Cost Savings from Reducing Pain Through the Delivery of Integrative Medicine Program to Hospitalized Patients

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Abstract

Objectives: An important task facing hospitals is improving pain management without raising costs. Integrative medicine (IM), a promising nonpharmacologic pain management strategy, is yet to be examined for its cost implications in an inpatient setting. This institution has had an inpatient IM department for over a decade. The purpose was to examine the relationship between changes in patients' pain, as a result of receiving IM therapy, and total cost of care during an inpatient hospital admission.

Design: In this retrospective analysis, data from an EPIC-based electronic health record (EHR) patient demographics, length of stay (LOS), and All Patient Refined Diagnosis Related Groups (APR-DRG) severity of illness measures were utilized. IM practitioners collected and entered patient-reported pain scores into the EHR. The authors regressed the demographic, change in pain, LOS, and APR-DRG variables with changes in pain on total cost for the hospital admission. To estimate cost savings to the hospital, they computed the average reduction in cost associated with reduction in pain by multiplying the coefficient for change in pain by average total cost.

Setting/Location: A large, tertiary care hospital in Minneapolis, MN.

Subjects: Adult inpatient admissions, 2730, during the study period where patients received IM for pain and met eligibility criteria.

Intervention: IM services provided to inpatients.

Outcome measures: Change in pain on an 11-point numeric rating scale before and after initial IM sessions; total costs for hospital admissions.

Results: Both LOS and age were found to increase cost, as did being white, male, married, and having APR-DRG severity coded as extreme. For patients receiving IM therapies, pain was reduced by an average of 2.05 points and this pain reduction was associated with a cost savings of \$898 per hospital admission.

Conclusions: For patients receiving IM therapies, pain was significantly reduced and costs were lowered by about 4%.

Keywords: integrative medicine, outcomes research, pain, electronic health record, costs and cost analysis, inpatients, hospitalization

Introduction

THE TREATMENT AND MANAGEMENT of pain constitute an important and expensive problem; the high cost of pain has been reported on in some depth as a significant contributor to healthcare costs.¹ An important task facing hospitals is improving pain management without raising costs. Innovative approaches to managing pain are becoming more critical as

hospitals attempt to balance Joint Commission standards for managing pain² and the emphasis on the long-term control of cost built into the Patient Protection and Affordable Care Act (ACA).³ These imperatives are driving players across the healthcare system to seek strategies to become more efficient without sacrificing quality or patient experience. Strategies such as targeted acute pain management systems have been associated with shorter ICU and hospital stays,⁴ and one study

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found that ambulatory surgical patients who did not receive analgesics for pain were discharged earlier than those requiring analgesic medications.⁵

Historically, the interest in managing acute pain predominantly has relied on the use of opioid analgesics.^{6,7} A 2012 Joint Commission statement on the use of opioids in hospitals urged caution in their use and called for prevention of adverse drug events,^{8,9} and in a 2015 revision to the pain management standard, several therapies, including acupuncture, massage, and relaxation therapy, were explicitly listed as examples of “nonpharmacologic strategies.”¹⁰ Revised standards for 2018 include the provision of “nonpharmacologic pain treatment modalities” as an expected element of performance.¹¹ The use of these therapies adjunctive to conventional medical care is a key strategy of the integrative medicine (IM) paradigm, which is the subject of increasing attention and interest by consumers and health-care providers.^{12–14} It remains to be determined whether IM therapies for pain may also have beneficial implications for hospital costs.

A number of systematic reviews have reported IM therapies, such as acupuncture, massage, and mind–body therapies, as beneficial for treating and managing pain.^{15–19} With a few exceptions,^{20–24} most of the evidence reported on IM therapies has been on outpatients. At the same time, a robust body of literature provides evidence regarding cost implications of IM.^{25–30} Again, the majority of this research is focused on outpatient programs and services,^{25,30} which provides limited guidance for understanding the effectiveness and cost of reducing pain via IM in inpatient settings.

Regarding IM in inpatient settings, studies have examined cost or cost-related measures among inpatients receiving IM therapies, with mixed results. For example, in a randomized controlled trial (RCT) of acupuncture in a general population of hospitalized patients, acupuncture did not reduce length of stay (LOS).³¹ In a prospective randomized trial, researchers found that acupuncture contributed to reduced narcotic analgesic use after thoracotomy.³² Massage was found to provide short-term postoperative pain relief to veterans undergoing major surgery, but had no effect on LOS in the hospital.²² In a multimodal IM inpatient intervention in an oncology sample, patients receiving the intervention had lower mean medication costs, which translated to cost savings compared with a non-IM group.³³ Most of these studies focused too narrowly on specific clinical populations to address the immediate need for hospitals to identify approaches that reduce pain across the entire hospital without raising costs.

There has not yet been a systematic assessment of the cost implications of reducing pain through providing IM to a broader population of inpatients. The study hospital established an inpatient IM department in 2003, in which a multidisciplinary team of IM practitioners worked with nursing staff, physicians, and midlevel providers across a large tertiary hospital to provide IM services at their professional discretion as part of patients’ care teams. This department was well received culturally and adapted to the operational processes of hospital orders and workflow.^{34,35} Here, the authors ask how this whole-hospital approach to providing inpatient IM care affects hospital costs for the patients who receive it.

In previous studies, the authors have demonstrated that IM therapies reduced pain among inpatient populations at this institution.^{20,36–38} Here, they explicitly examined the relationship between changes in pain, as a result of receiving an IM therapy session, and total cost of care during a hospital admission.

Materials and Methods

Setting

This study was conducted at Abbott Northwestern Hospital (ANW), a 630-bed teaching and specialty hospital in Minneapolis, MN. Starting in 2003, the Penny George Institute for Health and Healing (PGIHH) at ANW offered hospitalized patients a wide array of IM services for pain relief at no out-of-pocket cost to patients. Detailed descriptions of the program and how services were provided are available elsewhere.^{34,35,39} Physicians, nurses, and other care team members wrote orders through the medical record for IM for patients with pain. The demand for IM services in a large hospital often outstripped supply (i.e., the availability of IM providers); thus, not all patients for whom IM services were ordered received services.^{34,35}

Services were provided by a team of IM practitioners credentialed in their various specialties (e.g., acupuncture, massage) and trained in delivery of IM in the acute care setting. IM services were available across the hospital, Monday through Friday, from 9 AM to 5 PM. The time from IM referral by nurse or physicians to delivery of IM treatment is about 24 to 48 h. The IM practitioner team included acupuncturists, massage therapists, a music therapist, and holistic nurses. Holistic nursing is a framework for nursing practice that prioritizes comprehensive “whole-patient” care and often involves the use of complementary therapies.⁴⁰ The holistic nurses on the IM team at the study hospital all were registered nurses and were trained in various modalities and approaches, including Healing Touch and Reiki. All IM practitioners received periodic training in additional IM approaches such as relaxation techniques and aromatherapy.

IM practitioners used their clinical judgment to triage IM referrals. Treatment was provided after the practitioner consulted with each patient and obtained his or her permission to be treated. IM practitioners used a customized entry form to document patient encounters in the electronic health record (EHR).

Study population

The sample for this analysis was drawn from all adult (≥ 18 years old) inpatients admitted to ANW between July 1, 2009, and December 31, 2012, who gave written permission for the use of their records for research purposes ($n = 115,758$; Fig. 1). EHR data were obtained on all eligible inpatients (EPIC, Verona, WI). The analysis was limited to admissions where patients received an IM therapy session to address pain, as documented in the EHR.

Of the 5349 patient admissions where patients received IM for pain, in 2038 cases, patients did not provide either a pre- or postsession pain score and thus were excluded. Reasons for exclusion related to missing scores included the following: patients who declined to provide pain scores,

FIG. 1. Decision tree for analytic data set.

patients sleeping at the conclusion of the session, and patients who were unavailable or unable to provide scores for other reasons (e.g., cognition issues). In addition, hospital stays longer than 28 days ($n=85$) or of two or fewer days ($n=496$) were excluded, resulting in 581 fewer admissions due to LOS reasons. Patients with short stays (≤ 2 days) were excluded because the IM referral process and IM treatment initiation can take about 48 h and those with long (>28 days) hospital stays were excluded because these longer stays are outliers. Thus, 2619 admissions were not included in the analysis. The final sample size for this analysis was 2730 admissions.

The study was approved by the Institutional Review Board of Allina Health with a waiver of informed consent.

Variables

The dependent variable in the analysis was the natural logarithm of total cost. All IM care was provided as part of usual care, and thus, the cost of IM services was included in the total cost variable. Variables that were known to directly affect costs were included in the equation, most notably LOS and clinical severity. Several demographic variables that are known to be associated with differences in cost also were extracted from the hospital's EHR: age, sex, race, and marital status. Finally, the authors included their primary variable of interest, change in pain following receipt of IM

therapy for their pain. Although many patients received IM multiple times throughout a hospital admission, only the first IM session for pain during a single admission was included in the analysis.

All Patient Refined Diagnosis Related Groups (APR-DRG) severity⁴¹ of illness measures were calculated from patients' diagnoses codes. The APR-DRG measure includes four categories of severity: (1) minor, (2) moderate, (3) major, and (4) extreme.

Pain scores. Directly before and after each IM session, practitioners collected patients' self-reported pain scores. Patients provided a number between 0 and 10 to indicate the level of pain they were experiencing at that moment, where 0 was defined as "no pain" and 10 was defined as "worst pain imaginable."²⁰ Pain change was computed by subtracting the immediate postsession pain score from the immediate pre-session pain score.

Statistical analysis

Using ordinary least square regression, the demographic, change in pain, LOS, and APR-DRG severity variables were regressed with changes in pain on total cost for the hospital admission. Before estimating the regression, the distribution of total cost was examined using a Box-Cox transformation (optimal $\lambda=0.06$), which indicated transforming the dependent variable with the natural log. The regression equation to be estimated is

$$\ln(\text{total cost}) = b_0 + b_1(\text{change in pain}) + b_2'X + e$$

where b_1 is the primary estimate of interest, b_2 and X are vectors (the latter pertaining to additional covariates), and e is a zero mean residual error term. To compute estimates of the impact of pain reduction on hospital costs, the average reduction in pain after IM treatment was multiplied by the coefficient for change in pain to estimate change in total cost associated with pain reduction.⁴²

All analyses were conducted using SPSS version 12.0 (SPSS, Inc., Chicago).

Results

Table 1 shows summaries of the patients admitted to ANW during the study time frame. Patients were partitioned into three groups based on whether they had IM therapy and were eligible for analysis. In general, patients receiving IM sessions were more complex cases insofar as they typically had higher costs, longer stays, and were assigned to more severe APR-DRGs. Also, a higher percentage of women received IM. Table 2 summarizes the distribution of pain scores recorded immediately before and after IM session. For patients providing both pre- and post-IM treatment pain scores, the average pretreatment pain was 5.29 and post-treatment pain was 3.25, such that the average pain was reduced by 2.05 points (on 0–10-point scale) following an IM session.

The results of the regression analysis are displayed in Table 3. The overall regression was significant ($p<0.001$) with an R^2 of 0.43. As expected, both longer stays and older ages were associated with higher total cost, as were being white, male, married, and having an extreme APR-DRG

TABLE 1. SUMMARY OF DEMOGRAPHICS FOR ADMISSIONS AT ABBOT NORTHWESTERN FROM JULY 15, 2009, TO DECEMBER 31, 2012, WITH AND WITHOUT INTEGRATIVE MEDICINE FOR PAIN

	<i>Not seen by IM for pain (n=110,409) Mean or N (standard deviation or %)</i>	<i>Seen by IM for pain</i>	
		<i>Not eligible for analysis (n=2619) Mean or N (standard deviation or %)</i>	<i>Eligible for analysis (n=2730) Mean or N (standard deviation or %)</i>
Total cost (\$)	13,756 (18,548)	23,304 (35,357)	20,836 (17,013)
Length of stay (days)	4.45 (5.37)	7.49 (10.25)	6.82 (5.08)
Age (years)	56.7 (19.6)	54.2 (16.6)	56.4 (16.6)
Sex			
Female	64,398 (58)	1834 (70)	1864 (68)
Race			
White	95,273 (86)	2342 (89)	2468 (90)
Marital status			
Married/couple	60,458 (55)	1533 (59)	1561 (57)
APR-DRG severity			
Minor	29,566 (27)	512 (20)	415 (15)
Moderate	43,669 (40)	1079 (41)	1122 (41)
Major	29,030 (26)	775 (30)	954 (35)
Extreme	7977 (7)	253 (10)	239 (9)

All variables are significantly different across the three groups ($p < 0.001$ using Kruskal–Wallis or chi-square tests).
APR-DRG, All Patient Refined Diagnosis Related Groups; IM, integrative medicine.

severity. The primary interest was in the estimate between the association of change in pain and total cost (i.e., b_1 from regression equation), which was statistically significant ($p < 0.001$). Because the dependent variable was the log of total cost, the coefficient between total cost and change in pain was interpreted as the proportional change in *total cost* (not the log of cost) for every unit of change in pain. Multiplying the coefficient between total cost and change in pain by 100 yielded the percent change in total cost for 1 U of change in pain. Thus, each unit of pain change was associated with a 2.1% reduction in total cost (Table 2). Patients who received IM reported an average pain reduction of 2.05 U and had a 4.31% (2.1% times 2.05) cost reduction. Multiplying this estimate by average total cost (\$20,836; Table 1) yields an estimated reduction in total cost of \$898 per admission.

Discussion

At stake for care providers and health systems is the assumption that improving pain management will increase the cost of care. In this study, the authors explored whether a hospital can provide pain relief by way of nonpharmacologic approaches, without increasing (and even while *decreasing*)

TABLE 2. DISTRIBUTION OF PAIN SCORES BEFORE INTEGRATIVE MEDICINE THERAPY (N=2730)

	<i>Mean (standard deviation)</i>	<i>Median (first, third quartiles)</i>
Pain immediately before IM therapy	5.29 (2.42)	5 (3, 7)
Pain immediately after IM therapy	3.25 (2.53)	3 (1, 5)
Change in pain	2.05 (1.85)	2 (1,3)

IM, integrative medicine.

the total cost of hospitalized care. They found that among patients who received sessions of IM therapies for pain, self-reported pain was reduced by an average of 2.05 points on a scale of 0 to 10. This average reduction in pain was associated with a cost savings of \$898 per hospital admission.

There are limitations to this analysis. The authors did not use patients who did not receive IM as a comparison group because detailed information on their need for IM therapy was not available (e.g., whether or not the patient was consistently in pain). Patients who received IM therapy stay in the hospital longer and have higher costs (Table 1), which suggests that they are more complex cases. The IM referral and treatment process were based on clinical insights that are more nuanced than the available data.^{34,35} The lack of a

TABLE 3. RESULTS OF ORDINARY LEAST SQUARES REGRESSION ON LOG COST (N=2730)

	<i>Coefficient (t)</i>
Constant	8.775 (174.0)***
Change in pain	−0.021 (−4.3)***
Length of stay	0.071 (33.8)***
Age	0.007 (13.4)***
Sex	
Female	−0.059 (−3.0)**
Race	
White	0.093 (3.0)**
Marital status	
Married/couple	0.041 (2.2)*
APR-DRG severity	
Moderate	0.046 (1.7)
Major	−0.011 (−0.4)
Extreme	0.235 (5.4)***

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

APR-DRG, All Patient Refined Diagnosis Related Groups.

comparable control group means they cannot rule out noncausal explanations of the observed associations. For example, patients who have intractable pain may have higher costs than those whose pain can be managed with IM therapy.

Another limitation of these data is that pre- and postsession pain scores were collected by IM practitioners, creating the possibility of social desirability bias. It is possible that the presence of the practitioners could lead to an overstatement of pain reduction by some patients. However, it is also likely that some patients may worry that reporting reduced pain scores could impact their subsequent receipt of pain medications and, as a result, may not have reported the true favorable effect of their pain relief.

In addition to limitations of these data, operational characteristics of the ANW IM program limit generalizability to other hospitals. Specifically, since the IM services at ANW are free to patients, the results achievable in other hospital environments may be different than shown in this study.

Still another limitation is that this analysis only used the pain changes from each patient's initial IM visit. While some patients do receive more than one IM visit during their hospital stay, the majority of patients do not. Thus, restricting analysis to the initial visit allows for the maximal number of patients to be included in the analysis. Future research should explore whether similar changes in pain reduction occur at subsequent IM visits during patients' hospital stays.

Factors influencing the optimal delivery of IM services should be explored by future research, with a focus on real-world limitations facing hospitals. With increased research on the effectiveness of IM, this decision process should increasingly become evidence-informed in hospital IM programs. Mixed methods designs utilizing quantitative analysis together with qualitative analysis may be important to future research.⁴³ To collect observational data on large patient populations, practice-based effectiveness research will be particularly critical for determining how to target patients for whom IM services are most appropriate, have the best outcomes, and have positive cost implications.⁴⁴ While RCTs may be deemed the gold standard, they may not be as informative for studying the effect of real-world limitations facing hospital administrators. EHR data will increasingly provide research opportunities that can serve both as precursors and complements to RCTs.⁴⁵

The need for pain management in hospitals is not limited to specific populations such as cancer or postsurgical patients, but rather is a widespread challenge across inpatient populations,⁴⁶ with potential short- and long-term impacts on patient outcomes, patient experiences, and hospital costs.^{47–50} The present study suggests that adding IM therapies to the “service toolbox” for care teams in one hospital may reduce pain, and these reductions in pain may reduce hospital costs by about 4% for patients selected to receive these IM therapies for the reduction of pain.

The authors cannot confirm that the cost reduction they calculated is specifically attributable to pain reductions resulting from the provision of IM services. If pain control reduces cost as they propose, the precise mechanism by which reducing pain reduces cost remains to be understood.

One initial assumption might be that lowering pain reduces LOS. A relationship between pain reduction and LOS reduction has been reported in RCTs with various postoperative populations.^{51–53} However, in this study they held LOS constant, suggesting that reductions in pain, while they may have reduced LOS, led to reductions in cost for other reasons that are not yet understood. The relationship between LOS and cost has been found to be nonlinear, with earlier days in the stay being more expensive.⁵⁴ Although it was out of the scope of this analysis, future analyses should explore whether reducing pain with IM reduces cost by using fewer resources, promoting earlier discharge and/or reducing opioid usage and associated adverse events.

Conclusions

Provision of IM services to hospitalized patients is on average associated with a reduction in pain, which in turn is associated with reductions in total costs of care. Although the specific mechanisms for these associations are unknown, these findings highlight important questions for future study while demonstrating that a hospital may be able to save costs while reducing pain.

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