

Novel Measure of Opioid Dose and Costs of Care for Diabetes Mellitus: Opioid Dose and Health Care Costs

Santosh Gautam,^{*} Luisa Franzini,^{*} Osama I. Mikhail,^{*} Wenyaw Chan,^{*} and Barbara J. Turner[†]

^{*}School of Public Health, University of Texas Health Science Center at Houston, Houston, Texas.

[†]University of Texas Health Science Center at San Antonio (UTHSCSA), San Antonio, Texas.

Abstract: Diabetes mellitus (DM) has well known costly complications but we hypothesized that costs of care for chronic pain treated with opioid analgesic (OA) medications would also be substantial. In a statewide, privately insured cohort of 29,033 adults aged 18 to 64 years with DM and non-cancer pain who filled OA prescription(s) from 2008 to 2012, our outcomes were costs for specific health care services and total costs per 6-month intervals after the first filled OA prescription. Average daily OA dose (4 categories) and total dose (quartiles) in morphine-equivalent milligrams were calculated per 6-month interval after the first OA prescription and combined into a novel OA dose measure. Associations of OA measures with costs of care (n = 126,854 6-month intervals) were examined using generalized estimating equations adjusted for clinical conditions, psychotherapeutic drugs, and DM treatment. Incremental costs for each type of health care service and total cost of care increased progressively with average daily and total OA dose versus no OAs. The combined OA measure identified the highest incremental total costs per 6-month interval that were increased by \$8,389 for 50- to 99-mg average daily dose plus >900 mg total dose and, by \$9,181 and \$9,958 respectively, for ≥ 100 mg average daily dose plus 301- to 900-mg or >900 mg total dose. In this statewide DM cohort, total health care costs per 6-month interval increased progressively with higher average daily OA dose and with total OA dose but the greatest increases of >\$8,000 were distinguished by combinations of higher average daily and total OA doses.

Perspective: The higher costs of care for opioid-treated patients appeared for all types of services and likely reflects multiple factors including morbidity from the underlying cause of pain, care and complications related to opioid use, and poorer control of diabetes as found in other studies.

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Key words: Diabetes mellitus, narcotic, opioid analgesic, health care costs.

Diabetes mellitus presents a significant public health challenge for the United States and other developed countries because of increasing prevalence, complications, and associated costs.^{5,7,15} In 2012 alone, an estimated 22.3 million Americans with diabetes incurred total expenditures of approximately \$245 billion.² Diabetes-related complications such as renal and vascular disease are well recognized as signifi-

cant contributors to increasing costs of care.^{2,6} However, pain might also require consideration among the conditions that greatly affect diabetes costs of care. In an analysis of 11,689 community-dwelling adults with diabetes, 58% reported moderate to extreme pain.³ National data have shown that costs of care increase substantially with pain severity. In the 2008 to 2011 Medical Expenditure Panel Survey, adjusted average annual health care costs were \$5,804 and \$3,707 greater for persons with severe pain and moderate pain, respectively, than for those without pain.²⁵ Therefore, persons with diabetes might be disproportionately represented among those with more severe pain and higher associated costs of care.

One of the correlates of severe pain, treatment with opioid analgesics, might offer a clinically useful predictor of high costs of care for persons with diabetes. Among >400,000 community-based patients, long-term opioids

Received July 10, 2015; Revised October 8, 2015; Accepted November 3, 2015.

This study was funded by The University of Texas System Patient Safety Committee OGC Grant 150273.

The authors have no conflicts of interest to declare.

Address reprint requests to Barbara J. Turner, MD, MEd, MA, MACP, 7411 John Smith Rd, Suite 1050, San Antonio, TX 78229. E-mail: turner@uthscsa.edu

1526-5900/\$36.00

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<http://dx.doi.org/10.1016/j.jpain.2015.11.001>

were received by 24% of those with diabetes or thyroid disease versus only 8% of those without these conditions over 12 months in 2004.⁹ In a statewide cohort of persons with diabetes, we found that average daily opioid dose and total opioid dose had a dose–response association with greater odds of hospitalization for diabetes-related complications and all-cause hospitalization.¹² Among >200,000 persons enrolled in a national health care plan, we also reported that high total dose of opioids (>1,830 mg) filled for at least 3 of 6 months was associated with 50% greater adjusted odds of future costly inpatient care and 75% more inpatient days compared with those without opioid therapy.¹⁹

In this study, we hypothesized that persons with diabetes treated with higher doses of opioid analgesics would have significantly greater costs of care than low-dose or nonopioid users. On the basis of our group's previous study,¹⁸ we further hypothesized that a combined measure that incorporated average daily and total opioid dose would be more strongly predictive of costs of care among persons with diabetes. This analysis provided a novel approach for clinicians and policymakers to target resources aimed at improvement of outcomes and reduction of costs of care for persons with diabetes, a highly prevalent and expensive disease.

Methods

Study Design

A retrospective cohort of persons with diabetes and noncancer pain who filled at least 1 opioid prescription were examined with regard to dose of opioid therapy and costs of care in sequential 6-month intervals after the first filled opioid prescription. We chose 6-month intervals because this is the timeframe with evidence to support opioid therapy and has offered a useful timeframe for other studies.

Data Sources

Blue Cross and Blue Shield of Texas (BCBSTX) is the largest private health insurance provider in Texas and covers almost one-third of all commercial health plans in the state, totaling approximately 3 million individuals annually. BCBSTX data include enrollment, medical claims, and pharmacy claims files. The enrollment file provides information on members' age, sex, place of residence (ZIP Code), plan types, enrolled dates, and drug coverage. The medical claims file includes information on International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnoses and procedure codes, Current Procedural Terminology codes, along with provider data, date of service, and associated cost information. The pharmacy claims file includes drug name, National Drug Code, Generic Product Identifier code, date of prescription, drug quantity, duration, and cost information. To augment BCBSTX data with socioeconomic measures, ZIP Code Tabulation Area data were obtained from the American Community Survey (ACS) from 2008 through 2012. ACS is an ongoing survey conducted by the United States Census Bureau every year

that collects information such as age, sex, race, family and relationships, income and benefits, insurance, education, and disabilities. This information has been aggregated further and tabulated as ZIP Code Tabulation Areas, which are statistical units developed by the Bureau itself and are different from postal Zip Codes.²⁷

Subjects

Subjects with diabetes were identified from coded diagnoses.¹⁶ From these, we selected subjects aged 18 to 64 years who filled at least 1 prescription for a Schedule II or III opioid analgesic, excluding injectable opioid formulations. We excluded members who received methadone or buprenorphine for opioid dependence diagnosis. Eligible individuals had at least 12 continuous months of enrollment in a preferred provider organization plan with drug coverage or preferred provider organization plus plan with drug coverage. Because of differing health care demands and costs, we excluded subjects with a cancer diagnosis other than nonmelanoma skin cancer.

Outcome Measure

Our primary outcome of interest was total health care costs. We also examined costs for the following categories of health care services: pharmacy, inpatient facility, outpatient facility, and professional services. Costs were measured according to the allowed amount as observed in claims data, which included costs paid by the health plan as well as the patient, thus representative of the total amount paid to the provider. Costs were adjusted for inflation using the medical care component of Consumer Price Index and are reported in 2012 dollars to match the latest year of data used in this study. For each study subject, health care costs were calculated for each 6-month interval after the first filled opioid prescription.

Primary Independent Variable

To calculate opioid dose, each filled opioid prescription was standardized to morphine equivalent dose in milligrams calculated from 1) quantity dispensed, 2) strength, and 3) a morphine equivalent conversion factor on the basis of several sources^{1,11,13,29} and applied in other publications^{4,10} (details available in a previous study¹²). To capture different aspects of opioid dose, we defined 3 different measures. First, total dose was computed by aggregating morphine equivalent dose for all filled prescriptions with each 6-month interval and categorized in quartiles among users. Second, we calculated the average daily dose for filled opioid prescriptions within each 6-month interval by dividing the total dose by total days' supply covered by these prescriptions. Average daily dose was categorized as in other studies: 0, 1 to 19, 20 to 49, 50 to 99, and ≥ 100 mg.^{4,10} These daily dose categories have been widely used and total dose has been found to be predictive of several diabetes quality of care measures in this cohort.¹² Last, we created a novel measure of opioid dose by combining total dose categories and average daily dose categories

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