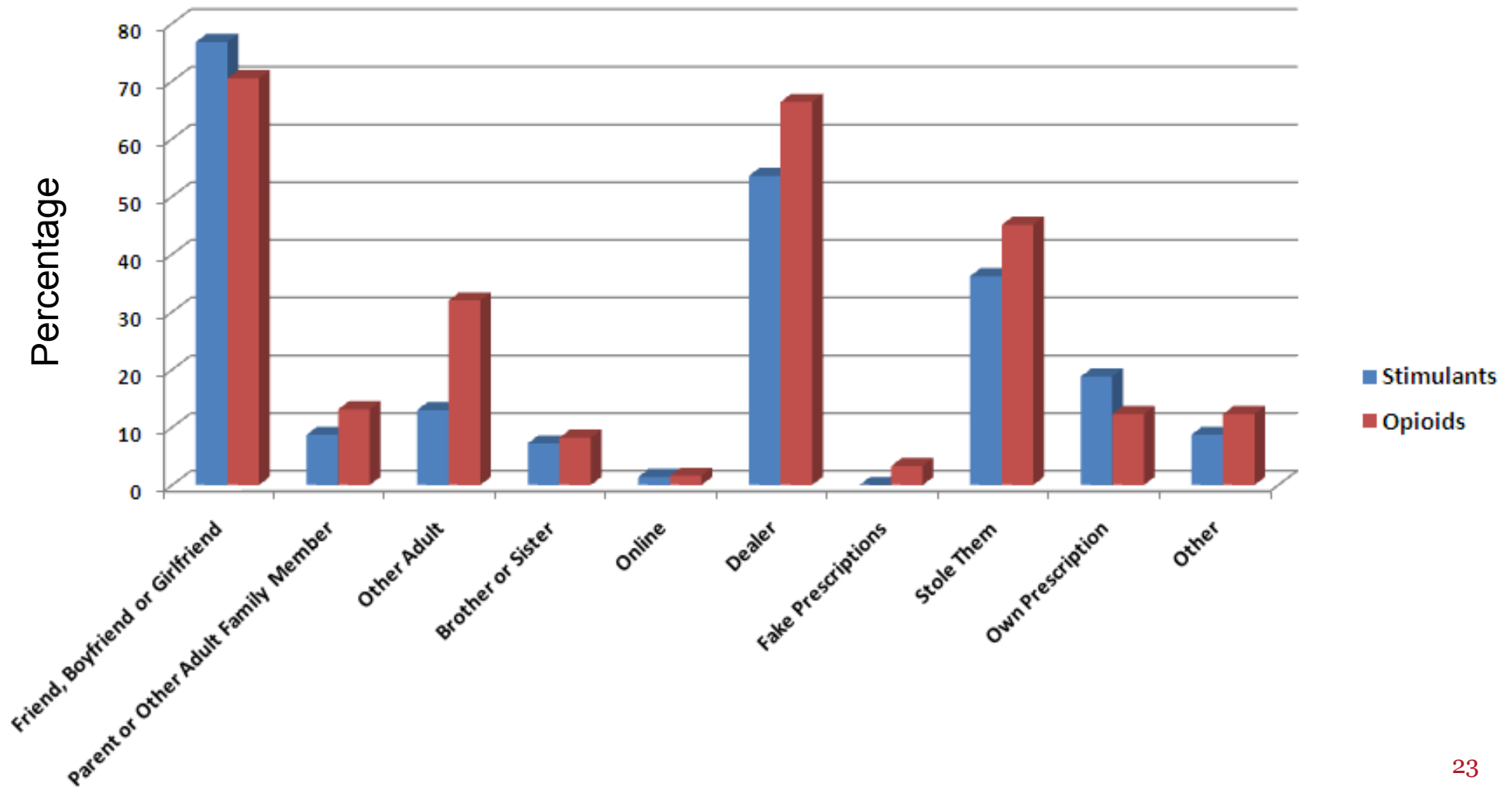




# CHAT™ Adolescent Pilot Data

Source of Drugs Reported for Adolescents  
Who Misused Stimulants *and* Opioids

N = 262





## Evolving Systems and Datasets - Challenges

1. Low data levels means that signal to noise levels are typically low.
2. Non-stationary and non-stable data means modeling is difficult.
3. Relatively new systems means that historical data is limited
4. Still requires evaluation for the use in epidemiological studies and whether results can be extrapolated





## CDC Goals of Surveillance

- Timeliness of detection
- Reliability of detection
- Automation and integration
- Robustness under adverse conditions
- Security of patient identifiable data
- Compatibility/adherence to standards



## Validation of data sources

- Quality of data is crucial
- Tradeoff of quality for timeliness
- Informant data vs. diagnostic codes
- Comparison with gold standard
- Understanding covariates/confounders (seasonal issues, drug availability, population demographics)

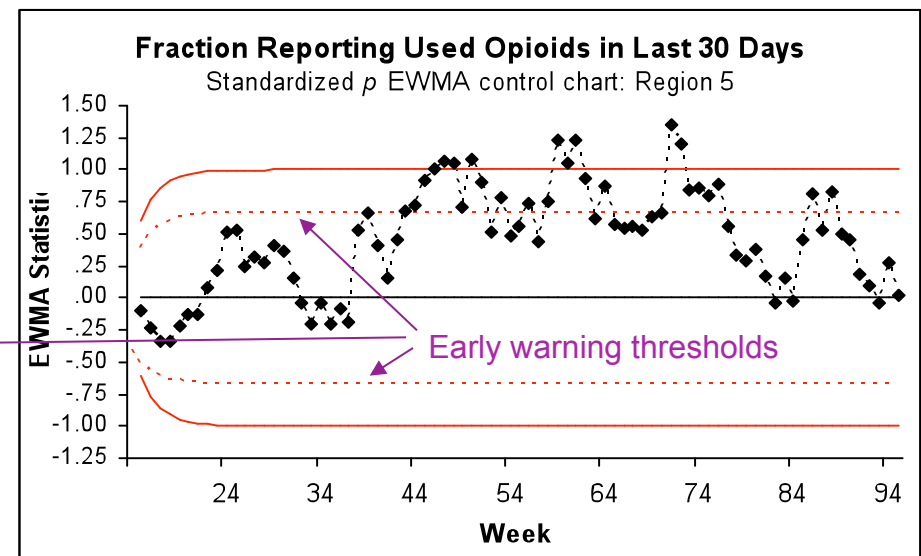
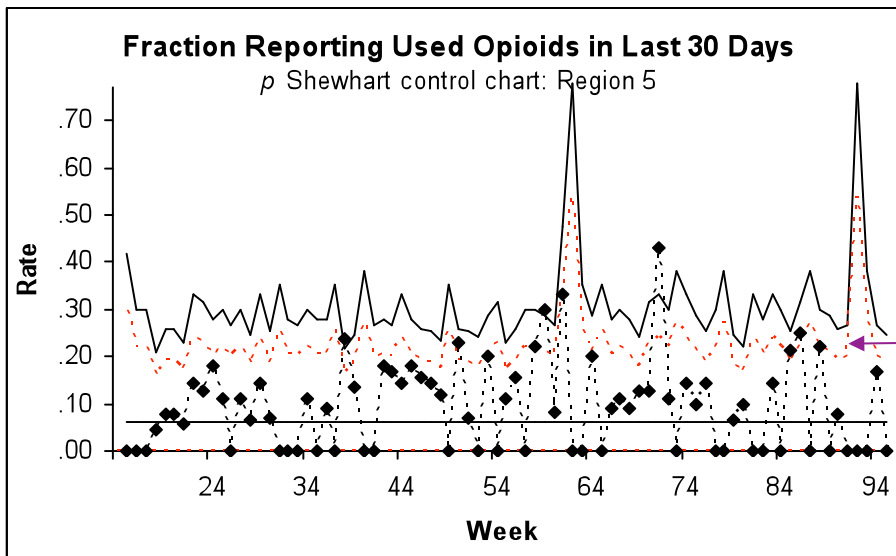


## Research Agenda

1. **Empirical signal detection performance**
  - Apply spatial cluster detection and SPC to empirical data
  - Insight re: type signals, rate definitions, baselines
  - Validation attempt
2. **Theoretical performance**
  - Mathematical OC and ARL curves
  - Current and planned sampling rates
  - Step and spike signals only
3. **Simulation performance**
  - Monte Carlo
  - Different types of signals, trends



# Opioid signal examples using Statistical Process Control (SPC)

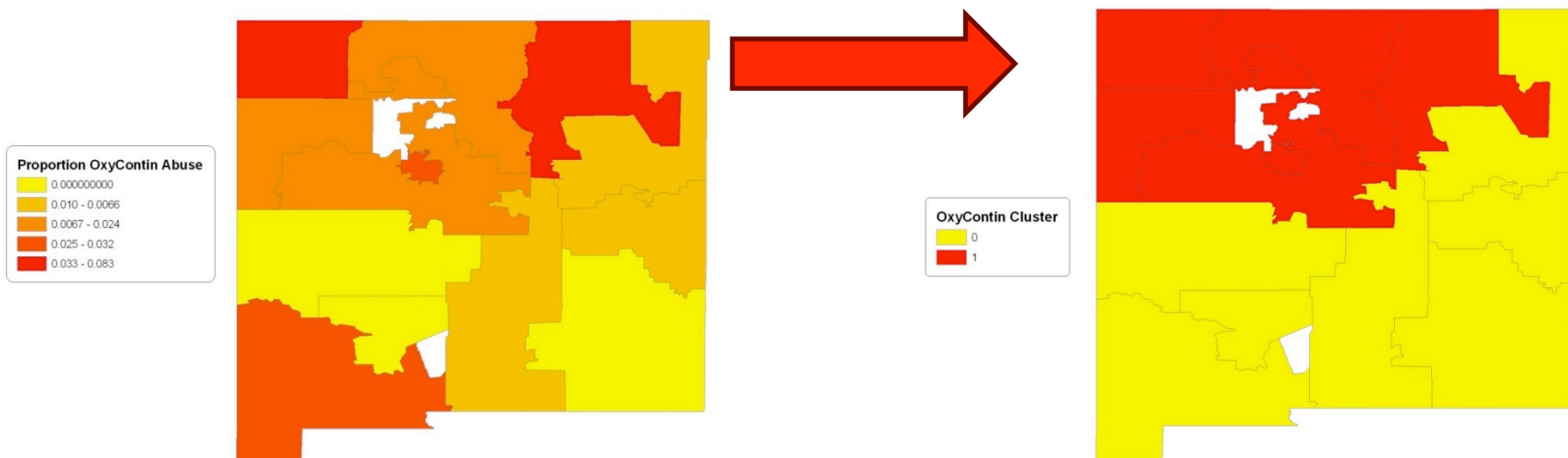




## Cluster Detection

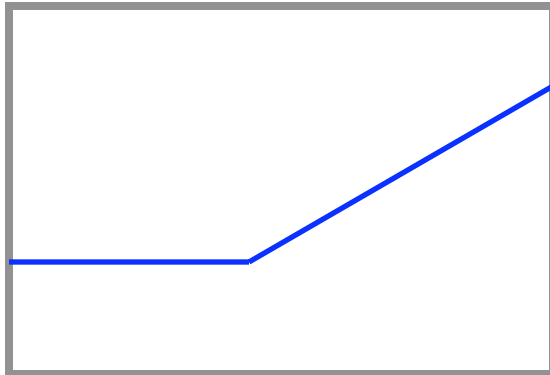
### Principles of hotspot detection

- (1) Comparing whether disease cases occur in a non-random pattern relative to pattern of non-cases (binary distribution)
- (2) Isolating areas with raised incidence taking into account base population (Poisson distribution)



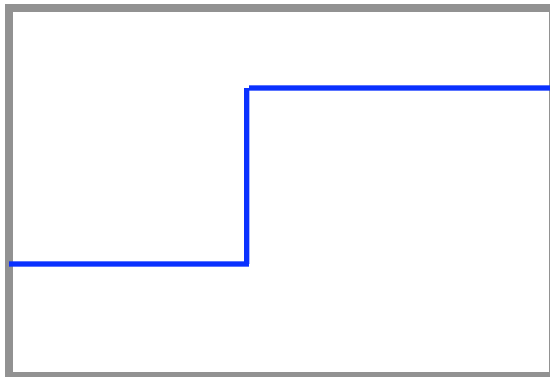


Signal

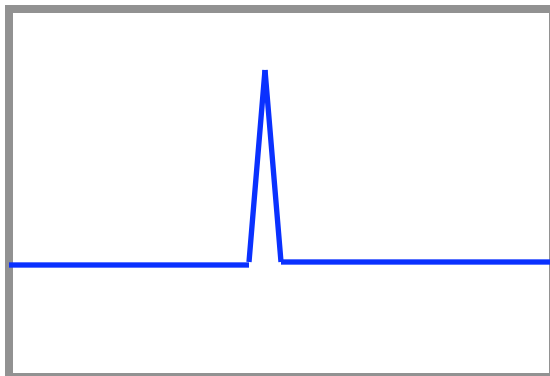


## Temporal scenarios

A rogue physician (linear increase from baseline)



A new supply chain (shift in baseline)

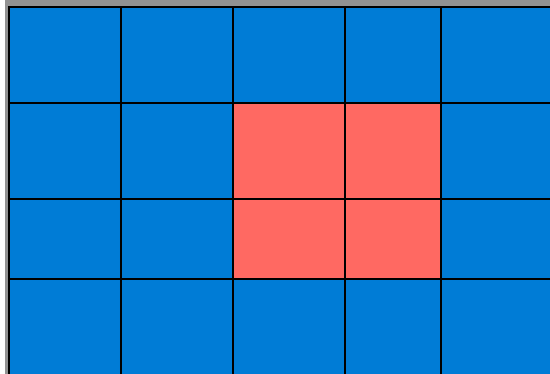


A robbery (a spike from baseline)

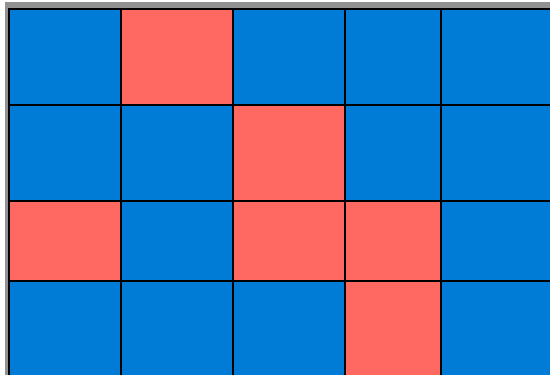


Signal

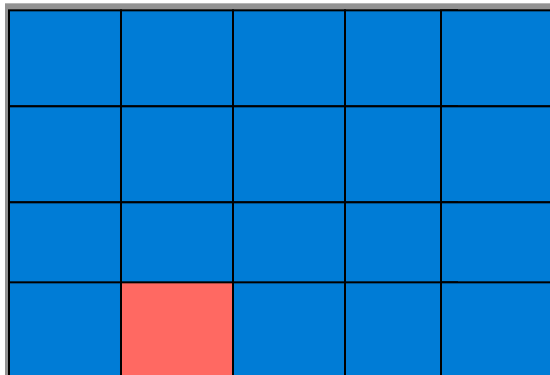
## Spatial scenarios



A highly clustered outbreak for the  
rogue physician scenario



A more spread out scenario for  
the supply chain scenario



A localized outbreak in the  
robbery scenario



# Surveillance Platform

**NAVIPRO**

HOME WHAT IS NAVIPRO? ADVISORS PRESS & PUBLICATIONS EVENTS CONTACT

NAVIPRO MAP

875 / NM  
Interviews: 5378  
Drug events: 1695  
OxylR: 544  
Oral: 478  
Snort: 59

Key (event counts): 2600 1950 1300 650 0

Drugs:  
 Fentanyl  
 Hydrocodone  
 Hydromorphone  
 MorphER  
 OxylR  
 Oxycodone  
 Snort

Routes:  
 Inject  
 Oral  
 Smoke  
 Snort

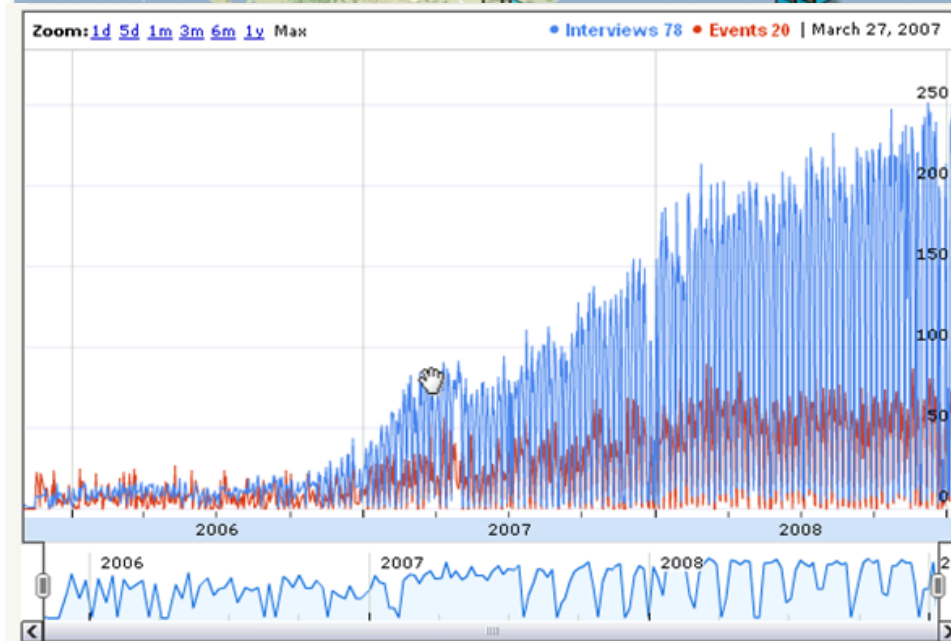
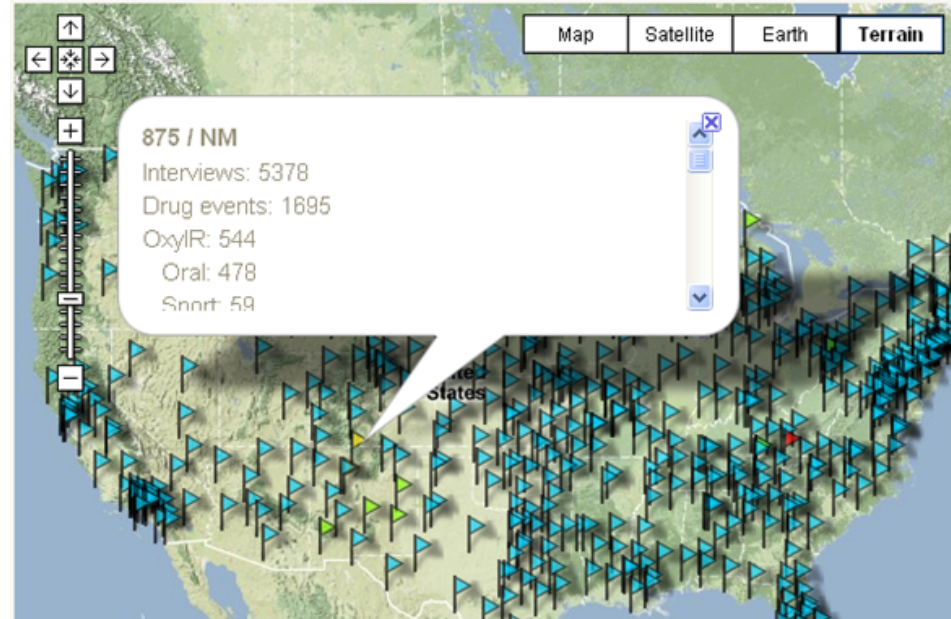
Methods of acquisition:  
 Dealer  
 Family  
 Forgery  
 Internet  
 Multiple Drs  
 Other  
 Over Prescription  
 Steal

Zoom: 1d 5d 1m 3m 6m 1y Max

Interviews 78 Events 20 March 27, 2007

The NAVIPRO™ system is a unique, turnkey solution for all of your risk management needs that integrates sensitive surveillance with sophisticated signal detection, signal verification, and targeted prevention and intervention programs.

## NAVIPRO MAP







Children's Hospital Boston  
Informatics Program

Harvard-MIT Division of  
Health Sciences and Technology



# Considerations for abuse deterrent formulations



# Correlation Analyses

- Across drugs (Oxycontin, Duragesic, Kadian, Dilaudid, and Hydrocodones) the correlation at the zip-code level with abuse and availability is  $r_s = 0.70$ .

- Availability = 
$$\frac{\text{Morphine equivalent grams}}{\text{Population Density at 3-Digit Zip-code Level}}$$

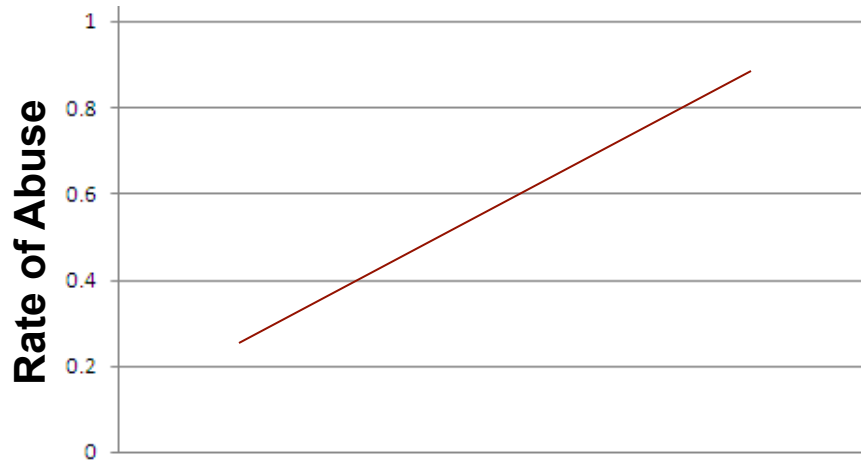
- Abuse = 
$$\frac{\text{\# of People Reporting Abuse}}{\text{Total Number of People in Zip-Code}}$$

$r_s$  = Spearman rho



# Abuse Deterrent Formulation Abuse and Availability Illustration

Drug A (Parent)



Increasing Availability

Drug B (ADF)

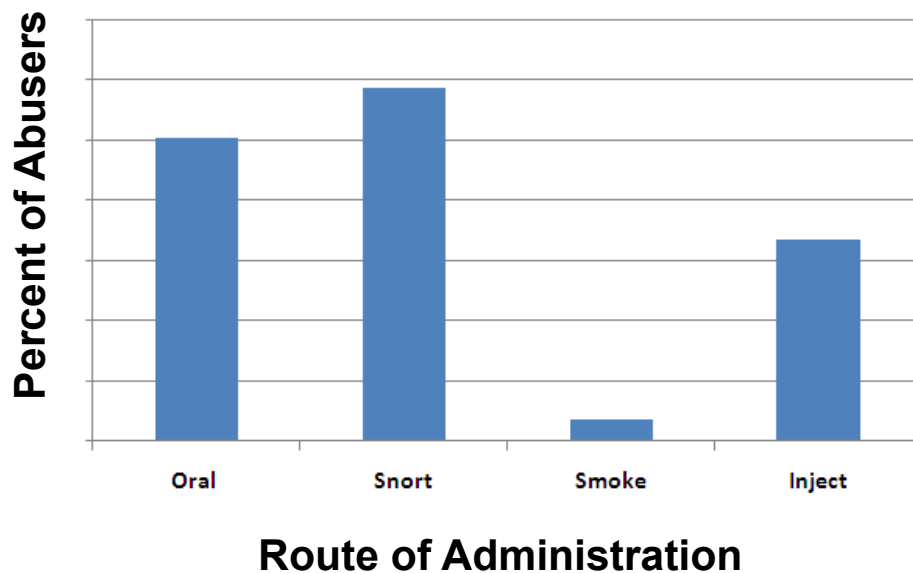


Increasing Availability

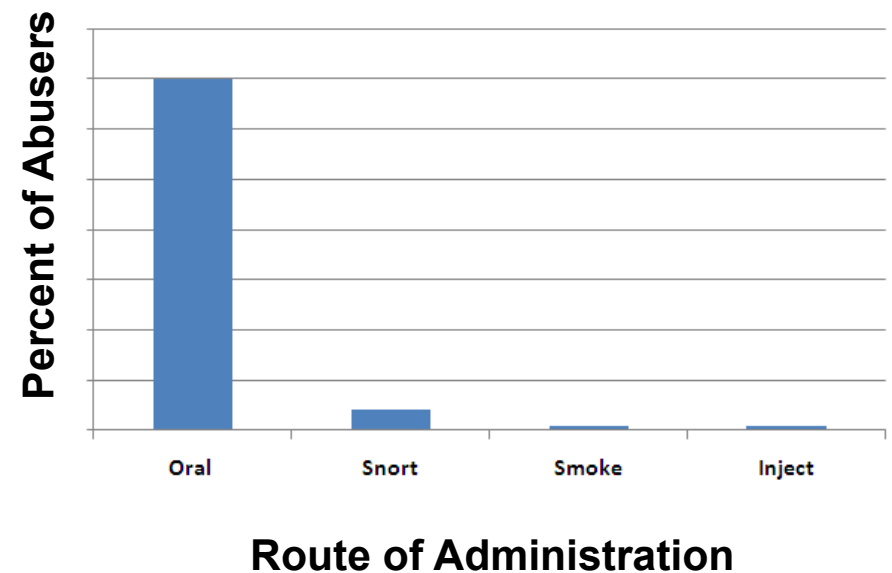


# Abuse Deterrent Formulation Route of Administration Illustration

Drug A (Parent)



Drug B (ADF)



The ROA profile for any specific ADF is dependent upon the unique properties/barriers to abuse for that drug



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# Other evidence for evaluating ADFs



## Internet Monitoring

- The Internet is an ideal medium for uncensored user-to-user communication
- Provides researchers access to a hidden populations
- Information can be aggregated from thousands of individuals at a relatively low cost
- Data may present leading edge indicators of new routes of administration



# Chat rooms/Message boards

**BLUELIGHT**

**IF SO CLICK HERE...**

[Home](#)

[Register](#)

[Forums](#)

[Donate](#)

[Gallery](#)

[Journal](#)

[About](#)

[Today's Posts](#)

[Search](#)

[Bluelight](#)  
 [Home](#)

User Name   Remember Me?  
Password

## News

- [Europe's approach to drugs is more enlightened ... it's tougher](#) n 2006, Governor-General Michaëlle Jean was hosting Queen Silvia of Sweden during the Swedish royal family's visit to Canada when the topic of illegal...  
E-llusion, 17 Jul, [0 comments](#)
- [We still await the scientific proof of harm reduction's success](#) Ten months before Vancouver's supervised-injection site opened in 2003, two young researchers gave a stirring presentation. They argued that such a fa...  
E-llusion, 17 Jul, [0 comments](#)
- [Ending Moderate Drinking Tied To Depression](#) Scientific evidence has long suggested that moderate drinking offers some protection against heart disease, certain types of stroke and some forms of ...  
erosion, 11 Jul, [20 comments](#)
- [The Sheriff's Stash](#) 11 Jul
- [UK: £80m To Stop Drugs In Prisons](#) 8 Jul
- [The DEA Turns 35 This Week!](#) 3 Jul
- [Canada: New enforcement rules on drug-impaired dr...](#) 30 Jun

## PDA Version

[pda.bluelight.ru](http://pda.bluelight.ru) Bluelight on your PDA or SmartPhone!

## Forums

### Focus Forums

- [Drug FAQs](#)
- [Ecstasy Discussion](#)
- [Cannabis Discussion](#)
- [Steroid Discussion](#)
- [Psychedelic Drugs](#)
- [Other Drugs](#)

### Drug Discussion

- [Drugs in the Media](#)
- [Basic Drug Discussion](#)
- [Advanced Drug Discussion](#)
- [The Dark Side](#)
- [Trip Reports](#)
- [Drug Culture](#)

### Community

- [Healthy Living](#)
- [Current Events and Politics](#)
- [Sex, Love and Relationships](#)
- [Philosophy and Spirituality](#)
- [College & University](#)
- [Legal Discussion](#)
- [Second Opinion](#)
- [The Lounge](#)
- [Sports & Gaming](#)
- [Science & Technology](#)

### Arts & Entertainment

- [Music & DJs](#)
- [Non-Electronic Music Discussion](#)
- [Words](#)
- [Film & Television](#)

### Australia & Asia

- [Australian Drug Discussion](#)
- [Australian Social](#)
- [Australian Events](#)

### Europe & Africa

- [European Drug Discussion](#)
- [European Events](#)

### North America & South America

- [No. America Drug Discussion](#)
- [North American Social](#)
- [North American Events](#)

### Pillreports.com

- [Pillreports](#)
- [Pillreports Discussion](#)
- [Pill Testing Q&A](#)

### Bluelight Basics

- [New Member Introductions](#)
- [Homeless Threads](#)
- [Anonymous Posting](#)
- [Testing Grounds](#)

### Bluelight Feedback

- [Announcements](#)
- [Support \(lost? try here!\)](#)

### Bluelight History

- [Best of Bluelight](#)
- [Bluelight Shrine](#)
- [General Archives](#)
- [Harm Reduction](#)

[New posts since our last visit](#) (can be thousands of posts!)

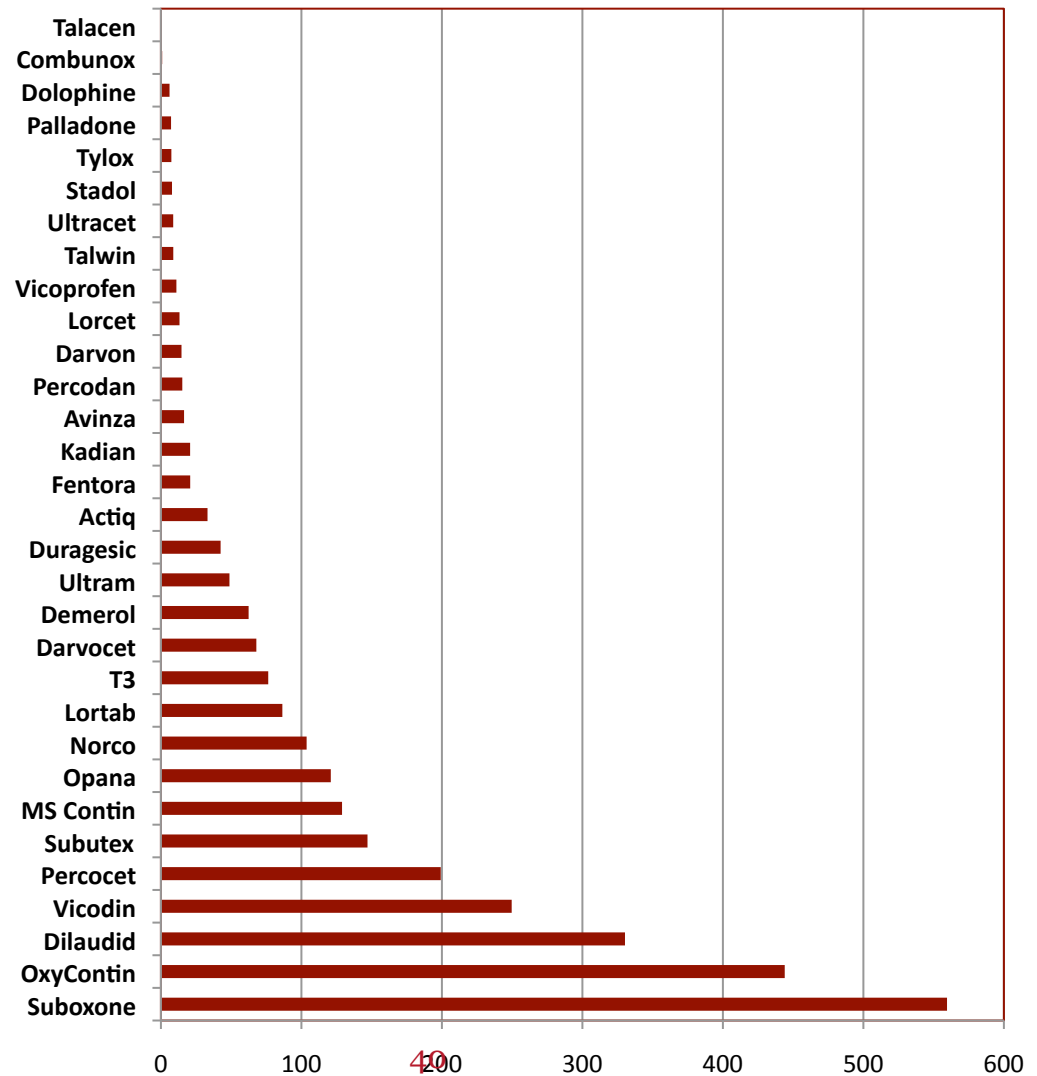


Database allows for  
quantitative comparisons of  
product-specific discussions.

As of July 30, 2008  
Entire database contains:  
2,281,572 posts

Unique authors discussing  
prescription opioids:  
27,065 screen names

Drug Posts per 100,000 posts in WIS Database  
(n = 1,760,771\*)



\*Only posts harvested between 11/30/2006 and 7/30/2008





## Example of External Correlation: Identifying and Tracking New Extraction & Route of Administration

### INDEX POST: NEW METHOD OF ADMINISTRATION

On September 11, 2007, an author described detailed instructions on how to prepare an extended-release morphine sulfate product for nasal spray administration. Recipe included step-by-step photo illustrations.





# Social Networking Websites

patientslikeme™ Patients helping patients live better every day.

Patients | Treatments | Symptoms | Research

Search this site

Learn Find Share

Celebrex Patients

alsking101 Male, 38 years Newton, MA

ALS Condition

What You've Learnt

Why Patients Took

Find Patient

Recent Updates

Treatments

Symptoms

Share Your Experience »  
See how easy it is...

Find Patients Like You »  
Try it out...

Learn From Others »  
Discover the power of many...

Join Now (It's free!)

Already a member? Log in

Click on member photos for more details

### Our Current Communities

<b>Neurological Conditions</b>	<b>Neuroendocrine Conditions</b>
MS (Multiple Sclerosis)	<b>Fibromyalgia (New!)</b>
Parkinson's Disease	<b>Mood Conditions</b>
ALS (Amyotrophic Lateral Sclerosis) / MND (Motor Neuron Disease)	Depression
PLS (Primary Lateral Sclerosis)	Anxiety
PMA (Progressive Muscular Atrophy)	Bipolar
PSP (Progressive Supranuclear Palsy)	OCD (Obsessive-Compulsive Disorder)
CBD (Corticobasal Degeneration)	PTSD (Post-Traumatic Stress Disorder)
MSA (Multiple System Atrophy)	<b>Immune Conditions</b>
Devic's Neuromyelitis Optica	HIV/AIDS

If we have a community for your condition, [join now!](#) Don't see your condition? [Request it here.](#)

### Highlights

**NEW Fibromyalgia Community**  
Introducing our new community for Fibromyalgia patients like you.  
[Learn more...](#)

**Lithium & ALS Study**  
See how ALS patients taking lithium are doing in real-time. [Learn more...](#)

**Clinical Trial Awareness**  
Two of our clinical trial awareness partners are seeking patients for clinical trials. [Find out more...](#)

	Lithium Population	ALS Population
<b>Type of Onset</b>		
Bulbar	66 29%	469 21%
Limb	162 70%	1660 76%
Breathing	3 1%	52 2%
<b>Time since Diagnosis</b>		
Less than 2 yrs	137 59%	810 39%
2-5 yrs	64 28%	573 28%
More than 5 yrs	10 4%	414 20%
<b>Sex</b>		
Male	145 69%	1211 59%
Female	66 31%	837 41%
<b>Age range at Diagnosis</b>		
Under 40	40 19%	343 19%
40-49	52 25%	477 26%
50-59	65 31%	572 31%
60-69	47 22%	343 19%
70 or older	6 3%	101 6%

### Side-effects

Severe	11%	14
Moderate	17%	23
Mild	28%	37
<b>None</b>	44%	59

sleepiness	28%	37
Fatigue	24%	32
Muscle weakness	22%	29
Made me wobbly	11%	14
Urinary frequency	9%	12
Dry mouth (xerostomia)	8%	11
Constipation	7%	9
Lightheadedness	7%	9

"I have been haunted, and that is really not too strong a term, by the vision of patient-connectedness that you outlined."  
— Information Executive, major pharmaceutical [Read more...](#)

# Media Grid

## Pharma tracking dashboard

### Alert categories

- Abuse/Possession (330)
- Celebrity (292)
- Medical Use (237)
- General Rx Abuse (118)
- Arts & Commentary (117)

### Products, last 30 days

- Select: [all](#), [none](#) [info](#)
- Morphine (429)
  - Vicodin (264)
  - OxyContin (259)
  - Amphetamine (178)
  - Hydrocodone (135)
  - Heroin (134)
  - Oxycodone (115)
  - Methadone (102)
  - Percocet (102)
  - Codeine (89)
  - Adderall (87)

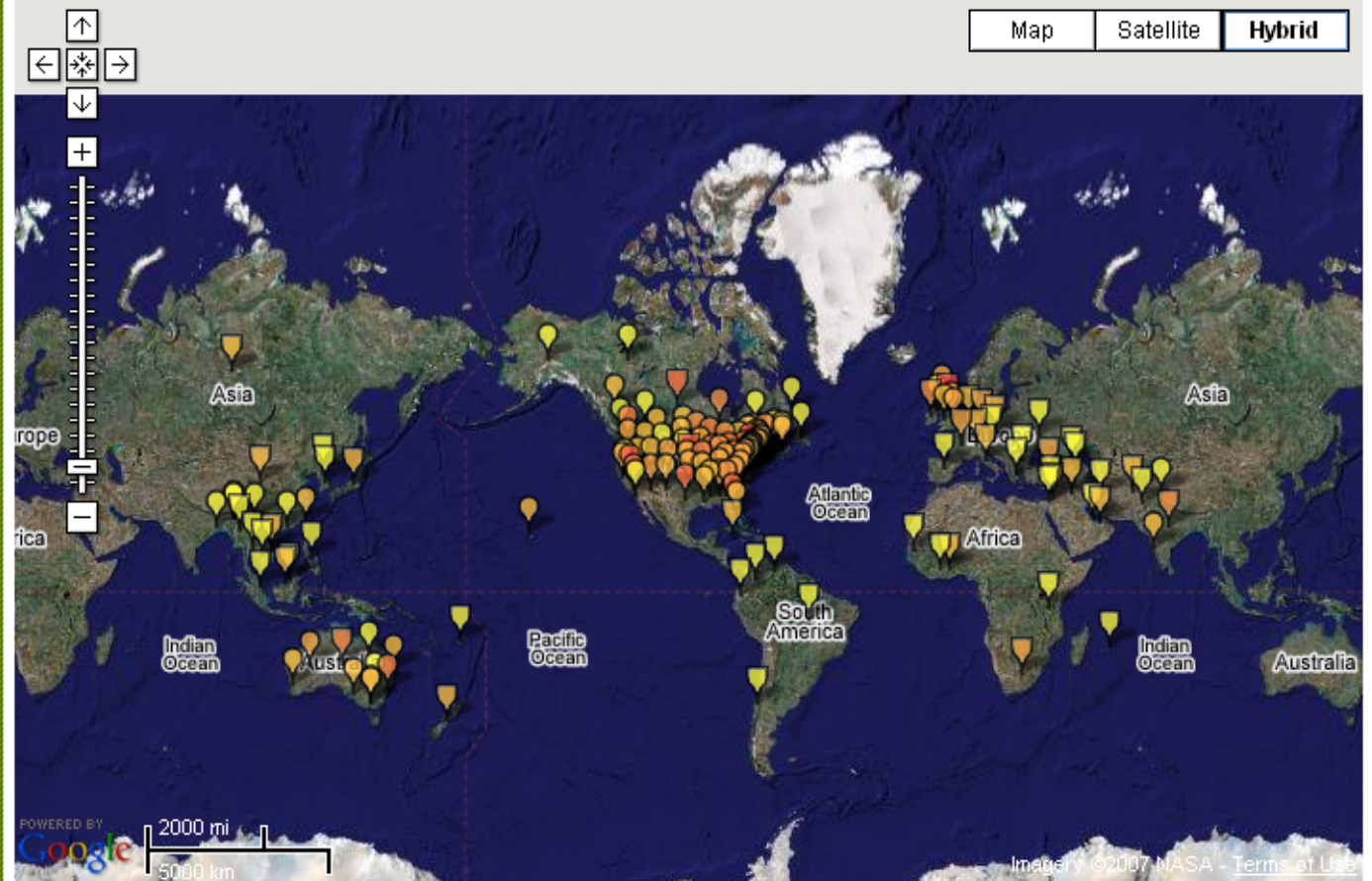
### Alerts by country

- Zoom to country:
- [United States \(1161\)](#)
  - [United Kingdom \(136\)](#)
  - [Canada \(120\)](#)
  - [Australia \(68\)](#)
  - [Afghanistan \(25\)](#)
  - [India \(19\)](#)
  - [Iraq \(15\)](#)
  - [China \(12\)](#)
  - [New Zealand \(11\)](#)
  - [Turkey \(9\)](#)

### Latest alerts

Zoom to region: [N. America](#) [S. America](#) [Europe](#) [Africa](#) [Mideast](#) [Asia](#) [Australia](#) [World](#)

[Full Screen](#)



Last update: 9 Jul 2007 07:53 | Next update: 9 Jul 2007 08:53

Enter your email address to sign up for our low-volume announcements list:

<b>Compare by</b>	<b>Search terms</b>	<b>Filter</b>
<input checked="" type="radio"/> Search terms <input type="radio"/> Locations <input type="radio"/> Time Ranges	Tip: Use the plus sign to indicate OR. (tennis + squash) <input type="text" value="hydrocodone"/> <input type="text" value="oxycodone"/> <input type="text" value="methadone"/> + <a href="#">Add search term</a>	Web Search United States   All subregions   All metros Last 12 months All Categories
		<input type="button" value="Search"/>

## Web Search Volume: hydrocodone vs. oxycodone vs. methadone

United States, Last 12 months

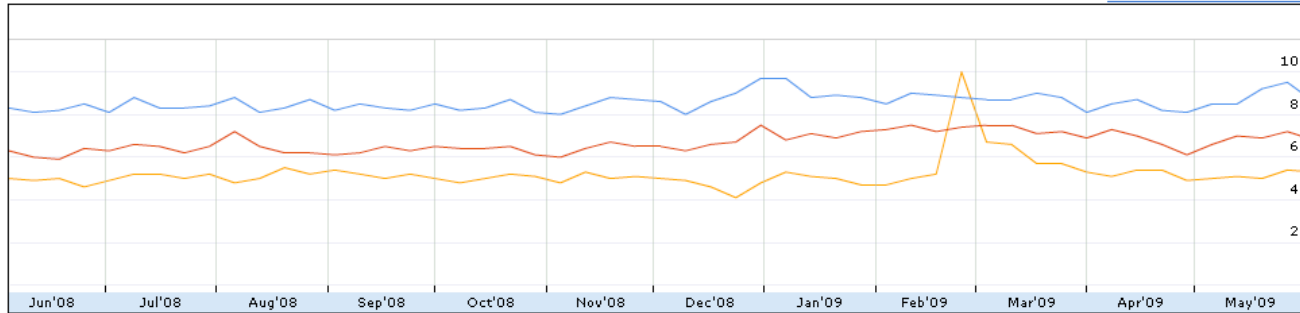
Categories: [Health](#), [Local](#), [Science](#)

Totals	hydrocodone	oxycodone	methadone
	86	67	52

### Interest over time

News headlines: [Show](#) [Hide](#)

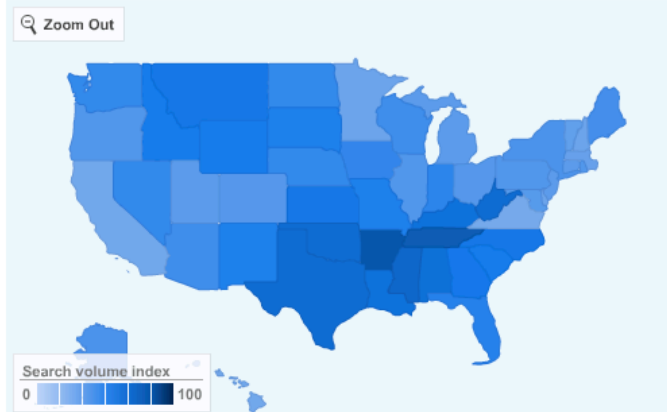
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### Regional interest

Subregion [Metro](#) [City](#)

Rank	State	hydrocodone	oxycodone	methadone
1	<a href="#">Arkansas</a>	High	Medium	Low
2	<a href="#">Tennessee</a>	High	Medium	Low
3	<a href="#">Mississippi</a>	High	Medium	Low
4	<a href="#">Texas</a>	High	Medium	Low
5	<a href="#">West Virginia</a>	High	Medium	Low
6	<a href="#">Oklahoma</a>	High	Medium	Low
7	<a href="#">Alabama</a>	High	Medium	Low
8	<a href="#">Kentucky</a>	High	Medium	Low
9	<a href="#">Louisiana</a>	High	Medium	Low
10	<a href="#">Kansas</a>	High	Medium	Low



### Search terms

United States, Last 12 months

#### Top searches

1.	<a href="#">vicodin hydrocodone</a>	100
2.	<a href="#">oxycodone hydrocodone</a>	100
3.	<a href="#">vicodin</a>	95
4.	<a href="#">oxycodone</a>	95
5.	<a href="#">hydrocodone apap</a>	95

#### Rising searches

1.	<a href="#">hydrocodone apap 5-500</a>	+300%
2.	<a href="#">hydrocodone 5-500</a>	+150%
3.	<a href="#">hydrocodone vs oxycodone</a>	+110%
4.	<a href="#">hydrocodone street value</a>	+90%
5.	<a href="#">pill identifier</a>	+80%



## Future Considerations

- **Signals vs situational awareness**
- **Population representativeness vs vulnerable sentinel populations**
- **Extrapolation of results**
- **Appropriate denominators**
- **Historical baseline**
- **Group difference (exchangeability)**
- **Sampling frame**
- **Validity of empirical surveillance data for epidemiologic studies**
- **Value to make regulatory decisions**