

Nationally representative healthcare expenditures of community-based older adults with pain in the United States prescribed opioids versus those not prescribed opioids

Running title: Opioid healthcare expenditures

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Abstract

Objective: To compare healthcare expenditures between older United States (US) adults (≥ 50 years) with pain who were prescribed opioid medications and those who were not.

Design: Cross-sectional.

Setting: Community-based adults in the 2015 Medical Expenditure Panel Survey (MEPS).

Subjects: Nationally-representative sample of US adults alive for the calendar year, aged 50 years or older, and reported having pain in the past four weeks.

Methods: Older US adults (≥ 50 years) with pain in the 2015 MEPS data were identified. The key independent variable was opioid prescription status (prescribed opioid versus not prescribed opioid). Hierarchical linear regression models assessed healthcare expenditures (inpatient, outpatient, office-based, emergency room, prescription medications, other, and total) in US dollars for opioid prescription status from a community-dwelling US population perspective, adjusting for covariates.

Results: The 2015 study cohort provided a national estimate of 50,898,592 non-institutionalized US adults aged ≥ 50 years with pain in the past four weeks (prescribed opioid $n=16,757,516$ [32.9%], not prescribed opioid $n=34,141,076$ [67.1%]). After adjusting for covariates, individuals prescribed an opioid had: 61% greater outpatient ($\beta=0.477$, $p<0.0001$), 69% greater office-based ($\beta=0.524$, $p<0.0001$), 14% greater emergency room ($\beta=0.131$, $p=0.0045$), 63% greater prescription medication ($\beta=0.486$, $p<0.0001$), 29% greater other ($\beta=0.251$, $p=0.0002$), and 105% greater total ($\beta=0.718$, $p<0.0001$) healthcare expenditures. There was no difference in opioid prescription status for inpatient expenditures ($p>0.05$).

Conclusions: This study raises awareness of the economic impact associated with opioid use among US older adults with pain. Future research should investigate these variables in greater depth, over longer time periods, and in additional populations.

Keywords

Healthcare expenditure; medical expenditure panel survey; older adults; analgesics, opioid; pain; cost of illness

Introduction

The number of adults aged 65 years and older in the United States (US) has increased substantially in recent years with the aging of the baby boomers,¹ from almost 35 million adults in 2000 (12.4% of the population) to over 40 million in 2010 (13.0% of the population), a 15.1% increase.² The increasing age of the population is due to declining fertility rates and rising life expectancy driven by economic and social development, advances in medical technology, and public health initiatives, and is likely to have considerable implications as society determines how best to care and pay for increasing numbers of older adults' health needs.³

Older adults typically have to manage multiple chronic conditions such as hypertension, arthritis, heart disease, cancer, diabetes, asthma, emphysema, and stroke.⁴ Data from the 2012 National Health Interview Survey (NHIS) indicated that 61% of US adults aged 65 or older had at least two chronic conditions.⁵ One such condition that warrants further investigation among older adults is pain.

Estimates of the prevalence of pain among US adults range from 100 million (according to a 2011 Institute of Medicine (IoM) report)⁶ to 126 million (according to a 2012 National Institute of Health (NIH) study),⁷ which represents a considerable burden to patients and results in

disability, frequent physician visits, medication use, poorer health outcomes, and poorer quality of life.^{6,8}

Pain also has significant economic consequences, for both patients and society, with total costs ranging from \$560 to \$635 billion per year in 2010.^{6,9} To put this in perspective, the costs associated with pain are greater than the annual costs of other major diseases such as heart disease, cancer, and diabetes.⁹

Furthermore, pain is associated with dependence on opioids.⁶ Multiple studies have reported that the use of opioid medications in the US has increased in recent years.¹⁰⁻²² For example, an analysis of data from the 1999-2010 National Ambulatory and National Hospital Ambulatory Medical Care surveys found that the use of opioids more than doubled from 4.1% to 9.0% among adults aged 65 and older visiting clinics in the US.²¹

The increase in opioid use has led to a subsequent increase in opioid-related problems such as opioid addiction and deaths from opioid overdose.^{15,17,23-24} For example, opioid-related deaths in the US increased by 345% from 9489 to 42245 between 2001 and 2016.²⁵ However, the benefits and risks of opioid therapy among older adults need to be considered in context to the specific needs of the patient. For example, opioid medications may be preferred to other medications such as non-steroidal anti-inflammatory drugs (NSAIDs) to avoid gastro-intestinal side effects

and renal toxicity among older adults.²⁶ Conversely, there are several side effects and complications of opioid therapy that disproportionately affect older adults, such as cardiovascular events, constipation, and bone fractures, thereby making opioids less suitable for use in older adults.²⁷⁻²⁹

Previous studies have explored the health of older adults, pain management, and prescribed opioid use, for example, patterns of pharmacological pain treatments (including opioid medications) among specific pain populations, such as chronic back pain,³⁰ and expenditures associated with various different classifications of opioid medications.³¹ However, there is a lack of research investigating expenditures associated with opioid use among a nationally representative sample of older US adults (≥ 50 years) with pain. This information is important to inform evidence-based policy development to address the opioid epidemic in this ever-increasing population.

The objective of this study was to determine if differences exist in the healthcare expenditure of older US adults (≥ 50 years) with pain in the past four weeks who were prescribed opioid medications versus those who were not prescribed opioid medications.

Methods

Study design and data source:

This study employed a cross-sectional design using the 2015 Medical Expenditure Panel Survey (MEPS) data. MEPS is a set of large-scale surveys conducted by the Agency for Healthcare Research and Quality (AHRQ) using a panel design that involves five interview rounds over two calendar years.³² Data from interview rounds 3, 4, and 5 of panel 19, and interview rounds 1, 2, and 3 of panel 20, constituted the data for calendar year 2015.³³ MEPS uses the sampling framework of the previous years' National Health Interview Survey (NHIS) and oversamples disabled and minority groups to obtain nationally representative estimates of the civilian, noninstitutionalized population. One of the main MEPS components, the MEPS household component (MEPS-HC), collects self-reported data for all household members on many variables, including demographic characteristics, health conditions, prescription medication use, and healthcare expenditures.³² Data for expenditures in the MEPS dataset refers to the sum of direct payments (those directly associated with healthcare services) for healthcare provided during the year, including payments by private insurance, Medicaid, Medicare, out-of-pocket, and other sources. Indirect payments (those not directly associated with healthcare services) and over-the-counter medicines are not captured in MEPS.³³ Healthcare expenditure data are collected directly from participants at each interview round, and supplemented by MEPS staff with available data from the MEPS medical provider component (MEPS-MPC) for the 2015

calendar year. Healthcare expenditures in the MEPS-MPC are typically considered more reliable than data collected in the MEPS-HC.³³ The MEPS 2015 full-year consolidated data file was used to identify the study cohort (individuals who were alive for the full year, age ≥ 50 years, and had pain in the past four weeks), subject characteristics, and healthcare expenditure. The 2015 prescribed medicines file was used to identify prescribed opioids.³⁴

Study population:

Subjects from the 2015 MEPS dataset were included in this study if they were alive for the full calendar year, aged 50 years or older, and reported having pain in the past four weeks. Pain was identified from responses to the item: “During the past 4 weeks, pain interfered with normal work outside the home and housework”. Those who responded: a little bit; moderately; quite a bit; or extremely were included (those who responded “not at all” were excluded).^{33,35} This pain item is a constituent of the short form – 12 item version 2 (SF-12v2) health survey that is widely used by individuals to report bodily pain, and has been shown to have good reliability and validity.³⁶ Subjects were also only included if they had positive total healthcare expenditure.

Dependent variables:

The dependent variable was healthcare expenditures (inpatient; outpatient; office-based; emergency room; prescription medication; other; and total expenditure).

Inpatient expenditure included hospital inpatient visits (including zero-night stays) for facility expenses and separately billing doctor (SBD) expenses (payments to physicians for services provided that were billed separately). In instances where a patient visited the emergency room and was then admitted to the hospital, the emergency room expenditure was included in the inpatient expenditure rather than emergency room expenditure.

Outpatient expenditure included hospital outpatient department visits to physicians and non-physician providers for facility and SBD expenses.

Office-based expenditure included costs for physician visits and non-physician provider visits (including chiropractor, midwife, nurse, nurse practitioner, optometrist, podiatrist, physician's assistant, physical therapist, occupational therapist, psychologist, social worker, technician, receptionist/clerk/secretary, among others).

Emergency room (ER) expenditure included facility and SBD expenses for ER visits.

Prescription medication expenditure included out-of-pocket and third-party costs for initial and refill prescription medicines.

Other expenditure included costs associated with dental care (general dentist, dental hygienist, dental technician, dental surgeon, orthodontist, endodontist, and periodontist visits), vision care (glasses and/or contact lenses), home health care (paid or unpaid caregivers, such as those from agencies, hospitals or nursing homes, self-employed persons, and unpaid informal caregivers not living with the sample person), and other medical equipment and services (ambulance services, orthopedic items, hearing devices, prostheses, bathroom aids, medical equipment, disposable supplies, alterations/modifications, and other miscellaneous items or services that were obtained, purchased, or rented).

Total expenditure included all healthcare service expenditures for subjects in 2015.^{33,35}

Independent variables:

The key independent variable in this study was prescribed opioid status (prescribed opioid or not prescribed opioid). Multum Lexicon therapeutic class codes are available for self-reported medication use in the calendar year. Prescriptions for opioid medications were determined using

the Multum Lexicon therapeutic sub sub-classification variables of “60” (narcotic analgesics) or “191” (narcotic analgesic combinations).³⁷⁻³⁸ Subjects who had data indicating a prescription for at least one narcotic analgesic or narcotic analgesic combination in 2015 constituted the prescribed opioid group, while the remainder was considered the not prescribed opioid group.

Other independent variables were organized according to the Andersen Behavioral Model (ABM).³⁹ The ABM was selected for this investigation because it can help organize the multiple factors that may influence healthcare expenditure of older US adults (≥ 50 years) with pain (the subjects of this study), and because it has been widely used in health service research studies, including those investigating healthcare expenditure. The ABM consists of five components: (1) predisposing factors; (2) enabling factors; (3) need factors; (4) personal health practices factors; and (5) external environmental factors.

Predisposing factors included: age (50-64 years, ≥ 65 years); gender (male, female); race (white, other); and ethnicity (Hispanic, non-Hispanic).

Enabling factors included: education status (less than high school, up to high school, higher than high school); employment status (employed, other); health insurance status (private, public, uninsured); marital status (married, other); and poverty status (poor/near poor/low income [$< 200\%$ federal poverty level], middle/high income [$\geq 200\%$ of federal poverty level]).

Need factors included: number of the following chronic conditions - hypertension, coronary heart disease, angina, myocardial infarction, other unspecified heart disease, stroke, emphysema, chronic bronchitis, high cholesterol, cancer, diabetes joint pain, arthritis, asthma, and Attention Deficit Hyperactivity Disorder/Attention Deficit Disorder [conditions selected because of their relatively high prevalence in the population and availability of clinical care standards] (none, one, two, three, four, five or more); activities of daily living (ADL) limitation [eating, dressing, bathing, toileting, getting in and out of bed, and mobility inside own residence] (yes, no); instrumental activities of daily living (IADL) limitation [help or supervision with using the telephone, paying bills, taking medications, preparing light meals, doing laundry, or going shopping] (yes, no); functional limitation [difficulty lifting ten pounds, walking up ten steps, walking three blocks, walking a mile, standing for 20 minutes, bending or stooping, reaching overhead, or using fingers to grasp] (yes/no); work, housework, or school limitation (yes, no); pain intensity (little/moderate, quite a bit/extreme); perceived physical health status (excellent/very good, good, fair/poor); and perceived mental health status (excellent/very good, good, fair/poor).

Personal health practices factors included: body mass index (underweight/normal [<25.0], overweight/obese [≥ 25.0]); exercise [≥ 30 minutes moderate to vigorous physical activity at least five times a week] (yes, no); and smoking status (current smoker, other).

External environmental factors included: census region (mid-west, northeast, west, south).^{33,35}

Data analysis:

First, univariate associations were tested between independent variables (the predisposing, enabling, need, personal health practices, and external environmental factors) and prescribed opioid status (prescribed opioid versus not prescribed opioid) using chi-square tests (for categorical variables) and t-tests (for continuous variables).

Then, hierarchical linear regression models were constructed with log-transformed data to estimate healthcare expenditures (inpatient, outpatient, office-based, emergency room, prescription medication, other, and total expenditure) attributable to those prescribed opioids (versus those not prescribed opioids) in 2015 US dollars from the US community-dwelling population perspective. The first model was an unadjusted model that assessed only the association of the key independent variable (prescribed opioid status; prescribed opioid versus not prescribed opioid) on the dependent variable. Successive models were multivariable in nature, adjusting for an additional group of factors (predisposing, enabling, need, personal health practices, and external environmental) until a fully adjusted model that incorporated all potential variables of interest was constructed and assessed. I.e., the second model included prescribed opioid status and predisposing factors, the third model included prescribed opioid status,

predisposing factors, and enabling factors, etc. The results of the fully adjusted models (i.e., models including prescribed opioid status, predisposing, enabling, need, personal health practices, and external environmental factors) are presented. Percent change represents the difference in expenditure between those who were prescribed an opioid and those who were not prescribed an opioid, calculated using semi-logarithmic equation ($e^{\beta}-1$).⁴⁰

The assumptions of linear regression models (linearity, normality, homoscedasticity, independent observations, no multicollinearity) were assessed. Given the non-linear nature of healthcare expenditures, these data were logarithmically transformed for analysis. The complex survey design of MEPS necessitated the use of a person-level weight variable (provided in the dataset) to calculate nationally-representative estimates of the 2015 community-based US population.³³ In addition, the Taylor-series linearization method was used when calculating variance estimates.³³ The An alpha level of 0.05 was set *a priori* for all analyses. All analyses were conducted using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). The University of Arizona Institutional Review Board approved this study.

Results

Selection of study participants:

As shown in figure 1, there was a total of 35,427 subjects in the 2015 MEPS dataset. The study eligibility criteria (alive for the full calendar year, aged 50 years or older, and had pain in the past four weeks) were applied to these potential study subjects, where 30,668 subjects were excluded, resulting in a study cohort of 4,759 subjects. Of these, 1,525 were prescribed an opioid, while the remaining 3,234 were not. All study subjects had positive total healthcare expenditures thus no further exclusions from the study were necessary.

Demographics of study participants:

The weighted total number of non-institutionalized US adults alive aged 50 years or older with pain in the past four weeks in the year 2015 was 50,898,592. Of these, 16,757,516 (32.9%) were prescribed an opioid, and 34,141,076 (67.1%) were not.

Approximately half of subjects in this study were at least 65 years of age (50.2%), and the majority were female (56.3%), white (83.3%) and non-Hispanic (90.7%). There were more

subjects prescribed an opioid in the younger age category (age 50-64 years) than subjects not prescribed an opioid (53.4% versus 48.1%, $p=0.0122$). Meanwhile, there were fewer Hispanic individuals in the prescribed opioid group than the not prescribed group (7.8% versus 10.1%, $p=0.0101$). Most subjects had completed high school (84.4%), were unemployed (63.0%), had private health insurance (62.2%), were married (58.6%), and were categorized as having a middle or high income (68.0%).

Compared to those not prescribed an opioid, a greater proportion of those prescribed an opioid reported having at least five chronic conditions (49.8% versus 37.0%); ADL limitations (13.7% versus 6.2%); IADL limitations (19.6% versus 11.1%); functional limitations (66.5% versus 44.4%); work, housework, or schoolwork limitations (52.8% versus 29.2%); quite a bit or extreme pain intensity (49.5% versus 21.0%); fair/poor physical health (39.9% versus 22.4%); and fair/poor mental health (18.4% versus 12.2%).

Likewise, compared to those not prescribed an opioid, a greater proportion of those prescribed an opioid were overweight/obese (77.2% versus 73.8%), did not exercise frequently (63.5% versus 58.1%), and were smokers (81.6% versus 88.1%). Overall, the most common residential region of subjects was the South (39.0%). See Table 1 for further information.

Descriptive mean healthcare expenditures:

Table 2 reports the unadjusted annual mean healthcare expenditures. Compared to those not prescribed an opioid, expenditures were higher among those prescribed an opioid for all categories of expenditure except emergency room expenditures.

Adjusted healthcare expenditures:

After adjustment for predisposing, enabling, need, personal health practices, and external environmental factors, those prescribed an opioid had 61% greater outpatient expenditure ($\beta=0.477$, $p<0.0001$), 69% greater office-based expenditure ($\beta=0.524$, $p<0.0001$), 14% greater emergency room expenditure ($\beta=0.131$, $p=0.0045$), 63% greater prescription medication expenditure ($\beta=0.486$, $p<0.0001$), 29% greater other healthcare expenditure ($\beta=0.251$, $p=0.0002$), and 105% greater total healthcare expenditure ($\beta=0.718$, $p<0.0001$). Inpatient expenditures were not significantly different ($p>0.05$). See Table 3 and Figure 2 for further information.

Discussion

In the present study, adjusted healthcare expenditures were greater among individuals prescribed opioids compared to those who were not prescribed opioids for all categories of expenditure, except for inpatient expenditures. New findings from this study found that total healthcare expenditures were 105% higher in the prescribed opioid group compared to the not prescribed group, which highlights the considerable financial burden of opioid use. This finding supports previous work that also identified the financial burden of pain for both patients and society, with total costs ranging from \$560 to \$635 billion per year in 2010.^{6,9} This is greater than the annual costs of major diseases such as heart disease, cancer, and diabetes.⁹ Previous work using 2008-2011 MEPS data found that chronic pain was associated with a \$2,498 (little chronic pain) to \$5,804 (severe chronic pain) increase in total adjusted expenditures compared to no pain.⁴¹ Likewise, the same study found that chronic pain was associated with a \$1,008 (little chronic pain) to \$4,315 (severe chronic pain) increase in total adjusted expenditures compared to non-chronic pain.⁴¹ Another study using MEPS data reported that among individuals with chronic back pain in 2011-2015, individuals using both opioids and NSAIDs had higher mean outpatient expenditures (\$3,087 versus \$3,020 versus \$2,177), office-based expenditures (\$3,083 versus \$2,652 versus \$1,984) and emergency room expenditures (\$2,168 versus \$1,883 versus \$1,607) compared to those who only used opioids or NSAIDs, after adjusting for covariates.⁴²

The current study adds to existing information by describing the economic burden of older adults with pain who were prescribed an opioid, accounting for several important predisposing, enabling, need, personal health practices, and external environmental factors. Given that annual health expenditure in the US was \$9536 per capita in 2015,⁴³ the present study suggests that pain management may constitute a considerable proportion of healthcare expenditure. This study also indicates that among individuals with pain, those prescribed an opioid have significantly higher expenditures compared to those not prescribed an opioid. However, our study design is only able to demonstrate an association, not causality, so further studies are needed to assess if stopping opioids causes a reduction in healthcare expenditure. Although controlled for in the model, it may be that those using opioids are generally less healthy, and therefore have higher overall healthcare expenditures, rather than attributing their healthcare expenditures to opioid use only.

The present study also found that approximately 17 million US older adults (≥ 50 years) with pain in the past four weeks were prescribed an opioid in 2015, which equates to approximately one-third (32.9%) of the 51 million US older adults (≥ 50 years) with pain – a staggering statistic. This is perhaps not surprising given the number of studies reporting increased use of opioids¹⁰⁻²² and opioid-related problems such as opioid addiction and dependence, and opioid-related deaths in recent years.^{15,17,23-25,44} For example, an analysis of data from the 1999-2012 National Health and Nutrition Examination Survey (NHANES) found a significant increase in opioid use in the past 30 days among US adults age 20 and older, increasing from 5.0% in 1999-2002 to 6.9% in 2003-2006.¹⁴ Meanwhile, an analysis of data from the 1999-2010 National Ambulatory and National Hospital Ambulatory Medical Care Surveys (NHAMCS) found that the use of opioids

more than doubled from 4.1% to 9.0% among adults aged 65 and older visiting clinics in the US.²¹ More recently, another MEPS study reported that 49% of their sample with chronic back pain used opioids during 2011-2015.⁴² However, the current study describes the number of older adults who were prescribed at least one opioid medication at least once in 2015, and thus does not differentiate between short-term opioid use (e.g., following acute dental work) and more chronic users, which may explain the high proportion of subjects prescribed an opioid in this population.

Alternatives to opioid medications are therefore needed to help address the opioid epidemic. Pain may be managed with a variety of strategies, including both pharmacological and non-pharmacological approaches.^{8,45} In 2016, the Centers for Disease Control and Prevention (CDC) published recommendations for prescribing opioids for chronic pain not related to cancer or palliative care. These recommendations included considering alternatives to opioids wherever possible, initiating opioids only after reviewing the risks and benefits of opioid treatment in consultation with the patient, and using the lowest effective dose of opioids, among others.⁴⁶

This study had some limitations. MEPS uses self-reported data that may be subject to recall bias, although MEPS interviews are conducted at regular intervals (five interview rounds over two years) in an attempt to minimize such bias.⁴⁷ No indication is provided at the medication level, thus it was not possible to confirm that opioid medications were being used for pain (rather than another condition). Due to data limitations, it was also not possible to assess number, duration,

and dosage of opioid medications. This study was also unable to decipher adherence to opioid medications. Due to the nature of using secondary data in a cross-sectional study, it is not possible to ascertain a cause and effect relationship, although statistical associations can be identified. This study had a large sample size, thus even small differences between the groups could be statistically significant, but may not be clinically meaningful.

Despite these limitations, strengths of the study include use of a nationally representative sample of community-dwelling older adults (≥ 50 years) with pain, and the inclusion of many individual-level variables to assess healthcare expenditure among older US adults (≥ 50 years) with pain.

The findings from this study pose several questions worthy of future investigation. First, it would be interesting to examine the reasons why there were significant differences between individuals prescribed opioids and those who were not for most healthcare expenditures, but not inpatient costs. In addition, more granular details about healthcare expenditures could be investigated to identify more precisely where differences occur between groups. This cross-sectional study assessed healthcare expenditure in one year (2015). It would be interesting to see if and how healthcare expenditures change after the public health policy initiatives began as new data become available. Future research could involve a longitudinal analysis to observe trends over time and attempt to predict future trends so that appropriate interventions can be implemented as necessary. This study used a sample of older adults (≥ 50 years) who reported having pain in the past four weeks, whereas future studies could involve a sample with chronic or recurrent pain, or

a sample of non-community-dwelling individuals, or a sample outside the US to compare international differences. To address some of the limitations of this study, future research could also attempt to account for the numbers, types, dosage, and duration of opioids therapy used.

Conclusion

This study raises awareness of the economic impact associated with opioid medication use among older adults with pain in the US. New information from this study found that adjusted total healthcare expenditures were 105% greater among individuals prescribed an opioid compared to those who were not prescribed an opioid, with some variation between categories of healthcare costs. Future research is warranted to investigate each category of healthcare cost in greater depth, over longer time periods, and in additional populations.

Conflicts of interest/disclosure summary:

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Figure legends

Figure 1. Cohort eligibility flowchart diagram

Figure 2. Annual percent change in healthcare expenditure for subjects prescribed an opioid compared to subjects not prescribed an opioid in older United States adults (age ≥ 50 years) with pain in the past four weeks, adjusted for predisposing, enabling, need, personal, and environmental factors

Percent change represents the difference in expenditure between subjects prescribed an opioid and subjects not prescribed an opioid, calculated using semi-logarithmic equation ($e^{\beta}-1$).