Kaur S, Kieu J, Rustad AM, Bodemer AA. An Overview of Hyperhidrosis Treatment Options with an Emphasis on Iontophoresis as a Non-invasive, Effective, and Safe Treatment Modality. *Journal of Integrative Dermatology*. Published online 2026.

Review Article

An Overview of Hyperhidrosis Treatment Options with an Emphasis on Iontophoresis as a Non-invasive, Effective, and Safe Treatment Modality

Simran Kaur, MD[1], Jacqueline Kieu, BS[2], Andrea M. Rustad, MD[3], Apple A. Bodemer, MD[1,3,4]

[1] School of Medicine and Public Health, University of Wisconsin–Madison, [2] School of Medicine, Loma Linda University, [3] Department of Dermatology, University of Wisconsin–Madison, [4] Section Chief of Dermatology, William S. Middleton Memorial Veterans Hospital

Keywords: Hyperhidrosis, Primary Hyperhidrosis, Iontophoresis, Secondary Hyperhidrosis, Palmar and plantar hyperhidrosis, Non-invasive treatment modality, MiraDry, Psychological Impact

Journal of Integrative Dermatology

Relevance

Hyperhidrosis, a condition characterized by excessive sweating beyond physiological needs, most commonly affects adolescents and young adults aged 18-39, though it can also present in pediatric populations. Approximately 15.3 million people in the United States, about 4.8% of the population, are affected. Despite its prevalence, evidence remains limited for many treatment modalities, particularly iontophoresis.

Objectives

The purpose of this manuscript is to review the general treatment options for hyperhidrosis, with a specific focus on iontophoresis as an integrative approach.

Methods

A comprehensive literature search was conducted using PubMed, Google Scholar, and the University of Wisconsin Libraries. Search terms included various combinations of keywords such as “hyperhidrosis”, “primary and secondary hyperhidrosis”, “treatment management”, “quality of life”, “prevalence”, “antiperspirants”, “iontophoresis” (including its mechanisms and guidelines), “botulinum toxin”, “anticholinergics”, “MiraDry”, “surgical management”, “psychological impact”, and “supplement.” Studies were selected based on their relevance to the pathophysiology and therapeutic applications of hyperhidrosis, with no restrictions on publication date or language.

Results

Treatment options for hyperhidrosis include topical antiperspirants, topical anticholinergics, oral anticholinergics, botulinum toxin injections, surgical sympathectomy, microwave-based treatment, iontophoresis, multidisciplinary care and supplements. Iontophoresis is considered a first-line, non-invasive treatment for palmar and plantar hyperhidrosis. It may also be used for axillary hyperhidrosis when compatible machines with specialized attachments are available. The procedure involves immersing the affected areas, typically the hands or feet, most commonly in tap water or medicated solutions such as aluminum salts, glycopyrrolate, glycopyrronium bromide, or poldine methosulfate while a mild electrical current is applied. Clinical studies have shown that iontophoresis can significantly improve quality of life, with symptom relief lasting up to three months following treatment. In pediatric patients, approximately 50% of those with primary palmar hyperhidrosis report noticeable symptom improvement. Treatment protocols vary depending on the manufacturer, but commonly recommend 10-30-minute sessions, administered 3-5 times per week. One retrospective review found that clinical benefit was typically observed after an average of 15 treatment sessions, though studies noted improvements between 6-15 sessions.

Conclusions

Hyperhidrosis can significantly impact quality of life, but a range of treatments can offer relief. Iontophoresis stands out as a safe, effective, and drug-free option for many patients, particularly those with focal symptoms. Further research is needed to standardize treatment protocols and better understand long-term outcomes.

INTRODUCTION

Hyperhidrosis is a medical condition characterized by excessive sweating that exceeds the body's physiological need for temperature regulation.[1] While hyperhidrosis most commonly affects adolescents and young adults aged 18-39, it can also present in pediatric populations. Studies have documented the onset of primary palmar hyperhidrosis as early as 5 years old, with typical onset occurring between 7 to 15 years old.[2-4] Estimates suggest that about 15.3 million people in the United States, roughly 4.8% of the population, are impacted by some form of hyperhidrosis.[2] Despite its prevalence, there remains a lack of robust evidence for certain treatment modalities, particularly iontophoresis.

This condition is typically caused by overactivity of the sympathetic nervous system, which over-stimulates cholinergic receptors on eccrine sweat glands, especially in areas where these glands are most numerous, such as the palms, soles, and underarms.[3,5] Hyperhidrosis is classified into two main types: primary hyperhidrosis, which typically presents as focal sweating, commonly affecting areas like the palms, soles, or underarms, and secondary hyperhidrosis, which may be either focal or generalized and is usually associated with underlying medical conditions.[6,7]

Primary hyperhidrosis typically begins during childhood or adolescence and is characterized by excessive sweating localized to specific areas such as the axillae, palms, soles, and craniofacial areas.[7] Excessive perspiration occurs during waking hours and disappears during sleep.[8] While it lacks a clearly identifiable underlying cause, evidence suggests that genetic predisposition plays a significant role in its development. A positive family history is frequently observed, with one study reporting that up to 65% of patients had affected relatives.[9,10] Secondary hyperhidrosis is linked to an underlying cause such as systemic diseases or adverse reactions to medication. This typically presents as more generalized and asymmetric sweat production.[7] A key clinical symptom that helps distinguish secondary from primary hyperhidrosis is the presence of significant night sweats during sleep which should only be seen in secondary.[8] Visible symptoms of hyperhidrosis include sweaty stains on clothing, shoes, or objects that are touched, waking up drenched in sweat, and sweat drops on the forehead.[8]

People suffering from hyperhidrosis often experience significant disruptions in their daily lives, including challenges in academic or professional performance, social interactions, and emotional well-being.[11] This condition can interfere with tasks such as writing, partaking in leisure or sports, or even shaking hands, contributing to embarrassment and social withdrawal.[11] As a result, effective treatment not only alleviates physical symptoms, but can also greatly enhance overall quality of life, improving both functional ability and psychological health.[10]

METHODS

We aimed to review the general treatment options for hyperhidrosis, with a specific focus on iontophoresis. A literature review was conducted using PubMed, Google Scholar, and the University of Wisconsin Libraries. Search terms included combinations of the following: "hyperhidrosis," "primary hyperhidrosis," "secondary hyperhidrosis," "treatment management," "quality of life," "prevalence," "antiperspirants," "iontophoresis," "mechanisms of iontophoresis," "iontophoresis guidelines," "botulinum toxin," "anticholinergics," "MiraDry," "surgical management," "psychological impact," and "supplements." Articles were not excluded based on publication date or language. Selection criteria prioritized relevance to the pathophysiology of iontophoresis and detailed descriptions of treatment approaches.

DISCUSSION

Management of hyperhidrosis follows a stepwise, individualized approach (Table 1).[12] Treatment typically begins with topical agents such as aluminum chloride 20% for mild to moderate cases.[12] If symptoms persist, options may escalate to botulinum toxin injections, oral anticholinergics, or device-based therapies like microwave thermolysis or iontophoresis for axillary or palmar/plantar hyperhidrosis.[12,13] Notably, iontophoresis and microwave thermolysis align with principles of integrative dermatology as they are non-invasive, energy-based, and often non-pharmacologic. They offer patients alternatives that minimize systemic exposure while supporting personalized care. In severe or refractory cases, surgical interventions such as endoscopic thoracic sympathectomy may be considered.[12] The choice of therapy depends on several factors, including the severity and location of symptoms, patient preferences, response to prior treatments, and any underlying comorbidities.[12] Each treatment modality carries its own profile of efficacy, side effects, and limitations, which must be carefully weighed in shared decision-making.[14]

TOPICAL AGENTS

Topical antiperspirants are considered the first-line treatment for mild to moderate focal hyperhidrosis.[15,16] These formulations most commonly contain aluminum chloride, but may also include aluminum chloride hexahydrate, aluminum sesquichlorohydrate, or aluminum lactate.[17-19] Although often categorized as conventional, aluminum-based antiperspirants can also be considered integrative due to their use of naturally occurring mineral salts, topical and localized application, and non-invasive mechanism of action. These work by forming temporary plugs within the eccrine sweat ducts, thereby reducing sweat production.[17] These are typically applied nightly to affected areas such as the underarms, palms, and soles until the desired outcome is achieved, then used as needed for maintenance.[17] However, their use is often limited by skin irritation, burning, or stinging, and they are generally not effective for severe cases or large treatment areas.[15,17]

When topical antiperspirants are insufficient, anticholinergic medications may be used in either topical or oral forms.[19,20] These agents reduce sweat production by blocking the action of acetylcholine at muscarinic receptors

on sweat glands.[20] Topical anticholinergic forms, including glycopyrrolate, glycopyrronium (Food and Drug Administration (FDA) approved for axillary hyperhidrosis), or oxybutynin. These are effective for localized areas like the palms, soles, axillae, and craniofacial area and are applied daily, though they may cause local irritation and have limited long-term safety data.[20]

ORAL ANTICHOLINERGICS

Oral anticholinergic agents, such as glycopyrrolate and oxybutynin, are effective in treating both focal and generalized hyperhidrosis. However, their use is often limited by systemic side effects including dry mouth, constipation, urinary retention, and blurred vision which can impact tolerability, particularly in older adults or those concurrently taking other medications with anticholinergic properties.[21] In clinical studies, glycopyrrolate has been initiated at doses as low as 0.5 mg, titrated up to a maximum of 8 mg daily, while oxybutynin typically starts at 2.5 mg, with doses reaching up to 20 mg per day. Notably, dry mouth tends to emerge at doses of 10 mg or higher of oxybutynin.[22] Anticholinergic medications are generally contraindicated in patients with glaucoma, paralytic ileus, Sjögren's syndrome, and myasthenia gravis, as they may exacerbate symptoms associated with these conditions.[19]

BOTULINUM TOXIN

Botulinum toxin injections are a highly effective treatment for focal hyperhidrosis, especially in the axillae, palms, and soles.[23] Botulinum toxin blocks the release of acetylcholine at the neuromuscular junction, preventing the activation of sweat glands and significantly reducing sweat production.[23,24] The injections are administered intradermally in the affected areas, typically every 4 to 6 months.[25] Adult studies have reported a wide dosing range of botulinum toxin from 20 to 400 units depending of the brand and location, with 50 units most commonly required to achieve anhidrosis in the axillary region.[25] Pediatric dosing varies by treatment site and botulinum toxin formulation, but the guidelines for Botox is up to 10 units per kilogram of body weight, with a maximum total dose of 340 units.[26] Although effective, this treatment presents several limitations. Injections can be painful, especially in sensitive areas such as the axillae, palms, and soles, and may lead to temporary muscle weakness, bruising, and discomfort. Additionally, the procedure is often cost prohibitive, as it may not be covered by insurance, and requires ongoing maintenance sessions to sustain results.[25,27]

ENDOSCOPIC THORACIC SYMPATHECTOMY

Surgical intervention, such as endoscopic thoracic sympathectomy (ETS), is generally reserved for severe cases of hyperhidrosis that do not respond to other treatments.[12,28] This minimally invasive procedure involves cutting, clipping, or cauterizing specific sympathetic nerves (eg, T2-T3 for palmar hyperhidrosis) to disrupt the nerve signals that trigger excessive sweating.[12,28] ETS is highly effective for treating palmar hyperhidrosis, but it carries several risks. These include compensatory sweating in other anatomical regions, infection, scarring, and pneumothorax. The latter may occur due to surgical trauma, as the procedure necessitates entry into the pleural cavity, increasing the potential for lung or pleural injury.[29,30]

MICROWAVE THERMOLYSIS

MiraDry (Figure 1) serves as a non-invasive, effective and generally safe treatment for primary axillary hyperhidrosis and bromhidrosis especially when compared to alternatives like drug therapies or ETS.[31,32] It gained FDA approval in 2002 for axillary hyperhidrosis and has demonstrated high patient satisfaction relative to other treatment modalities, with complete or near complete resolution of symptoms for years after 1-2 treatments.[33] The device uses microwave-based technology to deliver thermal energy to the junction between the deep dermal and subcutaneous fat layers.[13,33] This energy is selectively absorbed by tissues with high water content, allowing it to target sweat glands.[13,34,35] The resulting process, known as thermolytic obliteration, results in the destruction of eccrine and apocrine sweat glands and the surrounding deep dermis.[33] The duration of heat exposure is important as longer applications result in more extensive destruction of sweat glands.[33] Clinical studies have shown a statistically significant reduction in axillary sweat production measured both objectively and subjectively.[31] For instance, one study reported complete resolution or minimal sweating in 86% of patients six months after a single treatment session.[31] Treatment with the miraDry device takes 20-30 minutes per axilla with patients sometimes requiring two sessions, the second one at least three months after the first.[13] Reported side effects are minimal and temporary, such as swelling and redness.[32] However, rare, but more serious and even fatal complications have been reported in case reports, including necrotizing fasciitis, brachial plexus injury, and inflammatory nodules.[36-38] An additional limitation is its high cost, especially when compared to topical therapies.[35] Moreover, it is only FDA-approved for axillary hyperhidrosis, limiting its use for other regions of the body.[13] Despite these rare adverse events and limitations, MiraDry is generally considered safe when used appropriately for axillary hyperhidrosis.[35]

IONTOPHORESIS

Although these other treatments can offer symptomatic relief, iontophoresis stands out as a non-invasive and potentially drug-free option that can be highly effective.[3] Iontophoresis, first introduced in the 1930s, has consistently demonstrated both safety and efficacy. It can be considered a first-line therapeutic option, particularly for managing palmar and plantar hyperhidrosis.[3] It involves immersing the affected area, typically the hands or feet, into a solution, often tap water or a medicated medium such as aluminum salts, glycopyrrolate, glycopyrronium bromide, or poldine methosulfate, while a mild electrical current between 15-20 mA is passed through (Figure 2).[3,40] This setup

Figure 1. Depiction of microwave thermolysis, miraDry, machine (from sweathelp.org)[39]

Figure 2. Depiction of iontophoresis setup for palmar hyperhidrosis[44]

makes it less practical for axillary hyperhidrosis due to the difficulty of immersing the underarms in a medium, although some manufacturers have created specialized attachments to address these limitations.[41,42] Although the exact mechanism of action remains unclear, several theories exist. One suggests that iontophoresis may block sweat glands by promoting keratin plug formation or altering the electrochemical gradient, thereby impairing eccrine gland function. Another hypothesis proposes that the treatment causes jamming of mineral nanoparticles within the sweat ducts, temporarily halting sweat production.[43]

Studies have demonstrated that this treatment can significantly enhance quality of life, with symptom relief lasting up to three months post-treatment.[3] In pediatric populations, approximately 50% of patients with primary palmar hyperhidrosis reported symptom improvement.[41] Currently, there are no standardized guidelines regarding the optimal timing and frequency of sessions. These parameters may vary depending on the device manufacturer. However, treatment protocols commonly recommend 10-30-minute sessions, administered 3-5 times per week (Table 1).[45] One retrospective review observed clinical benefit after an average of 15 treatment sessions in adolescent patients.[42] However, typically 6 to 15 treatment sessions are administered over a period of 3 to 4 weeks to achieve initial improvement. Maintenance sessions are then recommended at intervals of every 1 to 4 weeks, depending on symptom recurrence and patient response.[40] Several FDA-approved manufacturers have developed devices that show promising results. These include RA Fischer Co. Corp., Dermadry Laboratories, Hidrex GmbH, Hightech Production, s.r.o., and Saalmann Medical GmbH & Co. KG.[42]

Despite its advantages, iontophoresis has limitations. Although not severe and generally well tolerated, side effects can include skin dryness, redness, itching, pain, and most commonly paresthesia which are usually transient and tolerable.[3,43,46-48] One study reported that tingling began within the first 30 minutes of application but gradually subsided and resolved completely thereafter.[48] Additionally, it often requires multiple sessions before noticeable improvement which may impact patient adherence.[41] Even though it might be cost-effective over time, iontophoresis devices can be expensive, with out-of-pocket costs ranging from $450 to $1,075 (Table 2). The upfront cost of purchasing an in-home device or repeated office visits can be cost-prohibitive for patients depending on their insurance coverage and resources, which can further limit accessibility.[41] Furthermore, the use of iontophoresis would benefit from more randomized controlled trials to not only better understand its mechanism of action and long-term efficacy, but also to standardize treatment protocols, evaluate long-term safety, and guide device innovation.

MULTIDISCIPLINARY CARE

As previously discussed, hyperhidrosis can substantially impair psychosocial functioning, with negative effects on academic performance, occupational productivity, and social engagement. These disruptions may hinder patients' ability to form and maintain relationships and carry out daily activities effectively.[10,11] In addition to addressing the physical manifestations of hyperhidrosis, integrating psychological support, such as consultation with an internist or psychiatrist, can be instrumental in managing the emotional and mental burden associated with the condition.[49] Notably, the relationship between hyperhidrosis and psychological stress is bidirectional: anxiety and emotional distress can exacerbate sweating, a phenomenon referred to as "emotional sweating," which typically subsides during sleep and periods of relaxation. This interplay underscores the importance of psychiatric evaluation, stress reduction strategies, and lifestyle modifications as integral components of comprehensive hyperhidrosis care.[14,50]

Given this interplay, dermatologists play a vital role not only in treating the physical symptoms but also in identifying psychological comorbidities such as generalized or social anxiety that may accompany or aggravate the dis-

Table 1. Summary of First- and Second-Line Treatments for Primary Focal Hyperhidrosis

Treatment	Effective Areas	Treatment Regimen	Side Effects / Risks	Costs / Insurance Notes	Outcomes
Topical Antiperspirants (Aluminum salts)	Axillae, palms, soles	Nightly application; reduce to maintenance use. Concentrations vary (eg, 15–20% aluminum chloride)	Skin irritation, burning, stinging	Low cost; often OTC; *covered	Effective for mild to moderate cases; limited efficacy in severe or large areas
Topical Anticholinergics (eg, glycopyrronium)	Axillae, craniofacial, palms/soles	Daily application; available in wipes, creams, or gels	Local irritation, limited long-term safety data	Moderate cost: prescription required; *often covered	Good option for localized focal sweating; studies show significant reduction in sweat production
Oral Anticholinergics (eg, glycopyrrolate)	Generalized and focal areas	Daily dosing; dosage adjusted by tolerance (commonly 1-2 mg 1-3x/day)	Dry mouth, constipation, blurred vision; caution in elderly or polypharmacy patients	Prescription; moderate expense; *may be covered	Effective for both types of sweating; dose-limited by tolerability
Botulinum Toxin Injections	Axillae, palms, soles	Intradermal injections every 3-6 months; requires skilled administration	Pain (especially in palms/soles), temporary muscle weakness, bruising	High cost; usually *covered with documentation	Highly effective; lasts 3-6 months
Microwave Thermolysis (MiraDry)	Axillae	Sessions: 20-30 minutes, second session 3 months after the first	Most common: swelling and erythema Rare: necrotizing fasciitis, brachial plexus injury, and inflammatory nodules	High cost; usually an in-office procedure	Highly effective with permanent results
Iontophoresis	Palms, soles (axillae with adapters)	Sessions: 10-30 mins, 3-5 times weekly; maintenance required; response seen after average 15 sessions	Paresthesia, dry skin, redness, itching; local discomfort	Device cost: $450-$1,075; *may be covered depending on insurer	Symptom relief lasts up to 3 months; ~50% improvement in children with palmar hyperhidrosis
Surgical Sympathectomy (ETS)	Palms (main indication)	Minimally invasive; targets T2-T3 nerves	Compensatory sweating (up to 90%), pneumothorax, infection, scarring	High cost; hospital procedure; *usually covered as last resort	Very effective (high success rate), but permanent, with high risk profile

* Indicates that insurance may cover the treatment under certain conditions or with documentation often requiring failed first line treatments (generally topical or oral agents).

order.[51] Routine screening for mood or anxiety symptoms, empathetic discussion of emotional distress, and timely referral to internists, psychiatrists, or clinical psychologists can optimize outcomes.[52] In addition, dermatologists can recommend mind-body interventions such as hypnosis as adjunct therapies in a comprehensive, integrated care plan.[53]

Clinical hypnosis has shown benefit in small studies and case reports when combined with standard hyperhidrosis treatments. One study demonstrated that hypnosis improved comfort and tolerability during botulinum toxin injections for palmar hyperhidrosis.[54] Similarly, a case report described successful control of sweating and social anxiety symptoms when hypnosis was integrated with conventional therapy.[55] Though data remain preliminary, these findings lend support to the therapeutic value of hypnosis in reducing anxiety-induced sweating and enhancing procedural acceptance.

Table 2. FDA approved iontophoresis device manufacturers and out of pocket costs.***

Manufacturer	Device Name	Out of Pocket Cost*
RA Fischer Co. Corp.	The Fischer	$750-1,075
Dermadry Laboratories, Inc	Dermadry	$450-500
Hidrex GmbH	DVP1000	$695-915
Saalmann Medical GmbH & Co. KG	Saalio Set	$654-679**

*Pricing tiers based on treatment coverage ranging from axillary-only to hand/foot sets and all-inclusive systems. Pricing information was obtained directly from each manufacturer's official website.
**Price converted from Euros to USD; product is available to ship to US.
***Prices were recorded on June 27th, 2025.

OMEGA-3-FATTY ACIDS

Omega-3 fatty acids are dietary supplements with a broad range of potential health benefits, including the modulation of vasomotor symptoms, such as night sweats, which may contribute to secondary hyperhidrosis in women undergoing the menopausal transition.[56] Preliminary data from a small single-blind study demonstrated a reduction in the frequency of vasomotor symptoms following omega-3 supplementation; however, the limited sample size and unclear statistical significance necessitate cautious interpretation.[56] Additional evidence suggests that omega-3 supplementation may attenuate both the frequency and intensity of vasomotor symptoms, although findings remain variable across studies.[57] Taken together, these observations support a potential therapeutic role for omega-3 fatty acids in the management of thermoregulatory disturbances, including hyperhidrosis, in this population.

CONCLUSION

Overall, hyperhidrosis is a common and often underrecognized condition that significantly affects the quality of life of all age groups, from children to adults.[2,3,11] Beyond the physical discomfort of excessive sweating, commonly affecting the hands, feet, and underarms, patients frequently experience emotional distress, social withdrawal, and reduced self-esteem.[11] A range of treatment options are available with various benefits and risks depending on patient characteristics and anatomic site(s) (Table 1). While additional randomized controlled trials and broader clinical applications could be helpful to fully assess its efficacy and establish standardized treatment protocols, iontophoresis emerges as a particularly promising option as it is safe, non-invasive, and capable of empowering individuals to manage their symptoms and enhance their quality of life.[3]

FUNDING

No funding related to this manuscript was obtained.

PATIENT CONSENT ON FILE

This study did not require approval by the institutional review board.

CONFLICTS OF INTEREST DISCLOSURES

The authors have no relevant conflicts of interest to disclose.

Submitted: September 04, 2025 PDT. Accepted: October 29, 2025 PDT.

REFERENCES

1. Brackenrich J, Medeus CF. Hyperhidrosis. In: *StatPearls*. StatPearls Publishing; 2022.

2. Doolittle J, Walker P, Mills T, Thurston J. Hyperhidrosis: an update on prevalence and severity in the United States. *Arch Dermatol Res*. 2016;308(10):743-749. doi:10.1007/s00403-016-1697-9

3. Nastase F, Busila C, Nicolescu AC, Marin CM, Tatu AL. Iontophoresis Improves the Impact on the Quality of Life of Children with Primary Hyperhidrosis-A Prospective Study and a Short Review. *Children (Basel)*. 2024;11(10):1253. doi:10.3390/children11101253

4. Lai FC, Tu YR, Li YP, et al. Nation wide epidemiological survey of primary palmar hyperhidrosis in the People's Republic of China. *Clin Auton Res*. 2015;25(2):105-108. doi:10.1007/s10286-014-0259-5

5. Wohlrab J, Bechara FG, Schick C, Naumann M. Hyperhidrosis: A Central Nervous Dysfunction of Sweat Secretion. *Dermatol Ther (Heidelb)*. 2023;13(2):453-463. doi:10.1007/s13555-022-00885-w

6. Gelbard CM, Epstein H, Hebert A. Primary pediatric hyperhidrosis: a review of current treatment options. *Pediatr Dermatol*. 2008;25(6):591-598. doi:10.1111/j.1525-1470.2008.00782.x. PMID:19067862

7. Nawrocki S, Cha J. The etiology, diagnosis, and management of hyperhidrosis: A comprehensive review: Etiology and clinical work-up. *J Am Acad Dermatol*. 2019;81(3):657-666. doi:10.1016/j.jaad.2018.12.071

8. Kisielnicka A, Szczerkowska-Dobosz A, Purzycka-Bohdan D, Nowicki RJ. Hyperhidrosis: disease aetiology, classification and management in the light of modern treatment modalities. *Postepy Dermatol Alergol*. 2022;39(2):251-257. doi:10.5114/ada.2022.115887

9. Schlereth T, Dieterich M, Birklein F. Hyperhidrosis--causes and treatment of enhanced sweating. *Dtsch Arztebl Int*. 2009;106(3):32-37. doi:10.3238/arztebl.2009.0032

10. McConaghy JR, Fosselman D. Hyperhidrosis: Management Options. *Am Fam Physician*. 2018;97(11):729-734.

11. Parashar K, Adlam T, Potts G. The Impact of Hyperhidrosis on Quality of Life: A Review of the Literature. *Am J Clin Dermatol*. 2023;24(2):187-198. doi:10.1007/s40257-022-00743-7

12. Walling HW, Swick BL. Treatment options for hyperhidrosis. *Am J Clin Dermatol*. 2011;12(5):285-295. doi:10.2165/11587870-000000000-00000

13. Glaser DA, Galperin TA. Local procedural approaches for axillary hyperhidrosis. *Dermatol Clin*. 2014;32(4):533-540. doi:10.1016/j.det.2014.06.014

14. Dunford L, Clifton AV, Stephenson J, et al. Interventions for hyperhidrosis. *Cochrane Database Syst Rev*. 2022;2022(2):CD015135. doi:10.1002/14651858.CD015135

15. Streker M, Kerscher M. Antiperspirantien bei der Behandlung der fokalen Hyperhidrose [Antiperspirants for the therapy of focal hyperhidrosis]. *Hautarzt*. 2012;63(6):452-455. doi:10.1007/s00105-012-2330-2

16. Pariser DM, Ballard A. Topical therapies in hyperhidrosis care. *Dermatol Clin*. 2014;32(4):485-490. doi:10.1016/j.det.2014.06.008

17. Thianboonsong T, Kanokrungsee S, Paichitrojjana A, Udompataikul M, Kamanamool N, Rojhirunsakool S. Efficacy and tolerability of 20% aluminum sesquichlorohydrate vs 20% aluminum chloride for the treatment of axillary hyperhidrosis: A randomized controlled trial. *Dermatol Ther*. 2020;33(6):e14354. doi:10.1111/dth.14354

18. Lütgerath C, Weiß C, Faulhaber J, Karsai S. Comparison of a novel aluminum lactate-based with an aluminum chloride-based antiperspirant in excessive axillary and inguinal perspiration: first randomized controlled trial. *J Dtsch Dermatol Ges*. 2022;20(12):1589-1601. doi:10.1111/ddg.14898

19. Wong NS, Adlam TM, Potts GA, Farshchian M. Hyperhidrosis: A Review of Recent Advances in Treatment with Topical Anticholinergics. *Dermatol Ther (Heidelb)*. 2022;12(12):2705-2714. doi:10.1007/s13555-022-00838-3

20. Morgado-Carrasco D, de Lucas R. Topical Anticholinergics in the Management of Focal Hyperhidrosis in Adults and Children. A Narrative Review. Anticolinérgicos tópicos en el manejo de la hiperhidrosis focal en adultos y niños. Una revisión narrativa. *Actas Dermosifiliogr*. 2024;115(4):356-367. doi:10.1016/j.ad.2023.09.006

21. Hilmer SN, Gnjidic D. The anticholinergic burden: from research to practice. *Aust Prescr*. 2022;45(4):118-120. doi:10.18773/austprescr.2022.031. PMID:36110165

22. Cruddas L, Baker DM. Treatment of primary hyperhidrosis with oral anticholinergic medications: a systematic review. *J Eur Acad Dermatol Venereol*. 2017;31(6):952-963. doi:10.1111/jdv.14081

23. Heckmann M, Ceballos-Baumann AO, Plewig G, Hyperhidrosis Study Group. Botulinum toxin A for axillary hyperhidrosis (excessive sweating). *N Engl J Med*. 2001;344(7):488-493. doi:10.1056/NEJM200102153440704

24. Lowe N, Naumann M, Eadie N. Treatment of hyperhidrosis with Botox (onabotulinumtoxinA): Development, insights, and impact. *Medicine (Baltimore)*. 2023;102(S1):e32764. doi:10.1097/MD.0000000000032764

25. Wollina U, Karamfilov T, Konrad H. High-dose botulinum toxin type A therapy for axillary hyperhidrosis markedly prolongs the relapse-free interval. *J Am Acad Dermatol*. 2002;46(4):536-540. doi:10.1067/mjd.2002.118341

26. AbbVie Inc. *Botox (onabotulinumtoxinA) for Injection, for Intramuscular, Intradetrusor, or Intradermal Use [Prescribing Information]*. AbbVie Inc; 2024. Accessed August 2, 2025. https://www.rxabbvie.com/pdf/botox_pi.pdf

27. Castiglione L, Murariu M, Boeriu E, Enatescu I. Assessing Botulinum Toxin Effectiveness and Quality of Life in Axillary Hyperhidrosis: A One-Year Prospective Study. *Diseases*. 2024;12(1):15. doi:10.3390/diseases12010015

28. Stolman LP. Hyperhidrosis: medical and surgical treatment. *Eplasty*. 2008;8:e22.

29. Moran KT, Brady MP. Surgical management of primary hyperhidrosis. *Br J Surg*. 1991;78(3):279-283. doi:10.1002/bjs.1800780306

30. Kux M. Thoracic endoscopic sympathectomy in palmar and axillary hyperhidrosis. *Arch Surg*. 1978;113(3):264-266. doi:10.1001/archsurg.1978.01370150036005

31. Wimmer F, Ramic A, Nolte JP, et al. Evaluation of Efficacy and Safety of miraDry®Procedure in the Treatment of Primary Axillary Hyperhidrosis. *Aesth Plast Surg*. 2025;49:2545-2551. doi:10.1007/s00266-024-04558-1

32. Tanzella U, Ueberreiter K, Bell A, Krapohl MA, Krapohl BD. Patient satisfaction after miraDry® treatment for axillary hyperhidrosis. Results of an online patient survey after miraDry® treatment to reduce excessive axillary sweating. *GMS Interdiscip Plast Reconstr Surg DGPW*. 2024;13:Doc06. doi:10.3205/iprs000188

33. Lin MJ, Dubin DP, Genece J, Younessi S, Rai S, Khorasani H. A survey of long-term results with microwave energy device for treating axillary hyperhidrosis. *J Cosmet Laser Ther*. 2021;23(3-4):49-51. doi:10.1080/14764172.2021.1957115

34. Ge Y, Liu J, Zhang R. Comparison of Microwave-Based Therapy and Negative-Pressure Suction-Curettage for Axillary Hyperhidrosis and Bromhidrosis: A Retrospective Analysis. *Ann Plast Surg*. 2024;93(2S Suppl 1):S86-S88. doi:10.1097/SAP.0000000000003929

35. Tan Y, Huang W, Liu J, et al. The application of microwaves in axillary hyperhidrosis: Curative effect observation of a pathological examination over 1 year. *J Cosmet Dermatol*. 2024;23(1):134-140. doi:10.1111/jocd.15909

36. Wen S, Unuma K, Makino Y, Mori H, Uemura K. Fatal consequence after MiraDry® treatment: Necrotizing fasciitis complicated with streptococcal toxic shock syndrome. *Leg Med (Tokyo)*. 2022;58:102095. doi:10.1016/j.legalmed.2022.102095

37. Puffer RC, Bishop AT, Spinner RJ, Shin AY. Bilateral Brachial Plexus Injury After MiraDry Procedure for Axillary Hyperhidrosis. *World Neurosurg*. 2019;124:370-372. doi:10.1016/j.wneu.2019.01.093

38. Aleisa A, Feingold DS. Development of inflammatory nodules and scarring mimicking hidradenitis suppurativa after treatment of axillary hyperhidrosis using a microwave-based energy device. *JAAD Case Rep*. 2020;6(10):999-1000. doi:10.1016/j.jdcr.2020.03.006

39. International Hyperhidrosis Society. miraDry treatment device [image]. SweatHelp.org. Accessed October 6, 2025. https://www.sweathelp.org/treatments-hcp/miradry.html

40. Gregoriou S, Sidiropoulou P, Kontochristopoulos G, Rigopoulos D. Management Strategies Of Palmar Hyperhidrosis: Challenges And Solutions. *Clin Cosmet Investig Dermatol*. 2019;12:733-744. doi:10.2147/CCID.S210973

41. Dagash H, McCaffrey S, Mellor K, Roycroft A, Helbling I. Tap water iontophoresis in the treatment of pediatric hyperhidrosis. *J Pediatr Surg*. 2017;52(2):309-312. doi:10.1016/j.jpedsurg.2016.11.026

42. Remington C, Ruth J, Hebert AA. Primary hyperhidrosis in children: A review of therapeutics. *Pediatr Dermatol*. 2021;38(3):561-567. doi:10.1111/pde.14551

43. Griffen BD. Proposed mechanism of action of tap water iontophoresis for treatment of hyperhidrosis. *Cogent Medicine*. 2018;5(1). doi:10.1080/2331205X.2018.1486783

44. Dermadry. Dermadry Hands & Feet device. Dermadry. Accessed October 6, 2025. https://dermadry.com/products/dermadryhandsandfeet

45. Kim DH, Kim TH, Lee SH, Lee AY. Treatment of Palmar Hyperhidrosis with Tap Water Iontophoresis: A Randomized, Sham-Controlled, Single-Blind, and Parallel-Designed Clinical Trial. *Ann Dermatol*. 2017;29(6):728-734. doi:10.5021/ad.2017.29.6.728

46. Roustit M, Blaise S, Cracowski JL. Trials and tribulations of skin iontophoresis in therapeutics. *Br J Clin Pharmacol*. 2014;77(1):63-71. doi:10.1111/bcp.12128

47. Stolman LP. Treatment of excess sweating of the palms by iontophoresis. *Arch Dermatol*. 1987;123(7):893-896. doi:10.1001/archderm.1987.01660310061015

48. Li GL, Van Steeg TJ, Putter H, et al. Cutaneous side-effects of transdermal iontophoresis with and without surfactant pretreatment: a single-blinded, randomized controlled trial. *Br J Dermatol*. 2005;153(2):404-412. doi:10.1111/j.1365-2133.2005.06741.x

49. Trettin B, Hansen J, Bygum A. The impact of adolescents' everyday life experiences on their primary hyperhidrosis treatment - a qualitative study. *J Dermatolog Treat*. 2022;33(2):928-934. doi:10.1080/09546634.2020.1789541. PMID:32628056

50. Wohlrab J, Bechara FG, Schick C, Naumann M. Hyperhidrosis: A Central Nervous Dysfunction of Sweat Secretion. *Dermatol Ther (Heidelb)*. 2023;13(2):453-463. doi:10.1007/s13555-022-00885-w

51. Bahar R, Zhou P, Liu Y, et al. The prevalence of anxiety and depression in patients with or without hyperhidrosis (HH). *J Am Acad Dermatol*. 2016;75(6):1126-1133. doi:10.1016/j.jaad.2016.07.001

52. Baskaran N, Arunima A, Shah S, et al. Psychological Morbidity in Chronic Dermatological Disorders: A Review. *Indian Dermatol Online J*. 2025;16(3):381-388. doi:10.4103/idoj.idoj_458_24

53. Graubard R, Perez-Sanchez A, Katta R. Stress and Skin: An Overview of Mind Body Therapies as a Treatment Strategy in Dermatology. *Dermatol Pract Concept*. 2021;11(4):e2021091. doi:10.5826/dpc.1104a91

54. Maillard H, Bara C, Célérier P. Intérêt de l'hypnose dans les injections palmaires de toxine botulique A [Efficacy of hypnosis in the treatment of palmar hyperhidrosis with botulinum toxin type A]. *Ann Dermatol Venereol*. 2007;134(8-9):653-654. doi:10.1016/s0151-9638(07)91826-8

55. Kraft T, Kraft D. An integrative approach to the treatment of hyperhidrosis: review and case study. *Contemp Hypnosis*. 2007;24:38-45. doi:10.1002/ch.323

56. Hall E, Frey BN, Soares CN. Non-hormonal treatment strategies for vasomotor symptoms: a critical review. *Drugs*. 2011;71(3):287-304. doi:10.2165/11585360-000000000-00000

57. Iqbal AZ, Wu SK, Zailani H, et al. Effects of Omega-3 Polyunsaturated Fatty Acids Intake on Vasomotor Symptoms, Sleep Quality and Depression in Postmenopausal Women: A Systematic Review. *Nutrients*. 2023;15(19):4231. doi:10.3390/nu15194231