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Essential oils: How safe? How effective?

Given the ubiquity of these plant-based oils, your patients might ask about using them. Here's the evidence on safety and efficacy to guide your response.

PRACTICE RECOMMENDATIONS

› *Utilize lavender essential oil as an adjunctive treatment for fibromyalgia, dysmenorrhea, anxiety, and insomnia symptoms.* **(B)**

› *Recommend peppermint essential oil as an adjunctive treatment for irritable bowel syndrome, chemotherapy-induced nausea, and headache.* **(B)**

Strength of recommendation (SOR)

- (A)** Good-quality patient-oriented evidence
- (B)** Inconsistent or limited-quality patient-oriented evidence
- (C)** Consensus, usual practice, opinion, disease-oriented evidence, case series

Essential oils (EOs), which are concentrated plant-based oils, have become ubiquitous over the past decade. Given the far reach of EOs and their longtime use in traditional, complementary, alternative, and integrative medicine, it is imperative that clinicians have some knowledge of the potential benefits, risks, and overall efficacy.

Commonly used for aromatic benefits (aromatherapy), EOs are now also incorporated into a multitude of products promoting health and wellness. EOs are sold as individual products and can be a component in consumer goods such as cosmetics, body care/hygiene/beauty products, laundry detergents, insect repellents, over-the-counter medications, and food.

The review that follows presents the most current evidence available. With that said, it's important to keep in mind some caveats that relate to this evidence. First, the studies cited tend to have a small sample size. Second, a majority of these studies were conducted in countries where there appears to be a significant culture of EO use, which could contribute to confirmation bias. Finally, in a number of the studies, there is concern for publication bias as well as a discrepancy between calculated statistical significance and actual clinical relevance.

What are essential oils?

EOs generally are made by extracting the oil from leaves, bark, flowers, seeds/fruit, rinds, and/or roots by steaming or pressing parts of a plant. It can take several pounds of plant material to produce a single bottle of EO, which usually contains ≥ 15 to 30 mL (.5 to 1 oz).¹

Some commonly used EOs in the United States are lavender, peppermint, rose, clary sage, tea tree, eucalyptus, and citrus; however, there are approximately 300 EOs available.² EOs are used most often via topical application, inhalation, or ingestion.



It is important to read ingredient labels before purchasing an essential oil. Reputable companies will identify the plant ingredient, usually by the formal Latin binomial name, and explain the extraction process.

As with any botanical agent, EOs are complex substances often containing a multitude of chemical compounds.¹ Because of the complex makeup of EOs, which often contain up to 100 volatile organic compounds, and their wide-ranging potential effects, applying the scientific method to study effectiveness poses a challenge that has limited their adoption in evidence-based practice.²

■ **Availability and cost.** EOs can be purchased at large retailers (eg, grocery stores, drug stores) and smaller health food stores, as well as on the Internet. Various EO vehicles, such as inhalers and topical creams, also can be purchased at these stores.

The cost varies enormously by manufacturer and type of plant used to make the EO. Common EOs such as peppermint and lavender oil generally cost \$10 to \$25, while rarer plant oils can cost \$80 or more per bottle.

How safe are essential oils?

Patients may assume EOs are harmless because they are derived from natural plants and have been used medicinally for centuries. However, care must be taken with their use.

The safest way to use EOs is topically, although due to their highly concentrated na-

ture, EOs should be diluted in an unscented neutral carrier oil such as coconut, jojoba, olive, or sweet almond.³ Ingestion of certain oils can cause hepatotoxicity, seizures, and even death.³ In fact, patients should speak with a knowledgeable physician before purchasing any oral EO capsules.

Whether used topically or ingested, all EOs carry risk for skin irritation and allergic reactions, and oral ingestion may result in some negative gastrointestinal (GI) adverse effects.⁴ A case report of 3 patients published in 2007 identified the potential for lavender and tea tree EOs to be endocrine disruptors.⁵

Inhalation of EOs may be harmful, as they emit many volatile organic compounds, some of which are considered potentially hazardous.⁶ At this time, there is insufficient evidence regarding inhaled EOs and their direct connection to respiratory health. It is reasonable to suggest, however, that the prolonged use of EOs and their use by patients who have lung conditions such as asthma or COPD should be avoided.⁷

How are quality and purity assessed?

Like other dietary supplements, EOs are not

IMAGE: JOE GORMAN

➤ Essential oils are one of the nonpharmacologic modalities that patients and clinicians have at their disposal for adjunctive treatment of migraine and tension-type headaches.

regulated. No US regulatory agencies (eg, the US Food and Drug Administration [FDA] or Department of Agriculture [USDA]) certify or approve EOs for quality and purity. Bottles labeled with “QAI” for Quality Assurance International or “USDA Organic” will ensure the plant constituents used in the EO are from organic farming but do not attest to quality or purity.

Manufacturers commonly use marketing terms such as “therapeutic grade” or “pure” to sell products, but again, these terms do not reflect the product’s quality or purity. A labeled single EO may contain contaminants, alcohol, or additional ingredients.⁷ When choosing to use EOs, identifying reputable brands is essential; one resource is the independent testing organization ConsumerLab.com.

It is important to assess the manufacturer and read ingredient labels before purchasing an EO to understand what the product contains. Reputable companies will identify the plant ingredient, usually by the formal Latin binomial name, and explain the extraction process. A more certain way to assess the quality and purity of an EO is to ask the manufacturer to provide a certificate of analysis and gas chromatography/mass spectroscopy (GC/MS) data for the specific product. Some manufacturers offer GC/MS test results on their website Quality page.⁸ Others have detailed information on quality and testing, and GC/MS test reports can be obtained.⁹ Yet another manufacturer has test results on a product page matching reports to batch codes.¹⁰

Which conditions have evidence of benefit from essential oils?

EOs currently are being studied for treatment of many conditions—including pain, GI disorders, behavioral health disorders, and women’s health issues. The **TABLE** summarizes the conditions treated, outcomes, and practical applications of EOs.¹¹⁻⁴⁴

Pain

■ **Headache.** As an adjunct to available medications and procedures for headache treatment, EOs are one of the nonpharmacologic modalities that patients and clinicians have at their disposal for both migraine and

tension-type headaches. A systematic review of 19 randomized controlled trials (RCTs) examining the effects of herbal ingredients for the acute treatment or prophylaxis of migraines found certain topically applied or inhaled EOs, such as peppermint and chamomile, to be effective for migraine pain alleviation; however, topically applied rose oil was not effective.¹¹⁻¹³ Note: “topical application” in these studies implies application of the EO to ≥ 1 of the following areas: temples, forehead, behind ears, or above upper lip/below the nose.

One RCT with 120 patients evaluated diluted intranasal peppermint oil and found that it reduced migraine intensity at similar rates to intranasal lidocaine.¹³ In this study, patients were randomized to receive one of the following: 4% lidocaine, 1.5% peppermint EO, or placebo. Two drops of the intranasal intervention were self-administered while the patient was in a supine position with their head suspended off the edge of the surface on which they were lying. They were instructed to stay in this position for at least 30 seconds after administration.

With regard to tension headache treatment, there is limited literature on the use of EOs. One study found that a preparation of peppermint oil applied topically to the temples and forehead of study participants resulted in significant analgesic effect.¹⁴

■ **Fibromyalgia.** Usual treatments for fibromyalgia include exercise, antidepressant and anticonvulsant medications, and stress management. Evidence also supports the use of inhaled and topically applied (with and without massage) lavender oil to improve symptoms.²⁶ Positive effects may be related to the analgesic, anti-inflammatory, sleep-regulating, and anxiety-reducing effects of the major volatile compounds contained in lavender oil.

In one RCT with 42 patients with fibromyalgia, the use of inhaled lavender oil was shown to increase the perception of well-being (assessed on the validated SF-36 Health Survey Questionnaire) after 4 weeks.²⁷ In this study, the patient applied 3 drops of an oil mixture, comprising 1 mL lavender EO and 10 mL of fixed neutral base oil, to the wrist and inhaled for 10 minutes before going to bed.

The use of a topical oil blend labeled “Oil

TABLE

Summary of essential oil uses, routes, and recommendations

Essential oil	Route ^a	SOR	Practical use	Comments
Peppermint				
Abort migraines and tension headaches ¹¹⁻¹⁴	Topical Intranasal	B	Apply 1-2 drops of oil to forehead and temples bilaterally	Many applicators and roll-ons are commercially available
Treat postoperative nausea ^{15,16}	Inhaled	C	Used via nebulization	Has been studied in blends
Improve symptoms in patients with irritable bowel syndrome ¹⁷⁻²⁰	Oral	B	Ingest ~180 mg PO capsule ≤ 3 times/d	Common adverse effects include heartburn and indigestion
Lavender				
Reduce anxiety symptoms ²¹⁻²⁵	Inhalation Topical with or without massage	B	Apply 1-2 drops of oil on a cloth, inhale a few minutes prior to start of a procedure	May also use diffusers/fans over a glass with oil to fill exam rooms with scent. However, concern for respiratory safety with prolonged exposure exists
Decrease fibromyalgia pain scores ²⁶⁻²⁸	Inhaled Topical massage	B	Combine 1 mL of lavender oil with 10 mL of carrier oil, place 3 drops on wrist and inhale for 10 minutes, keeping it ~10 cm away from nose	Patient can utilize inhalation daily prior to recommended exercise regimen
Improve insomnia ²⁹⁻³⁴	Inhaled	B	Dab oil on temples, back of ears, and chest prior to bedtime or spray EO solution onto pillow	May be used as needed
Reduce dysmenorrhea ³⁵⁻³⁷	Topical massage Inhaled	C	Apply via abdominal massage	Some studies included lavender blended with other EOs
Ginger				
Reduce chemotherapy-induced nausea ³⁸⁻⁴⁰	Inhaled	C	Utilize mask device for inhalation	Effect can be short lasting: 1 study used at 10-min intervals
Orange				
Decrease anxiety due to dental and other procedures ⁴¹⁻⁴⁴	Inhaled	C	Use diffusers/fans over a glass with oil to fill exam or waiting rooms with scent	Concern for respiratory safety with prolonged exposure exists

EOs, essential oils; SOR, strength of recommendation (see page 374 for definitions).

^a When used topically/directly on skin, all EOs should be diluted in an unscented carrier oil such as coconut, jojoba, olive, or sweet almond.

24” (containing camphor, rosemary, eucalyptus, peppermint, aloe vera, and lemon/orange) also has been shown to be more effective than placebo in managing fibromyalgia symptoms. A randomized controlled pilot study of 153 participants found that regular application of Oil 24 improved scores on pain scales and the Fibromyalgia Impact Questionnaire.²⁸

GI disorders

■ **Irritable bowel syndrome.** Peppermint oil relaxes GI smooth muscle, which has led

to investigation of its use in irritable bowel syndrome (IBS) symptom amelioration.¹⁷ One meta-analysis including 12 RCTs with 835 patients with undifferentiated IBS found that orally ingested peppermint EO capsules reduced patient-reported symptoms of either abdominal pain or global symptoms.¹⁸

One study utilized the Total IBS Symptom Score to evaluate symptom reduction in patients with IBS-D (with diarrhea) and IBS-M (mixed) using 180-mg peppermint EO capsules ingested 3 times daily. There was a significant improvement in abdominal

> Evidence supports the use of inhaled and topically applied lavender oil to improve fibromyalgia symptoms.

pain/discomfort, bloating/distension, pain at evacuation, and bowel urgency.¹⁹ A reduction in symptoms was observed after the first 24 hours of treatment and at the end of the 4-week treatment period.

In another study, among the 190 patients meeting Rome IV criteria for general (non-specific) IBS who were treated with 182-mg peppermint EO capsules, no statistically significant reduction in overall symptom relief was found (based on outcome measures by the FDA and European Medicines Agency). However, in a secondary outcome analysis, peppermint oil produced greater improvements than placebo for the alleviation of abdominal pain, discomfort, and general IBS severity.²⁰

■ Chemotherapy-induced nausea and vomiting. Patients with cancer undergoing chemotherapy often explore integrative medicine approaches, including aromatherapy, to ameliorate adverse effects and improve quality of life.³⁸ A few small studies have shown potential for the use of inhaled ginger oil to reduce nausea and vomiting severity and improve health-related quality-of-life measures in these patients.

For example, a study with 60 participants found that inhaling ginger EO for 10 minutes was beneficial for reducing both nausea and vomiting.³⁹ A single-blind, controlled, randomized crossover study of 60 patients with breast cancer receiving chemotherapy showed that ginger EO inhaled 3 times per day for 2 minutes at a time can decrease the severity of nausea but had no effect on vomiting. The same study showed that health-related quality of life improved with the ginger oil treatment.⁴⁰

Other EOs such as cardamom and peppermint show promise as an adjunctive treatment for chemotherapy-induced nausea and vomiting as well.³⁸

■ Postoperative nausea. A 2013 randomized trial of 303 patients examined the use of ginger EO, a blend of EOs (including ginger, spearmint, peppermint, and cardamom), and isopropyl alcohol. Both the single EO and EO blend significantly reduced the symptom of nausea. The number of antiemetic medications requested by patients receiving an EO

also was significantly reduced compared to those receiving saline.¹⁵

The use of EOs to reduce nausea after cardiac operations was reviewed in an RCT of 60 surgical candidates using 10% peppermint oil via nebulization for 10 minutes.¹⁶ This technique was effective in reducing nausea during cardiac postoperative periods. Although the evidence for the use of EOs for postoperative nausea is not robust, it may be a useful and generally safe approach for this common issue.

Behavioral health

■ Insomnia. EOs have been used as a treatment for insomnia traditionally and in complementary, alternative, and integrative medicine. A 2014 systematic review of 15 quantitative studies, including 11 RCTs, evaluated the hypnotic effects of EOs through inhalation, finding the strongest evidence for lavender, jasmine, and peppermint oils.²⁹ The majority of the studies in the systematic review used the Pittsburgh Sleep Quality Index (PSQI) to evaluate EO effectiveness. A more recent 2021 systematic review and meta-analysis that evaluated 34 RCTs found that inhalation of EOs, most notably lavender aromatherapy, is effective in improving sleep problems such as insomnia.³⁰

Findings from multiple smaller RCTs were consistent with those of the aforementioned systematic reviews. For example, in a well-conducted parallel randomized double-blind placebo-controlled trial of 100 people using orally ingested lemon verbena, the authors concluded that this intervention can be a complementary therapy for improving sleep quality and reducing insomnia severity.³¹ Another RCT with 60 participants evaluated an inhaled EO blend (lemon, eucalyptus, tea tree, and peppermint) over 4 weeks and found lowered perceived stress and depression as well as better sleep quality, but no influence on objective physiologic data such as stress indices or immune states.³²

In a 2020 randomized crossover placebo-controlled trial of 37 participants with diabetes reporting insomnia, inhaled lavender improved sleep quality and quantity, quality of life, and mood but not physiologic or metabolic measures, such as fasting glucose.³³

Findings were similar in a cohort of cardiac rehabilitation patients ($n = 37$) who were treated with either an inhaled combination of lavender, bergamot, and ylang ylang, or placebo; cotton balls infused with the intervention oil or placebo oil were placed at the patient's bedside for 5 nights. Sleep quality of participants receiving intervention oil was significantly better than the sleep quality of participants receiving the placebo oil as measured by participant completion of the PSQI.³⁴

■ **Anxiety** is a common disorder that can be managed with nonpharmacologic treatments such as yoga, deep breathing, meditation, and EO therapy.^{21,22} In a systematic review and meta-analysis, the inhaled and topical use (with or without massage) of lavender EO was shown to improve psychological and physical manifestations of anxiety.²³ Lavender EO is purported to affect the parasympathetic nervous system via anxiolytic, sedative, analgesic, and anticonvulsant properties.²⁴ One systematic review and meta-analysis evaluating the anxiolytic effect of both inhaled and topical lavender EO found improvement in several biomarkers and physiologic data including blood pressure, heart rate, and cortisol levels, as well as a reduction in self-reported levels of anxiety, compared with placebo.²⁵

Anxiety related to dental procedures is another area of study for the use of EOs. Two RCTs demonstrate statistically significant improvement in anxiety-related physiologic markers such as heart rate, blood pressure, and salivary cortisol levels in children who inhaled lavender EO during dental procedures.^{41,42} In 1 of the RCTs, the intervention was described as 3 drops of 100% lavender EO applied to a cloth and inhaled over the course of 3 minutes.⁴¹ Additionally, 2 studies found that orange EO was beneficial for dental procedure-induced anxiety, reducing pulse rates, cortisol levels, and self-reported anxiety.^{43,44}

■ **Dementia-related behavioral disturbances.** A small, poorly designed study examining 2 EO blends—rosemary with lemon and lavender with orange—found some potential for improving cognitive function, especially in patients with Alzheimer dis-

ease.⁴⁵ A Cochrane review of 13 RCTs totaling 708 patients concluded that it is not certain from the available evidence that EO therapy benefits patients with dementia in long-term-care facilities and hospital wards.⁴⁶ Given that reporting of adverse events in the trials was poor, it is not possible to make conclusions about the risk vs benefit of EO therapy in this population.

Women's health

■ **Dysmenorrhea.** Interest has grown in the use of EOs for dysmenorrhea symptom relief, and there is a small body of evidence demonstrating that a variety of oils—most notably lavender, rose, and clary sage—may reduce symptom severity. One meta-analysis of 9 RCTs and 12 controlled clinical trials including women with moderate-to-severe dysmenorrhea found that inhaled and/or topical use of singular or mixed lavender, clary sage, rose, marjoram, and cinnamon EOs demonstrated the strongest evidence of effectiveness in reducing menstrual cramping.³⁵

In a randomized, double-blind clinical trial of 48 women, a cream-based blend of lavender, clary sage, and marjoram EO (used topically in a 2:1:1 ratio diluted in unscented cream at 3% concentration and applied daily via abdominal massage) reduced participants' reported menstrual pain symptoms and duration of pain.³⁶ In a meta-analysis of 6 studies, topical abdominal application of EO (mainly lavender with or without other oils) with massage showed superiority over massage with placebo oils in reducing menstrual pain.³⁷ A reduction in pain, mood symptoms, and fatigue in women with premenstrual symptoms was seen in an RCT of 77 patients using 3 drops of inhaled lavender EO.⁴⁷

■ **Labor.** There is limited evidence for the use of EOs during labor. In an RCT of 104 women, patient-selected diffused EOs, including lavender, rose geranium, citrus, or jasmine, were found to help lower pain scores during the latent and early active phase of labor. There were no differences in labor augmentation, length of labor, perinatal outcomes, or need for additional pain medication.⁴⁸



Use of an inhaled blend of lemon, eucalyptus, tea tree, and peppermint was associated with lower perceived stress and depression as well as better sleep quality.

CONTINUED

➤ There is a small body of evidence demonstrating that a variety of essential oils, most notably lavender, rose, and clary sage, may reduce dysmenorrhea symptom severity.

Other uses

■ **Antimicrobial support.** Some common EOs that have demonstrated antimicrobial properties are oregano, thyme, clove, lavender, clary sage, garlic, and cinnamon.^{49,50} Topical lemongrass and tea tree EOs have shown some degree of efficacy as an alternative treatment for acne, decolonization of methicillin-resistant *Staphylococcus aureus*, and superficial fungal infections.⁵¹ Support for an oral mixture of EOs labeled *Myrtol* (containing eucalyptus, citrus myrtle, and lavender) for viral acute bronchitis and sinusitis was found in a review of 7 studies.⁵² More research needs to be done before clear recommendations can be made on the use of EOs as antimicrobials, but the current data are encouraging.

■ **Insect repellent.** Reviews of the insect-repellent properties of EOs have shown promise and are in the public's interest due to increasing awareness of the potential health and environmental hazards of synthetic repellents.⁵³ Individual compounds present in EOs such as citronella/lemongrass, basil, and eucalyptus species demonstrate high repellent activity.⁵⁴ Since EOs require frequent reapplication for efficacy due to their highly volatile nature, scientists are currently developing a means to prolong their protection time through cream-based formulations.⁵⁵

The bottom line

Because of the ubiquity of EOs, family physicians will undoubtedly be asked about them by patients, and it would be beneficial to feel comfortable discussing their most common uses. For most adult patients, the topical and periodic inhaled usage of EOs is generally safe.⁵⁶

There is existing evidence of efficacy for a number of EOs, most strongly for lavender and peppermint. Future research into EOs should include higher-powered and higher-quality studies in order to provide more conclusive evidence regarding the continued use of EOs for many common conditions. More evidence-based information on dosing, application/use regimens, and safety in long-term use also will help

providers better instruct patients on how to utilize EOs effectively and safely. **JFP**

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