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Patterns of pain medication use associated with reported pain interference in older adults with and without cancer

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Abstract

Context—Concerns about the adequacy of pain management among older adults are increasing, particularly with restrictions on opioid prescribing.

Objectives—To examine associations between prescription pain medication receipt and patient-reported pain interference in older adults with and without cancer.

Methods—Using the 2007–2012 Surveillance Epidemiology and End Results (SEER)-Medicare Health Outcomes Survey (MHOS) database linked to Medicare Part D prescription claims, we selected MHOS respondents ($N = 15,624$) aged 66 years, 5 years of a cancer diagnosis ($N = 9105$), or without cancer ($N = 6519$). We measured receipt of opioids, non-steroidal

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antiinflammatory drugs, and antiepileptics, and selected antidepressants within 30 days prior to survey. Patient-reported activity limitation due to pain (pain interference) within the past 30 days was summarized as severe, moderate, or mild/none. Logistic regression using predictive margins estimated associations between pain interference, cancer history, and pain medication receipt, adjusting for socio-demographics, chronic conditions, and Part D low-income subsidy.

Results—Severe or moderate pain interference was reported by 21.3% and 46.1%, respectively. Pain medication was received by 21.5%, with 11.6% receiving opioids. Among adults reporting severe pain interference, opioid prescriptions were filled by 27.0% versus 23.8% ($p = 0.040$) with and without cancer, respectively. Over half (56%) of adults reporting severe pain in both groups failed to receive any prescription pain medication.

Conclusions—Older adults with cancer were more likely to receive prescription pain medications compared with adults without cancer; however, many older adults reporting severe pain interference did not receive medications. Improved assessment and management of pain among older adults with and without cancer is urgently needed.

Keywords

Pain treatment; Opioids; Pain interference; Cancer; Medicare part D; Medicare health outcomes study

Background/introduction

The U.S. population is aging, and the prevalence of chronic health conditions, including cancer, is increasing. Older adults are susceptible to acute and chronic pain, with approximately 29% of U.S. adults aged 60 years reporting persistent pain [1]. Chronic non-cancer pain may result from a broad array of medical concerns including joint problems, orthopedic trauma including osteoporotic fractures, or the result of conditions such as heart failure [2]. Cancer may contribute further to the burden of pain, due to the disease itself, or sequelae of cancer-directed therapies [3]. Adequate pain management is essential to sustain quality of life and may reduce emotional distress and improve survival [4–6].

Understanding patterns and predictors of medication therapy for pain has become a critical research focus, given competing concerns about undertreatment and the potential for adverse medication side effects, longer-term dependence, and misuse. Opioids are the most commonly prescribed medications used to treat pain, prescribed for as many as two-thirds of those reporting severe pain [7]. Recent studies have reported higher opioid use rates for adults with, compared with without cancer [8–11], but few population-based studies have examined associations between pain medication use and pain severity [7, 12] and whether it differs for older adults with and without cancer.

In this study, we use a unique linkage between survey data detailing pain interference with usual activities, with cancer registry data and Medicare prescription drug (Part D) claims. We test the hypothesis that pain medication receipt will differ for older adults with and without cancer overall and across different levels of pain interference. We also examine whether beneficiary sociodemographic characteristics are associated with pain medication

receipt when controlling for reported pain interference. Improving our understanding of these relationships is essential to address barriers to pain management for older adults both with and without cancer.

Methods

Data

We used the Surveillance, Epidemiology and End Results (SEER)-Medicare Health Outcomes Survey (MHOS) with a novel linkage to Medicare Part D claims. SEER provides detailed cancer registry data from selected U.S. regions including cancer type(s), stage, histology, and diagnosis date. The Centers for Medicare & Medicaid Services (CMS) uses MHOS to collect self-reported responses to questions on the Veteran's Rand 12 item survey (VR-12), in addition to selected other questions related to health status. [13] The survey is administered annually to randomly sampled Medicare beneficiaries enrolled in Medicare Advantage (MA) plans. The SEER-MHOS represents a linkage for beneficiaries with a SEER-reported cancer who responded to a MHOS [13, 14]. The SEER-MHOS is augmented by a 5% sample of MHOS respondents without cancer but residing in SEER regions [14]. Medicare Part D prescription drug claims for the period from 2007 to 2014 were linked for Part D-enrolled MHOS respondents.

Sample selection

We selected beneficiaries in the SEER-MHOS dataset with only one cancer primary, any invasive disease or Stage 0 breast cancer, and diagnosed between January 2003 and December 2012. Beneficiaries had to complete at least one MHOS between January 2008 and December 2012 and within 5 years after their cancer diagnosis, a period during which respondents may receive active or adjuvant therapy or experience late or long-term effects of cancer treatment. The non-cancer comparison group completed at least one MHOS between January 2008 and December 2012 and did not self-report cancer on any MHOS surveys. We excluded observations if the cancer diagnosis month was unknown; diagnosis was first reported on death certificate or autopsy. To ensure complete claims data, we excluded beneficiaries age ≥ 65 years at MHOS date, and without continuous enrollment in Medicare Parts A, B, MA, and Part D during the 12 months pre-post the MHOS month or until death [Appendix Fig. 2].

Key measures

The key outcome was receipt of prescription medications for treatment of pain as of the MHOS date. We categorized pain medications as opioids, non-opioid analgesic (non-steroidal antiinflammatory drugs (NSAIDs), local anesthetics), and adjuvant pain medications (antiepileptics and selected antidepressants). We did not include steroids because they are prescribed for multiple clinical conditions, including part of chemotherapy regimens, and we were unable to distinguish the indication for use. We identified relevant individual medications for pain based on input from the literature [9, 15], and clinical guidelines [16]. Once we identified the medications, we searched Part D claims to identify relevant generic drug names, including combination medications. Finally, we searched for evidence of drug supply on the MHOS date or the 30 days prior. For opioid users, we

quantified days supplied in the prior 60 days, categorized into ranges. We calculated the morphine equivalent daily dose (MEDD) as of the MHOS date or the closest prior date with opioid supply, using morphine equivalencies published by the Centers for Disease Control and Prevention (CDC) [17] and modified by CMS [18]. We generated an indicator for high MEDD (≥ 90 mg) based on thresholds designated as high-risk for overdose [19]. All medication measurement decisions were reviewed by palliative care clinicians and pharmacists on the research team.

Key independent variables were pain interference with function and cancer history. Pain interference was measured based on responses to the MHOS question “During the past 4 weeks, how much did pain interfere with your normal work (include both work outside the home and housework)?” We grouped the responses into three levels: mild/none (responses: not at all, a little bit); moderate; and severe (responses: quite a bit, extremely). Our analyses included adjustment for beneficiary demographics (age, race/ethnicity, sex, marital status, educational attainment), health status (indicators from a chronic condition checklist, and time from MHOS survey to death, (< 6 months compared with ≥ 6 months)), zip code level percentage of the population living in poverty, region (Northeast, South, Midwest, West), MA plan type (HMO or PPO/other), and receipt of the Part D low-income subsidy (LIS, full or partial versus none).

Analysis

We described sample characteristics overall and stratified by cancer history, using chi-squared statistics to compare by cancer history. We calculated percentages receiving pain medications (any, by type, in combinations). Medication use was compared by cancer history and level of pain interference, with comparisons using chi-squared analysis, or Student’s *T* test. We estimated multivariable logistic regressions to test for associations between pain interference, cancer history, and the interaction between them with receipt of (a) any pain medication and (b) any opioid, adjusting for socio-demographics, health status, and plan characteristics as previously described. We report predictive margins and 95% confidence intervals (CI), which represent the predicted percentage with medication use, by cancer history, pain severity, and for selected covariates, adjusted for all other socio-demographic, health status, and plan characteristics. All comparisons were two-sided with $\alpha = .05$. Analyses were conducted using SAS version 9.4 (SAS Institute Inc., Cary, NC) and Stata 15 (Statacorp, College Station, Tx). The Yale Human Investigations Committee granted exempt status to this project.

Results

The sample of 15,624 beneficiaries (9105 with cancer; 6519 without cancer) was 49% female and 66.4% white, non-Hispanic (Table 1). The sample came disproportionately from the western region (54.7%), with 20.6% receiving the Part D LIS; 2.9% died within 6 months of survey. Severe pain interference was reported by 21.3%, with 46.1% reporting moderate levels. The characteristics of beneficiaries with cancer differed from those without cancer on almost all dimensions except for marital status, LIS receipt, and plan type. Death occurred within 6 months for 4.2% and 1.0% of those with and without cancer, respectively.

More beneficiaries with cancer (22.6%) reported severe pain interference than those without cancer (19.5%, $p < 0.001$). (Cancer type, stage at diagnosis and initial treatment modality is reported in Appendix Table 5.)

Overall, pain medication was received by 21.5% of the total sample, with 11.6% receiving an opioid, 17.0% a non-opioid analgesic, and 15.8% an adjuvant pain medication (Table 2). Medication rates overall and for each individual category were higher for beneficiaries with cancer versus without, for example, 22.5% versus 20.1% ($p < 0.001$) received any pain medication, and 13.1% versus 9.5% ($p < 0.001$) received opioid pain medication. The percentage receiving pain medication also varied by level of pain interference, with those reporting severe pain most likely to report medication use, overall (44.4%) and in each medication category, with levels decreasing with lower levels of pain interference. Among those receiving pain medications (Appendix Table 6), 46.1% received only non-opioid analgesics, while the remainder received both non-opioids and opioids. A larger percentage of adults with a cancer history received medication combinations (55.8%) compared with the non-cancer subgroup (44.9%, $p < 0.001$), who were more likely to receive only non-opioid analgesics.

After adjusting for all characteristics, the percentage receiving any pain medication or any opioid varied by cancer history and severity of pain interference (Fig. 1). The percentage receiving any pain medication was higher for those with cancer versus the non-cancer comparison group for those with severe (cancer 38.7%; 95% CI 36.5–40.9 versus non-cancer 37.1%; 95% CI 34.4–39.8 $p = 0.048$) or little/no pain interference (cancer 12.6%; 95% CI 11.3–14.0 versus non-cancer 9.6%; 95% CI 8.3–10.9, $p = 0.001$). Opioid receipt was higher for individuals with cancer compared with the non-cancer group across all three levels of pain interference. For example, among the cancer sample reporting severe pain interference, 26.4% (95% CI 24.4–28.4) received opioids versus 23.8% (95% CI 21.5–26.2, $p = 0.003$) in the non-cancer group. Receipt of any pain medication was also higher for women compared with men (23.1% (95% CI 22.2–24.0) versus 19.8% (95% CI 18.9–20.7) $p < 0.001$), decreased with increasing age, and was higher for individuals with the Part D LIS compared with those without, and higher for those with proximal death (Table 3). Paralleling receipt of any pain medication, opioid receipt was higher for women versus men, with the Part D LIS, proximal death, and decreased with increasing age. In addition, opioid receipt was higher for non-Hispanic whites compared with all other race/ethnic groups, with lower educational attainment, and with higher poverty rates.

Approximately half (45.7%) of adults receiving opioids had less than a 7-day supply during the 30-day observation period, while 38.4% received opioids for 30 days or longer (Table 4), with no difference by cancer history. Hydrocodone, oxycodone, and tramadol were the mostly commonly received opioids overall (Appendix Table 7). The median MEDD was 30.0 mg, with a mean of 55.7 mg (standard error (S.E.) 2.0). Mean MEDD was higher for adults with cancer (58.3 mg, S.E. 2.7) versus without (50.7 mg, S.E. 2.6, $p = 0.044$). Overall, 14.5% had a high or very high MEDD (90 mg or greater), with no difference by cancer history.

Discussion/conclusion

In this first, large, U.S. population-based study, we documented patterns of pain medication use associated with patient-reported pain interference and compared patterns for older adults with and without cancer. We found a strong association between increasing severity of pain interference and the likelihood of receiving any prescription pain medication, particularly opioids. In addition, older adults with a cancer history were more likely to receive pain medications compared with older adults without a cancer history; however, the magnitude of difference was small. Finally, we found that despite national efforts to increase the availability of supportive and palliative care services, many older adults who reported severe pain interference did not receive any prescription pain medication. This is concerning as pain is an important contributor to diminished quality of life and function, across health conditions, and particularly in older age.

During our 30-day observation period, over one-fifth of older adults received prescription pain medications and approximately half of those received an opioid. Our results parallel those of Barbera et al. [7], which used the Edmonton Symptom Assessment Scale to characterize pain intensity for older adults with cancer [20], and then assessed opioid use during the 30 days prior and 7 days after pain assessment. The results from that study indicate that 26.3% who reported severe pain received opioids during the 30-day pre-period, which matches the 27.0% reported in this study. Several other smaller studies that have assessed pain symptoms and medication management find higher opioid use rates, but these tend to be clinical cohorts of oncology patients undergoing active treatment or surveillance [12, 21], which are more homogeneous than our sample. While numerous other studies address pain medication use overall [22–27] or either for adults with [28–35] or without cancer [36, 37], few compare medication patterns across these groups within a single population setting [8, 9]; incorporation of patient-reported pain information is rare.

Our results suggest that older adults with cancer were more likely than adults without cancer to receive opioids. This finding is consistent with CDC guidelines on chronic pain management, which discourage opioid prescribing except for adults receiving active cancer therapy, palliative, or end-of-life care [19]. In contrast, opioids are seen as an important component of pain management for patients with cancer undergoing active therapy or at end-of-life [16]. In fact, we found that among adults receiving pain medication, a larger proportion of adults without cancer received non-opioid analgesics only, suggesting a focus on prescribing non-opioid analgesics instead of opioids. The relatively small magnitude of the difference in use rates may be explained by the heterogeneity of our sample of adults with cancer, with respect to the criteria mentioned in the CDC guidelines. While we observed slightly higher rates of proximal death, our dataset did not include information on active cancer therapy for all cancer types, so we could not test whether meeting the CDC criteria predicted an even higher likelihood of opioid use than observed.

Beginning in the 1980s, clinicians and patient advocacy groups placed increasing emphasis on pain assessment and treatment, which spurred increasing opioid use [9, 10, 27, 32]. Opioids were prescribed frequently and without careful oversight, resulting in prolonged dependence, misuse, or diversion. In response, over the past 5–7 years, states have added

new or strengthened existing laws or regulations restricting opioid prescribing [38, 39]. This has the potential to reduce access to opioids for patients who need them, the so-called “chilling effect,” potentially increasing the problem of undertreated or untreated pain. This study spans the early transition period—when states were just beginning to respond by increasing restrictions. This may explain the failure to find time trends in the data. Furthermore, despite the perception of opioid overuse, we find that a large proportion of older adults had untreated pain, including 56% of those who reported severe pain interference and did not receive any pain medication, and 70% who did not receive an opioid. These results suggest that any increase in untreated pain associated with new restrictions will build on high baseline rates. Mechanisms to ensure access to opioids for individuals with severe pain are essential as overall opioid use restrictions and safety measures are implemented.

While some characteristics significantly predicted both non-opioid and opioid receipt, only the latter was associated with race/ethnicity, marital status, education, and poverty rates. Racial minorities and individuals in higher poverty and lower educational attainment areas were less likely to receive opioid prescriptions when compared with non-Hispanic whites, and those living in areas with higher socioeconomic status, consistent with prior research suggesting bias in prescribing opioids [24, 40]. In addition, adults receiving the Part D LIS were more likely to receive opioid and non-opioid medications. The LIS is associated with lower cost-sharing for prescriptions, and there is evidence that Part D enrollees respond to price variation, including that associated with the LIS [41–44]. The estimated effect of the LIS in this analysis of any pain medication may reflect physician prescribing of NSAIDs for low-income beneficiaries, which would bias estimates. However, that explanation would not hold for opioids, which are never obtained over-the-counter.

Limitations

Our study is subject to limitations typically associated with use of survey and administrative datasets. This dataset captures medication use patterns for beneficiaries enrolled in MA plans, which may undertake internal review of prescribing practices. As a result, the patterns observed in the MA setting may differ from fee-for-service enrolled populations with Part D plans. This analysis focused on prescription medications typically prescribed for pain management. Medications such as acetaminophen and NSAIDs are available over-the-counter and would not be captured with claims unless prescribed and covered by Part D. As a result, our estimates may under-report use of these medications. Recent estimates suggest that 8.7% of older adults purchase acetaminophen and 4.7% naproxen, but the study did not distinguish prescription from over-the-counter purchase [45]. We are unable to discern the prescriber’s intent from claims, so that some antidepressants or antiepileptics may have been prescribed for purposes other than pain management. Our measures cannot capture pharmacologic pain treatments typically administered in a physician office (or hospital), through an implanted device, or non-pharmacologic treatments for pain that may be covered by the MA plan. These might include acupuncture, massage therapy, or palliative radiation. Finally, our measures are based on prescriptions filled, but do not measure medications prescribed but not filled.

Despite these limitations, the study has substantial strengths, including a large population-based sample that includes older adults with and without a cancer history. The linkage between Part D claims and the SEER-MHOS allows us to examine the association between pain medication use and self-reported pain symptoms, specifically severity of pain interference with daily activities. Other studies examining associations between pain and medication use have used scales that report pain levels, such as the Edmonton Symptom Assessment Scale. By using pain interference, we can provide unique insights, as older adults commonly focus on functional status as a key contributor to quality of life. We were unable to assess the sensitivity of study results to the use of alternative pain measures because the linked dataset available for this study only included the pain interference measure.

In conclusion, older adults with cancer were more likely to receive prescription pain medications compared with adults without cancer, overall and when stratifying by severity of pain interference. Furthermore, a large proportion of both groups reporting severe pain interference did not receive medications for pain management, a special concern for older adults with cancer, for whom pharmacologic therapy is recommended. New ways to improve and standardize assessment and management of pain are urgently needed to limit functional impairment and enhance quality of life. Increasing clinician training, as well as building on quality metrics and electronic-health records, is a strategy that may ensure more routine capture and treatment of symptoms, including pain, among older adults with and without cancer.

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Appendix

Fig. 2.

Sample selection steps and exclusions

1 Linked cancer sample with known date of cancer diagnosis and cancer diagnosis not at autopsy. (Without ANY restriction by cancer N=49,766)

2 Cancer sample has additional SEER restrictions: age > 65, only primary tumor and invasive disease

3 Non-cancer sample with SEER restrictions: age > 65, In SEER region at time of survey and cancer status=NO for all records

Table 5

Cancer type, stage at diagnosis, and initial therapy

Sample N	Cancer	
	9105	
	N	%
Cancer type		
Breast	1746	19.2
Prostate	2798	30.7
Colorectal	958	10.5
Lung	582	6.4
Other	3021	33.2
Stage at diagnosis		
I	2324	25.5
II	3387	37.2
III	888	9.8
IV	516	5.7

Sample N	Cancer	
	9105	
	N	%
Unknown	1990	21.9
Initial therapy		
Surgery	5693	62.5
Radiation	2923	32.1

Source: SEER-MHOS-Part D linked data, 2008–2012

Table 6

Combinations of medication type for pain management among treated adults, overall, by cancer history and level of pain interference (unadjusted)

	Overall		By cancer history				<i>p</i> value ^b	By level of pain interference						<i>p</i> value
			Cancer		No cancer			Severe		Moderate		Mild/none		
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%		<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	
By type ^a							< 0.001							< 0.001
Opioids only	79	2.3	53	2.5	27	2.0		44	2.9	26	1.8	11	2.1	
Non-opioids only	1550	46.1	853	41.7	697	53.1		492	33.4	766	54.3	292	61.6	
Both	1732	51.6	1142	55.8	589	44.9		939	63.7	620	44.0	171	36.3	

^aCategories are mutually exclusive

^b*p* values reported for chi-squared comparison of medication use rates by cancer history and pain interference

Source: SEER-MHOS-Part D linked data, 2008–2012

Table 7

Use of individual opioids conditional on opioid receipt, overall and by cancer history

Specific opioids received	Overall		Cancer		Non-cancer	
	N	%	N	%	N	%
Hydrocodone	948	52.3	630	52.7	318	51.6
Oxycodone	363	20.0	269	22.5	94	15.3
Tramadol	333	18.4	197	16.5	136	22.1
Codeine	116	6.4	74	6.2	42	6.8
Propoxyphene	93	5.1	55	4.6	38	6.2
Fentanyl	74	4.1	64	5.3	10	1.6
Morphine	64	3.5	46	3.9	18	3.0
Methadone	18	1.0	< 11		< 11	
Hydromorphone	15	0.8	< 11		< 11	
Meperidine	< 11		< 11		< 11	
Oxymorphone	< 11		< 11		< 11	
Sum	2027	111.9	1357	113.5	669	108.7

Multiple opioids may be received; row categories are not mutually exclusive

Source: SEER-MHOS Part D linked data, 2008–2012

References

- Kennedy J, Roll JM, Schraudner T, Murphy S, McPherson S (2014) Prevalence of persistent pain in the U.S. adult population: new data from the 2010 national health interview survey. *J Pain* 15:979–984 [PubMed: 25267013]
- Institute of Medicine (2011) Relieving pain in America: a blueprint for transforming prevention, care, education, and research. National Academies of Science and Medicine, Washington, DC
- Burton AW, Fanciullo GJ, Beasley RD, Fisch MJ (2007) Chronic pain in the cancer survivor: a new frontier. *Pain Med* 8:189–198 [PubMed: 17305690]
- Deandrea S, Montanari M, Moja L, Apolone G (2008) Prevalence of undertreatment in cancer pain. A review of published literature. *Ann Oncol* 19:1985–1991 [PubMed: 18632721]
- Reis-Pina P, Lawlor PG, Barbosa A (2017) Adequacy of cancer-related pain management and predictors of undertreatment at referral to a pain clinic. *J Pain Res* 10:2097–2107 [PubMed: 28919809]
- Greco MT, Roberto A, Corli O, Deandrea S, Bandieri E, Cavuto S, Apolone G (2014) Quality of cancer pain management: an update of a systematic review of undertreatment of patients with cancer. *J Oncol Pract* 32:4149–4154
- Barbera L, Seow H, Husain A, Howell D, Atzema C, Sutradhar R, Earle C, Sussman J, Liu Y, Dudgeon D (2012) Opioid prescription after pain assessment: a population-based cohort of elderly patients with cancer. *J Oncol Pract* 30:1095–1099
- Barbera L, Sutradhar R, Chu A, Seow H, Howell D, Earle CC, O'Brien MA, Dudgeon D, Atzema C, Husain A, Liu Y, DeAngelis C (2018) Comparison of opioid prescribing among cancer and noncancer patients aged 18–64: analysis using administrative data. *J Pain Symptom Manag* 56:72–79
- Barbera L, Sutradhar R, Chu A, Seow H, Howell D, Earle CC, O'Brien MA, Dudgeon D, Atzema C, Husain A, Liu Y, DeAngelis C (2017) Opioid prescribing among cancer and non-cancer patients: time trend analysis in the elderly using administrative data. *J Pain Symptom Manag* 54:484–492
- Harrison JM, Lagisetty P, Sites BD, Guo C, Davis MA (2018) Trends in prescription pain medication use by race/ethnicity among US adults with noncancer pain, 2000–2015. *Am J Public Health* 108:788–790 [PubMed: 29672145]
- Sutradhar R, Lokku A, Barbera L (2017) Cancer survivorship and opioid prescribing rates: a population-based matched cohort study among individuals with and without a history of cancer. *Cancer* 123:4286–4293 [PubMed: 28782114]
- Moryl N, Dave V, Glare P, Bokhari A, Malhotra VT, Gulati A, Hung J, Puttanniah V, Griffo Y, Tickoo R, Wiesenthal A, Horn SD, Inturrisi CE (2018) Patient-reported outcomes and opioid use by outpatient cancer patients. *J Pain* 19:278–290 [PubMed: 29154919]
- Ambs A, Warren JL, Bellizzi KM, Topor M, Haffer SC, Clauser SB (2008) Overview of the SEER–medicare health outcomes survey linked dataset. *Health Care Financ Rev* 29:5–21 [PubMed: 18773611]
- Kent EE, Ambs A, Mitchell SA, Clauser SB, Smith AW, Hays RD (2015) Health-related quality of life in older adult survivors of selected cancers: data from the SEER-MHOS linkage. *Cancer* 121:758–765 [PubMed: 25369293]
- Check DK, Rosenstein DL, Dusetzina SB (2016) Early supportive medication use and end-of-life care among Medicare beneficiaries with advanced breast cancer. *Support Care Cancer* 24:3463–3472 [PubMed: 26994634]
- Denlinger CS, Ligibel JA, Are M, Baker KS, Demark-Wahnefried W, Friedman DL, Goldman M, Jones L, King A, Ku GH, Kvale E, Langbaum TS, Leonardi-Warren K, McCabe M, Melisko M, Montoya JG, Mooney K, Morgan MA, Moslehi JJ, O'Connor T, Overholser L, Paskett ED, Raza M, Syrjala KL, Urba SG, Wakabayashi MT, Zee P, McMillian N, Freedman-Cass D, National Comprehensive Cancer Network (2014) Survivorship: pain version 1.2014. *J Natl Compr Cancer Netw* 12:488–500

17. Centers for Disease Control and Prevention (2017) Calculating total daily dose. Centers for Disease Control and Prevention, Atlanta
18. Center for Medicare & Medicaid Services (2017) Opioid oral morphine milligram equivalent (MME) conversion factors. Centers for Medicare and Medicaid Services, Baltimore
19. Dowell D, Haegerich TM, Chou R (2016) CDC guideline for prescribing opioids for chronic pain - United States, 2016. *MMWR Recomm Rep* 65:1–49
20. Bruera E, Kuehn N, Miller MJ, Selmsler P, Macmillan K (1991) The Edmonton Symptom Assessment System (ESAS): a simple method for the assessment of palliative care patients. *J Palliat Care* 7:6–9 [PubMed: 1714502]
21. Fisch MJ, Lee JW, Weiss M, Wagner LI, Chang VT, Cella D, Manola JB, Minasian LM, McCaskill-Stevens W, Mendoza TR, Cleeland CS (2012) Prospective, observational study of pain and analgesic prescribing in medical oncology outpatients with breast, colorectal, lung, or prostate cancer. *J Oncol Pract* 30:1980–1988
22. Brown W (2008) Opioid use in dying patients in hospice and hospital, with and without specialist palliative care team involvement. *Eur J Cancer Care (Engl)* 17:65–71 [PubMed: 18181893]
23. Gomes T, Juurlink DN, Dhalla IA, Mailis-Gagnon A, Paterson JM, Mamdani MM (2011) Trends in opioid use and dosing among socio-economically disadvantaged patients. *Open Med* 5:e13–e22 [PubMed: 22046214]
24. Guy GP Jr, Zhang K, Bohm MK, Losby J, Lewis B, Young R, Murphy LB, Dowell D (2017) Vital signs: changes in opioid prescribing in the United States, 2006–2015. *MMWR Morb Mortal Wkly Rep* 66:697–704 [PubMed: 28683056]
25. Mosher HJ, Krebs EE, Carrel M, Kaboli PJ, Weg MWV, Lund BC (2015) Trends in prevalent and incident opioid receipt: an observational study in veterans health administration 2004–2012. *J Gen Intern Med* 30:597–604 [PubMed: 25519224]
26. Schubert I, Ihle P, Sabatowski R (2013) Increase in opiate prescription in Germany between 2000 and 2010: a study based on insurance data. *Dtsch Arztebl Int* 110:45–51 [PubMed: 23413387]
27. Smolina K, Gladstone E, Morgan SG (2016) Determinants of trends in prescription opioid use in British Columbia, Canada, 2005–2013. *Pharmacoepidemiol Drug Saf* 25:553–559 [PubMed: 26947145]
28. Barbera L, Sutradhar R, Chu A, Seow H, Earle CC, O'Brien MA, Dudgeon D, DeAngelis C, Atzema C, Husain A, Liu Y, Howell D (2017) Has province-wide symptom screening changed opioid prescribing rates in older patients with cancer? *J Oncol Pract* 13:e927–e934 [PubMed: 28926291]
29. Berger A, Dukes E, Mercadante S et al. (2006) Use of antiepileptics and tricyclic antidepressants in cancer patients with neuropathic pain. *Eur J Cancer Care (Engl)* 15:138–145 [PubMed: 16643261]
30. Berger A, Dukes E, Smith M, Hagiwara M, Seifeldin R, Oster G (2003) Use of oral and transdermal opioids among patients with metastatic cancer during the last year of life. *J Pain Symptom Manag* 26:723–730
31. Gagnon B, Scott S, Nadeau L, Lawlor PG (2015) Patterns of community-based opioid prescriptions in people dying of cancer. *J Pain Symptom Manag* 49:36–44
32. Higginson IJ, Gao W (2012) Opioid prescribing for cancer pain during the last 3 months of life: associated factors and 9-year trends in a nationwide United Kingdom cohort study. *J Oncol Pract* 30: 4373–4379
33. Jarlbaek L, Hansen DG, Bruera E, Andersen M (2010) Frequency of opioid use in a population of cancer patients during the trajectory of the disease. *Clin Oncol (R Coll Radiol)* 22:199–207 [PubMed: 20045301]
34. Vardy J, Agar M (2014) Nonopioid drugs in the treatment of cancer pain. *J Oncol Pract* 32:1677–1690
35. Ziegler L, Mulvey M, Blenkinsopp A, Petty D, Bennett MI (2016) Opioid prescribing for patients with cancer in the last year of life: a longitudinal population cohort study. *Pain* 157:2445–2451 [PubMed: 27626624]
36. Campbell CI, Weisner C, Leresche L et al. (2010) Age and gender trends in long-term opioid analgesic use for noncancer pain. *Am J Public Health* 100:2541–2547 [PubMed: 20724688]

37. Smolina K, Gladstone EJ, Rutherford K, Morgan SG (2016) Patterns and trends in long-term opioid use for non-cancer pain in British Columbia, 2005–2012. *Can J Public Health* 107:e404–e409 [PubMed: 28026706]
38. Wickramatilake S, Zur J, Mulvaney-Day N, Klimo MC, Selmi E, Harwood H (2017) How states are tackling the opioid crisis. *Public Health Rep* 132:171–179 [PubMed: 28152337]
39. Patrick SW, Fry CE, Jones TF, Buntin MB (2016) Implementation of prescription drug monitoring programs associated with reductions in opioid-related death rates. *Health Aff (Project Hope)* 35: 1324–1332
40. Cleeland CS, Gonin R, Baez L et al. (1997) Pain and treatment of pain in minority patients with cancer. The Eastern Cooperative Oncology Group Minority Outpatient Pain Study. *Ann Intern Med* 127:813–816 [PubMed: 9382402]
41. Doshi JA, Li P, Huo H, Pettit AR, Kumar R, Weiss BM, Huntington SF (2016) High cost sharing and specialty drug initiation under Medicare Part D: a case study in patients with newly diagnosed chronic myeloid leukemia. *Am J Manag Care* 22:s78–s86 [PubMed: 27270157]
42. Dusetzina SB, Winn AN, Abel GA, Huskamp HA, Keating NL (2014) Cost sharing and adherence to tyrosine kinase inhibitors for patients with chronic myeloid leukemia. *J Clin Oncol* 32:306–311 [PubMed: 24366936]
43. Olszewski AJ, Dusetzina SB, Eaton CB, Davidoff AJ, Trivedi AN (2017) Subsidies for oral chemotherapy and use of immunomodulatory drugs among Medicare beneficiaries with myeloma. *J Oncol Pract* 35:3306–3314
44. Wieder R, Delarosa N, Bryan M et al. (2014) Prescription coverage in indigent patients affects the use of long-acting opioids in the management of cancer pain. *Pain Med* 15:42–51 [PubMed: 24106748]
45. Qato DM, Wilder J, Schumm LP, Gillet V, Alexander GC (2016) Changes in prescription and over-the-counter medication and dietary supplement use among older adults in the United States, 2005 vs 2011. *JAMA Intern Med* 176:473–482 [PubMed: 26998708]

Fig. 1.

Adjusted Levels (predictive margins) for pain medication receipt by severity of pain interference and cancer history. Definition: color graphic with shading

Models adjust for age, sex, race/ethnicity, marital status, education, comorbidities, area poverty rates, region of the country, Part D LIS, and plan type. Levels of any pain medication use (Figure 1a) or any opioid use (Figure 1b) differ by cancer history when stratified by pain severity at * $p < .01$; ** $p < .05$. Abbreviations: CA, cancer. Source: SEER-MHOS-Part D linked data, 2008–2012.

Table 1

Sample characteristics

Sample N's	Overall		Cancer		No CANCER		<i>p</i> value ^a
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	
Level of pain interference							
Severe	3322	21.3	2054	22.6	1268	19.5	<0.001
Moderate	7201	46.1	4190	46.0	3011	46.2	
Mild/none	5101	32.7	2861	31.4	2240	34.4	
Sex							
Male	7968	51.0	5059	55.6	2909	44.6	<0.001
Female	7656	49.0	4046	44.4	3610	55.4	
Age group							
66–69	4387	28.1	2323	25.5	2064	31.7	<0.001
70–74	4447	28.5	2556	28.1	1891	29.0	
75–79	3328	21.3	2048	22.5	1280	19.6	
80+	3462	22.2	2178	23.9	1284	19.7	
Race/ethnicity							
White, non-Hispanic	10,370	66.4	6142	67.5	4228	64.9	<0.001
Black, non-Hispanic	1474	9.4	911	10.0	563	8.6	
Hispanic	1673	10.7	878	9.6	795	12.2	
Asian, other	2107	13.5	1174	12.9	933	14.3	
Marital status							
Currently married	9181	58.8	5321	58.4	3860	59.2	0.547
Formerly married	5823	37.3	3426	37.6	2397	36.8	
Never married	620	4.0	358	3.9	262	4.0	
Education							
< High school diploma	3868	24.8	2266	24.9	1602	24.6	<0.001
High school diploma	4850	31.0	2791	30.7	2059	31.6	
> High school diploma	6906	44.2	4048	44.5	2858	43.8	
Has a doctor ever told you that you have...							

Has a doctor ever told you that you have...

Sample N's	Overall			Cancer			No CANCER			p value ^a
	N	%	N	%	N	%	N	%	N	
Coronary artery disease	2144	13.7	1331	14.6	813	12.5	6519	12.5	813	< 0.001
Stroke	1299	8.3	827	9.1	472	7.2	6519	7.2	472	< 0.001
Pulmonary disease	2440	15.6	1538	16.9	902	13.8	6519	13.8	902	< 0.001
Diabetes	4072	26.1	2428	26.7	1644	25.2	6519	25.2	1644	0.042
Depression	2255	14.4	1399	15.4	856	13.1	6519	13.1	856	< 0.001
Arthritis	6109	39.1	3535	38.8	2574	39.5	6519	39.5	2574	0.405
Sciatica	3388	21.7	1919	21.1	1469	22.5	6519	22.5	1469	0.029
Poverty rates										< 0.001
Low (0 to < 5%)	3055	19.6	2265	24.9	790	12.1	6519	12.1	790	
5 to < 10%	4384	28.1	2428	26.7	1956	30.0	6519	30.0	1956	
10 to < 20%	5099	32.6	2725	29.9	2374	36.4	6519	36.4	2374	
High (20 to 100%)	3086	19.8	1687	18.5	1399	21.5	6519	21.5	1399	
Region										< 0.001
Northeast	1945	12.5	1258	13.8	687	10.5	6519	10.5	687	
South	1427	9.1	848	9.3	579	8.9	6519	8.9	579	
Central	3699	23.7	2098	23.0	1601	24.6	6519	24.6	1601	
West	8548	54.7	4901	53.8	3647	55.9	6519	55.9	3647	
Part D low income subsidy										0.284
Full/partial	3218	20.6	1902	20.9	1316	20.2	6519	20.2	1316	
None	12,406	79.4	7203	79.1	5203	79.8	6519	79.8	5203	
Plan type										0.118
HMO	14,451	92.5	8396	92.2	6055	92.9	6519	92.9	6055	
Other plan type	1173	7.5	709	7.8	464	7.1	6519	7.1	464	
Proximity of death										< 0.001
< 6 months from MHOS survey	446	2.9	378	4.2	68	1.0	6519	1.0	68	
6 months from MHOS survey	15,178	97.1	8727	95.8	6451	99.0	6519	99.0	6451	
MHOS survey year										< 0.001
2008	2907	18.6	1771	19.5	1136	17.4	6519	17.4	1136	
2009	3951	25.3	2338	25.7	1613	24.7	6519	24.7	1613	

Sample N's	Overall			Cancer			No CANCER			<i>p</i> value ^a
	<i>N</i>	%		<i>N</i>	%		<i>N</i>	%		
2010	3237	20.7		1882	20.7		1355	20.8		
2011	2884	18.5		1680	18.5		1204	18.5		
2012	2645	16.9		1434	15.7		1211	18.6		

^a *p* value reported for comparison of distribution for cancer and non-cancer samples. *HMO*, health maintenance organization; *MHOS*, Medicare Health Outcomes Survey. Source: SEER-MHOS-Part D linked data, 2008–2012

Table 2
Medication therapy for pain management by type, overall, by cancer history, and level of pain interference (unadjusted)

	Overall			By cancer history			By level of pain interference					
							Severe		Moderate		Mild/none	
	N	%		Cancer	N	%	N	%	N	%	N	%
By type ^a								<i>p</i> value ^b				<i>p</i> value
Any pain medication	3361	21.5	2048	22.5	1313	20.1	1475	44.4	1412	19.6	474	9.3
Opitoid	1811	11.6	1195	13.1	616	9.5	983	29.6	646	9.0	182	3.6
Non-opitoid analgesic	2663	17.0	1635	18.0	1028	15.8	1206	36.3	1098	15.3	359	7.0
Adjuvant pain medications	2475	15.8	1499	16.5	976	15.0	953	28.7	1068	14.8	454	8.9

^aCategories not mutually exclusive. Ns may sum to > 100%

^b*p* values reported for chi-squared comparison of medication use rates by cancer history and pain interference
Source: SEER-MHOS-Part D linked data, 2008–2012

Adjusted levels (predictive margins) for any pain medication or any opioid receipt by cancer history, severity of pain interference, and selected respondent characteristics

Table 3

	Any pain medication			Any opioid		
	Predictive margin	95% CI margin	p value*	Predictive margin	95% CI margin	p value*
Pain interference						
Severe	38.1	36.3	39.9	25.3	23.7	27.0
Moderate	19.5	18.6	20.4	9.0	8.3	9.7
Mild/none	11.3	10.4	12.3	4.2	3.6	4.9
Cancer history						
Cancer	22.4	21.6	23.2	9.8	9.1	10.5
No cancer	20.3	19.4	21.3	12.9	12.2	13.5
Cancer history, stratified by pain interference						
Severe						
Cancer	38.7	36.5	40.9	26.4	24.4	28.4
No cancer	37.1	34.4	39.8	23.8	21.5	26.2
Moderate						
Cancer	20.3	19.1	21.5	10.6	9.6	11.5
No cancer	18.4	17.0	19.8	6.8	5.9	7.7
Mild/none						
Cancer	12.6	11.3	14.0	5.3	4.4	6.2
No cancer	9.6	8.3	10.9	2.8	2.0	3.5
Sex						
Male	19.8	18.9	20.7	11.0	10.3	11.7
Female	23.1	22.2	24.0	12.2	11.5	12.8
Age group						
66–69	23.3	22.1	24.6	13.0	12.0	14.0
70–74	22.6	21.4	23.7	12.5	11.6	13.5
75–79	20.7	19.5	22.0	11.3	10.3	12.3
80+	18.9	17.7	20.2	9.4	8.5	10.3
Race/ethnicity						

	Any pain medication			Any opioid		
	Predictive margin	95% CI margin	p value*	Predictive margin	95% CI margin	p value*
White, non-Hispanic	22.6	21.7	23.4	13.0	12.3	13.6
Black, non-Hispanic	20.5	18.6	22.5	10.8	9.4	12.3
Hispanic	22.0	20.1	23.9	9.8	8.5	11.1
Asian, other	17.0	15.5	18.6	7.9	6.7	9.0
Currently married			< 0.001			< 0.001
Married	21.0	20.1	21.8	10.8	10.1	11.4
Not married	22.2	21.2	23.2	12.6	11.8	13.3
Education						
< High school diploma	22.4	21.1	23.7	12.8	11.8	13.8
High school diploma	21.5	20.4	22.6	11.6	10.7	12.4
> High school diploma	20.9	20.0	21.9	10.8	10.0	11.5
Has a doctor ever told you that you have...						
Coronary artery disease	20.6	19.1	22.2	11.7	10.5	12.9
Stroke	22.9	20.9	24.9	10.3	9.0	11.7
Pulmonary disease	22.5	21.1	24.0	12.8	11.7	13.9
Diabetes	23.7	22.5	24.9	12.0	11.2	12.9
Depression	22.2	20.7	23.7	11.8	10.7	12.8
Arthritis	24.3	23.4	25.2	12.6	12.0	13.2
Sciatica	24.3	23.0	25.6	12.8	11.9	13.8
Poverty rates						
Low (0 to < 5%)	21.3	19.8	22.7	11.4	10.2	12.5
5 to < 10%	21.0	19.9	22.2	11.0	10.1	11.9
10 to < 20%	21.5	20.5	22.6	11.1	10.3	11.9
High (20 to 100%)	22.3	20.9	23.7	13.1	12.0	14.2
Region						
Northeast	17.8	16.2	19.4	9.1	7.9	10.3
South	22.8	20.7	24.8	12.6	11.0	14.2
Central	22.1	20.8	23.4	11.6	10.7	12.6
West	21.9	21.0	22.8	12.0	11.3	12.7
Part D Low income subsidy						

	Any pain medication			Any opioid		
	Predictive margin	95% CI margin	p value*	Predictive margin	95% CI margin	p value*
Full/partial	25.3	23.8	26.8	13.6	12.5	14.7
None	20.3	19.6	21.1	10.9	10.3	11.4
Plan type						
HMO	21.6	20.9	22.2	11.5	11.0	12.0
Other plan type	20.8	18.7	23.0	12.5	10.8	14.2
Proximity of death						
< 6 months from MHOS survey	26.4	22.8	30.1	17.4	14.5	20.3
6 months from MHOS survey	21.3	20.7	22.0	11.4	10.9	11.8

^a p values reported for comparison of predictive margins for each attribute compared with a reference category. *HMO*, health maintenance organization; *MHOS*, Medicare Health Outcomes Survey. Source: SEER-MHOS-Part D linked data, 2008–2012

Table 4

Detailed characteristics of opioid use, overall and by cancer status

	Overall			Cancer			Non-cancer			<i>p</i> value ^a
	<i>N</i>	col%	Mean	<i>N</i>	col%	Mean	<i>N</i>	col%	Mean	
<i>N</i> opioid users	1811	100.0		1195	100.0		616	100.0		
Duration of opioid use prior to MHOS date										0.44
< 7 days	827	45.7		553	46.3		274	44.5		
7–29 days	288	15.9		195	16.3		93	15.1		
30+ days	696	38.4		447	37.4		249	40.4		
MEDD (continuous)			Median			Mean			Median	<i>p</i> value
Overall by pain interference	30.0	55.7	2.0	31.3	58.3	2.7	30.0	50.7	2.6	0.04
Severe	30.0	56.5	2.7	30.0	59.4	3.7	30.0	51.5	3.3	0.12
Moderate	30.0	54.1	3.5	31.3	57.4	4.6	30.0	47.2	4.4	0.11
Mild/none	36.6	57.0	6.4	37.5	56.3	8.2	32.1	59.0	9.9	0.83
MEDD—% high or very high (MEDD > 90 mgs)	%			%			%			
Overall by pain interference	14.5			15.2			13.1			0.50
Severe	15.6			16.6			13.8			0.46
Moderate	13.6			14.6			11.6			0.43
Mild/none	12.1			<i>b</i>			<i>b</i>			

^a *p* values reported for comparison of cancer and non-cancer samples^b Value suppressed because cell size *n* < 11

MHOS, Medicare Health Outcomes Survey; MEDD, morphine equivalent daily dose. Source: SEER-Medicare-Part D linked data, 2008–2012