10-8-2010

Reducing Overdose Deaths Associated with Pharmaceutical Opioid Treatment of Chronic Pain: Analyzing Interventions with a System Dynamics Model

Wayne Wakeland
Portland State University, wakeland@pdx.edu

Follow this and additional works at: https://pdxscholar.library.pdx.edu/systems_science_seminar_series

Part of the Other Chemicals and Drugs Commons, and the Substance Abuse and Addiction Commons

Let us know how access to this document benefits you.

Recommended Citation
https://pdxscholar.library.pdx.edu/systems_science_seminar_series/18

This Book is brought to you for free and open access. It has been accepted for inclusion in Systems Science Friday Noon Seminar Series by an authorized administrator of PDXScholar. For more information, please contact pdxscholar@pdx.edu.
REDUCING OVERDOSE DEATHS ASSOCIATED WITH PHARMACEUTICAL OPIOID TREATMENT OF CHRONIC PAIN: ANALYZING INTERVENTIONS WITH A SYSTEM DYNAMICS MODEL

Wayne Wakeland
Systems Science Seminar
October 8, 2010
Research Team

Core Team
• Lewis Lee, M.S.
• Teresa Schmidt, M.S.
• Louis Macovsky, DVM, M.S.
• Wayne Wakeland, Ph.D.

Sponsors & Expert Panelists
• Dave Haddox, DDS
  – Sponsor
• John Fitzgerald, Ph.D.
  – Sponsor
• Dennis McCarty, OHSU
  – Drug abuse expert
• Lynn Webster, MD
  – Pain treatment expert
• Aaron Gilson, Ph.D
  – Drug abuse policy expert
• Jack Homer, Ph.D.
  – System dynamics expert

Support provided by Purdue Pharma, L.P.
Major Health Problem

- Dramatic rise in rates of pharmaceutical opioid (PO) abuse and addiction
- Many people suffer from chronic pain (CP)
- POs used increasingly to treat CP
Prevalence and Incidence of Chronic Pain: WHO Study

Persistent pain in primary care:
World Health Organization (WHO) Study

- 5438 patients from 15 sites in 14 countries were assessed by interview and questionnaires
- 22% of primary care patients had persistent pain (>6 months + care or disability)
  - More likely to have anxiety or depressive disorder (OR* = 4.14)
- Pain-distress relationships were more consistent across cultures than pain-disability

Gureje et al, JAMA 1998;280:147-151

11.2% for Seattle

Persistent pain in primary care:
WHO Study

- 3197 patients from 15 sites in 14 countries were assessed at baseline and 12 months
- 50% with persistent pain at baseline still had pain at 12 months
  - Predicted by number of pain sites at baseline
- 8.8% had new-onset persistent pain
  - Predicted by psychiatric disorder, perceived poor health, and occupational role disability

Gureje et al, JAMA 1998;280:147-151
PO Treatment Rate in CP Patients: Incidence

Suggests in 2005 that (10.5/1000)*250M or ~3M new patients received opioid treatment for chronic non-cancer pain

⇒ OpA initiation rate of (3/75) = 4% for chronic non-cancer pain

Supported by NIDA grant DA-022557 (PIs: Michael Von Korff and Connie Weisner)

From: Sullivan M, Epidemiology of Pain
Source: National Health Interview Survey
PO Treatment Rate in CP Patients: Prevalence

Provisional Results

Prevalence of opioid use episodes per 1,000 adults: chronic non-cancer pain at Group Health Cooperative*

*population of approximately 300,000 adults

Suggests in 2005 that (35/1000)*250M or ~9M under opioid treatment for chronic non-cancer pain

⇒ OpA treatment rate of (9/75) = 12% for chronic non-cancer pain

Supported by NIDA grant DA-022557 (PIs: Michael Von Korff and Connie Weisner)

From: Sullivan M, Epidemiology of Pain
Source: National Health Interview Survey
**Prescriptions (TRX, millions)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Long-acting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>oxycodone ER</td>
<td>1.80</td>
<td>3.10</td>
<td>5.40</td>
<td>6.50</td>
<td>6.30</td>
<td>6.50</td>
<td>6.30</td>
<td>6.40</td>
<td>7.00</td>
<td>7.50</td>
</tr>
<tr>
<td>methadone</td>
<td>0.45</td>
<td>0.60</td>
<td>0.80</td>
<td>1.10</td>
<td>1.60</td>
<td>2.20</td>
<td>2.80</td>
<td>3.40</td>
<td>3.90</td>
<td>4.10</td>
</tr>
<tr>
<td>fentanyl</td>
<td>1.00</td>
<td>1.20</td>
<td>1.60</td>
<td>2.20</td>
<td>3.10</td>
<td>4.00</td>
<td>4.50</td>
<td>4.60</td>
<td>5.00</td>
<td>5.50</td>
</tr>
<tr>
<td>morphine ER</td>
<td>1.00</td>
<td>1.20</td>
<td>1.30</td>
<td>1.50</td>
<td>1.80</td>
<td>2.20</td>
<td>2.70</td>
<td>3.20</td>
<td>3.70</td>
<td>4.20</td>
</tr>
<tr>
<td><strong>Short-acting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hydrocodone</td>
<td>60.00</td>
<td>68.00</td>
<td>76.00</td>
<td>80.00</td>
<td>85.00</td>
<td>90.00</td>
<td>95.00</td>
<td>105.00</td>
<td>110.00</td>
<td>120.00</td>
</tr>
<tr>
<td>oxycodone IR</td>
<td>14.00</td>
<td>15.90</td>
<td>16.60</td>
<td>18.50</td>
<td>20.50</td>
<td>23.50</td>
<td>25.00</td>
<td>27.50</td>
<td>31.00</td>
<td>34.70</td>
</tr>
<tr>
<td>hydromorphone</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.60</td>
<td>0.70</td>
<td>0.80</td>
<td>1.00</td>
<td>1.20</td>
<td>1.40</td>
<td>1.60</td>
</tr>
<tr>
<td>morphine IR</td>
<td>0.60</td>
<td>0.60</td>
<td>0.70</td>
<td>0.80</td>
<td>0.90</td>
<td>1.00</td>
<td>1.20</td>
<td>1.20</td>
<td>1.20</td>
<td>1.40</td>
</tr>
</tbody>
</table>

**Patients (Millions)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Long-acting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>oxycodone ER</td>
<td>0.36</td>
<td>0.62</td>
<td>1.08</td>
<td>1.30</td>
<td>1.26</td>
<td>1.30</td>
<td>1.26</td>
<td>1.28</td>
<td>1.40</td>
<td>1.50</td>
</tr>
<tr>
<td>methadone</td>
<td>0.09</td>
<td>0.12</td>
<td>0.16</td>
<td>0.22</td>
<td>0.36</td>
<td>0.48</td>
<td>0.55</td>
<td>0.65</td>
<td>0.72</td>
<td>0.82</td>
</tr>
<tr>
<td>fentanyl</td>
<td>0.20</td>
<td>0.24</td>
<td>0.32</td>
<td>0.44</td>
<td>0.62</td>
<td>0.80</td>
<td>0.90</td>
<td>0.92</td>
<td>1.00</td>
<td>1.10</td>
</tr>
<tr>
<td>morphine ER</td>
<td>0.21</td>
<td>0.25</td>
<td>0.27</td>
<td>0.31</td>
<td>0.37</td>
<td>0.45</td>
<td>0.56</td>
<td>0.66</td>
<td>0.76</td>
<td>0.87</td>
</tr>
<tr>
<td><strong>Short-acting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hydrocodone</td>
<td>22.82</td>
<td>25.87</td>
<td>28.91</td>
<td>30.43</td>
<td>32.33</td>
<td>34.24</td>
<td>36.14</td>
<td>39.94</td>
<td>41.84</td>
<td>45.65</td>
</tr>
<tr>
<td>oxycodone IR</td>
<td>5.33</td>
<td>6.05</td>
<td>6.31</td>
<td>7.04</td>
<td>7.80</td>
<td>8.94</td>
<td>9.51</td>
<td>10.46</td>
<td>11.79</td>
<td>13.20</td>
</tr>
<tr>
<td>hydromorphone</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.12</td>
<td>0.14</td>
<td>0.16</td>
<td>0.20</td>
<td>0.24</td>
<td>0.28</td>
<td>0.32</td>
</tr>
<tr>
<td>morphine IR</td>
<td>0.19</td>
<td>0.19</td>
<td>0.23</td>
<td>0.26</td>
<td>0.29</td>
<td>0.32</td>
<td>0.39</td>
<td>0.36</td>
<td>0.39</td>
<td>0.45</td>
</tr>
</tbody>
</table>

From: Governale L, FDA, CDER, Outpatient Drug Utilization Trends for Oxycodone Products, November, 2008
Governale L, FDA, CDER, Outpatient Drug Utilization Trends for Extended-Release Morphine Products, Nov., 2008
Source: Verispan, LLC, SDI Vector One®: National (VONA) and SDI Total Patient Tracker
Adverse Outcomes

• Overdose incidents
• Emergency room visits
• Fatalities
Rate of Drug Overdose and Mortality among CP Patients

• Overdose rate for individuals receiving 3 or more PO prescriptions within 90 days is 148 per 100,000 person-years.

• Among those prescribed the highest dosage level (100mg/day or more), the annual OD rate was 1791 per 100,000 person-years, representing an “8.9-fold increase in overdose risk” (p. 85) compared to those prescribed lower doses.

• Rate of overdose Mortality for these individuals is 17 per 100,000 person-years.

# Opioid Analgesic Poisoning Deaths NCHS/ NVSS


<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>4,041</td>
<td>4,419</td>
<td>5,538</td>
<td>7,475</td>
<td>8,535</td>
<td>9,876</td>
<td>10,947</td>
<td>13,755</td>
<td>3.4</td>
<td>1</td>
</tr>
<tr>
<td>Deaths per 100,000 population</td>
<td>1.4</td>
<td>1.6</td>
<td>1.9</td>
<td>2.6</td>
<td>2.9</td>
<td>3.4</td>
<td>3.7</td>
<td>4.6</td>
<td>3.3</td>
<td>1</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 15 years</td>
<td>*</td>
<td>0.0</td>
<td>0.0</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>*</td>
<td>1</td>
</tr>
<tr>
<td>15–24 years</td>
<td>0.7</td>
<td>0.8</td>
<td>1.3</td>
<td>1.7</td>
<td>2.2</td>
<td>2.7</td>
<td>2.8</td>
<td>3.8</td>
<td>5.4</td>
<td>1</td>
</tr>
<tr>
<td>25–34 years</td>
<td>1.9</td>
<td>1.9</td>
<td>2.3</td>
<td>3.3</td>
<td>3.7</td>
<td>4.4</td>
<td>5.2</td>
<td>6.7</td>
<td>3.5</td>
<td>1</td>
</tr>
<tr>
<td>35–44 years</td>
<td>3.5</td>
<td>3.7</td>
<td>4.5</td>
<td>5.7</td>
<td>6.2</td>
<td>6.8</td>
<td>6.9</td>
<td>8.3</td>
<td>2.4</td>
<td>1</td>
</tr>
<tr>
<td>45–54 years</td>
<td>2.9</td>
<td>3.3</td>
<td>4.0</td>
<td>5.5</td>
<td>6.2</td>
<td>7.1</td>
<td>8.0</td>
<td>9.7</td>
<td>3.3</td>
<td>1</td>
</tr>
<tr>
<td>55–64 years</td>
<td>1.0</td>
<td>1.1</td>
<td>1.4</td>
<td>1.8</td>
<td>2.2</td>
<td>2.6</td>
<td>3.1</td>
<td>4.0</td>
<td>4.0</td>
<td>1</td>
</tr>
<tr>
<td>65 years and over</td>
<td>0.4</td>
<td>0.3</td>
<td>0.4</td>
<td>0.6</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
<td>2.3</td>
<td>1</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.0</td>
<td>2.1</td>
<td>2.5</td>
<td>3.3</td>
<td>3.7</td>
<td>4.2</td>
<td>4.5</td>
<td>5.8</td>
<td>2.9</td>
<td>1</td>
</tr>
<tr>
<td>Female</td>
<td>0.9</td>
<td>1.1</td>
<td>1.4</td>
<td>1.9</td>
<td>2.1</td>
<td>2.5</td>
<td>2.8</td>
<td>3.3</td>
<td>3.7</td>
<td>1</td>
</tr>
<tr>
<td>Race and Hispanic origin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.7</td>
<td>1.2</td>
<td>1.2</td>
<td>1.5</td>
<td>1.6</td>
<td>1.6</td>
<td>2.0</td>
<td>1.2</td>
<td>1.2</td>
<td>1</td>
</tr>
<tr>
<td>Non-Hispanic white</td>
<td>1.6</td>
<td>1.8</td>
<td>2.4</td>
<td>3.2</td>
<td>3.7</td>
<td>4.3</td>
<td>4.7</td>
<td>5.8</td>
<td>3.6</td>
<td>1</td>
</tr>
<tr>
<td>Non-Hispanic black</td>
<td>0.9</td>
<td>0.9</td>
<td>1.1</td>
<td>1.3</td>
<td>1.3</td>
<td>1.5</td>
<td>1.8</td>
<td>2.7</td>
<td>3.0</td>
<td>1</td>
</tr>
</tbody>
</table>

* Figure does not meet standards of reliability or precision. Rate is based on fewer than 20 deaths and is considered unreliable.
0.0 Quantity more than zero but less than 0.05.

*Interpret the ratio of 2006 to 1999 for the total number of deaths as follows: the number of deaths in 2006 was 3.4 times the number of deaths in 1999.

Includes pain patients and nonmedical users

Medical Use Fraction of OpA Overdose Deaths


• Limited, state-level data without trends.

• W. Virginia data in 2006 indicate that ~45% of decedents involving opioid analgesics had a prescription within the past year.

...using centralized prescription records maintained by the state’s prescription drug monitoring program, we also were able to assess the decedents’ prescription histories in the year before their deaths.

particularly prevalent among drug diverters. Multiple contributory substances were implicated in 234 deaths (79.3%). Opioid analgesics were taken by 275 decedents (93.2%), of whom only 122 (44.4%) had ever been prescribed these drugs.
What to do?

- Need effective interventions
- Need tools to identify policies to reduce opioid abuse, addiction, and overdose deaths.
- Would a system dynamics (SD) model meet this need?
  - SD model structure features stocks and flows
  - Auxiliary variables, equations, parameters
1. New Chronic Pain Patients

2. Treating New Patients with Long Acting Opioids

3. Treating New Patients with Short Acting Opioids

4. Patients on Short Acting Opioids

New Chronic Pain Diagnosis Rate
MU Add/Switch Rates to Long-Acting Rx Opioid oxycodone ER

- ~81% of new Rx dispensed to those had previous Rx for ER oxycodone product within past 3 months
- ~6% had no previous Rx
- ~14% of new Rx switched or added-on from another pain therapy product, including other long-acting opioids

*3 month look-back period

From: Governale L, FDA, CDER, Outpatient Drug Utilization Trends for Oxycodone Products, November, 2008
Source: Verispan, LLC, SDI Vector One®: National (VONA)
**SA, LA, and SA+LA Utilization Pattern (White Study)**

Direct Costs of Opioid Abuse in an Insured Population in the United States

(population ~2M covered by 16 employer health plans)

**TABLE 4** Comparison of Drug Utilization Patterns, 1998-2002 (Patients Aged 12-64 Years)

<table>
<thead>
<tr>
<th></th>
<th>Opioid Abusers (N=740)</th>
<th>Nonabusers (N=2,220)</th>
<th>Relative Risk Ratio*+</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number (%) of Patients With at Least 1 Claim</td>
<td>Number of Claims per Patient</td>
<td>Number (%) of Patients With at Least 1 Claim</td>
</tr>
<tr>
<td><strong>Prescription drugs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All prescription drugs</td>
<td>643</td>
<td>86.9%</td>
<td>41.6^a</td>
</tr>
<tr>
<td>All nonopioids</td>
<td>637</td>
<td>86.1%</td>
<td>32.4^a</td>
</tr>
<tr>
<td><strong>Prescription opioids</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAOs only</td>
<td>304</td>
<td>41.1%</td>
<td>9.4^a</td>
</tr>
<tr>
<td>LAOs only</td>
<td>7</td>
<td>0.9%</td>
<td>6.9</td>
</tr>
<tr>
<td>Both SAOs and LAOs</td>
<td>127</td>
<td>17.2%</td>
<td>25.7</td>
</tr>
</tbody>
</table>

* Chi-square tests were conducted to compare the mean number of claims per patient between opioid abusers and nonabusers; ^a denotes significance at the 1% level (P < 0.01).
+ Short-acting (prescription) opioids (SAOs): any prescription drug with these active ingredients: hydrocodone (308 patients), oxycodone (153), tramadol (88), codeine (110), propoxyphene (93), and other SAOs (78, meperidine, butorphanol, fentanyl, hydromorphone, buprenorphine, morphine, pentazocine, dihydromorphone, opium, sufentanil, nalbuphine or drugs administered as a medical procedure with the following HCPCS codes: J0592, J0745, J1170, S0092, J2175, J2180, J2270, J2271, J2300, and J3010). “SAOs only” includes patients with claims only for SAOs.

§ Long-acting (prescription) opioids (LAOs): oxycodone ER (97 patients), fentanyl transdermal system (38), methadone (29), extended-release morphine (16, including the claims for brand names Kadian, Avinza, MS Contin, Oramorph, Astramorph PE, Duramorph, and Infumorph or extended-release morphine administered as a medical procedure with the following HCPCS codes: J2275 and S0093). “LAOs only” includes patients with claims only for LAOs.

**Are there other claims database analyses that can be used to validate the above splits?**

J Manag Care Pharm. 2005;11(6):469-79
Who develops opioid abuse/dependence among those receiving opioid therapy for chronic non-cancer pain?

Using pharmacy and diagnostic codes from VA VISN-16 data warehouse for 2000-2005 to identify individuals with at least 91+ days of opioid use in 2002. [N= 15,162; ~5% of all pts]

Excluded individuals with opioid abuse diagnosis in 2000-2002, to ensure that predictors preceded the outcome.

Dependent Variable:

Diagnosis of Opioid Abuse or Dependence in Years 2003-2005. [N=298; ~2% chronic users]

Edlund ME et al. *Pain* In Press
Prescribers concerned about the risk of abuse and addiction and possible regulatory action are likely to prescribe fewer opioids overall (Wolfert et al., 2010) and to more cautiously prescribe long-acting products (Potter et al., 2001).
## Model Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Cause Mortality Rate for Patients on Long-acting</td>
<td>0.012</td>
<td>Modeling Team Judgment</td>
</tr>
<tr>
<td>All Cause Mortality Rate for Patients on Short-acting</td>
<td>0.01</td>
<td>Panel Consensus</td>
</tr>
<tr>
<td>All Cause Mortality Rate for Patients with Dependence or Abuse</td>
<td>0.015</td>
<td>Panel Consensus</td>
</tr>
<tr>
<td>Average Long-acting Treatment Duration (in years)</td>
<td>7</td>
<td>Panel Consensus</td>
</tr>
<tr>
<td>Average Short-acting Treatment Duration (in years)</td>
<td>2</td>
<td>Panel Consensus</td>
</tr>
<tr>
<td>Base Rate for Adding or Switching</td>
<td>0.03</td>
<td>Extrapolation from outcome data: Verispan, LLC, SDI Vector One®: National (VONA; see Governale, 2007)</td>
</tr>
<tr>
<td>Base Rate of Treatment</td>
<td>0.25</td>
<td>Panel Consensus</td>
</tr>
<tr>
<td>Base Risk Factor</td>
<td>1.5</td>
<td>Modeling Team Judgment</td>
</tr>
<tr>
<td>New Chronic Pain Diagnosis Rate</td>
<td>0.112</td>
<td>WHO (World Health Organization; see Gureje et al., 2001)</td>
</tr>
<tr>
<td>Overdose Mortality Rate for Patients Abusing Opioids</td>
<td>0.0015</td>
<td>Extrapolation from Heroin Research (see Fisher et al., 2004)</td>
</tr>
<tr>
<td>Overdose Mortality Rate for Patients on Long-acting</td>
<td>0.0025</td>
<td>CONSORT study (Consortium to Study Opioid Risks and Trends; see Dunn et al., 2010)</td>
</tr>
<tr>
<td>Overdose Mortality Rate for Patients on Short-acting</td>
<td>0.00005</td>
<td>CONSORT study (Consortium to Study Opioid Risks and Trends; see Dunn et al., 2010)</td>
</tr>
<tr>
<td>Rate of Addiction for Patients on Long-acting</td>
<td>0.05</td>
<td>Meta-Analyses (see Fishbain et al., 2008; Højsted &amp; Sjøgren, 2007)</td>
</tr>
<tr>
<td>Rate of Addiction for Patients on Short-acting</td>
<td>0.02</td>
<td>VISN16 data (South Central Veterans Affairs Health Care Network; see Edlund et al., 2007)</td>
</tr>
</tbody>
</table>
Baseline Results

MU Opioid OD deaths per year

Time (year)

MU Opioid OD deaths per year : baseline
Interventions

1. New highly tamper resistant LA formulation
   – Reduces risk AND risk perception
2. Prescriber education program
   – More cautious prescribing
3. Reduced rate of abuse/addiction
   – But w/o changing prescriber baseline perceived risk
An Alternative Metric

• Deaths per 10,000 patients
Discussion

• System dynamics modeling has promise
  – Tool for understanding the public health problem of PO-related mortality
  – Tool for evaluating policy options and regulations to address the problem
• May be difficult to minimize negative outcomes without reduced CP patient access to PO treatment
• Important to choose the right metric(s)
• Need to consider multiple metrics
Study Strengths and Weaknesses

😊 Systems perspective
😊 Empirical support for many parameter values
😊 Highlights need to carefully consider metrics
😊 Recognizes need for policy makers to make value judgments to balance access to treatment and reducing adverse outcomes

😊 Excludes acute pain
😊 Assumes all pain patients are legitimate
😊 Weak data support for some parameter values
😊 Does not consider impacts of poly-drug use
😊 Does not consider impact of drug abuse treatment programs
😊 Excludes alternative treatments for pain
Questions?

• Comments?

• Suggestions?