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Background

RxOA has become a major social problem in the United States[1-6]

- **Emphasis on development of risk management approaches to maximize the benefits of prescription opioids (RxOs) while minimizing the risks associated with abuse[7]**
- **Annual per patient direct health care costs for RxO abusers more than eight times higher than for non-abusers[8]**
- **Estimated societal costs of RxO abuse in U.S.**
  - **Total societal costs $11.8 billion**
  - **Health care costs $3.5 billion[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 mis-use (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[10]

- 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

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

where

- **p_i is the probability that a patient *i* is an RxO abuser via ICD-9-CM codes**
- **a and ß$_j$ 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 mis-use behavior**
  - **Use Analysis Group employer database to analyze over different geographic areas/nationally**

Sources

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