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Authors

Dusek, Jeffery
Rivard, Rachael
Griffin, Kristen
et al.

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Significant Pain Reduction in Hospitalized Patients Receiving Integrative Medicine Interventions by Clinical Population and Accounting for Pain Medication

Jeffery A. Dusek, PhD,[1,2,*] Rachael L. Rivard, MPH,[1,3,*]
Kristen H. Griffin, MA, MPH,[4,*] and Michael D. Finch, PhD[4]

Abstract

Background: Prior research has reported that integrative medicine (IM) therapies reduce pain in inpatients, but without controlling for important variables. Here, the authors extend prior research by assessing pain reduction while accounting for each patient's pain medication status and clinical population.

Methods: The initial data set consisted of 7,106 inpatient admissions, aged ≥18 years, between July 16, 2012, and December 15, 2014. Patients' electronic health records were used to obtain data on demographic, clinical measures, and pain medication status during IM.

Results: The final data set included first IM therapies delivered during 3,635 admissions. Unadjusted average pre-IM pain was 5.33 (95% confidence interval [CI]: 5.26 to 5.41) and post-IM pain was 3.31 (95% CI: 3.23 to 3.40) on a 0–10 scale. Pain change adjusted for severity of illness, clinical population, sex, treatment, and pain medication status during IM was significant and clinically meaningful with an average reduction of −1.97 points (95% CI: −2.06 to −1.86) following IM. Adjusted average pain was reduced in all clinical populations, with largest and smallest pain reductions in maternity care (−2.34 points [95% CI: −2.56 to −2.14]) and orthopedic (−1.71 points [95% CI: −1.98 to −1.44]) populations. Pain medication status did not have a statistically significant association on pain change. Decreases were observed regardless of whether patients were taking narcotic medications and/or nonsteroidal anti-inflammatory drugs versus no pain medications.

Conclusions: For the first time, inpatients receiving IM reported significant and clinically meaningful pain reductions during a first IM session while accounting for pain medications and across clinical populations. Future implementation research should be conducted to optimize identification/referral/delivery of IM therapies within hospitals.

Clinical Trials.gov #NCT02190240.

Keywords: integrative medicine, inpatient, pain, narcotic, clinical population, pain medication

Introduction

Pain medications, often consisting of narcotics, are the usual approach to treating acute pain in hospitals, but these drugs often have side effects and can lead to problems such as misuse and dependency. Updates to the Joint Commission standards in recent years have called for minimizing the use of narcotic pain medication and using nonpharmacologic approaches to the extent possible for hospitals that are accredited by the Joint Commission.[1] The 2017

[1]UH Connor Integrative Health Network, University Hospitals, Cleveland, OH, USA.
[2]Department of Family Medicine and Community Health, School of Medicine, Case Western Reserve University, Cleveland, OH, USA.
[3]Center for Evaluation and Survey Research, HealthPartners Institute, Minneapolis, MN, USA.
[4]Children's Minnesota Research Institute, Children's Minnesota, Minneapolis, MN, USA.
*This work was conducted while Dr. Dusek, Ms. Rivard and Ms. Griffin were employees of the Integrative Health Research Center, Penny George Institute for Health and Healing, Allina Health, Minneapolis, MN, USA.

update specifically highlighted that ''the hospital provides nonpharmacologic pain treatment modalities. (…) Nonpharmacologic strategies include, but are not limited to: physical modalities (for example, acupuncture therapy, chiropractic therapy, osteopathic manipulative treatment, massage therapy, and physical therapy), relaxation therapy, and cognitive behavioral therapy.''[2]

Although much research on integrative medicine (IM) modalities (e.g., massage, acupuncture, meditation) has been conducted in outpatient populations,[3] meta-analyses[4–6] and randomized controlled studies suggest that acupuncture, massage, and mind–body therapies, as provided adjunctively to conventional pain management, result in reduced pain for specific populations of inpatients, primarily postsurgical populations.[7–12]

While assessment of efficacy via randomized trials provides valuable evidence for how well various IM modalities work in controlled settings, these studies do not capture the more variable contexts appropriate for clinical practice. Effectiveness research, that is, using observational study designs, is appropriate for practice-based research in real-world settings where interventions already have been implemented and/or are subjected to inherent variability and flexibility.[13,14]

For more than 10 years, the study hospital has offered IM as a component of usual care for inpatients, prompted by an electronic health record (EHR) order.[15] The authors previously reported that pain was a leading documented reason for providers and/or patients to request a visit by an IM practitioner.[16,17] In 2010, the authors reported significant pain reduction of 1.9 points on the 0–10 numeric rating scale (NRS)[18] among 1,837 inpatient admissions who received IM across the entire hospital.[19] Subsequent articles by the authors examined pain change within specific clinical populations (e.g., cardiovascular oncology, and joint replacement) in the same hospital,[20–22] all revealing significant reductions in pain from pre-IM to post-IM treatment of about 2 points. In 2018, the authors published a study including 2,370 inpatient admissions, in which the authors again observed a 2-point decrease in pain while documenting cost savings of $898 per admission when pain was reduced by IM.[23]

However, one challenge in the prior work of the authors is that due to sample size limitations, they have been unable to compare post-IM with pre-IM pain changes across clinical populations (e.g., oncology vs. orthopedic). It is reasonable to consider that the effects of IM could vary by clinical population, and if true, this variation could inform the implementation of IM services across the hospital. Another challenge was that the authors were unable to control for the presence of pain medications (such as opioids or nonsteroidal anti-inflammatory drugs [NSAIDs]) on the post-IM to pre-IM pain changes. Since IM interventions in the hospital typically are provided along with conventional medicine approaches, studies on IM and pain change need to account for the possibility of pain medications alone being the major driver of pain relief observed following IM treatment.

Accordingly, in the current study, the authors examine changes in pain among patients who received IM by clinical population, accounting for pain medication status, to determine whether receiving IM during hospitalizations decreases patients' pain intensity over and above the effect of pain medication on patients' reports of pain relief.

Methods

Population and setting

The final population consisted of 7,016 inpatient admissions at the study hospital; of those, 3,635 admissions (representing 3,231 unique patients) were eligible for analysis. Patients were aged 18 years or older and were hospitalized between July 16, 2012, and December 15, 2014, with a hospital stay longer than 24 h. Descriptions of the IM referral and delivery processes have been reported previously.[15–17] Briefly, the study hospital had an IM program that delivered IM to patients during Monday through Friday business hours, prompted by EHR orders by clinicians (physicians, nurses, or mid-level providers). During the data collection period, the IM team consisted of between 15 and 19 practitioners, including acupuncturists, massage therapists, holistic nurses, and a music therapist. IM practitioners charted patient visits in a customized flow sheet in the EPIC EHR, including pre- and post-IM pain scores and IM therapy delivered. For patients who did not opt out of generalized research consent, data were extracted from the EHR on demographics, severity of illness (3M's All Patients Refined Diagnosis Related Groups [APR-DRG] variable[24]), pre-IM, and immediate post-IM therapy pain scores on a 0–10 verbal NRS, and patient receipt of narcotic and/or non-narcotic pain medications. The final sample included the following clinical populations: cardiovascular, neuroscience and spine, oncology, maternity care, and orthopedic and an ''all other'' category composed of patients who did not fit into one of the aforementioned areas (e.g., internal medicine patients). IM services that were provided to patients receiving joint replacement, mental health, or rehabilitation services were excluded from this evaluation due to the differential referral and delivery of those IM services.

As shown in Figure 1 (flow diagram), IM therapies were delivered in 7,016 unique admissions or hospital encounters. Of these, 153 encounters were missing APR-DRG severity of illness scores. Additional encounters were excluded due to missing pre-IM pain scores ($n = 1{,}471$), missing post-IM pain scores ($n = 1{,}804$), a ''0'' in the pre-IM pain score (no pain present) ($n = 629$), no therapeutic IM treatment ($n = 1{,}237$) or an IM treatment that was provided by someone other than an employee IM practitioner (e.g., intern/student) ($n = 55$). It is important to recognize that exclusions were not mutually exclusive, such that encounters were often unavailable for several of the listed exclusion reasons.

Missing post-IM pain scores were most commonly due to patients sleeping (40.5%), interruptions (19.2%), and patients declining to answer (14.6%). Remaining reasons for missing post-IM scores included patients who were aphasic, cognitively impaired, sedated, or sleepy; patients who declined to provide scores or did not know their score; and when practitioners determined that a post-IM was not necessary. The resulting analytic data set included the first eligible IM therapies delivered in 3,635 unique admissions/encounters (Fig. 1). The study was approved by the institutional review board of the study hospital with a complete waiver of informed consent.

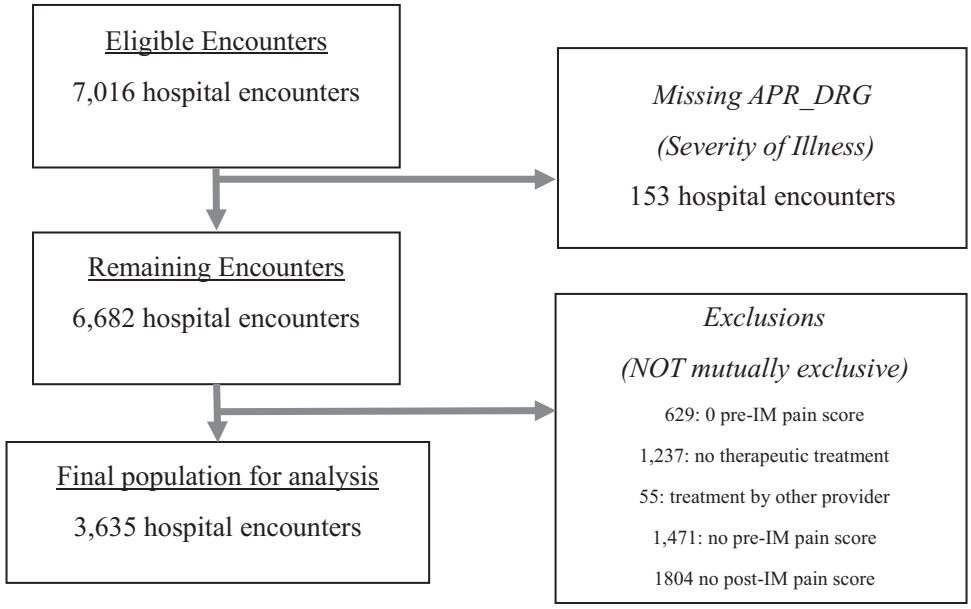

FIG. 1. Flow diagram. IM, integrative medicine.

Measures

Pain intensity: Before and immediately after the IM session, each patient's pain was assessed on a scale of 0–10 verbal numeric scale (with 10 being the most severe pain) by the IM practitioner. The 0–10 NRS is a widely validated for measuring acute pain intensity in hospital settings.[18] For acute care settings, pain changes of 1.3–1.9 points are considered clinically meaningful.[25]

Pain medication status: Each pain medication in the data set (e.g., oxycodone, ibuprofen) was classified by a research pharmacist to determine the medication's lag time from administration to onset of active pain relief and its duration of effect. Medications were considered ''active pain medication'' if the period of effectiveness overlapped with any part of the time frame of the IM treatment. Lag times and duration of effect were provided by the pharmacist in ranges. The authors used the lower value of the range for lag time and the upper value for duration, to be conservative in the estimates of possible active pain medication during the IM treatment. The four categories of pain medication status are: narcotic pain medications alone, NSAIDs alone, narcotics in combination with NSAIDs, or no pain medications.

Severity of illness: A commercial product from 3M (APR-DRG) is routinely used by U.S. hospitals to classify each hospital patient's severity of illness.[24] The APR-DRG severity of illness has one of four levels (extreme, major, minor, or moderate) and was extracted for each hospital admission.

Statistical methods

Demographics, treatment types, and baseline variables are summarized as *n* (%) for the overall group and by clinical population at the admission level ($n = 3{,}653$, Table 1). A mixed model was used to estimate self-reported pain change of the first therapy received during an admission and adjusted for severity of illness, sex, treatment category, clinical population, and pain medication status. There were no imputation processes used to model missing pain scores and/or severity of illness scores.

Regression estimates are summarized in Table 2. From these estimates, least squared means by clinical population are calculated in Table 3, whereas differences between adjusted least squared means for pain change by two variables of interest, clinical population, and pain medication status during an initial visit are shown in Table 4. To control for the multiple comparisons generated in calculating all pairwise differences, the Tukey correction was applied to both *p*-values and confidence intervals (CIs). All analyses were conducted using SAS 9.4 (Cary, NC).

Results

As shown in Table 1, the analysis data set included 3,635 admissions composed of 69.6% females, 70.5% of patients from 39 to 79 years of age, 89.8% White, 6.1% African American, 70.8% with a severity of illness as moderate or major, and only 21.0% with no pain medications during their IM session. The maternity care clinical population consisted of 386 eligible admissions, of which 48% were not on pain medications at the time of their first IM session. This clinical population is also composed of 93% women younger than 39 years, and 6.7% women between the ages of 39 and 59 years. With regard to the receipt of IM therapies, patients could receive bodywork, mind–body therapies, acupuncture, or various combinations of these therapies. Of first eligible IM therapy received during the 3,635 admissions, bodywork was the most frequent (40% alone and 77% in combination) (Table 1).

For the 3,635 admissions where patients provided both pre- and post-IM pain scores and had a pre-IM pain greater than zero, the unadjusted average for pre-IM pain was 5.33 (95% CI: 5.26 to 5.41) and the unadjusted average post-IM pain score was 3.31 (95% CI: 3.23 to 3.40). When controlling for severity of illness, sex, clinical population, IM treatment type, and pain medication status, the average pain reduction across all inpatients was −1.97 (95% CI: −2.06 to −1.86) on 0–10 point NRS.

TABLE 1. PATIENT CHARACTERISTICS BY CLINICAL POPULATION

	Total (n = *3,635*)	*Cardiovascular* (n = *454*)	*Maternity care* (n = *386*)	*Neuroscience and spine* (n = *973*)	*Oncology* (n = *434*)	*Orthopedic* (n = *182*)	*All other* (n = *1,206*)
Small age category groups							
Age ≤39	877 (24.1%)	33 (7.3%)	360 (93.3%)	141 (14.5%)	55 (12.7%)	20 (11.0%)	268 (22.2%)
39< Age ≤59	1,343 (36.9%)	165 (36.3%)	26 (6.7%)	371 (38.1%)	204 (47.0%)	80 (44.0%)	497 (41.2%)
59< Age ≤79	1,222 (33.6%)	207 (45.6%)	0 (0.0%)	412 (42.3%)	163 (37.6%)	72 (39.6%)	368 (30.5%)
Age >79	193 (5.3%)	49 (10.8%)	0 (0.0%)	49 (5.0%)	12 (2.8%)	10 (5.5%)	73 (6.1%)
Gender							
Female	2,530 (69.6%)	243 (53.5%)	386 (100.0%)	676 (69.5%)	295 (68.0%)	117 (64.3%)	813 (67.4%)
Male	1,105 (30.4%)	211 (46.5%)	0 (0.0%)	297 (30.5%)	139 (32.0%)	65 (35.7%)	393 (32.6%)
Marital status							
Life partner, married, significant other	2,006 (55.2%)	227 (50.0%)	278 (72.0%)	589 (60.5%)	257 (59.2%)	95 (52.2%)	560 (46.4%)
Separated, divorced	427 (11.7%)	73 (16.1%)	11 (2.8%)	117 (12.0%)	47 (10.8%)	26 (14.3%)	153 (12.7%)
Widowed	245 (6.7%)	49 (10.8%)	0 (0.0%)	72 (7.4%)	33 (7.6%)	15 (8.2%)	76 (6.3%)
Single	954 (26.2%)	105 (23.1%)	96 (24.9%)	195 (20.0%)	97 (22.4%)	46 (25.3%)	415 (34.4%)
Unknown, other	3 (0.1%)	0 (0.0%)	1 (0.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.2%)
Primary race designation							
American Indian or Alaska Native	69 (1.9%)	7 (1.5%)	11 (2.8%)	13 (1.3%)	2 (0.5%)	2 (1.1%)	34 (2.8%)
Asian	39 (1.1%)	4 (0.9%)	11 (2.8%)	3 (0.3%)	5 (1.2%)	0 (0.0%)	16 (1.3%)
Black or African American	220 (6.1%)	23 (5.1%)	54 (14.0%)	27 (2.8%)	23 (5.3%)	4 (2.2%)	89 (7.4%)
Native Hawaiian or Other Pacific Islander	4 (0.1%)	0 (0.0%)	2 (0.5%)	1 (0.1%)	0 (0.0%)	0 (0.0%)	1 (0.1%)
Patient declined/unknown	38 (1.0%)	4 (0.9%)	15 (3.9%)	3 (0.3%)	5 (1.2%)	1 (0.5%)	10 (0.8%)
White	3,265 (89.8%)	416 (91.6%)	293 (75.9%)	926 (95.2%)	399 (91.9%)	175 (96.2%)	1,056 (87.6%)
Demographics: ethnicity							
Patient declined	28 (0.8%)	3 (0.7%)	10 (2.6%)	4 (0.4%)	3 (0.7%)	0 (0.0%)	8 (0.7%)
Caucasian, Not Hispanic/Not Latino	3,543 (97.5%)	442 (97.4%)	361 (93.5%)	958 (98.5%)	422 (97.2%)	180 (98.9%)	1,180 (97.8%)
Hispanic or Latino	64 (1.8%)	9 (2.0%)	15 (3.9%)	11 (1.1%)	9 (2.1%)	2 (1.1%)	18 (1.5%)
Severity of illness							
Minor	594 (16.3%)	25 (5.5%)	64 (16.6%)	273 (28.1%)	54 (12.4%)	44 (24.2%)	134 (11.1%)
Moderate	1,358 (37.4%)	92 (20.3%)	135 (35.0%)	459 (47.2%)	196 (45.2%)	91 (50.0%)	385 (31.9%)
Major	1,213 (33.4%)	192 (42.3%)	179 (46.4%)	209 (21.5%)	143 (32.9%)	35 (19.2%)	455 (37.7%)
Extreme	470 (12.9%)	145 (31.9%)	8 (2.1%)	32 (3.3%)	41 (9.4%)	12 (6.6%)	232 (19.2%)
Pain medication status during IM visit							
No drugs	762 (21.0%)	63 (13.9%)	185 (47.9%)	138 (14.2%)	107 (24.7%)	24 (13.2%)	245 (20.3%)
NSAIDs only	1,308 (36.0%)	263 (57.9%)	74 (19.2%)	371 (38.1%)	139 (32.0%)	69 (37.9%)	392 (32.5%)
Narcotic only	1,247 (34.3%)	90 (19.8%)	118 (30.6%)	315 (32.4%)	176 (40.6%)	57 (31.3%)	491 (40.7%)
Narcotic and NSAIDs	318 (8.7%)	38 (8.4%)	9 (2.3%)	149 (15.3%)	12 (2.8%)	32 (17.6%)	78 (6.5%)

(*continued*)

TABLE 1. (CONTINUED)

	Total (n = *3,635*)	*Cardiovascular* (n = *454*)	*Maternity care* (n = *386*)	*Neuroscience and spine* (n = *973*)	*Oncology* (n = *434*)	*Orthopedic* (n = *182*)	*All other* (n = *1,206*)
Session treatment category							
Bodywork	1,450 (39.9%)	178 (39.2%)	155 (40.2%)	393 (40.4%)	213 (49.1%)	54 (29.7%)	457 (37.9%)
Bodywork/MB	886 (24.4%)	159 (35.0%)	127 (32.9%)	136 (14.0%)	103 (23.7%)	24 (13.2%)	337 (27.9%)
Bodywork/MB/TCM	200 (5.5%)	17 (3.7%)	36 (9.3%)	44 (4.5%)	27 (6.2%)	7 (3.8%)	69 (5.7%)
Bodywork/TCM	254 (7.0%)	17 (3.7%)	17 (4.4%)	102 (10.5%)	32 (7.4%)	17 (9.3%)	69 (5.7%)
MB	264 (7.3%)	50 (11.0%)	19 (4.9%)	48 (4.9%)	25 (5.8%)	11 (6.0%)	111 (9.2%)
MB/TCM	190 (5.2%)	15 (3.3%)	7 (1.8%)	67 (6.9%)	16 (3.7%)	16 (8.8%)	69 (5.7%)
TCM	391 (10.8%)	18 (4.0%)	25 (6.5%)	183 (18.8%)	18 (4.1%)	53 (29.1%)	94 (7.8%)

Pain medication status and session treatment category were collected at first eligible treatment session.
IM, integrative medicine; LOS, length of stay; MB, mind–body therapy; NSAIDs, nonsteroidal anti-inflammatory drugs; TCM, Traditional Chinese Medicine.

Estimates, 95% CIs, and *p*-values for the mixed model are displayed in Table 2. Variables of interest in the model were clinical population and pain medication status. From these results, the data show that sex, treatment type, and pain medication status at the time of the IM therapy have no significant statistical association on pain change.

F-tests from the mixed model showed that severity of illness ($p = 0.0023$) and clinical population ($p < 0.0001$) were significant while treatment type was not ($p = 0.0581$). Neither sex ($p = 0.02932$) nor pain medication status ($p = 0.6039$) was significant in relationship to the first visit pain change.

Least squared mean estimates for average pain change were summarized by clinical population, as shown in Table 3. The mean pain change (from post-IM to pre-IM) was largest in maternity care (–2.34 points [95% CI: –2.56 to –2.13]) and smallest in orthopedic patients (–1.71 points [95% CI: –1.98 to –1.45]). As noted above, pain changes of 1.3–1.9 points are clinically meaningful.[25] Since pain medication status was not significantly associated with pain change, the authors did not include any estimates in the table.

To adjust for multiple comparisons while calculating differences in least squared means for clinical population and pain medication status, the Tukey correction was applied to *p*-values and CIs. All adjusted pairwise comparisons are shown in Table 4 for the two *a priori* variables of interest: clinical population and pain medication status. Table 4 is organized such that pairwise comparisons are between columns labeled as Condition 1 and Condition 2. For example, the pairwise comparison between maternity care (Condition 1) and oncology (Condition 2) means that patients in maternity care exhibited stronger pain change decreases than patients in oncology (–0.46 difference [95% CI: –0.83 to –0.09]). Driven by the high estimate for the maternity care population, it follows that patients in maternity care exhibited similarly larger pain decreases than patients in other clinical populations as well: orthopedic (–0.63 difference [95% CI: –1.12 to –0.15]) and neuroscience and spine (–0.55 difference [95% CI: –0.89 to –0.22]). Additionally, patients in the internal medicine ''all other'' clinical population had significantly stronger pain change decreases only when compared with neuroscience and spine (–0.25 difference [95% CI: –0.49 to –0.02]). No other pairwise comparisons were statistically different.

Since the impact of pain medication status was an *a priori* variable of interest, the authors also include these results in Table 4. Importantly, there were no significant between-group differences in pain change across the adjusted least squared means of the four medication status groups.

Discussion

In this practice-based research setting with a large heterogeneous population and a care model that encompasses multiple IM modalities and is based on clinician judgment rather than protocol, there is an inherent challenge in teasing apart in which clinical population the IM therapies may be most effective in reducing pain. Specifically, the authors report that after their first eligible IM session, patients in this study reported an average pain change of –1.97 points on the 0–10 NRS. This reduction was both statistically significant and clinically meaningful.[25] This level of change is

Table 2. Results from Mixed-Model Linear Regression

Effect	*Category*	*Estimate*	*95% CI*	p-*Value*
Intercept		−1.675	−1.93 to −1.42	<0.0001
Severity of illness	Extreme	−0.045	−0.24 to 0.15	0.6616
	Major	−0.238	−0.38 to −0.10	0.0011
	Minor	0.051	−0.12 to 0.23	0.5684
	Moderate	0		.
Clinical population	All other	−0.255	−0.42 to −0.09	0.0021
	Cardiovascular	−0.235	−0.45 to −0.02	0.0352
	Maternity care	−0.554	−0.78 to −0.33	<0.0001
	Oncology	−0.097	−0.31 to 0.11	0.3662
	Orthopedic	0.079	−0.21 to 0.36	0.587
	Neuroscience and spine	0		.
Sex	Female	−0.071	−0.20 to 0.06	0.2932
	Male	0		.
Integrative medicine treatment	Bodywork	0.073	−0.13 to 0.28	0.4867
	Bodywork/MB	−0.019	−0.24 to 0.20	0.8647
	Bodywork/MB/TCM	0.374	0.06 to 0.69	0.0184
	Bodywork/TCM	−0.063	−0.35 to 0.22	0.664
	MB	0.167	−0.12 to 0.45	0.2531
	MB/TCM	−0.127	−0.44 to 0.19	0.4273
	TCM	0		.
Pain medication status	Narcotic only	−0.093	−0.26 to 0.07	0.2703
	Narcotic and NSAIDs	−0.116	−0.36 to 0.13	0.3524
	NSAIDs only	−0.108	−0.28 to 0.06	0.2049
	No drugs	0		

CI, confidence interval; MB, mind–body therapy; NSAIDs, nonsteroidal anti-inflammatory drugs; TCM, Traditional Chinese Medicine.

comparable to the 2-point decrease observed in the prior evaluations of pain change after IM in oncologic,[20] cardiovascular,[21] orthopedic,[22] and hospital-wide patient populations.[19]

Most importantly, for the first time in the series of the research evaluations,[15–17,19–23] the authors were able to explore the role of pain medications at the time of the IM delivery. The authors found that patients' pain medication status did not have a significant impact on their pain change. That is, decreases were observed regardless of whether patients were on a narcotic pain medication alone or in combination with NSAIDs versus no pain medications. Of course, these analyses of clinical population response and the nondifference of pain medication status on pain change after IM require replication by other researchers at other hospitals. While IM treatment in the presence of pain medication warrants further study, the current findings support the real effect of IM on pain change improvements in hospitalized patients. In other words, it is not simply that pain medications reduce patients' pain, but that IM therapies appear to have a measurable clinical effect on pain reduction comparable to that of pain medications. The authors consider this an important finding for the field of IM.

While all clinical populations had a significant reduction in pain post-IM from pre-IM, there were some differences in the pain change scores. For example, the clinical population with the largest pain reduction was in the maternity care population (−2.34 points) and the smallest improvement was in the orthopedic population (−1.71 points). This does not mean that IM therapies are more or less able to reduce pain in different clinical populations because the timing of the IM delivery, in this study setting, varies by clinical population due to patient needs and/or IM practitioner availability.[17] Specifically, there were dedicated IM providers assigned to maternity care versus IM providers who were periodically providing services in the medical/surgical unit. The data do not address whether different IM therapies were more effective at reducing pain during the first IM session. A deeper exploration of potential differences of utilization of IM and of specific IM therapies within clinical populations should be a focus of future research.

There are limitations to this study. First, the authors conducted a pragmatic effectiveness evaluation of the real-world delivery of IM for clinical purposes; as such, this study design did not include a comparison group. However, this research on the impact of IM on clinical populations and

Table 3. Differences in Pain Change by Clinical Population

Clinical population	*Estimate*	*StdErr*	p-*Value*	*Lower*	*Upper*
Maternity care	−2.3438	0.1082	<0.0001	−2.5560	−2.1317
All other	−2.0446	0.06381	<0.0001	−2.1697	−1.9195
Cardiovascular	−2.0251	0.09508	<0.0001	−2.2115	−1.8387
Oncology	−1.8865	0.09722	<0.0001	−2.0771	−1.6959
Orthopedic	−1.7106	0.1381	<0.0001	−1.9815	−1.4398
Neuroscience and spine	−1.7897	0.06967	<0.0001	−1.9263	−1.6531

Table 4. Changes in Pain Between Clinical Populations and Between Pain Medication Statuses

Variables of interest	*Condition 1*	*Condition 2*	*Estimate*	*Tukey-adjusted confidence interval*	*Tukey-adjusted* p-*Value*
Clinical population	Cardiovascular	Maternity care	0.3187	–0.07 to 0.70	0.1728
	Cardiovascular	Oncology	–0.1386	–0.50 to 0.22	0.8798
	Cardiovascular	Orthopedic	–0.3145	–0.78 to 0.15	0.3954
	Cardiovascular	Neuroscience and spine	–0.2354	–0.55 to 0.08	0.2840
	Maternity care	Oncology	–0.4574	–0.83 to –0.09	0.0056*
	Maternity care	Orthopedic	–0.6332	–1.12 to –0.15	0.0025*
	Maternity care	Neuroscience and spine	–0.5541	–0.89 to –0.22	<0.0001*
	Oncology	Orthopedic	–0.1759	–0.64 to 0.29	0.8880
	Oncology	Neuroscience and spine	–0.09677	–0.40 to 0.21	0.9457
	Orthopedic	Neuroscience and spine	0.07910	–0.34 to 0.49	0.9944
	All other	Cardiovascular	–0.01955	–0.31 to 0.27	1.0000
	All other	Maternity care	0.2992	–0.02 to 0.62	0.0752
	All other	Oncology	–0.1582	–0.45 to 0.13	0.6278
	All other	Orthopedic	–0.3340	–0.75 to 0.08	0.2040
	All other	Neuroscience and spine	–0.2549	–0.49 to –0.02	0.0259*
Pain medication status	Narcotic only	Narcotic and NSAIDs	0.02226	–0.27 to 0.32	0.9974
	Narcotic only	NSAIDs only	0.01493	–0.17 to 0.20	0.9969
	Narcotic only	No drugs	–0.09325	–0.31 to 0.12	0.6880
	Narcotic and NSAIDs	NSAIDs only	–0.00732	–0.30 to 0.28	0.9999
	Narcotic and NSAIDs	No drugs	–0.1155	–0.43 to 0.20	0.7887
	NSAIDs only	No drugs	–0.1082	–0.33 to 0.11	0.5834

*Statistically significant difference.
NSAIDs, nonsteroidal anti-inflammatory drugs.

by pain medication status did not require a group of patients who did not receive IM. Yet, the authors did have a group of patients who did receive IM without receiving any pain medications.

Second, since IM practitioners collected the pre-IM and post-IM pain scores and delivered the IM intervention, there may be a concern that patients provided lower scores at the post-IM session to ''please'' the IM practitioner. Our future research should include blinded data obtained by having individuals other than IM providers to collect post-IM pain scores.

Third, as the study hospital has had a large clinical program for several years, the results of the study do not necessarily generalize to other hospitals. Future research on inpatient IM in a multi-institutional setting would be beneficial for determining effectiveness more broadly.

Fourth, the authors restricted the analysis to the pain outcomes relative to the first eligible IM session, and the authors know that patients can receive more than one IM session and that patient pain levels can vary during the course of a hospital admission. Accordingly, the future analyses will be structured to include additional IM sessions through a patient's entire hospital admission.

Fifth, the authors recognize that the time difference between the pre-IM pain score and the post-IM pain score is relatively short ($\sim$30 min). Importantly, in the future, the authors will report on pain scores using a longer follow-up period after receipt of an IM session.

Sixth, the study data were collected from 2012 to 2014, and results may not be reflective of current IM care delivery. However, the relationships explored between pain change, clinical population, and pain medication status during IM raise important questions about integrative care that may have relevance for other IM care delivery structures.

Seventh, it is not lost upon the authors that numerous encounters were excluded for missing data, either pre-IM or post-IM pain scores. As this was a practice-based evaluation of IM provided for clinical reasons in an acute care setting using the EHR as a data collection tool, missing data is a reality. While patients may not provide post-IM pain scores for valid reasons (e.g., sleeping, cognitive issues), there are instances where the IM practitioner elected not to ask the patient their post-IM pain score. Before the study began, the research team and the IM clinical manager provided the IM practitioners with training sessions in the EHR in a preemptive attempt to minimize IM practitioner missing data. Future research should build on this training by providing real-time feedback to each IM practitioners on their percentage of missing data to enhance the use of the EHR for data collection.[26]

Finally, the referral for IM and IM delivery were entirely based on the clinical needs of the patients. Factors influencing the optimal use and implementation of IM therapies[27] for pain relief in hospitals should be the focus of future research. The research on the implementation of acupuncture in the inpatient setting[28,29] is at an early stage. However, with the expected inclusion of dissemination and implementation science at the National Center for Complementary and Integrative Health as part of their 2021–2025 Strategic Plan (https://files.nccih.nih.gov/nccih-strategic-plan-2021-2025-draft.pdf), the authors are encouraged that evaluating implementation of numerous IM interventions (e.g., massage, mind–body therapies, music therapy, and acupuncture) in the inpatient setting would be an appropriate venue for future research.

Efficacy of individual modalities has been studied to an extent in randomized trials with specific patient populations.[7–12] A 2004 study observationally assessed the effectiveness of massage on pain in for IM delivered clinically in

the inpatient setting,[30] and a 2016 protocol described an effectiveness study of acupuncture provided as part of routine inpatient care for pain and symptom management.[31] A strength of this study is the inclusion of patients across the hospital, and an individualized IM approach rather than specific modalities provides a valuable practice-based perspective. The inclusion of pain medication status during IM with a definition based on the duration of each medication is a distinct strength of this study, as the question of concurrent pain medication naturally arises when assessing the effectiveness of adjunctive IM in the inpatient setting.

Conclusions

This study is one of the first to report that adjusted average pain change improved after receiving IM therapies in hospitalized patients, regardless of patients' pain medication status. This suggests that pain medications may not be the sole driver of pain reduction and that IM therapies may be impactful for clinically significant pain relief in the inpatient setting. A recent study described the demand for IM and inpatients' willingness to pay for it,[32,33] and the authors previously reported evidence of the cost savings of IM in the hospital setting.[23] The current findings demonstrate the value of IM for pain relief with an example from clinical practice of the Joint Commission's call for nonpharmacological pain management strategies to be offered in hospitals. Optimization of patient identification, provider referral, and IM delivery are still needed to maximize the impact of the nonpharmacologic IM interventions in hospitals.

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Address correspondence to:
Jeffery A. Dusek, PhD
UH Connor Integrative Health Network
University Hospitals
11000 Euclid Avenue
Cleveland, OH 44106
USA

E-mail: jeffery.dusek@uhhospitals.org