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Background

RxOA has become a major social problem in the United States\textsuperscript{1-6}

- Emphasis on development of risk management approaches to maximize the benefits of prescription opioids (RxOs) while minimizing the risks associated with abuse\textsuperscript{7}

- Annual per patient direct health care costs for RxO abusers more than eight times higher than for non-abusers\textsuperscript{8}

- Estimated societal costs of RxO abuse in U.S.
  - Total societal costs $11.8 billion
  - Health care costs $3.5 billion\textsuperscript{9}

- Issues
  - Abuse and diversion of RxOs
  - Under-treatment of pain for those with legitimate need for RxOs by limiting RxO access
Data-Driven Approaches to Identifying At-Risk Patients is Important to Multiple Stakeholders

Payers
- Identifying at-risk individuals important to control health care costs, address fraud, and provide quality care

State Public Health and Controlled Substance Authorities
- Prescription monitoring program administrators need validated cutoffs for threshold reports
- Public health authorities need validated methods for characterizing and identifying at-risk individuals and communities

Federal Government
- National prescription monitoring legislation requires a rational implementation

Clinicians
- “External” outcome measures critical for assessing clinical outcomes
Project Objectives

1. Develop a model based on prescription drug claims data for prescription drug monitoring programs (PMPs) to help identify patients at risk for prescription opioid abuse, dependence and misuse (RxOA)

2. Develop a model based on medical claims data (with information on medical services utilization and comorbidity risk factors) to help identify patients at risk for RxOA

3. Combine the two models to create a hybrid model to help identify patients at risk for RxOA
Risk Factors

**Drug Claims**

- Demographic features
  - Age
  - Gender

- Utilization parameters
  - Number of RxO prescriptions

- At-risk behavior
  - Pharmacy shopping
  - Physician shopping
  - Refilling RxO prescriptions early
  - Escalating RxO dosage over time

**Medical Claims**

- Demographic features
  - Age
  - Gender

- Medical diagnoses
  - Non-opioid substance abuse, depression, PTSD, hepatitis, cancer, and fibromyalgia

- Medical treatment facility visits
  - Hospital
  - Mental inpatient
Data

Data from the Maine Health Data Organization

- Contains all privately insured drug and medical claims in Maine from January 1, 2005 through December 31, 2006
  - De-identified information
  - Approximately 800,000 patients (~146,000 with at least one RxO claim)
- Drug claims data fields include
  - National Drug Codes (NDCs) to identify the actual drug and its associated dose, date of fill, days supply, and (de-identified) pharmacy and prescribing physician identifiers (the latter information available beginning in September 2006)
- Medical claims data fields include
  - ICD-9-CM codes to identify the diagnosis associated with a medical claim and the type of facility that the patient visited (e.g., hospital, physician’s office, mental inpatient/outpatient facility)
RxOA Definitions

- RxO “user” sample criteria
  - All patients between ages of 12 and 64 years
  - At least one claim for an RxO
  - At least one medical claim during 2005-2006

- RxO “abuser” sample criteria
  - Same as above and additionally having at least one medical claim associated with the following ICD-9-CM codes
    - Opioid type dependence (304.0)
    - Combinations of opioid type with any other (304.7)
    - Opioid abuse (305.5)
    - Poisoning by opiates and related narcotics (965.0) but excluding poisoning by heroin (965.01)
Logistic Model

The model has the following general form

\[ \log \left( \frac{p_i}{1 - p_i} \right) = \alpha + \sum_{j=1}^{J} \beta_j X_{ij}, \]

where

- \( p_i \) is the probability that a patient \( i \) is an RxO abuser via ICD-9-CM codes
- \( \alpha \) and \( \beta_j \) are the parameters to be estimated
- \( X_{ij} \) are the risk factors
ROC Curves

The performance of various algorithms was evaluated using the area under the Receiver Operating Characteristic (ROC) curves.

- The ROC curves were used to assess overall fit:
  - Higher area under the ROC curve indicates better fit
  - An area under the ROC curve equal to one indicates perfect predictive power, whereas an algorithm with weak predictive power is described by the 45-degree line (i.e., an area under the curve equal to 0.5)

- The framework sought to develop the curve with the optimal trade-off between sensitivity and specificity:
  - A curve with the most correct predictions of abuse (true positives) for any given level of false positives was preferred
Model Selection Criteria

The logistic model was estimated using forward step-wise regression

- To identify the “best” model, the following criteria were used
  - Area under the ROC curve
    - Evaluated using the c-value
    - A curve with the most correct predictions of abuse (true positives) for any given level of false positives was preferred
  - Parsimony
    - A model with a smaller set of relevant independent variables was preferred
  - Statistical significance
    - Variables with a p-value of less than 0.10 and an adjusted odds ratio greater than 2.0 were preferred
  - Clinical relevance
    - Variables that were clinically relevant based on existing literature and research were preferred
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Hybrid Analysis

- **Sample selection**
  - Followed each patient for the entire 2005-2006 time period combining data from drug and medical claims analyses
    - 134,542 eligible patients
    - 984 patients identified as abusers (0.73% of eligible patients)

- **Summary of results**
  - The c-value for the best ROC curve was 0.924
  - A sensitivity cut-off of 0.80 yields a specificity of about 0.92
    - Identifying 80% of the abusers would result in a 8% false positive rate
Implications and Discussion

- Models to identify patients at risk to RxOA were successfully developed
  - Using prescription drug claims data
  - Using medical claims data
  - Via a hybrid model using both drug and medical claims data

- Using ICD-9-CM codes underestimates RxOA since these conditions are infrequently diagnosed by physicians
  - Therefore, the actual number of patients in the Maine sample with RxOA may be significantly higher
  - As a result, a substantial number of false positives may actually be true positives
Next Steps and Potential Future Directions

- **Dissemination**
  - Manuscript forthcoming: *American Journal of Managed Care*

- **Payer application**
  - Create generic algorithm for payers to screen for patients at risk for prescription opioid abuse
    - “Added value” in payer meetings
    - AG could create model customized to payer database

- **Public health application**
  - Create model of public health implications of abuse-deterrent opioids
    - In addition to cost savings estimates, could also include: hospitalizations, ED visits, poisonings, deaths, absenteeism/presenteeism, criminal costs, etc.

- **Extend analysis for more generalizable results**
  - Conduct analysis over longer time period to assess prior medical history as a determinant of future opioid abuse, dependence and misuse behavior
  - Use Analysis Group employer database to analyze over different geographic areas/nationally
Sources


