American Pain Society
RESEARCH
EDUCATION
TREATMENT
ADVOCACY
PUBLISHED BY ELSEVIER

The Journal of Pain, Vol 16, No 4 (April), 2015: pp 380-387
Available online at www.jpain.org and www.sciencedirect.com

Automated Prediction of Risk for Problem Opioid Use in a Primary Care Setting

Timothy R. Hylan,* Michael Von Korff,† Kathleen Saunders,† Elizabeth Masters,‡ Roy E. Palmer,* David Carrell,† David Cronkite,† Jack Mardekian,§ and David Gross*

**North America Medical Affairs, Global Innovative Pharma, Pfizer Inc, New York, New York.*
†Group Health Research Institute, Seattle, Washington.
‡Outcomes & Evidence, Global Health & Value, Pfizer Inc, New York, New York.
§Statistics, Global Innovative Pharma, Pfizer Inc, New York, New York.

Abstract: **Identification of patients at increased risk for problem opioid use is recommended by chronic opioid therapy (COT) guidelines, but clinical assessment of risks often does not occur on a timely basis. This research assessed whether structured electronic health record (EHR) data could accurately predict subsequent problem opioid use. This research was conducted among 2,752 chronic noncancer pain patients initiating COT (≥70 days' supply of an opioid in a calendar quarter) during 2008 to 2010. Patients were followed through the end of 2012 or until disenrollment from the health plan, whichever was earlier. Baseline risk indicators were derived from structured EHR data for a 2-year period prior to COT initiation. Problem opioid use after COT initiation was assessed by reviewing clinician-documented problem opioid use in EHR clinical notes identified using natural language processing techniques followed by computer-assisted manual review of natural language processing–positive clinical notes. Multivariate analyses in learning and validation samples assessed prediction of subsequent problem opioid use. The area under the receiver operating characteristic curve (c-statistic) for problem opioid use was .739 (95% confidence interval = .688, .790) in the validation sample. A measure of problem opioid use derived from a simple weighted count of risk indicators was found to be comparably predictive of the natural language processing measure of problem opioid use, with 60% sensitivity and 72% specificity for a weighted count of ≥4 risk indicators.**

Perspective: ***An automated surveillance method utilizing baseline risk indicators from structured EHR data was moderately accurate in identifying COT patients who had subsequent problem opioid use.***

Key words: *Chronic opioid therapy, opioid surveillance, primary care, risk for problem opioid use.*

Received October 9, 2014; Revised January 22, 2015; Accepted January 23, 2015.

This study was part of a research collaboration between Group Health Research Institute and Pfizer Inc ("Electronic Research of Opioid Abuse Detection and Surveillance [e-ROADS]"), carried out with financial support from Pfizer. The research concepts and publication plans were agreed upon prior to commencing the study by the Joint Research Governance Committee of the Group Health-Pfizer Research Collaboration, composed of Group Health and Pfizer Inc employees.

Funding for work by Group Health Research Institute from Pfizer Inc included support for the development of this manuscript. M.V.K., K.S., D.Ca., and D.Cr. participated in this work as employees of Group Health Research Institute. T.R.H., E.M., R.E.P., J.M., and D.G. are employees and stockholders of Pfizer Inc. K.S. has stock in Merck.

M.V.K. and D.Ca. are principal investigators of funded and pending grants to Group Health Research Institute from Pfizer Inc for research on use of natural language processing to identify problem opioid use. They are also principal investigators for pending grants to Group Health Research Institute from a consortium of drug companies to conduct FDA-mandated research concerning risks for problem opioid use among patients receiving extended-release opioids.

Address reprint requests to Michael Von Korff, ScD, Group Health Research Institute, 1730 Minor Ave, Suite 1600, Seattle, WA 98101. E-mail: vonkorff.m@ghc.org

1526-5900/$36.00

http://dx.doi.org/10.1016/j.jpain.2015.01.011

Problem use of prescription opioids exacts an increasing clinical, economic, and societal burden within the United States.[1,12,34] Recent calls to action challenge clinicians and health care organizations to ensure patient safety while offering effective care for chronic pain.[8,11,18] Although clinical guidelines recommend a "Universal Precautions" approach to opioid prescribing that includes timely assessment of risks for problem opioid use, available evidence indicates that timely risk assessment usually does not occur.[3,9-11,14,15,20,22,25,26,31] Rigorous longitudinal research evaluating the prediction of subsequent problem opioid use is also lacking.[4]

Accurate identification of patients most likely at risk for problem opioid use is a prerequisite for widely recommended approaches to mitigating these risks. Multiple patient- and clinician-based screeners exist to assess potential problem opioid use risks.[4,13,16,19,29] However,

there are deficiencies in evaluation of the accuracy of these screeners in predicting risks for subsequent onset of problem opioid use, so there is no consensus about the value of screening or which screeners are most useful.[16,19,29] These screeners assess patient risk factors including substance use disorder history, family history of substance use disorder, and significant psychological problems. However, it has proven difficult to implement routine risk assessment in community practice for several reasons. Busy clinicians working in time-constrained care settings may not administer screeners because of competing demands and clinical priorities among often complex chronic pain patients. And it is often unclear when patients transition from short-term to long-term use of opioids, so formal evaluation visits to assess the appropriateness of chronic opioid therapy (COT) do not reliably occur.[14]

Automated assessment utilizing structured electronic health records (EHRs) data could address several of these difficulties, thereby facilitating more timely and consistent opioid risk assessment by clinicians and health care systems. Recently, predictive models of opioid abuse have used insurance claims data to assess the likelihood of problem opioid use, with initially promising results.[6,21,27] However, these studies relied solely upon recorded International Classification of Diseases, Ninth Revision (ICD-9), diagnostic codes to ascertain opioid abuse and were of short duration (≤6 months).

The increasing availability of data from patients' EHRs including clinicians' notes offers new opportunities to develop predictive models for assessing potential risks for problem opioid use. In this research, we generated and evaluated a measure of problem opioid use based on natural language processing (NLP) techniques utilizing information contained within clinicians' notes in the EHR pertaining to COT patients.

The aim of this article is to report on a predictive model developed to assess the likelihood of problem opioid use over a 2- to 5-year period following initiation of COT within a large health plan. We assessed whether readily accessible baseline risk indicators obtained from structured EHR data at initiation of long-term opioid therapy were able to accurately predict subsequent problem opioid use.

Methods

Setting and Data

This study was conducted at Group Health Cooperative (GHC), a large, mixed-model health plan established in 1945 that now serves approximately 600,000 patients in urban, suburban, and rural areas of Washington State. Group Health is composed of both integrated group practice (IGP; salaried physicians working in GHC clinics) and network (fee-for-service physicians working in community settings) segments. This research is limited to members in the IGP because the study relies on clinical electronic medical records data that are available only in the IGP. The GHC uses the Epic EHR system (http://www.epic.com/; Epic, Verona, WI) to document care delivery, including primary, specialist, and emergency care encounters and hospital discharge summaries. The GHC Epic EHR system is the digital chart used for patient care within the IGP, having replaced the paper chart in 2005. The GHC maintains structured data, which are data elements entered into the GHC Epic system by health care staff using predefined options (eg, diagnostic codes), including information on most aspects of care delivery such as patient demographics, diagnostic codes, procedures, medications, and laboratory results. In addition, the GHC Epic EHR system includes free text clinical notes entered by health care staff during patient encounters and other contacts with patients. Approval for this study was granted by the Group Health Human Subjects institutional review board.

The sample consisted of GHC members aged 18 years or older who initiated COT for noncancer pain between 2008 and 2010. COT was defined as receipt of ≥70 days' supply of transdermal or oral opioids (except buprenorphine) in a calendar quarter, which corresponded to >75% of the days in the quarter covered by an opioid prescription. We employed this definition because it corresponded to the operational definition of COT employed by GHC for a COT risk reduction initiative implemented in 2010. Because analyses examined opioid use over multiple years, we counted the number of quarters that study patients met this criterion for receiving COT. To ensure sustained use of opioids and a sufficient COT duration to permit clinician identification of problem opioid use, we required that study patients receive at least 2 quarters of COT within a 1-year period. We identified the first calendar quarter between 2008 and 2010 in which a subject received COT (index quarter). If the subject received at least 1 more quarter of COT in the 3 quarters following the index quarter, she or he was provisionally eligible for the study. To restrict the sample to those initiating COT between 2008 and 2010, we excluded subjects who received COT in any quarter in 2006 and 2007. Further, subjects were required to be enrolled in the health plan at least 6 of the 8 calendar quarters before the index quarter and 6 of the 8 quarters following the index quarter (inclusive) so each subject had a 2-year "pre-period" and at least a 2-year follow-up period. These enrollment requirements ensured the availability of EHR data to capture utilization prior to the initiation of COT use and the potential availability of clinical notes data to document problem opioid use after COT initiation. To restrict the study to patients receiving COT for noncancer pain, patients were excluded if they had ≥2 visits with cancer diagnoses (excluding nonmelanoma skin cancer) during any calendar 1-year period between 2006 and 2012 or had received an opioid prescription from an oncologist or were admitted to hospice during the study period. Based on a random assignment performed on the entire pool of subjects potentially eligible for the study (eg, before application of study inclusion/exclusion criteria), patients were grouped into "learning" and "validation" samples.