Acupuncture's Role in Solving the Opioid Epidemic: Evidence, Cost-Effectiveness, and Care Availability for...

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Acupuncture’s Role in Solving the Opioid Epidemic: Evidence, Cost–Effectiveness, and Care Availability for Acupuncture as a Primary, Non–Pharmacologic Method for Pain Relief and Management—White Paper 2017

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ABSTRACT

The United States (U.S.) is facing a national opioid epidemic, and medical systems are in need of non-pharmacologic strategies that can be employed to decrease the public’s opioid dependence. Acupuncture has emerged as a powerful, evidence-based, safe, cost-effective, and available treatment modality suitable to meeting this need. Acupuncture has been shown to be effective for the management of numerous types of pain conditions, and mechanisms of action for acupuncture have been described and are understandable from biomedical, physiologic perspectives. Further, acupuncture’s cost-effectiveness can dramatically decrease health care expenditures, both from the standpoint of treating acute pain and through avoiding addiction to opioids that requires costly care, destroys quality of life, and can lead to fatal overdose. Numerous federal regulatory agencies have advised or mandated that healthcare systems and providers offer non-pharmacologic treatment options for pain. Acupuncture stands out as the most evidence-based, immediately available choice to fulfill these calls. Acupuncture can safely, easily, and cost-effectively be incorporated into hospital settings as diverse as the emergency department, labor and delivery suites, and...
neonatal intensive care units to treat a variety of commonly seen pain conditions. Acupuncture is already being successfully and meaningfully utilized by the Veterans Administration and various branches of the U.S. Military, in some studies demonstrably decreasing the volume of opioids prescribed when included in care.

**Keywords:** acupuncture; opioid epidemic; pain; opiate dependency; effectiveness; safety; cost-effectiveness; mechanism; United States


## 1 Introduction

In 2015 it was estimated that 25.3 million Americans suffered from chronic pain, while an estimated 126 million American adults reported some type of pain in the prior three months.\(^\text{[1]}\) As a result, more than 240 million prescriptions were written for opioid medications during that year.\(^\text{[2]}\) An unfortunate consequence of this high use and availability of opioids, is a growing number of opioid-related deaths from addiction and overdose. More than 33 000 Americans died from opioid drugs in 2015, and more than 64 000 died in 2016.\(^\text{[3]}\) Due to the severity of this epidemic, a White House panel urged the United States (U.S.) president to declare the opioid crisis a national emergency, and August 31, 2017 was designated as “International Overdose Awareness Day” by the Centers for Disease Control and Prevention (CDC).\(^\text{[4]}\)

To cope with the opioid crisis, various federal regulatory and oversight agencies, including the U.S. Food and Drug Administration (FDA), the National Academies of Sciences, Engineering, and Medicine (NASEM), and the Joint Commission have started to advise or mandate that healthcare systems and providers offer non-pharmacologic treatment options for pain control.\(^\text{[5–7]}\) Acupuncture stands as the most evidence-based, immediately available choice to fulfill these calls.

The aim of this white paper is to summarize for academic scholars, healthcare professionals, administrators, policymakers, and the general public the available evidence for acupuncture as a treatment for various pain conditions as well as for opiate dependency. This includes evidence on the safety, cost-effectiveness, mechanisms of action, and provider availability for acupuncture.

## 2 Acupuncture is an effective, safe, and cost-effective treatment for numerous types of acute and chronic pain; acupuncture should be recommended as a first line treatment for pain before opiates are prescribed, and may reduce opioid use

### 2.1 Effectiveness/Efficacy of acupuncture for different types of pain

There is growing research evidence to support the effectiveness and efficacy of acupuncture for the relief of numerous types of pain, especially chronic pain, as well as for the use of acupuncture for a diverse array of medical conditions. In an independently published work, which is the largest and most comprehensive of its kind for the period evaluated, McDonald and Janz\(^\text{[8]}\) summarized the research from March 2013 to September 2016 for acupuncture, published and available in all languages on PubMed and in the Cochrane Library. They looked at systematic reviews, meta-analyses, network meta-analyses, overviews of systematic reviews (NHMRC level I evidence), and a number of narrative reviews. They performed meta-analyses on 62 of the non-Cochrane systematic reviews, representing pooled data from more than 1 000 randomized controlled trials (RCTs). They assessed and graded the quality of evidence, and noted the strength of evidence for acupuncture for numerous conditions (Box 1, Appendix 1).

Acupuncture has been found to be effective for treating various types of pain, with the strongest evidence emerging for back pain, neck pain, shoulder pain, chronic headache, and osteoarthritis. In an individual patient meta-analysis of 17 922 people from 29 RCTs, patients receiving acupuncture had less pain, with scores that were 0.23 (95% confidence interval (CI) [0.13–0.33]), 0.16 (95% CI [0.07–0.25]), and 0.15 (95% CI [0.07–0.24]) standard deviations (SDs) lower than sham controls for back and neck pain, osteoarthritis, and chronic headache, respectively; the effect sizes in comparison to non-acupuncture controls were 0.55 (95% CI [0.51–0.58]), 0.57 (95% CI [0.50–0.64]), and 0.42 (95% CI [0.37–0.46]) SDs. A variety of pain severity and disability scores were used, including Visual Analog Scale (VAS) ratings, the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and the Roland Morris Disability Questionnaire. These results were robust to a variety of sensitivity analyses, including those related to publication bias.\(^\text{[9]}\)

In the largest study of its kind to date, 454 920 patients were treated with acupuncture for headache, low-back pain, and/or osteoarthritis in an open pragmatic trial. Effectiveness was rated by the 8 727 treating physicians as marked or moderate in 76% of cases.\(^\text{[10]}\)

In a network meta-analysis comparing different
physical interventions for pain from knee osteoarthritis, acupuncture was found to be superior to sham acupuncture, muscle-strengthening exercise, \textit{Tai Chi}, weight loss, standard care, and aerobic exercise (in ranked order). Acupuncture was found to be more effective than muscle-strengthening exercises, with a statistically significant difference $= 0.49$, 95% CI $[0.00–0.98]$.$^{[11]}$

In early 2017, the American College of Physicians (ACP) published guidelines based on the evidence for the non-invasive treatment of low-back pain. For acute or subacute low-back pain, the ACP recommends non-pharmacologic treatment with acupuncture, along with superficial heat, massage, or spinal manipulation, and nonsteroidal anti-inflammatory drugs or skeletal muscle relaxants. For chronic low-back pain, the ACP also recommends acupuncture, in addition to exercise, multidisciplinary rehabilitation, mindfulness-based stress reduction, \textit{Tai Chi}, yoga, motor control exercise, progressive relaxation, electromyography biofeedback, low-level laser therapy, operant therapy, cognitive behavioral therapy, and spinal manipulation, etc.$^{[12]}$

A systematic review and meta-analysis on acupuncture for the treatment of sciatica reported that acupuncture was superior to standard pharmaceutical care (such as ibuprofen, diclofenac, and prednisone) in reducing pain intensity (mean difference (MD) $= –1.25$, 95% CI $[–1.63$ to $–0.86]$) and pain threshold (MD $= 1.08$, 95% CI $[0.98–1.17]$). Effectiveness, pain intensity, and pain threshold scales were used.$^{[13]}$

A systematic review and network meta-analyses of 21 different interventions for sciatica found that acupuncture was second in global effect only to biological agents, and superior to all other interventions including non-opioid and opioid medications.$^{[14]}$

A systematic review on acupuncture and moxibustion for lateral elbow pain found moderate-level evidence that acupuncture and moxibustion were more effective than sham, and found low-level evidence that acupuncture and moxibustion may be superior or equal to standard care.$^{[15]}$

A systematic review on acupuncture for plantar heel pain found that evidence supporting the effectiveness of acupuncture was comparable to the evidence available

| Box 1 Acupuncture for the Use of Numerous Conditions Including Pain Conditions: 
the Acupuncture Evidence Project (Mar 2013–Sept 2016) |
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Evidence of positive effect</strong></td>
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<tr>
<td>- Allergic rhinitis (perennial &amp; seasonal)</td>
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<tr>
<td>- Chemotherapy-induced nausea and vomiting (with anti-emetics)</td>
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<tr>
<td>- Chronic low-back pain</td>
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<tr>
<td>- Headache (tension-type and chronic)</td>
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<tr>
<td>- Knee osteoarthritis</td>
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<td>- Migraine prophylaxis</td>
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<td>- Post-operative nausea &amp; vomiting</td>
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<td>- Post-operative pain</td>
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<td><strong>Evidence of potential positive effect</strong></td>
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<td>- Acute low-back pain</td>
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<td>- Acute stroke</td>
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<td>- Ambulatory anaesthesia</td>
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<tr>
<td>- Anxiety</td>
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<tr>
<td>- Aromatase inhibitor-induced arthralgia</td>
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<tr>
<td>- Asthma in adults</td>
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<td>- Back or pelvic pain during pregnancy</td>
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<td>- Cancer pain</td>
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<td>- Cancer-related fatigue</td>
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<tr>
<td>- Constipation</td>
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<tr>
<td>- Craniootomy anaesthesia</td>
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<tr>
<td>- Depression (with antidepressants)</td>
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<tr>
<td>- Dry eye</td>
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<tr>
<td>- Hypertension (with medication)</td>
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<tr>
<td>- Insomnia</td>
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<tr>
<td>- Irritable bowel syndrome</td>
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<tr>
<td>- Labor pain</td>
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<tr>
<td>- Lateral elbow pain</td>
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<tr>
<td>- Menopausal hot flashes</td>
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<tr>
<td>- Modulating sensory perception thresholds</td>
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<tr>
<td>- Neck pain (some types/non-whiplash)</td>
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<tr>
<td>- Obesity</td>
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<tr>
<td>- Peri-menopausal &amp; post-menopausal insomnia</td>
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<tr>
<td>- Plantar heel pain</td>
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<tr>
<td>- Post-stroke insomnia</td>
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<td>- Post-stroke shoulder pain</td>
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<td>- Post-stroke spasticity</td>
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<tr>
<td>- Post-traumatic stress disorder</td>
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<td>- Prostatitis pain/chronic pelvic pain syndrome</td>
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<tr>
<td>- Recovery after colorectal cancer resection</td>
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<tr>
<td>- Restless leg syndrome</td>
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<tr>
<td>- Schizophrenia (with antipsychotics)</td>
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<tr>
<td>- Sciatica</td>
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<tr>
<td>- Shoulder impingement syndrome (early stage) (with exercise)</td>
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<tr>
<td>- Shoulder pain</td>
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<tr>
<td>- Smoking cessation (up to 3 months)</td>
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<tr>
<td>- Stroke rehabilitation</td>
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<tr>
<td>- Temporomandibular joint disorder</td>
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for standard care interventions such as stretching, night splints, and dexamethasone.\[^{16}\]

The use of acupuncture to relieve pain associated with surgical procedures captured the world’s attention in the early 1970s. When in China, well-known New York Times journalist James Reston witnessed acupuncture’s effectiveness on his post-operative pain. He published his personal experience with acupuncture shortly before President Richard Nixon’s trip to China. Since then, reports in the scientific literature reveal that acupuncture has been used before, during, and after surgery to manage pain and to improve post-surgical recovery in a variety of contexts.\[^{17-25}\] It is noteworthy to mention that acupuncture has been reported to be effective in pain relief during and after surgical procedures on children and animals as well.\[^{19,20,26,27}\]

Nonetheless, over the past two decades in the U.S., post-operative pain management has come to rely increasingly on opioids, while underutilizing alternative analgesics such as acupuncture. In 2012, surgeons and dentists combined prescribed 16.2% of all opioids in the U.S., trailing only family practices as the leading source of opioid prescriptions at 18.2%.\[^{28}\] Eighty to ninety-four percent of patients undergoing low-risk surgical procedures fill a prescription for opioids within 7 days.\[^{29,30}\] Recent data has shown that opioid prescriptions vary widely and that the majority of surgical patients are over-prescribed opioids, as approximately 70% of pills go unused.\[^{31}\] The risk of chronic opioid use after surgery in previously non-dependent patients is determined to be 5.9%–6.5%,\[^{32}\] although in select populations such as head and neck cancer patients, the risk is up to 40%.\[^{33}\] The increase in post-operative opioid use is somewhat paradoxical considering that known adverse effects such as sedation, pneumonia, ileus, urinary retention, and delirium prolong patient recovery and delay the meeting of discharge goals.\[^{36}\]

Acupuncture has emerged as a promising adjunctive analgesic modality to reduce the risk of post-operative opioid dependence. A meta-analysis published in late 2017 in JAMA Surgery focused on non-pharmacological treatments in reducing pain after total knee arthroplasty. Thirty-nine RCTs were included in the meta-analysis (2 391 patients). Moderate-certainty level evidence showed that electrotherapy reduced the use of opioids (MD = −3.50; 95% CI [−5.90 to −1.10] morphine equivalents in milligrams per kilogram per 48 hours; \(P = 0.004; \ I^2 = 17\%\)), and that acupuncture delayed opioid use (MD = 46.17; 95% CI [20.84–71.50] minutes to the first patient-controlled analgesia; \(P < 0.001; \ I^2 = 19\%\)). There was low-certainty level evidence that acupuncture improved pain (MD = 1.14; 95% CI [1.90–0.38] on a VAS at 2 days; \(P = 0.003; \ I^2 = 0\%\)). Evidence showed that acupuncture out-performed cryotherapy, continuous passive motion, and preoperative exercise in the studied condition.\[^{35}\] Reduction in opioid use has been demonstrated across a wide range of both minor and major surgical procedures, including cardiac surgery,\[^{38}\] thoracic surgery,\[^{39}\] and craniotomy.\[^{40}\] Additionally, it was reported that acupuncture may even reduce post-operative ileus and expedite bowel recovery after colorectal cancer resection.\[^{41}\] Acupuncture is often combined with electric stimulation, and electro-acupuncture may have added clinical benefit in post-operative pain management.

A Cochrane systematic review on acupuncture or acupressure for primary dysmenorrhea found that both acupuncture and acupressure were more effective in reducing pain than placebo controls. Five other systematic reviews and/or meta-analyses on various forms of acupoint stimulation including acupuncture, acupressure, and moxibustion for primary dysmenorrhea have reported similar outcomes.\[^{43-47}\]

The effectiveness of acupuncture for labor pain is still unclear, largely due to the heterogeneity of designs and methods in studies, which have produced mixed results. While some studies reported no reduction in analgesic medications, some studies reported reduction of pain during labor, reduced use of opioid medications and epidural analgesia, and a shorter second stage of labor.\[^{48-50}\]

A systematic review of acupuncture for trigeminal neuralgia suggests that acupuncture may be equal to or superior to carbamazepine, but the evidence is weakened by the low methodological quality of some included studies.\[^{51}\]

A Cochrane systematic review on acupuncture for fibromyalgia found low- to moderate-certainty level evidence that acupuncture improves pain and stiffness compared with no treatment and standard therapy. Furthermore, electro-acupuncture is likely better than manual acupuncture for pain in fibromyalgia, although more studies with methodological rigor are warranted.\[^{52}\]

A prospective, randomized trial of acupuncture vs. morphine to treat emergency department/emergency room patients with acute onset, moderate to severe pain was conducted. Acupuncture provided more effective and faster analgesia than morphine and was better tolerated. The study included 300 patients, with 150 patients in each group. Success rate was significantly different between the 2 groups (92% in the acupuncture group vs 78% in the morphine group, \(P < 0.001\)). Resolution time was (16 ± 8) minutes in
the acupuncture group vs (28 ± 14) minutes in the morphine group (P < 0.005). Overall, 89 patients (29.6%) experienced minor adverse events; of these, 85 (56.6%) were in the morphine group and only 4 (2.6%) were in the acupuncture group (P < 0.001).[53]

The above mentioned meta-analysis included 29 trials and 17 922 patients with chronic pain conditions; data on longer-term follow-up (available for 20 trials, including 6 376 patients) suggests that approximately 90% of the benefit of acupuncture relative to controls would be sustained at 12 months post-treatment. Patients can generally be reassured that treatment effects persist for some duration.[54]

2.2 Safety and feasibility of acupuncture for pain management

Strong evidence for the safety of acupuncture in chronic pain management comes from an open pragmatic trial involving 454 920 patients who were treated for headache, low-back pain, and/or osteoarthritis. Minor adverse events were reported in 7.9% of patients while only 0.003% (13 patients) experienced severe adverse events. Minor adverse events included needling pain, hematoma, and bleeding, while serious adverse events included pneumothorax, acute hyper- or hypotensive crisis, erysipelas, asthma attack, and aggravation of suicidal thoughts.[10] In a prospective feasibility study, acupuncture was seen as feasible, safe, and acceptable in an intensive care unit setting by patients from diverse backgrounds.[55] A systematic review suggests that acupuncture performed by trained practitioners using clean needle technique is a generally safe procedure.[56] The medical literature also indicates that acupuncture may be used successfully on cancer patients for symptom management due to the low risks associated with its use.[57]

2.3 Cost-effectiveness of acupuncture for pain management

In a systematic review of 8 cost-utility and cost-effectiveness studies of acupuncture for chronic pain, the cost per quality-adjusted life-year gained was below the thresholds used by the UK National Institute for Health and Clinical Excellence for “willingness to pay.” The chronic pain conditions discussed in the systematic review included low-back pain, neck pain, dysmenorrhea, migraine and headache, and osteoarthritis.[58] In a cost-effectiveness analysis of non-pharmacological treatments for osteoarthritis of the knee, acupuncture was found to be the most cost-effective option when analysis was limited to high-quality studies.[59] Using acupuncture for pain management, patients and insurers can save money and successfully manage their pain and other symptoms without the adverse risks associated with prescription medications. A recent study from the Center for Health Information and Analysis in response to a piece of Massachusetts legislation seeking mandated coverage for acupuncture for some conditions, found that full insurance coverage for acupuncture would increase an average insured member’s monthly health insurance premium only by $0.38 to $0.76. Acupuncture was noted to save $35 480, $32 000, $9 000, and $4 246 per patient for migraine, angina pectoris, severe osteoarthritis, and carpal tunnel syndrome respectively.[60] Compared to the large fees associated with imaging, prescription medications and surgery for pain conditions, acupuncture proved extremely cost-effective.

The Acupuncture Evidence Project also enumerates those conditions for which they found evidence of acupuncture being cost-effective (Box 2).[61]

<table>
<thead>
<tr>
<th>Box 2 Conditions with Demonstrated Evidence of Cost-Effectiveness</th>
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<tr>
<td>● Allergic rhinitis</td>
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<td>● Low-back pain</td>
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<td>● Ambulatory anaesthesia</td>
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<tr>
<td>● Migraine</td>
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<tr>
<td>● Chronic pain: neck pain (plus usual medical care)</td>
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<tr>
<td>● Depression</td>
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<tr>
<td>● Osteoarthritis</td>
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<tr>
<td>● Dysmenorrhea</td>
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<tr>
<td>● Post-operative nausea and vomiting</td>
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<tr>
<td>● Headache</td>
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</table>

A study by Da Silva[62] published in the journal *Headache* in 2015 showed acupuncture to be at least as effective as conventional drug preventative therapy for migraine and to be safe, long lasting, and cost-effective. A 2015 study by Liodden and Norheim[63] noted acupuncture to be potentially useful for post-operative pain and post-operative nausea and vomiting, and to be a low-cost intervention. A 2014 study by Spackman et al.[64] showed acupuncture to be cost-effective compared to counselling or usual care alone. Two studies demonstrated acupuncture’s cost-effectiveness for the treatment of low-back pain. A study by Taylor et al.[65] from 2014 showed that acupuncture as a complement to standard care for the relief of chronic low-back pain was highly cost-effective, costing around $48 562 per disability-adjusted life-year (DALY) avoided. It also found that when comorbid depression was alleviated at the same rate as pain, the cost was around $18 960 per DALY avoided. A study by Andronis et al.[66] also identified acupuncture as likely to be cost-effective for low-back pain.
2.4 Can adjunctive acupuncture treatment reduce the use of opioid-like medications?

Some studies have reported reduced consumption of opioid-like medication (OLM) by more than 60% following surgery when acupuncture is used. A pilot RCT also showed a reduction by 39% in OLM use in non-malignant pain after acupuncture, an effect which lasted fewer than 8 weeks after acupuncture treatment ceased. The above mentioned meta-analysis, having moderate-certainty level evidence, showed that electro-acupuncture therapy reduced the use of opioids, and acupuncture delayed opioid use, with low-certainty level evidence indicating that acupuncture improved pain.

The conclusions suggest that electro-acupuncture may be effective in reducing or delaying the use of opioid medications.

In a study examining acupuncture’s effectiveness in treating pain in a military cohort of 172 at a U.S. Air Force medical center, acupuncture dramatically decreased the use of opiates and other pain medications among personnel. Opioid prescriptions decreased by 45%, muscle relaxants by 34%, non-steroidal anti-inflammatories by 42%, and benzodiazepines by 14%. Quality of life measures also showed impressive changes, with some measures of improvements showing statistical significance (P < 0.001).

The Veterans Administration is increasingly looking to incorporate acupuncture into care, as is the U.S. Air Force and other military branches. Training of military physicians is increasing, and systems are being studied to further incorporate acupuncture. The military is rapidly incorporating this care into its offered services for service members.

Studies of the effects of opioid analgesia in the elderly reveal a significant burden of disease due to falls from mental impairment. This is worsened when seniors are using multiple medications affecting cognition. In a recent study, serious falls as per Medicare Part A and B ICD/CPT codes were evaluated in 5,556 nursing home residents aged 65 or greater. Seniors taking three or more central nervous system (CNS) standardized daily doses were more likely to have a serious fall than those not taking any CNS medications (adjusted odds ratio = 1.83, 95% CI [1.35–2.48]), and the authors urge, “Clinicians should be vigilant for opportunities to discontinue or decrease the doses of individual CNS medications and/or consider non-pharmacological alternatives.”

A recent study in the New Zealand Medical Journal noted that medication-related harms were both common and created a substantial burden of disease for patients and the healthcare system. They listed opioids first among the six categories of medications causing the most significant burden. In light of the findings of these studies and similar, utilization of non-pharmacologic treatment options such as acupuncture must be a priority of paramount status.

3 Acupuncture’s analgesic mechanisms have been extensively researched and acupuncture can increase the production and release of endogenous opioids in animals and humans

Mechanisms underlying acupuncture’s analgesic effects have been extensively researched for over 60 years. In animal models, acupuncture and/or electro-acupuncture has been shown to be effective for the alleviation of inflammatory, neuropathic, cancer-related, and visceral pain. Mechano-transduction of the needle stimulus at specific points on the body triggers the release of ATP and adenosine, which bind to local afferents. Ascending neural pathways involving Aβ, Aδ, and C sensory fibres have been mapped (using techniques such as single fiber recordings with Evans blue dye extravasation), as have been a mesolimbic analgesic loop in the brain and brainstem, descending pathway mechanisms, dopaminergic contributors, and cytokine, glutamate, nitric oxide, and gamma-aminobutyric acid (GABA) effects. Acupuncture analgesia has been shown to involve several classes of opioid neuropeptides including enkephalins, endorphins, dynorphins, endomorphins, and nociceptin (also known as orphanin FQ). Among the non-opioid neuropeptides, substance P, vasoactive intestinal peptide, and calcitonin gene-related peptide have been investigated for their roles in both the analgesic and anti-inflammatory effects of acupuncture.

Given that acupuncture analgesia activates the production and release of endogenous opioids and activates μ and δ opioid receptors, it is feasible that acupuncture, used in conjunction with OLM, might alleviate pain with a lower OLM dose for patients already taking OLM. This idea is further supported by evidence that acupuncture increases μ opioid receptor binding potential, allowing for effective analgesia at lower doses of OLM. For patients not yet prescribed OLM, acupuncture should be recommended prior to OLM prescription commencement. This would be in-line with existing guidelines, such as those by the ACP and the CDC, which recommend that safe and effective non-opioid alternatives should first be exhausted before resorting to OLM.

It is important to note as well that opioids as a monotherapy are often not as successful as may be thought in the general public perception. A recent systematic review of opioid analgesics for low-back pain, which included 7,925 participants, found
that opioids were poorly tolerated and for those who
tolerate them the effect is unlikely to be clinically
important within guideline recommended doses.[84] The
first ever RCT evaluating the long-term effectiveness
of opioids, found that those on long-term opioid
analgesia were actually in marginally more pain at 12
months than those in the non-opioid group.[85] Hence,
complementary methods of pain control are critical to
successful patient management.

4 Acupuncture is effective for the treatment of
chronic pain involving maladaptive neuroplasticity

Adverse neuroplastic changes can present a challenge
in pain management, as maladaptive neuroplasticity can
be associated with severe chronic pain that is resistant to
treatment. Via peripheral stimulation, acupuncture may
relieve the symptoms of patients affected by problematic
neuroplastic changes. There is evidence that acupuncture
has the capacity to reverse adverse neuroplastic changes
in the dorsal horns of the spine, as well as in the
somatosensory cortex.[86–89] This suggests that acupuncture
may have an important role in treating chronic pain which
involves adverse neuroplastic changes.

5 Acupuncture is a very promising, already
utilized adjunctive therapy in opiate dependency
and rehabilitation

In 1973, Wen et al.[90] from Hong Kong published an
accidental finding that ear acupuncture treatment for
respiratory patients had apparently alleviated opioid
withdrawal signs and symptoms. These findings were
replicated by others around the world, including in
New York and Sydney in the mid-1970s. In 1985, Dr.
Michael Smith and colleagues in New York established
the National Acupuncture Detoxification Association
(NADA), which today operates in over 40 countries
with an estimated 25,000 providers. There are more
than 1,000 programs in the U.S. and Canada that
now use acupuncture to help addicts overcome their
addictions.[91]

Evidence for acupuncture’s place in addiction
treatment has been found in both animal and human
studies. In 2009, Hu et al.[92] found that electro-
acupuncture in rats appeared to affect dopamine
neurons in the ventral tegmental area, meaningfully
improving the deleterious effects caused to this
area by opioid medication. In 2012 Lee et al.[93]
demonstrated that electro-acupuncture could be used
to decrease drug-seeking behaviour in rats. As far
back as 1978 it was demonstrated that acupuncture
decreased biochemical markers of stress in heroin
addicts compared to observational controls.[94] In 2014
Chan et al.[95] demonstrated that acupuncture decreased
the amount of morphine used by addicts in treatment,
and simultaneously improved sleep in the treatment
subjects. Acupuncture for addiction is a versatile
modality that can be effortlessly integrated into many
environments including prisons, in- and outpatient
programs, community centers, disaster relief, and
humanitarian aid efforts. Furthermore, acupuncture
addiction protocols can address acute and prolonged
withdrawal symptoms, stress and anxiety related to
drug withdrawal, and help prevent relapse. Using drugs
to treat those already drug-addicted is not a rational
plan of action, and finding sound, non-pharmacologic
treatment options is of paramount importance.

A meta-analysis done in 2012 concluded that “the majority [of studies] agreed on the efficacy of
acupuncture as a strategy for the treatment of opiate addiction” and that “neurochemical and behavioral
evidence has shown that acupuncture helps reduce the effects of positive and negative reinforcement
involved in opiate addiction by modulating mesolimbic
dopamine neurons. Moreover, several brain
neurotransmitter systems involving opioids and GABA
have been implicated in the modulation of dopamine
release by acupuncture.”[96] In a recent RCT involving
28 newborns with neonatal abstinence syndrome,
laser acupuncture plus OLM significantly reduced the
duration of oral morphine therapy when compared to
OLM alone.[97] The mechanism for acupuncture in opiate
withdrawal was found to be mediated by the endogenous
opoid “dynorphin” binding to κ opioid receptors.[98]
While considerable research on acupuncture’s role in
addiction is still greatly needed, long-standing and new
data provide a sound foundation for that future research.
Demonstration of trans-species effects with multiple,
plausible mechanisms and documented clinical efficacy
in humans for opioid addiction specifically, coupled
with vast, existing clinical precedent of use in this
realm, argues strongly for acupuncture’s likely value in
this domain.

6 Acupuncture has been recommended as a
first line, non–pharmacologic therapy by the
FDA as well as the NASEM in coping with
the opioid crisis; the Joint Commission has
also mandated that hospitals provide non–
pharmacologic pain treatment modalities

The U.S. FDA released proposed changes to its
Entitled a “Blueprint for Prescriber Education for
Extended-Release and Long-Acting Opioids,” the

www.jcimjournal.com/jim
guidelines now recommend that doctors become informed about non-pharmacologic options for pain control to help avoid the overuse of opioids.\textsuperscript{8} Per the FDA’s request, the NASEM released a report to outline the state of the science regarding prescription opioid abuse and misuse, as well as the evolving role that opioids play in pain management. The new NASEM report on pain management and opioids recommends more public education, reimbursement models, and support for non-drug approaches to pain treatment. It systematically summarizes the evidence for acupuncture’s clinical benefits in treating different pain conditions, and provides an overview of some of the basic science underlying acupuncture’s mechanisms in pain management.\textsuperscript{9} Further, effective January 1, 2018, the Joint Commission has mandated that hospitals provide non-pharmacologic pain treatment modalities.\textsuperscript{10} Acupuncture is ideally suited to fulfill this mandate. These official, evidence-based clinical guidelines are in line with global healthcare trends. As of November 2015, acupuncture had over 870 recommendations in official clinical guidelines for over 100 conditions from institutions in over 30 countries.\textsuperscript{[99]}

### 7 Among the most commonly recommended, non-pharmacological management options for pain relief, evidence supports acupuncture as the most specific and effective for opioid abuse and overuse

Several forms of non-pharmacological management options for acute and chronic pain have been examined, including physical therapy, spinal column manipulation, yoga, Tai Chi, cognitive behavioral therapy, as well as others. Among those therapies commonly recommended by medical authorities, evidence supports acupuncture as the most specific in targeting the endogenous opioid system. There is more evidence that acupuncture can induce endorphins to cope with acute and chronic pain in basic research than for any other non-pharmacological approach for pain.\textsuperscript{[12,37,53,60]} Other mechanisms for acupuncture’s effects have also been discussed above.

### 8 Acupuncture is widely available from qualified practitioners nationally

In 2013 more than 28 000 licensed acupuncturists were estimated to be practicing in the U.S., with many more in training.\textsuperscript{100} A 2015 study found the number of professionals practicing as “Licensed Acupuncturists” (or state equivalent) to be approximately 34 400. The number of licensed acupuncturists was noted to have increased by 23.3% and 52.1% compared to the years 2009 ($n = 27,965$) and 2004 ($n = 22,671$) respectively, increasing about 1 266 per year.\textsuperscript{[101]} Currently, the Council of Colleges of Acupuncture and Oriental Medicine has 57 schools in its membership,\textsuperscript{102} with approximately ten schools offering doctoral degrees. The National Certification Council for Acupuncture and Oriental Medicine has certified more than 18 000 practitioners for minimal competency.\textsuperscript{[103]} The practitioners emerging from this educational and testing infrastructure are the most highly trained in Chinese medicine as a complete system, and the training capacity is vastly underutilized. This system could produce many more practitioners were demand increased. The American Academy of Medical Acupuncture also represents more than 1 300 medical doctors trained to offer acupuncture services, and has approved nine programs for medical doctor certification in acupuncture.\textsuperscript{[104]} One certification program alone has trained more than 6 000 physicians in medical acupuncture,\textsuperscript{[105]} so a conservative estimate of the total number of physicians trained would be approximately 10 000, though the number actively practicing acupuncture is unknown. Most states allow physicians to practice acupuncture, with some specifying additional training.\textsuperscript{[106]} Increased coverage and demand for acupuncture will lead to a greater supply of providers as well. As noted above, NADA providers are estimated at 25 000 individuals, with more than 1 000 programs in the U.S. and Canada.

### 9 Acknowledgements

This paper was written and revised on the basis of original work provided by the Joint Acupuncture Opioid Task Force (JAOTF). The JAOTF was chaired by Bonnie M. Abel Bolash, M.Ac, L.Ac. The current authors would like to thank the original contributors of that paper: Matthew Bauer, L.Ac, Bonnie Bolash, L.Ac, Lindy Camardella, L.Ac, Mel Hopper Koppelman, MSc, John McDonald, PhD, FAACMA, Lindsay Meade, L.Ac, and David W. Miller, MD, L.Ac who come from the Acupuncture Now Foundation (ANF) and the American Society of Acupuncturists (ASA). We express thanks also to Jun Xu, MD, L.Ac of the American Alliance for Professional Acupuncture Safety (AAPAS) for fostering valuable collaboration on this project.

### 10 Competing interests

The authors declare that they have no competing interests. Comments or corrections are welcomed and appreciated.
<table>
<thead>
<tr>
<th>Author, year</th>
<th>Topic/intervention</th>
<th>Participants/population</th>
<th>Primary outcomes</th>
<th>Key findings</th>
<th>Study quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vickers et al., 2012*</td>
<td>Acupuncture versus sham acupuncture and non-acupuncture in back, neck and shoulder pain, chronic headache, and osteoarthritis</td>
<td>Systematic review of 31 RCTs (17,922 subjects) and meta-analysis of individual patient data from 29 of those 31 RCTs in back, neck and shoulder pain; chronic headache; osteoarthritis</td>
<td>A variety of pain severity and disability scores such as VAS, WOMAC, Roland Morris Disability Questionnaire</td>
<td>Acupuncture was superior to sham acupuncture and non-acupuncture for each pain condition</td>
<td>High-quality evidence</td>
</tr>
<tr>
<td>Weidenhammer et al., 2007*[t]</td>
<td>Acupuncture for headache, low-back pain, and osteoarthritis</td>
<td>Open pragmatic trial of 454,920 subjects with headache, low-back pain, and osteoarthritis</td>
<td>Treating physician rating of “marked, moderate, minimal or poor improvement (which included no improvement and worse)”</td>
<td>Physician ratings: 22% marked, 54% moderate, 16% minimal and 4% poor improvement</td>
<td>Low-quality evidence—open pragmatic trial with no blinding and no external assessors</td>
</tr>
<tr>
<td>Corbett et al., 2013[1]</td>
<td>Comparison of 22 physical therapies for knee osteoarthritis pain</td>
<td>Review of 152 trials and network meta-analysis of 12 RCTs with low risk of bias comparing 22 physical therapies in knee osteoarthritis pain</td>
<td>Knee pain</td>
<td>Acupuncture was equal to balneotherapy and superior to sham acupuncture, muscle-strengthening exercise, Tai Chi, weight loss, standard care and aerobic exercise (in ranked order)</td>
<td>110 of 152 studies analysed were of poor quality. Network meta-analysis included 12 RCTs with low risk of bias</td>
</tr>
<tr>
<td>Ji et al., 2015*[1]</td>
<td>Acupuncture versus standard pharmaceutical care in sciatica</td>
<td>Systematic review and meta-analysis of 12 RCTs in sciatica</td>
<td>Effectiveness, pain intensity, and pain threshold</td>
<td>Acupuncture was superior to standard pharmaceutical care in effectiveness, reducing pain intensity and pain threshold</td>
<td>Low- to moderate-quality evidence</td>
</tr>
<tr>
<td>Lewis et al., 2015*[1]</td>
<td>Comparison of 21 different interventions for sciatica</td>
<td>Systematic review and network meta-analyses of 122 studies including 90 randomized or quasi-randomized controlled trials comparing 21 different interventions for sciatica</td>
<td>Global effect, and pain intensity</td>
<td>In global effect and reduction in pain intensity, acupuncture was second only to biological agents (cytokine-modulating drugs), and superior to all other interventions tested including non-opioid and opioid medications</td>
<td>9% of studies had a strong overall quality rating; 7% of studies had a strong overall external validity rating; 21% of studies used both adequate randomization and adequate or partially adequate allocation concealment</td>
</tr>
</tbody>
</table>
## Appendix 1: Effectiveness of Acupuncture (continuation 1)

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Topic/intervention</th>
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<th>Key findings</th>
<th>Study quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gadau et al., 2014&lt;sup&gt;[15]&lt;/sup&gt;</td>
<td>Acupuncture and/or moxibustion versus sham acupuncture, another form of acupuncture, or conventional treatment in lateral elbow pain</td>
<td>Systematic review of 19 RCTs</td>
<td>Pain, and grip strength</td>
<td>Acupuncture is more effective than sham acupuncture (moderate-quality studies); acupuncture or moxibustion is more effective than conventional treatment (low-quality studies)</td>
<td>Low- to moderate-quality evidence</td>
</tr>
<tr>
<td>Cho et al., 2015&lt;sup&gt;[20]&lt;/sup&gt;</td>
<td>Real versus sham acupuncture in acute post-operative pain after back surgery</td>
<td>Systematic review and meta-analysis of 5 trials</td>
<td>24-hour post-operative pain intensity on VAS; 24-hour opiate demands</td>
<td>Real acupuncture was superior to sham in reducing pain intensity but not opiate demand at 24 hours</td>
<td>3 of 5 trials were high quality</td>
</tr>
<tr>
<td>Levett et al., 2014&lt;sup&gt;[48]&lt;/sup&gt;</td>
<td>Acupuncture, standard care, sham acupuncture, acupressure and mixed controls in various combinations in labor pain</td>
<td>A critical narrative review of 4 systematic reviews in labor pain</td>
<td>Pain intensity, analgesic use, and length of labor</td>
<td>Acupuncture reduces pain intensity, analgesic use and length of labor</td>
<td>Conflicting evidence</td>
</tr>
<tr>
<td>Clark et al., 2012&lt;sup&gt;[16]&lt;/sup&gt;</td>
<td>Acupuncture versus various comparators including standard care, sham acupuncture and other forms of acupuncture in plantar heel pain</td>
<td>Systematic review of 5 RCTs and 3 non-randomized comparative trials</td>
<td>Various pain and disability scales (morning pain, walking pain, and tenderness)</td>
<td>Acupuncture for plantar heel pain is supported by evidence which is equivalent to evidence supporting standard care (stretching, splints, and dexamethasone)</td>
<td>Evidence at levels I and II supporting the effectiveness of acupuncture for heel pain, leading to a recommendation at Grade B</td>
</tr>
<tr>
<td>Deare et al., 2013&lt;sup&gt;[52]&lt;/sup&gt;</td>
<td>Manual and electroacupuncture compared with sham acupuncture, standard therapy and no treatment in fibromyalgia</td>
<td>Cochrane systematic review of 9 RCTs in fibromyalgia</td>
<td>Pain, stiffness, sleep, fatigue and global wellbeing</td>
<td>Acupuncture improves pain and stiffness compared to standard therapy and no treatment, but not compared to sham acupuncture</td>
<td>Low- to moderate-quality evidence</td>
</tr>
<tr>
<td>Smith et al., 2011&lt;sup&gt;[42]&lt;/sup&gt;</td>
<td>Acupuncture or acupressure versus placebo control, usual care or pharmacological treatment in primary dysmenorrhea</td>
<td>Cochrane systematic review of 10 RCTs (944 subjects) on acupuncture (6) or acupressure (4) for primary dysmenorrhea</td>
<td>Pain relief, analgesic use, quality of life, improvement in menstrual symptoms, and absenteeism</td>
<td>Acupuncture was superior to placebo and Chinese herbs in pain relief, and superior to medication and Chinese herbs in reducing menstrual symptoms. Acupressure was superior to placebo in pain relief and reducing menstrual symptoms</td>
<td>Low risk of bias in 50% of included RCTs</td>
</tr>
</tbody>
</table>
### Appendix 1 Effectiveness of Acupuncture (continuation 2)

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Topic/intervention</th>
<th>Participants/population</th>
<th>Primary outcomes</th>
<th>Key findings</th>
<th>Study quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abaraogu et al., 2015[43]</td>
<td>Acupuncture or acupressure versus placebo control, wait list or pharmacological treatment in primary dysmenorrhea</td>
<td>Systematic review of 8 RCTs (&gt; 3 000 subjects) and meta-analysis of 4 RCTs</td>
<td>Pain intensity (VAS, McGill scale), quality of life, and blood nitric oxide</td>
<td>Acupuncture and acupressure reduced pain, while acupuncture also improved quality of life</td>
<td>Moderate-quality evidence</td>
</tr>
<tr>
<td>Chen et al., 2013[47]</td>
<td>Acupuncture or acupressure at acupoint SP6 versus minimal stimulation at SP6 or stimulation of another point in primary dysmenorrhea</td>
<td>Meta-analysis of acupuncture (3) and acupressure (4) RCTs in primary dysmenorrhea</td>
<td>Pain intensity (VAS)</td>
<td>Acupuncture is effective and acupressure may be effective at SP 6 for pain relief</td>
<td>Acupuncture trials had low to moderate risk of bias; acupressure trials had high risk of bias</td>
</tr>
<tr>
<td>Cho et al., 2010[44]</td>
<td>Acupuncture versus sham acupuncture, pharmacological treatment or Chinese herbs in primary dysmenorrhea</td>
<td>Systematic review of 27 RCTs in primary dysmenorrhea</td>
<td>Pain intensity (VAS, Menstrual Pain Reduction Score, and other pain scores)</td>
<td>Acupuncture was superior to pharmacological treatment or Chinese herbs in pain relief</td>
<td>Only 5 out of 27 trials had low risk of bias</td>
</tr>
<tr>
<td>Chung et al., 2012[46]</td>
<td>Acupoint stimulation versus non-acupoint stimulation or medication in primary dysmenorrhea</td>
<td>Systematic review of 30 RCTs (&gt; 3 000 subjects) and meta-analysis of 25 RCTs</td>
<td>Pain intensity, and plasma prostaglandin F2/ prostaglandin E2 ratio</td>
<td>Acupoint stimulation was superior in short-term pain relief to stimulation on non-acupoints. Non-invasive stimulation of acupoints was more effective than invasive stimulation</td>
<td>Some trials were of low quality</td>
</tr>
<tr>
<td>Xu et al., 2014[45]</td>
<td>Various forms of acupoint stimulation (including acupuncture, moxibustion and other methods) versus a variety of controls in primary dysmenorrhea</td>
<td>Meta-analysis of 20 RCTs (2 134 subjects) of acupoint stimulation for primary dysmenorrhea</td>
<td>Pain relief</td>
<td>Acupoint stimulation was more effective than controls for pain relief</td>
<td>Low- to moderate-quality evidence</td>
</tr>
</tbody>
</table>

RCT: randomized controlled trial; VAS: Visual Analog Scale; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index.

There is currently debate within the scientific and academic communities on how to perform high-quality studies on acupuncture. It is widely recognized that standards applied to drug trials are inappropriate for acupuncture studies, as it is impossible to effectively blind patients to treatment with acupuncture as can be done with medications. Hence, this literature review, adhering to standards for drug studies, may undervalue some existing studies, and hence the strength of acupuncture for care may also be underestimated.
REFERENCES


Journal of Integrative Medicine (JIM) is an international, peer-reviewed, PubMed-indexed journal, publishing papers on all aspects of integrative medicine, such as acupuncture and traditional Chinese medicine, Ayurvedic medicine, herbal medicine, homeopathy, nutrition, chiropractic, mind-body medicine, Taichi, Qigong, meditation, and any other modalities of complementary and alternative medicine (CAM). Article types include reviews, systematic reviews and meta-analyses, randomized controlled and pragmatic trials, translational and patient-centered effectiveness outcome studies, case series and reports, clinical trial protocols, preclinical and basic science studies, papers on methodology and CAM history or education, editorials, global views, commentaries, short communications, book reviews, conference proceedings, and letters to the editor.

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