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ORIGINAL RESEARCH

Longitudinal Utilization of Invasive Pain Treatment Procedures Among Veterans with Chronic Pain Following Use of Whole Health Services and Complementary and Integrative Health Therapies

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Objective: To assess whether Whole Health, a system of care that emphasizes non-pharmacological approaches for chronic pain management, is associated with changes in downstream utilization of invasive pain treatment procedures.

Methods: Longitudinal retrospective cohort analysis of VHA administrative data. A total of 53,412 Veterans with chronic pain were identified between April and September 2018, with 584 initiating Whole Health and 3794 initiating a complementary and integrative health (CIH) therapy independent of Whole Health (CIH-only). Whole Health included use of coaching, personal health planning, and other services including CIH referral. CIH therapies included chiropractic care, acupuncture, massage therapy, yoga, Tai Chi/Qigong, and meditation. Propensity score matching was used to estimate expected rates of invasive pain treatment procedures 0–3, 4–12, and 13–18 months after initiating Whole Health or CIH-only compared to similar Veterans who had not engaged in either.

Results: Overall, 14% of the population were female, 11% had received prior spine injections, 3.3% had received surgery, and 0.4% had an implantable spinal stimulator. Whole Health use was associated with 42% (−61% to −17%) lower utilization of invasive pain procedures at three months compared to matched patients who did not use Whole Health. This reduction was attenuated at 18 months: 22% (−39% to −5%). CIH-only was associated with 18% (−29% to −4%) lower utilization at three months compared with matched patients, but differences were minimal at 18 months: 1% (−9% to 9%).

Discussion: Whole Health care, including CIH therapies, may help patients interrupt patterns of escalating and invasive pain care.

Keywords: chronic pain, complementary and integrative health, invasive spine procedures, whole health, veterans

Introduction

Chronic pain, a costly health issue which leads to poor patient outcomes and high healthcare costs, is estimated to impact approximately 21% of adults in the United States (US) and is a leading cause of disability.[1,2] Veterans of the US military are disproportionately affected by chronic pain as compared to the general adult population, including by the experience of severe pain.[3] As such, chronic pain management is a key priority for healthcare providers, including the Veterans Health Administration (VHA) national healthcare system.

Common conventional front-line treatment options for pain include physical therapy and medications, as appropriate.[4] If such non-invasive options do not work, more invasive pain treatment procedures (eg, spinal injections and nerve

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blocks) are considered.[4] However, such invasive procedures incur high costs for patients and healthcare systems, pose numerous potential risks for patients, and have limited evidence of long-term efficacy.[5] Alternative strategies for managing pain, including but not limited to complementary and integrative health (CIH) therapies like yoga, meditation, acupuncture, and chiropractic care, as well as services focused on helping patients set goals around pain management and increase effective self-management capabilities, may represent more effective, sustainable, and less costly strategies for pain management.[6]

In 2016, the 114th US Congress passed the Comprehensive Addiction and Recovery Act of 2016 (CARA), which called for the establishment of non-opioid-based best practices for pain management.[7] In response to the CARA legislation, VHA initiated a national demonstration project expanding its Whole Health system of care.[8,9] VHA's Office of Patient-Centered Care and Cultural Transformation provides oversight for Whole Health which, for the past decade, has been focused on transforming VHA care from a traditional, disease-centric model to a model that emphasizes the provision of personalized care tailored to the needs, goals, and preferences of each individual Veteran.[10,11] As part of this demonstration project, 18 VHA medical centers across the country were designated as Whole Health "Flagship" sites and received additional resources and training to support Whole Health implementation, including the expansion of CIH availability. Encompassed within VHA's Whole Health System of Care is the provision of core services, which include strategies focused on bolstering Veteran goal-setting, healthcare engagement, and the provision of whole-person clinical care, as well as the offering of CIH therapies in addition to conventional clinical care options for Veterans.[10]

Early findings from evaluation of the VHA Whole Health demonstration program suggest that among Veterans with chronic pain, receipt of Whole Health care is associated with benefits including decreased opioid use and increased healthcare engagement and self-care.[9,12] The question then arose amongst VHA leaders whether Whole Health utilization could impact other pain-related treatment such as downstream utilization of costly invasive pain management strategies. The objective of the current study was to examine the relationship between the use of VHA Whole Health care and downstream utilization of invasive pain treatment procedures, including steroid injections and spine surgeries, among Veterans with chronic pain.

Materials and Methods

We conducted a longitudinal retrospective cohort analysis of VHA administrative data from 18 Whole Health Flagship medical centers, one in each of VHA's 18 Veterans Integrated Service Networks. These sites were funded to hire staff dedicated to implementing Whole Health and specifically included funding for expanding CIH therapies and targeting patients with chronic pain.[7,10,13] Assessment of differences in patient outcomes following initiation of Whole Health activities at these 18 Flagship sites was requested as part of the CARA Act legislation to guide internal quality improvement activities.[7] This evaluation was exempt from human subjects review as it was initiated and executed as an internal quality improvement effort for VA operations and was conducted as a non-research operations activity in accordance with VHA Handbook 1058.05 and Program Guide 1200.21.[14] Participants did not provide informed consent, as the study was restricted to secondary data analysis of routinely collected VHA data. The findings and information being shared in this manuscript are being contributed externally to support knowledge sharing for the public good based on information from this VHA operational activity. We report the findings according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.[15]

Veterans Health Administration (VHA)

This project was conducted within the real-world environment of the VHA, the largest integrated health care system in the United States, which provides care at 1380 health care facilities including 170 VA Medical Centers and 1193 outpatient sites of care of varying complexity (VHA outpatient clinics) to over 9.1 million Veterans enrolled in the VA health care program.

Data Source and Cohort Identification

All study data were extracted from VHA electronic health records (EHR) maintained by VHA's Corporate Data Warehouse (CDW). The study sample included Veterans with chronic musculoskeletal pain who received longitudinal

care at VHA locations during the 18-month period (10/01/2017–03/31/2019) that overlapped with the hiring of Whole Health coaches and CIH providers at the Flagship sites (Figure 1). To ensure that Veterans in our analytic cohort were active users of VHA services and reduce the likelihood of missing outcome events associated with receiving care paid for by outside insurance or Medicare, we included only those Veterans who had VHA visits at least semi-annually during the full 18-month follow-up period. Chronic musculoskeletal pain was identified using the EHR algorithm recommended by the Pain Management Collaboratory and based on at least two instances of documentation of ICD-10 codes consistent with musculoskeletal disorder diagnoses in their VHA medical record in the year prior to their first identified VHA healthcare encounter within our evaluation timeframe.[16,17] We further excluded Veterans with "red flag" conditions potentially related to serious spinal pathology (eg, cancer, stroke, contraindicating spine-related conditions, and pregnancy).[18]

Veterans were grouped into three mutually exclusive levels of exposure during the study period: 1) Conventional Care; 2) CIH therapies alone; and 3) comprehensive Whole Health in which Veterans participated in both CIH therapies and core Whole Health educational or coaching activities. We identified a starting index date for each Veteran in the cohort, which we defined as the date of their earliest VHA primary care visit during the study period (for Veterans who used Conventional Care only), or the date of their first recorded CIH therapy or Whole Health encounter. To establish a wash-out period and ensure that we were capturing Veterans as they initiated Whole Health services or CIH therapies, Veterans who had any Whole Health or CIH utilization prior to their index date were excluded from the analytic cohort.

Measures

Whole Health Services and CIH Therapies

We identified the use of Whole Health services and CIH therapies using algorithms that collected both structured and unstructured data contained in the EHR using string searches.[19] Structured data included CPT codes for therapies which had such codes available, VHA's internal accounting coding system (CHAR4 codes), and internal templated clinical reminders called Health Factors that can be appended to clinic visit notes. Unstructured data extraction included searches for clinical note titles that included keyword strings such as "Whole Health or WH". Details of these coding algorithms

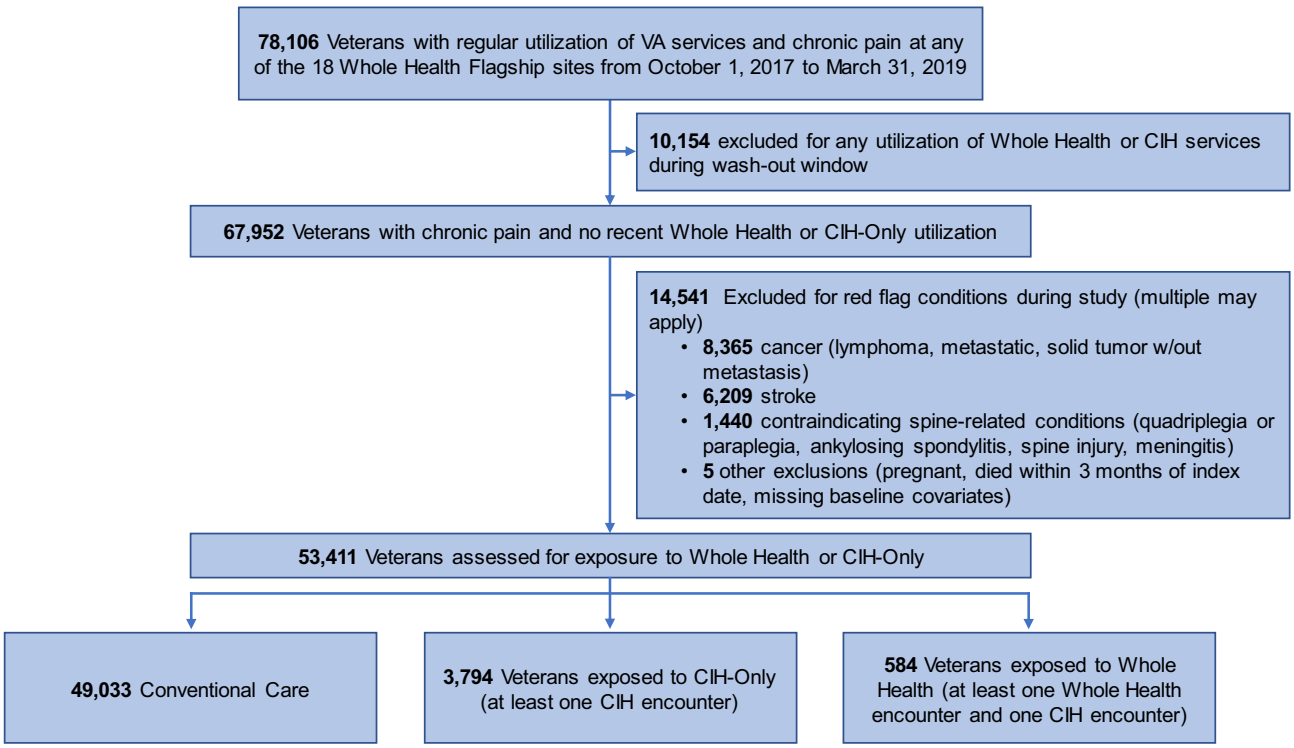

Figure 1 Cohort Construction.

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are described in Bokhour et al[9] and Taylor et al.[20] Whole Health services included health coaching, personal health planning, and Whole Health educational classes. We included six CIH therapies in our definition of CIH use: chiropractic care, acupuncture, massage therapy, yoga, Tai Chi/Qigong, and mindfulness meditation. We tallied Whole Health and CIH use during the evaluation timeframe for all Veterans in our analytic cohort. Of note, due to the focus of the CARA Act on evidence-based practices for pain management, individuals who used only Whole Health services without participation in at least one CIH therapy were included in the Conventional Care group as they were not considered exposed to non-pharmacological pain-related care.

Demographics and Baseline Clinical Characteristics

We included the following demographics for the Veterans in our analytic cohort based on information extracted from the EHR: sex, race, ethnicity, age, marital status, urban or rural residence, smoking status, co-existing chronic conditions as assessed using Elixhauser categorization,[21] and mental health diagnoses common among Veterans.[22] We also included several pain-related characteristics: pain at specific body sites in the year prior to the index date, worst numeric pain rating score in the 90 days prior to the index date, and utilization of specialty pain services in the 30 days prior to the index date. Finally, we assessed prior opioid use, which we defined as the presence or absence of opioid prescriptions in the 90 days prior to the index date, examining prescriptions up to a year prior to the index date to determine ongoing utilization.

Receipt of Invasive Pain Treatment Procedures

We defined invasive pain treatment procedures as invasive procedures used to treat musculoskeletal pain. We identified use of these procedures using a curated set of 435 CPT, HCPCS II, ICD-9, and ICD-10 procedure codes developed as part of a prior clinical trial,[23] and categorized procedures as being: (1) surgical; (2) non-surgical, including epidural injections, facet injections, and other procedures; or (3) spinal cord stimulator implantation/removal. We included procedures performed within VHA (inpatient or outpatient), as well as those identified as having been provided in community-based clinics where care was paid for by VHA, as identified using the VHA Program Integrity Tool. Procedures were assessed for each Veteran's baseline period (12 months prior to the index date, eg, first Whole Health service or CIH therapy encounter or matched primary care encounter) as well as downstream utilization following the index date up to 18 months. By design, all Veterans were alive and at-risk up to the initial 3-month downstream outcome window. Only Veterans who had full follow-up time for subsequent periods were included in those analyses.

Statistical Analyses

We used descriptive statistics to characterize Veteran demographics and pain-related characteristics across the three exposure groups (CIH therapy use only, Comprehensive Whole Health services, and Conventional Care), as well as unadjusted patterns of utilization of invasive pain treatment procedures. To examine adjusted associations between the use of Whole Health services and CIH therapies on downstream receipt of invasive pain treatment procedures, we used propensity scores to match each Veteran in the two exposure groups to Veterans from the Conventional Care group. Propensity scores, eg, likelihood to use either comprehensive Whole Health services or CIH therapies only, were estimated for all patients on the 29 available baseline demographic and clinical variables using the Covariate Balancing Propensity Score (CBPS) R package.[24] We then created matched samples by matching each Veteran in the two exposure groups to five Veterans in the Conventional Care group that had similar propensity scores using a nearest neighbor matching algorithm.[25] The balance in the resulting samples was assessed graphically by displaying the unadjusted and adjusted standardized mean difference (SMDs) side-by-side (Figure 2).[26] Baseline characteristics were considered sufficiently balanced when the SMDs were less than 0.1, except for the proportion of Veterans utilizing specialty pain services in the prior 30 days, which had an SMD of 0.13.

Based on the matched samples, we compared the number of observed procedures utilized by each of the two exposure groups in contrast to the adjusted count of procedures used by the matched Conventional care group. These model-produced counts are interpreted as the number of downstream procedures similar groups of patients in the Conventional care group would have been expected to use, with the only difference being exposure to Whole Health services or CIH

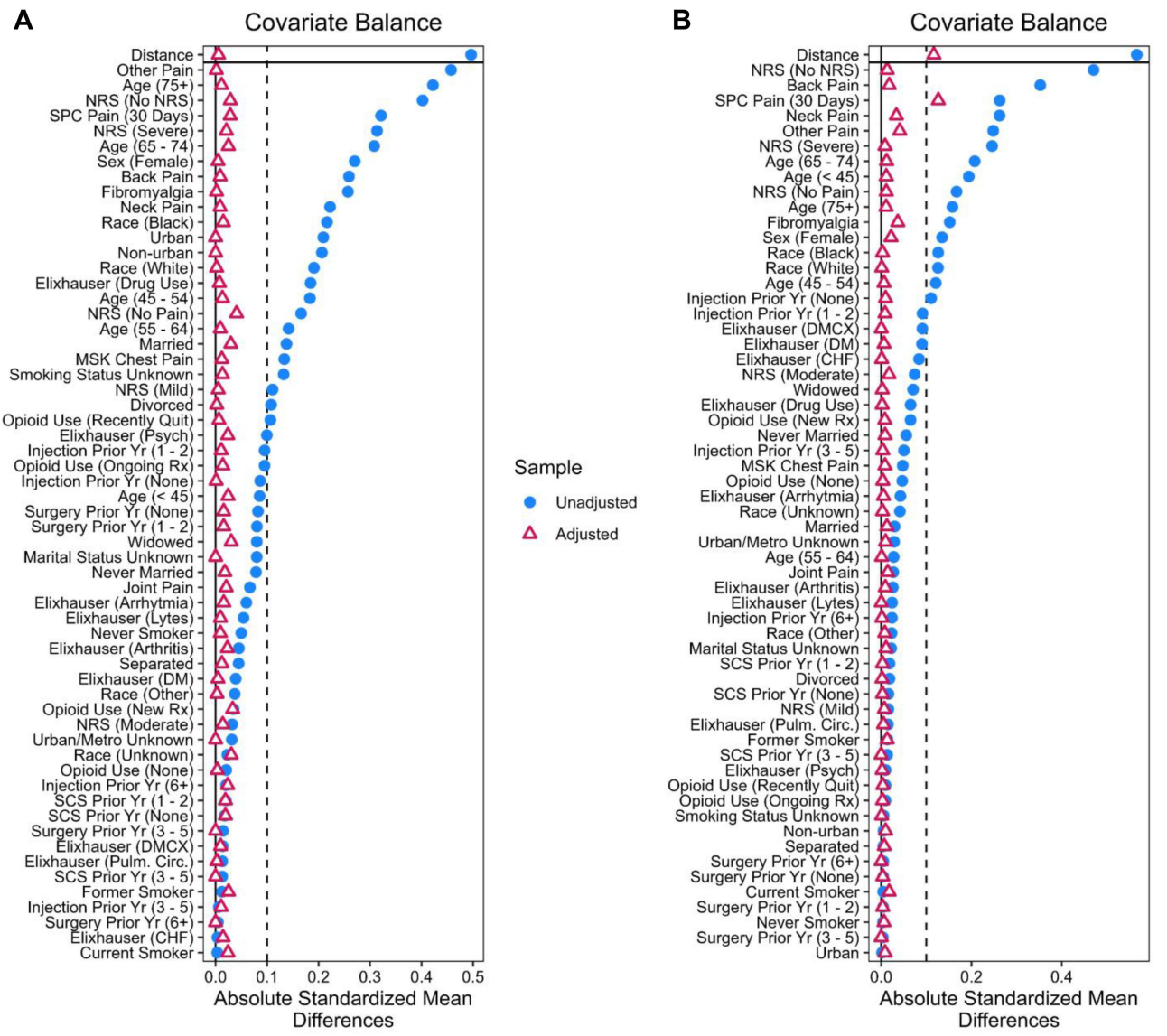

Figure 2 Baseline Covariate Balance Before and After Propensity Score Matching. Whole Health cohort (**A**) and CIH cohort (**B**) vs Conventional Care cohort before (unadjusted) and after (adjusted) propensity score matching.

therapies. Due to the small number of spinal cord stimulator procedures observed in the initial 3-month window for the Whole Health exposure group, this outcome was not assessed for this period. Confidence intervals were estimated using a simple bootstrap procedure, which involved resampling with replacement 500 times from each matched group selecting the 2.5% and 97.5% percentiles.[27] Statistical analyses were performed with R version 4.1.2.

We also conducted a sensitivity analysis to supplement the propensity score models using predictive negative binomial outcome models directly adjusting for baseline covariates (Table S1 and S2). The count of invasive pain treatment procedures in each period was included as the dependent variable with direct adjustment for the 29 demographic and baseline clinical variables.

Results

Sample Description

We identified 78,106 Veterans with chronic pain and VHA healthcare utilization between 10/01/2017 and 03/31/2019 (Figure 1). We excluded 10,154 Veterans identified as using Whole Health care during our washout period and 14,541

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Veterans who had a red flag condition during our evaluation timeframe, resulting in a final analytic cohort of 53,411 Veterans.

Among the Veterans in our analytic cohort, 584 (1%) received comprehensive Whole Health that included at least one core Whole Health services encounter *and* one CIH therapy encounter. These individuals were classified as exposed to comprehensive Whole Health. A total of 3794 (7%) utilized CIH therapies without also using Whole Health services. The remaining 49,033 (92%) individuals were classified as Conventional Care. Overall, Veterans were predominantly male (86%), non-Hispanic (92%), White (67%), and married (53%) (Table 1). Over two-thirds (67%) had documentation of experiencing back pain in the prior year, and over three-fourths (78%) had documentation of experiencing joint pain in the prior year. Just over half (53%) had current or prior use of opioids within 30 days of their index date. Of the sample overall, 13% had undergone at least one invasive pain treatment procedure in the prior year; specifically, 11% had undergone a non-surgical spine procedure, 2% had undergone at least one spinal surgery, and 0.4% had received an implantable spinal stimulator.

Unadjusted Comparisons of Exposure Groups

Comparisons of Veterans in the comprehensive Whole Health, CIH-Only, and Conventional Care groups at baseline are shown in Table 1. Compared to Veterans in the Conventional Care group, a greater proportion of Veterans in the comprehensive Whole Health group and CIH-only group were younger, were more likely to be female (14% vs 25% and 19%, respectively), had recently quit using opioids (18% vs 23% and 19%, respectively), were more likely to have a substance use disorder diagnosis (10% vs 16% and 12%, respectively), had reported recent severe (≥7 out of 10) pain scores (43% vs 59% and 56%, respectively), and had used specialty pain services in the prior 30 days (3% vs 14% and 11%, respectively). A greater proportion of Veterans who used CIH therapies only were White (73%) compared to the Whole Health group (58%) or the Conventional care group (67%).

Downstream Utilization of Invasive Pain Treatment Procedures

Over the 18-month study period, Veterans who used comprehensive Whole Health experienced a 23% decrease (95% Confidence Interval: −41% to −4%) in non-surgical spine procedures compared to their matched comparison patients receiving Conventional Care (Table 2). The initial period after first utilizing Whole Health was associated with larger

Table 1 Veteran Demographic and Clinical Characteristics at Baseline

	Overall (N=53,411)	Conventional Care (N=49,033)	CIH-Only (N=3794)	Whole Health (N=584)	SMD
Demographics, % (n)					
Sex					0.20
Male	86% (45,884)	86% (42,370)	81% (3078)	75% (436)	
Female	14% (7527)	14% (6663)	19% (716)	25% (148)	
Age					0.33
<45	15% (8006)	14% (7050)	22% (853)	18% (103)	
45–54	18% (9850)	18% (8822)	23% (876)	26% (152)	
55–64	29% (15,566)	29% (14,297)	28% (1059)	36% (210)	
65–74	29% (15,642)	30% (14,720)	22% (816)	18% (106)	
75+	8% (4347)	8% (4144)	5% (190)	2% (13)	

(*Continued*)

Table 1 (Continued).

	Overall (N=53,411)	Conventional Care (N=49,033)	CIH-Only (N=3794)	Whole Health (N=584)	SMD
Race					0.24
White	67% (36,019)	67% (32,922)	73% (2760)	58% (337)	
Black	25% (13,528)	26% (12,541)	20% (777)	36% (210)	
Other	2% (1078)	2% (980)	2% (89)	2% (9)	
Unknown	5% (2786)	5% (2590)	4% (168)	5% (28)	
Ethnicity					0.13
Not Hispanic or Latino	92% (49,017)	92% (44,970)	92% (3499)	94% (548)	
Hispanic or Latino	6% (3451)	6% (3174)	6% (241)	6% (36)	
Unknown	2% (943)	2% (889)	1% (54)	0% (0)	
Marital Status					0.15
Married	53% (28,079)	53% (25,866)	51% (1945)	46% (268)	
Divorced	28% (14,740)	27% (13,476)	28% (1074)	33% (190)	
Never married	11% (5962)	11% (5394)	13% (488)	14% (80)	
Separated	4% (2308)	4% (2110)	4% (167)	5% (31)	
Widowed	4% (1997)	4% (1880)	3% (102)	3% (15)	
Unknown	1% (325)	1% (307)	0% (18)	0% (0)	
Urban/Metro Residence					0.14
Yes	78% (41,632)	78% (38,177)	78% (2957)	85% (498)	
No	22% (11,722)	22% (10,808)	22% (828)	15% (86)	
Unknown	0% (57)	0% (48)	0% (9)	0% (0)	
Smoking Status					0.09
Current smoker	38% (20,139)	38% (18,480)	38% (1438)	38% (221)	
Never smoker	33% (17,588)	33% (16,127)	33% (1255)	35% (206)	
Former smoker	21% (11,049)	21% (10,160)	20% (765)	21% (124)	
Unknown	9% (4635)	9% (4266)	9% (336)	6% (33)	
Pain-Related Characteristics, % (n)					
Opioid Use at Baseline (Prior 30 days)					0.11
No use	47% (24,966)	47% (23,006)	45% (1692)	46% (268)	
Ongoing Rx	31% (16,314)	31% (14,984)	31% (1176)	26% (154)	
Recently quit	18% (9822)	18% (8980)	19% (709)	23% (133)	
New Rx	4% (2309)	4% (2063)	6% (217)	5% (29)	

(*Continued*)

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Table 1 (Continued).

	Overall (N=53,411)	Conventional Care (N=49,033)	CIH-Only (N=3794)	Whole Health (N=584)	SMD
Worst Numerical Rating Scale (NRS) Pain Score at Baseline (Prior 90 days)*					0.31
No pain	5% (2923)	6% (2796)	3% (110)	3% (17)	
Mild	11% (5655)	11% (5224)	10% (386)	8% (45)	
Moderate	21% (11,392)	21% (10,340)	24% (921)	22% (131)	
Severe	44% (23,679)	43% (21,230)	56% (2106)	59% (343)	
No NRS score in record	18% (9762)	19% (9443)	7% (271)	8% (48)	
Specialty Pain Care (Prior 30 Days)	4% (1979)	3% (1467)	11% (429)	14% (83)	0.27
Back Pain (Prior Year)	67% (36,040)	66% (32,540)	80% (3049)	77% (451)	0.21
Fibromyalgia (Prior Year)	6% (3368)	6% (2880)	11% (400)	15% (88)	0.20
Joint Pain (Prior Year)	78% (41,537)	78% (38,080)	79% (2988)	80% (469)	0.04
MSK Chest Pain (Prior Year)	18% (9478)	18% (8732)	16% (609)	23% (137)	0.12
Neck Pain (Prior Year)	23% (12,433)	22% (10,924)	35% (1318)	33% (191)	0.19
Other Pain (Prior Year)	23% (12,394)	22% (10,847)	34% (1285)	45% (262)	0.33
Invasive Pain Treatment Procedures (Prior Year), % (n)					
Any Spine Procedures					0.09
None	87% (46,463)	87% (42,805)	83% (3164)	85% (494)	
1–2	10% (5214)	10% (4670)	12% (472)	12% (72)	
3–5	3% (1595)	3% (1436)	4% (143)	3% (16)	
6+	0% (139)	0% (122)	0% (15)	0% (2)	
Non-Surgical Spine Procedures					0.09
None	89% (47,433)	89% (43,698)	85% (3232)	86% (503)	
1–2	8% (4391)	8% (3916)	11% (411)	11% (64)	
3–5	3% (1461)	3% (1309)	4% (137)	3% (15)	
6+	0% (126)	0% (110)	0% (14)	0% (2)	
Spine Surgeries					0.05
None	98% (52,295)	98% (48,006)	98% (3712)	99% (577)	
1–2	2% (1104)	2% (1016)	2% (81)	1% (7)	
3+	0% (12)	0% (11)	0% (1)	0% (0)	

(*Continued*)

Table 1 (Continued).

	Overall (N=53,411)	Conventional Care (N=49,033)	CIH-Only (N=3794)	Whole Health (N=584)	SMD
Spinal Cord Stimulators					0.02
None	100% (53,199)	100% (48,843)	99% (3775)	99% (581)	
1–2	0% (204)	0% (182)	1% (19)	1% (3)	
3+	0% (8)	0% (8)	0% (0)	0% (0)	
Comorbidities, % (n)					
Congestive Heart Failure	7% (3908)	7% (3655)	6% (210)	7% (43)	0.05
Cardiac Arrhythmias	14% (7385)	14% (6817)	12% (474)	16% (94)	0.07
Pulmonary Circulation Disorder	2% (832)	2% (756)	2% (66)	2% (10)	0.01
Diabetes w/o Chronic Complications	28% (15,221)	29% (14,119)	25% (944)	27% (158)	0.06
Diabetes w/ Chronic Complications	9% (4691)	9% (4388)	7% (253)	9% (50)	0.06
Rheumatoid Arthritis	4% (2321)	4% (2106)	5% (184)	5% (31)	0.03
Fluid/Electrolyte Disorders	5% (2915)	5% (2687)	5% (188)	7% (40)	0.05
Drug Abuse	10% (5250)	10% (4710)	12% (444)	16% (96)	0.14
Psychoses	3% (1811)	3% (1644)	4% (134)	6% (33)	0.07

Notes: *Veteran pain scores reported on a Numerical Rating Scale from 0 to 10, with thresholds defined as: No pain = 0; Mild = 1–3; Moderate = 4–6; Severe = 7–10.

Table 2 Longitudinal Utilization of Invasive Pain Treatment Procedures Following Use of Whole Health Based on a Propensity-Score Matched Comparison to Conventional Care

	Any Spine Procedure	Nonsurgical Procedures	Spine Surgeries	Spinal Cord Stimulators
0–3 Months				
Observed Events (Whole Health), n	38	36	2	0
Expected Events (Conventional Care), n (95% CI)	65 (57 to 74)	60 (52 to 69)	4 (2 to 6)	-*
Difference, % (95% CI)	−42% (−61% to −17%)	−40% (−59% to −13%)	−47% (−100% to 67%)	-*
4–12 Months				
Observed Events (Whole Health), n	119	101	8	10
Expected Events (Conventional Care), n (95% CI)	158 (141 to 177)	140 (126 to 156)	11 (8 to 14)	7 (4 to 10)
Difference, % (95% CI)	−25% (−43% to −4%)	−28% (−49% to −8%)	−25% (−76% to 50%)	43% (−69% to 222%)
13–18 Months				
Observed Events (Whole Health), n	72	62	8	2

(*Continued*)

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Table 2 (Continued).

	Any Spine Procedure	Nonsurgical Procedures	Spine Surgeries	Spinal Cord Stimulators
Expected Events (Conventional Care), n (95% CI)	84 (73 to 96)	75 (65 to 84)	5 (3 to 8)	3 (2 to 5)
Difference, % (95% CI)	−14% (−37% to 19%)	−18% (−43% to 15%)	54% (−57% to 254%)	−41% (−100% to 159%)
0–18 Months				
Observed Events (Whole Health, n	229	199	18	12
Expected Events (Conventional Care), n (95% CI)	294 (267 to 318)	258 (234 to 282)	22 (17 to 26)	13 (9 to 18)
Difference, % (95% CI)	−22% (−39% to −5%)	−23% (−41% to −4%)	−17% (−59% to 36%)	−10% (−75% to 82%)

Notes: *Not enough outcomes observed in either Whole Health cohort, Conventional Care cohort, or both: analysis was not performed.

decreases in downstream procedures compared to matched patients, with the differences attenuating slightly over time. For example, the initial 0–3-month period was associated with a 40% decrease (95% Confidence Interval: −59% to 13%), and the 4–12-month period was associated with a 28% decrease (95% Confidence Interval: −49% to −8%). Over the full 18-month study period, the 584 Veterans comprehensive Whole Health group experienced fewer than expected procedures compared to the matched Conventional Care cohort – 199 versus 258, respectively. While there were trends towards lower-than-expected utilization of spine surgeries (95% Confidence Interval: −59% to 36%) and spinal cord stimulators (95% Confidence Interval: −75% to 82%) over the 18-month study period, the differences were not statistically significant.

Among Veterans who utilized CIH therapies only, we observed a 22% decrease (95% Confidence Interval: −33% to −10%) in non-surgical spine procedures in the initial 3-months after first using a CIH therapy compared to matched patients from the Conventional Care group (Table 3). This decrease was not sustained beyond the initial 3-month period. Over the 18-month period, there was no difference in non-surgical procedures for Veterans who used CIH therapies only compared to matched patients (95% Confidence Interval: −13% to 7%). There was a pattern of higher utilization of spine

Table 3 Longitudinal Utilization of Invasive Pain Treatment Procedures Following Use of CIH Therapies Based on a Propensity-Score Matched Comparison to Conventional Care

	Any Spine Procedure	Nonsurgical Procedures	Spine Surgeries	Spinal Cord Stimulators
0–3 Months				
Observed Events (CIH Cohort), n	339	285	44	10
Expected Events (Conventional Care), n (95% CI)	413 (392 to 433)	366 (346 to 385)	33 (27 to 38)	14 (10 to 19)
Difference, % (95% CI)	−18% (−29% to −4%)	−22% (−33% to −10%)	34% (−33% to 131%)	−31% (−69% to 34%)
4–12 Months				
Observed Events (CIH Cohort; n)	976	845	88	43
Expected Events (Conventional Care), n (95% CI)	932 (891 to 981)	831 (795 to 867)	69 (62 to 76)	32 (26 to 39)
Difference, % (95% CI)	5% (−5% to 15%)	2% (−9% to 13%)	28% (−6% to 75%)	34% (−24% to 95%)

(*Continued*)

Table 3 (Continued).

	Any Spine Procedure	Nonsurgical Procedures	Spine Surgeries	Spinal Cord Stimulators
13–18 Months				
Observed Events (CIH Cohort), n	615	544	51	20
Expected Events (Conventional Care), n (95% CI)	568 (539 to 595)	510 (484 to 537)	39 (33 to 45)	19 (15 to 24)
Difference, % (95% CI)	8% (−4% to 22%)	7% (−6% to 20%)	32% (−13% to 85%)	4% (−52% to 69%)
0–18 Months				
Observed Events (CIH Cohort), n	1922	1667	182	73
Expected Events (Conventional Care), n (95% CI)	1936 (1860 to 2006)	1726 (1658 to 1798)	144 (132 to 156)	65 (57 to 76)
Difference, % (95% CI)	−1% (−9% to 9%)	−3% (−13% to 7%)	26% (−1% to 58%)	12% (−21% to 54%)

surgeries among patients using CIH therapies compared to matched controls over each of the longitudinal study periods, although none of these differences were statistically significant. Similarly, there were no differences in the use of spinal cord stimulators among Veterans initiating CIH therapies compared to matched patients.

The findings from the sensitivity analysis for models applying direct covariate adjustment (Table S1 and S2) were similar to those of the propensity score matched analysis. The direct adjustment model identified a 26% decrease (95% Confidence Interval: −42% to −10%) in non-surgical procedures over the 18-month study period associated with Whole Health utilization compared to Veterans in the Conventional Care group. The differences in non-surgical spine procedures associated with initiation of CIH therapies compared to Conventional Care was greater when using the direct adjustment approach compared to the propensity score matched comparison groups. Notably, the difference in non-surgical procedures over the 18-month study period was −16% (95% Confidence Interval: −22% to −7%) using the direct adjustment approach compared to −3% (95% Confidence Interval: −13% to 7%) estimated from the propensity score model. Similar to the propensity score model, the largest differences were observed in the initial period after initiating CIH therapies but were not sustained over time. Notably, the increase in spine surgeries observed among the CIH therapy cohort over the 18-month study period using the direct adjustment approach was 24% (95% Confidence Interval: 1% to 57%) compared to 26% (95% Confidence Interval: −1% to 58%) estimated from the propensity score model.

Discussion

The present findings represent the first exploration of the associations between use of Whole Health care and downstream use of invasive pain treatment procedures in VHA's initial implementation of its Whole Health System of Care. These preliminary results suggest that use of Whole Health among patients with chronic pain is associated with meaningful decreases in downstream use of non-invasive pain treatment procedures. Similarly, use of CIH therapies alone was associated with an initial decrease in the use of non-invasive interventions; though, these initial differences appear to be less durable, with no substantial differences observed after the initial 3-month period following their initial utilization.

Our results are consistent with a body of literature showing that the use of CIH therapies can effectively reduce pain intensity. Recent review articles have underscored the effectiveness of mind-body therapies that incorporate exercise-related elements, such as yoga and Tai Chi, as well as therapies that are not primarily movement-based such as meditation and hypnosis, at improving pain intensity and functional outcomes.[28–32] Similarly, literature suggests that practitioner-delivered CIH therapies, including chiropractic care,[33,34] acupuncture,[35,36] and massage therapy,[37] are effective treatment options for pain reduction and may help some patients avoid more invasive procedures such as epidural injections. Although we observed trends in lower expected utilization of spine surgeries and spinal cord

stimulators among Veterans who used Whole Health services and CIH therapies, the differences were not statistically significant.

Our finding that CIH therapies utilized in combination with other Whole Health services had more durable outcomes in contrast to the use of CIH therapies alone is notable Beyond their physiological impacts, mind-body CIH therapies such as yoga and meditation may help improve pain management by equipping patients with increased self-management capabilities, including bolstered ability to manage pain interference and pain-related stress.[38] Integration of these therapies in the context of Whole Health care may help Veterans integrate these practices more wholistically as part of their pain care. Prior studies have shown that participating in mind-body CIH therapies, including yoga, meditation, and hypnosis, improves pain interference, symptoms of depression, and self-efficacy among Veterans with chronic pain.[39,40] These studies have noted how these therapies address pain as well as target multiple interrelated symptoms simultaneously, including depression and trauma. The ability to better manage the impacts of pain on daily life and mood through the use of mind-body CIH therapies may diminish patient need for further intervention, reducing willingness and/or desire to undergo invasive pain management procedures. Our findings further suggest there is an additive effect of Whole Health services. It may be that these services, which include Whole Health coaching and personalized health planning, help patients to identify pain management as an important health goal. This could be accomplished, in part, by completion of the Personal Health Inventory,[41] which involves having patients reflect on the main aspects of well-being and health, and set personal health goals accordingly.

In addition, related evaluations of CIH in VHA have observed exposure to CIH is associated with improved quality of pain care including comprehensive assessment by primary care, development of a care plan, and reassessment of effectiveness of the plan.[42] This work suggests that connecting with CIH may indicate better care earlier by primary care providers and that part of the positive association observed with exposure to CIH may be attributable to better engagement by providers more generally. Other previous work has shown that Whole Health care may act as a "gateway", connecting patients to other needed healthcare services including evidence-based psychotherapies.[43] Accordingly, Whole Health services may also connect patients with chronic pain to other pain management strategies, including but not limited to CIH therapies. Such services may also include pain-focused treatments like pain-focused psychotherapies. Various psychotherapy options may help Veterans manage pain, including modalities like Acceptance and Commitment Therapy and Cognitive Behavioral Therapy.[44,45]

Further, receipt of Whole Health care has been associated with increased patient engagement in healthcare.[10] Accordingly, Whole Health services may not only connect patients to other needed and effective pain treatments but may also increase their proclivity to engage with such treatments. Such increased engagement may thereby increase their likelihood of effectiveness and, in turn, reduction of downstream need for more invasive intervention.

Collectively, our results suggest that Whole Health care should be offered to patients who experience chronic pain. In early 2023, the National Academies released a report highlighting the benefits of Whole Health care and calling for all US healthcare providers to implement Whole Health,[11] a process which may require substantive initial and ongoing resource allocation. The positive impacts of Whole Health care for patients, including the decreased downstream reliance on invasive, costly, and risky pain treatment procedures highlighted in this analysis, as well as decreased opioid use and improved patient-reported outcomes reported in previous analyses, may provide ample justification for such investment.[12] This work has been used by the Office of Patient Centered Care and Cultural Transformation to guide decisions within VHA to continue to expand Whole Health and mind-body CIH therapies. Publication of this study outside of VHA may help facilitate other healthcare systems to adopt and/or expand these therapies.

Limitations

The cross-sectional data from this retrospective cohort analysis cannot be used to infer causality; randomized controlled trials are needed to substantiate the preliminary relationship between the use of Whole Health services and CIH therapies and downstream use of invasive pain management procedures observed in the current evaluation. Additionally, based on the follow-up period of our current analysis, we cannot be sure if use of Whole Health care is reducing patient use of invasive pain management procedures, or merely delaying them. While the VHA's EHR includes a wide range of

demographic and clinical information, administrative data are subject to coding errors which could potentially add noise, introduce misclassification bias, and attenuate study findings to be null.

Conclusions

Our data suggest that use of Whole Health services when combined with CIH therapies is associated with decreased downstream use of invasive non-surgical pain management procedures. VHA's effort to implement Whole Health care nationally and expand the availability of non-pharmacological pain care strategies including CIH therapies appears promising in helping patients interrupt patterns of escalating and invasive pain care such as epidural and facet injections. This work complements assessments of improvements in patient-reported outcomes, highlighting that efforts to expand non-pharmacological pain care bring value to patients.

Data Sharing Statement

The United States Department of Veterans Affairs (VA) places legal restrictions on access to Veterans' health care data, which includes both identifiable and de-identified data, and sensitive patient information. The datasets generated and analyzed in this study are derived from the Veterans Health Administration (VHA) Corporate Data Warehouse. The analytic data sets used for this project are not permitted to leave the VA firewall without a Data Use Agreement (DUA). This limitation is consistent with other studies based on VA data. However, VA data are made freely available to investigators behind the VA firewall with an approved VA study protocol. The programming code generated by this study is available to facilitate reproducibility of study findings by supporting the extraction and transformation of identical data from VA data sources. Study authors can make the programming code available upon request. For more information about data access within VA, please visit https://www.virec.research.va.gov or contact the VA Information Resource Center (VIReC) at VIReC@va.gov.

Acknowledgments and Disclaimer

The views expressed in this article are those of the authors and do not necessarily reflect the position and/or policy of the Department of Veterans Affairs or the United States Government.

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Disclosure

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