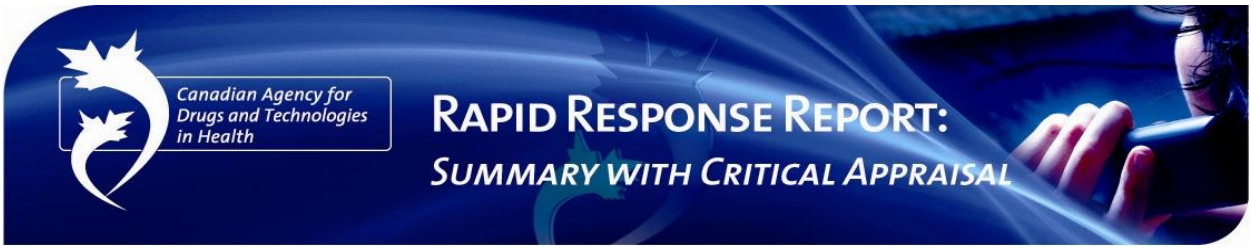

TITLE: Laser Therapy for Hyperhidrosis: A Review of the Clinical Effectiveness and Guidelines

DATE: 29 April 2015

CONTEXT AND POLICY ISSUES

Hyperhidrosis is a condition where sweating is in excess of that required for normal regulation and maintenance of body temperature.[1,2] It can be categorized as primary hyperhidrosis and secondary hyperhidrosis. Primary hyperhidrosis is not associated with any underlying condition, whereas secondary hyperhidrosis usually arises as a result of drug use, endocrine disturbances, or certain malignancies.[1] Areas generally affected by hyperhidrosis are those that have the greatest density of eccrine or apoeccrine sweat glands.[1] Commonly affected areas in primary hyperhidrosis include armpits (axillary), hands (palmar), and feet (plantar).[3,4] Other areas may also be affected by primary hyperhidrosis but it is less common.[2] Secondary hyperhidrosis can affect areas such as the scalp, face, neck, back, groin and legs.[4]

The worldwide prevalence of hyperhidrosis is estimated to be between 2% and 4%.[4] Hyperhidrosis affects males and females similarly and generally occurs in the age range 25 to 64 years.[1] Hyperhidrosis can be challenging as it can affect one's work performance, psychosocial functioning, and self-esteem, and could significantly impact one's quality of life.[1] Treatment options for hyperhidrosis include topical or systemic medications, botulinum toxin injection, surgical procedures (such as local excision, liposuction-curettage, and sympathectomy) and the more recent therapies (such as laser therapy, microwave technology, and ultrasound technology).[1,2] There is growing interest in the use of laser therapy for hyperhidrosis.

The purpose of this report is to review the clinical effectiveness of laser therapy for hyperhidrosis and to review evidence-based guidelines regarding the use of laser therapy for hyperhidrosis.

RESEARCH QUESTIONS

1. What is the clinical effectiveness of laser therapy for hyperhidrosis?

2. What are the evidence-based guidelines regarding the use of laser therapy for hyperhidrosis?

KEY FINDINGS

Evidence from studies of relatively small size suggests that laser therapy may reduce sweating in case of axillary hyperhidrosis. Adverse effects were generally few and resolved within a few weeks. However the results need to be interpreted with caution in light of the associated limitations of the studies.

No relevant evidence-based guidelines regarding the use of laser therapy for hyperhidrosis was identified

METHODS

Literature Search Strategy

A limited literature search was conducted on key resources including PubMed, The Cochrane Library, University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit the retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2010 and March 31, 2015.

Selection Criteria and Methods

One reviewer screened citations and selected studies. In the first level of screening, titles and abstracts were reviewed and potentially relevant articles were retrieved and assessed for inclusion. The final selection of full-text articles was based on the inclusion criteria presented in Table 1.

Table 1: Selection Criteria

Population	Adults with hyperhidrosis
Intervention	Laser therapy
Comparator	Other active therapy No laser treatment or sham treatment
Outcomes	Clinical effectiveness (e.g. a reduction in excessive sweating, duration of effect), safety
Study Designs	Health technology assessment (HTA), systematic review (SR), meta-analysis (MA), randomized controlled trial (RCT) and non-randomized study (NRS)

Exclusion Criteria

Studies were excluded if they did not satisfy the selection criteria, if they were duplicate publications, or were published prior to 2010.

Critical Appraisal of Individual Studies

Critical appraisal of a study was conducted based on an assessment tool appropriate for the particular study design. The Downs and Black checklist[5] was used for RCT and NRS.

For the critical appraisal, a numeric score was not calculated. Instead, the strength and limitations of the study were described.

SUMMARY OF EVIDENCE

Quantity of Research Available

A total of 131 citations were identified in the literature search. Following screening of titles and abstracts, 120 citations were excluded and 11 potentially relevant reports from the electronic search were retrieved for full-text review. No potentially relevant publication was retrieved from the grey literature search. One potentially relevant report was identified from the reference list of a review article. Of these 12 potentially relevant articles, seven publications were excluded for various reasons, while five publications[6-10] met the inclusion criteria and were included in this report. These five publications were comprised of three randomized controlled trials (RCTs)[6,8,9] and two non-randomized studies (NRSs).[7,10] No relevant evidence-based guidelines were identified. Appendix 1 describes the PRISMA flowchart of the study selection.

Summary of Study Characteristics

Characteristics of the included RCTs and NRSs are summarized below and details are provided in Appendix 2.

<u>Randomized controlled trial (RCT)</u>

Three relevant RCTs[6,8,9] were identified that examined laser therapy for treating patients with hyperhidrosis. One RCT[6] was published in 2015 from Europe, and two RCTs were published in 2012, one each from Germany[8] and USA.[9]

In one RCT[6] patients were randomized to four treatment groups (Group 1: 975 nm laser, Group 2: 924 & 975 nm laser, Group 3: curettage [removal of tissue with a curette] and Group 4: 924 & 975 nm laser plus curettage) and in two RCTs[8,9] each patient had by random assignment, one axillary side exposed to laser and one not exposed. In one RCT[8] an 800 nm laser was used and in one RCT[9] a 1064 nm laser was used.

In the RCTs, the number of patients ranged between six and 100. Average age was reported as 39 years in one RCT[8] and was not reported in two RCTs[6,9] but one RCT[9] mentioned patients were adults. The proportion of females and males was not reported in one RCT[6] and was reported in two RCTs,[8,9] both with a higher proportion of females. Study duration ranged between nine and 12 months. All RCTs reported on sweat reduction. Methods used for assessing sweat reduction varied among the studies. Assessment methods included the hyperhidrosis disease severity scale (HDSS), the global aesthetic improvement scale (GAIS), the global aesthetic questionnaire (GAQ), the visual analog scale (VAS), gravimetry, and the starch iodine test. Histology findings with respect to sweat gland density and morphology were

reported in two[8,9] of the three RCTs. Adverse events were reported quantitatively in one RCT[6] and qualitatively in two RCTs.[8,9]

Non-randomized studies (NRS)

Two relevant NRSs[7,10] were identified that investigated the effect of laser treatment in patients with hyperhidrosis. Both were pre-post studies, assessing the hyperhidrosis status before and after laser treatment. One study[7] was prospective and was published in 2014 from USA and one study[10] was retrospective and was published in 2011 from eastern Europe. In one study,[7] a 1400 nm laser was used, the average age of patients (N = 15) was 39 years, the female to male ratio was 10 to 5 and follow up was for 12 months. In one study,[10] a 1064 nm laser was used, the average age of patients (N = 32) was 31 years, female to male ratio was 23 to 9 and follow up was for 24 months. Outcomes reported in the studies included sweat reduction, histology findings, and adverse events.

Summary of Critical Appraisal

Critical appraisal of the included RCTs and NRSs are summarized below and additional details are provided in Appendix 3.

Randomized controlled trials

All the included RCTs[6,8,9] stated the objective and the inclusion criteria, and provided details of interventions and outcomes. Two RCTs[6,8] explicitly reported exclusion criteria and one RCT did not.[9] There did not appear to be any significant concern with the inclusion and exclusion criteria impacting generalizability. One RCT[8] provided details of patient characteristics and two RCTs[6,9] did not. None of the RCTs described the randomization method, or provided information on sample size determination. Studies were not blinded, hence there is potential for bias. One RCT[8] provided *P* values for the outcome data in some instances and two RCTs[6,9] did not provide *P* values. In the RCTs, the sample size was small for each treatment group (six to 25) In two RCTs[6,9], all patients completed the study and in one RCT[8] about 10% did not complete the study and reasons for withdrawal were provided. Generalizability was limited as all the RCTs appeared to be single centre studies. All RCTs disclosed conflict of interest. In one RCT[6], it was stated that the authors had completed disclosure forms and that there were no conflicts of interest. In one RCT[8], it was stated that there was no significant interest with commercial supporters. In one RCT[9], it was stated that one author received a travel grant from industry and that the other authors had no relevant conflicts of interest.

Non-randomized studies (NRS)

All the included NRSs[7,10] stated the objective, the inclusion and exclusion criteria, and provided details of patient characteristics, interventions and outcomes. There did not appear to be any significant concern with the inclusion and exclusion criteria impacting generalizability. Both studies were pre-post studies; one study[7] was prospective and one study was retrospective.[10] In one study,[7] no patients were lost to follow up, and in one study[10] patients were followed up after treatment, but follow-up times varied and not all patients were followed up for the entire 24 months. In one study[7], the authors' conflicts of interest were disclosed. This study[7] was funded by industry. In one study[10] there was no disclosure of conflict of interest of the authors. Generalizability was limited as both were single centre studies with a small number of patients (15 and 32).

Summary of Findings

What is the clinical effectiveness of laser therapy for hyperhidrosis?

The overall findings are summarized below and details of the findings of included RCTs[6,8,9] and NRSs[7,10] are provided in Appendix 4.

Randomized controlled trial

One RCT[6] involving 100 patients (25 patients in each treatment group) with axillary hyperhidrosis, showed that there was reduction in sweating with the various laser treatment strategies. The effect as assessed by the HDSS score and the starch iodine test score and was most pronounced with laser 924/975 plus curettage, followed sequentially by laser 924/975 alone, curettage alone and laser 975 alone (Table 2). Lower scores with HDSS and starch iodine test indicate better outcomes. Overall the effect of treatment appeared to be sustained up to 12 months, however in some instances the HDSS scores and the starch iodine test scores were slightly higher at the 12 month assessment compared to that at one month. Adverse events were reported to be few. In the laser 975 group there were two burns, in the laser 924/975 group there was one sensation disorder, in the curettage group there were three bruises and in the laser 924/975 plus curettage group there were one bruise and one loss of sensation. These complications were resolved by one month. None of the patients reported any compensatory sweating in other parts of the body.

Table 2: Efficacy of interventions for treating patients with hyperhidrosis

Outcome	Time point	Intervention[a]			
		Laser 975	Laser 924/975	Curettage	Laser 924/975 + curettage
HDSS score	Baseline	3.88 ± 0.33	3.84 ± 0.37	3.84 ± 0.37	3.88 ± 0.33
	1 month	3.40 ± 0.50	1.96 ± 0.68	2.20 ± 0.41	1.24 ± 0.44
	12 months	3.44 ± 0.51	1.96 ± 0.61	2.32 ± 0.48	0.48 ± 0.51
Starch iodine test score	Baseline	2.60 ± 0.48	2.60 ± 0.60	2.58 ± 0.48	2.64 ± 0.49
	1 month	2.48 ± 0.51	1.36 ± 0.49	1.56 ± 0.51	0.40 ± 0.50
	12 months	2.76 ± 0.44	1.48 ± 0.51	1.76 ± 0.60	0.44 ± 0.51

[a]Interventions: laser 975 = laser emitting at 975 nm, laser 924/975 = laser emitting at 924 nm and 975 nm, laser 924/975 + curettage = two lasers emitting at 924 nm and 975 nm at the same time and curettage

In one RCT[8] involving 21 patients with axillary hyperhidrosis, each patient had by random assignment, one axilla exposed to laser (800 nm) and one not exposed. Overall, there was greater reduction in sweating in the axilla treated with laser compared to that in the untreated axilla however the difference was not statistically significant, $P = 0.10$ (Table 3). Some patients experienced increased sweating on the untreated axilla, which could be compensatory sweating in that area. Histological findings showed there was no notable change in the number or morphology of the sweat glands. No serious complications were reported during the laser treatment. There was one case of skin depigmentation and was resolved during the 12 months of follow up.

Table 3: Gravimetric assessment of sweat rate with and without laser			
Study group	**Sweat rate (mg/min), (median [range])**		***P* value (laser vs no laser)**
	Before treatment	**At follow up (FU)**	
Side (axilla)exposed to laser	89 (42 to 208)	48 (17 to 119)	0.10
Side (axilla) not exposed to laser	78 (25 to 220)	65 (24 to 399)	

In one RCT[9] involving six patients with axillary hyperhidrosis, each patient had, by random assignment, one axilla exposed to laser (1064 nm) and one not exposed. Laser treatment was administered monthly for six sessions or until complete or close to complete axillary hair removal was observed at the following visit. Results were reported qualitatively. There was good to excellent improvement in sweating after laser treatment based on patient response to the global aesthetic questionnaire (GAQ). The starch iodine test demonstrated there was reduced sweating of the laser treated axilla compared with the control (untreated axilla). Histological findings showed there was no notable change in the number or morphology of the sweat glands. No adverse events (such as blistering, hyperpigmentation, hypopigmentation, ulceration or scarring) were reported.

Non-randomized studies

One prospective NRS[7] involving 15 patients with axillary hyperhidrosis assessed the sweating status before and after laser (1400 nm)treatment based on HDSS scores. Of the 15 patients, three patients were non-responders and so were given a second treatment six months after the initial treatment. Patients were considered as non-responders if their HDSS scores were greater than two after treatment. Overall there was improvement with laser therapy; the changes in HDSS scores from baseline were 2.2, 1.8, and 1.9 at three months, six months and 12 months respectively, indicating improvement. Histological findings showed eccrine gland necrosis after laser therapy. None of the patients reported any compensatory sweating as a result of treatment. Adverse effects such as numbness, pain, redness, swelling, bruising, and itching were experienced by 73% to 100% of the patients, however these complications were resolved within two to three days. No serious adverse events were reported.

One retrospective NRS[10] involving 32 patients with axillary hyperhidrosis assessed the sweating status before and after laser (1064 nm) treatment using the starch iodine test and patient interviews. Data were however not available for all patients at all time-points. Measurements of sweat producing areas using the starch iodine test were reported for 15 patients (30 axillas) who attended follow-up visits at one to three months and it was found that after treatment there was on average a 93% reduction in the sweating area, the range being 73% to 100%. All 32 patients were interviewed but the follow-up times varied; 47% of patients had follow-up 18 to 24 months, 22% of patients had follow-up 12 to 18 months, 16% of patients had follow-up six to12 months and 16% of patients had follow-up of less than six months. Patients were asked if they had found any difference between the sweat reduction one month after treatment and around the time of the interview. Patients' perception of the extent of improvement and level of satisfaction with the treatment were assessed using 4-point scales (scale details in Appendix 4). The proportion of patients experiencing ≥ 75% reduction in sweating was 37% and 22% at one month after treatment and at final follow-up (up to 24 months) respectively. The proportion of patients experiencing ≥ 50% reduction in sweating was 87% and 84% at one month after treatment and at final follow-up (up to 24 months) respectively. The proportions of patients, who considered the treatment to be very satisfying, satisfying, somewhat satisfying, and not satisfying were 53%, 22%, 22%, and 3% respectively. Histological findings showed desquamation and rupture of the sweat glands after laser therapy. Six (19%) patients reported

compensatory sweating after treatment (between 10% to 50% increased sweating in palm, feet and abdomen). Within 48 hours of treatment, 44% of the patients experienced pain. A few patients experienced other adverse effects such as edema, hematoma, pulling sensation and partial skin erosion. No patients reported long lasting adverse effects.

What are the evidence-based guidelines regarding the use of laser therapy for hyperhidrosis?

No relevant evidence-based guideline regarding the use of laser therapy for hyperhidrosis was identified

Limitations

Sample sizes were mostly small (6 to 32 in four studies[7-10] and in one study[6] with 100 patients each treatment arm included 25 patients). Also the studies appeared to be single centre studies hence generalizability was limited.

All the studies were on axillary hyperhidrosis so it is unclear if results would be applicable in case of hyperhidrosis in other parts of the body.

Efficacy and safety outcomes were not reported consistently across studies and the wavelengths of the lasers used varied across studies hence comparison across studies was difficult.

In some studies[7,9,10], data for all patients were not available for the entire follow up time or for all follow up visits. Data on long term effects of laser therapy are lacking. Though one study[10] reported a follow up extending up to 24 months, only 47% of the patients had a follow up of 18 to 24 months and the actual proportion of patients with 24 month follow up was not reported. As the patients were followed over a few months after treatment, there is the potential for recall bias in the responses of the patients with respect to the extent of improvement in sweating.

Among the included studies there were two NRSs and as with NRSs they have the potential of selection bias. Also, in one NRS[7] it was not always clear how some results were calculated.

None of the studies were conducted in Canada, hence it is unclear to what extent the results will be applicable to a Canadian setting.

Results need to be interpreted with caution in the light of the limitations associated with the studies included in this report. No relevant evidence-based guideline regarding the use of laser therapy for hyperhidrosis was identified.

CONCLUSIONS AND IMPLICATIONS FOR DECISION OR POLICY MAKING

Three RCTs and two non-randomized studies, comparing laser therapy with no therapy or other forms of laser therapies very identified. Most of the included studies suggested there may be improvement in sweating after laser therapy and adverse effects were few and generally resolved within a few weeks. One RCT showed there was reduction in sweating in both the treated and the untreated axilla and did not find any statistically significant difference in sweating reduction between the treated and untreated areas. Results need to be interpreted with caution in the light of the limitations associated with the studies included in this report. Generalizability is limited as all the studies appear to be single centre studies. All the studies

involved patients with axillary hyperhidrosis hence the results may not be applicable to hyperhidrosis at other locations of the body.

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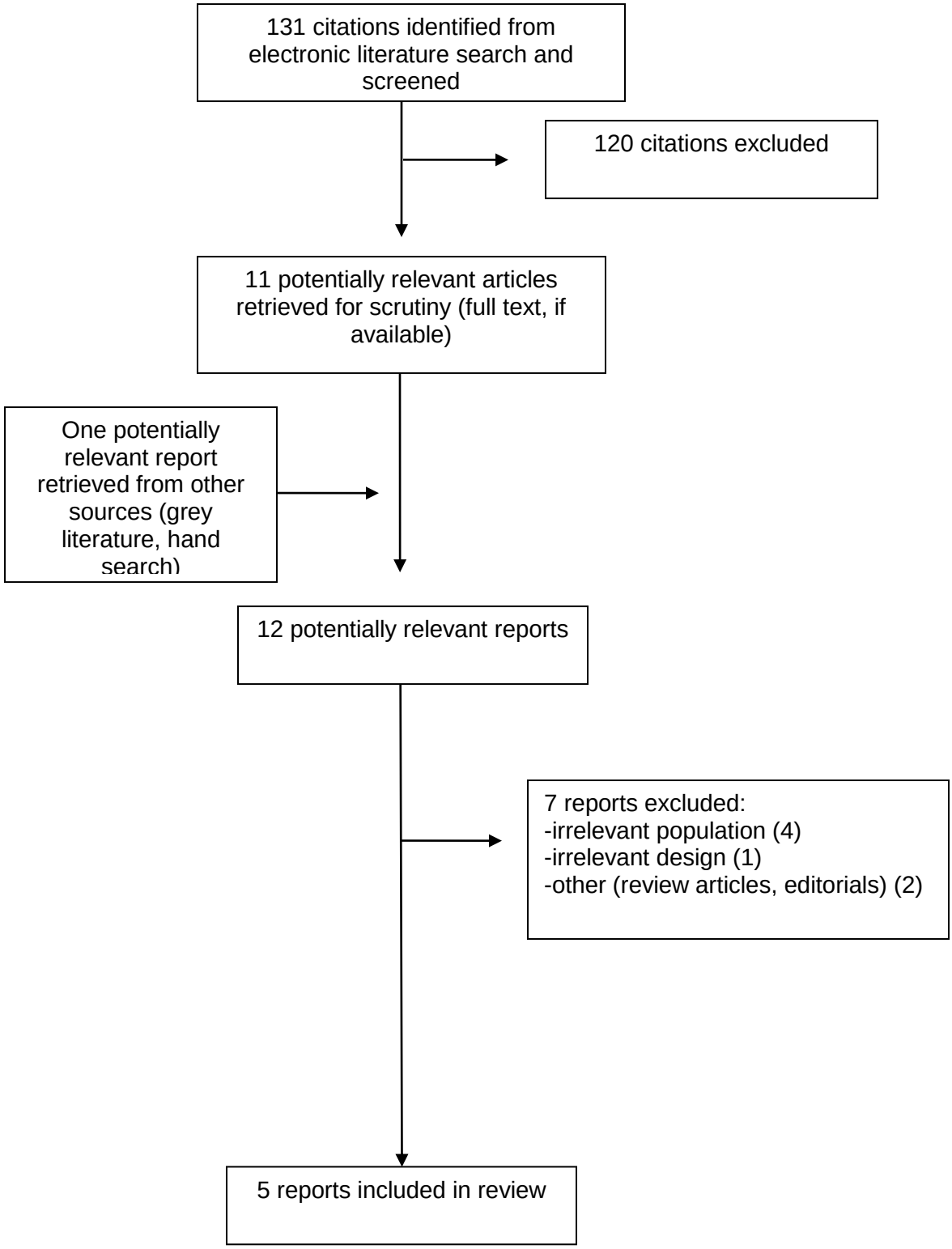
ABBREVIATIONS

AE	adverse effect
FU	follow-up
GAIS	global aesthetic improvement scale
GAQ	global assessment questionnaire
HDSS	hyperhidrosis disease severity scale
Nd:YAG	neodymium:yttrium-aluminum-garnet
NA	not applicable
NR	not reported

APPENDIX 1: Selection of Included Studies



APPENDIX 2: Characteristics of Included Studies

First Author, Publication Year, Country	Study Design, Duration	Patient Characteristics, Sample Size (N)	Comparison	Outcomes Measured
Randomized controlled trial				
Leclère,[6] 2015, Europe	Randomized controlled trial FU: 1 year	Patients with axillary hyperhidrosis N = 100 (25 in each of 4 groups Age: NR Female/Male: NR HDSS score (range): NR but inclusion criterion was 3 to 4	Group 1: Laser (975 nm), Group 2: Laser (924 nm & 975 nm simultaneously), Group 3: Curettage, Group 4: Laser (924 nm & 975 nm simultaneously) and curettage Laser: Diode laser system with two lasers (emitting at 924 nm and 975 nm) built into one console (Aspire SlimLipo Palomer™). The lasers may be used separately or simultaneously.	Sweat reduction (HDSS, GAIS, starch iodine test), AE
Bechara,[8] 2012, Germany	Randomized controlled trial (For each patient, randomly one axilla was exposed to laser and the other not exposed) FU: 12 month	Adult patients with axillary hyperhidrosis N = 21 Age (years) (mean [range]): 39 [24 to 66) Female/male: 16/5 HDSS score: NR	Laser vs no laser Laser: Long pulsed diode laser, 800 nm (Light Sheer). Five cycles of laser treatment at intervals of four weeks.	Sweat reduction (gravimetry, VAS), histology, AE
Letada,[9] 2012, USA	Prospective, case-controlled, randomized pilot study. (For each patient, randomly one axilla was exposed to laser and the other not exposed)	Adult patients with history of intolerable axillary hyperhidrosis refractory to standard therapies N = 6 Age: NR	Laser vs no laser Laser: Long pulsed Nd:YAG 1064 nm laser. Laser treatment was administered monthly up to six sessions or until	Sweat reduction (GAQ, starch iodine test), histology, AE

First Author, Publication Year, Country	Study Design, Duration	Patient Characteristics, Sample Size (N)	Comparison	Outcomes Measured
	FU: 9 months	Female/Male: 5/1 HDSS: NR	complete or close to complete removal of axillary hair was observed at the following visit.	
Non randomized study (NRS)				
Caplin,[7] 2014, USA	Non randomized study: prospective, single centre pre-post study FU: 12 months	Adults with axillary hyperhidrosis. (86% of the patients in addition had excessive sweating in hands, feet, back and face) N = 15 Age (years) (mean [range]): 39 [18 to 51) Female/male: 10/5 HDSS score (range): 3 to 4 (majority [93%] with score 4)	Pre and post laser treatment Laser: Nd:YAG 1400 nm laser (SmartLipo triplex)	Sweat reduction (HDSS, starch iodine test), histology, AE
Maletic,[10] 2011, Europe (Croatia and Slovenia)	Non-randomized study: retrospective, single centre pre-post study FU: 24 months	Adults with axillary hyperhidrosis. N = 32 Age (years) (mean [range]): 30.6 (18 to 51) Female/male: 23/9 HDSS score (range): NR but inclusion criterion was 3 to 4	Pre and post laser treatment Laser: Nd:YAG 1064 nm laser (Fotona XP-2)	Sweat reduction (starch iodine test, 4-point scale, histology), AE

AE = adverse event, FU = follow-up, GAIS = global aesthetic improvement scale, GAQ = global assessment questionnaire, HDSS = hyperhidrosis disease severity scale, Nd:YAG = neodymium:yttrium-aluminum-garnet, NR = not reported

APPENDIX 3: Summary of Study Strengths and Limitations

First Author, Publication Year, Country	Strengths	Limitations
Randomized controlled trial (RCT)		
Leclère,[6] 2015, Europe	• Objectives were clearly stated. • Inclusion and exclusion criteria were stated. • Interventions and outcomes were described. • Randomized • All patients completed the study • Authors disclosed conflict of interest	• Lacked details of patient characteristics. • There appeared to be inconsistencies in the descriptions of scales used for assessment • Randomization method not described • Sample size calculation not described • *P* values not provided • Generalizability limited as appears to be a single centre study however it was not explicitly mentioned
Bechara,[8] 2012, Germany	• Objectives were clearly stated. • Inclusion and exclusion criteria were stated. • Patient characteristics, interventions and outcomes were described. • Randomized (for each patient, randomly one axilla was exposed to laser and the other not exposed) • Withdrawals described (2 of the 21 patients did not complete the study; one became pregnant and was excluded and one did not attend the follow up appointment • Authors disclosed conflict of interest	• Randomization method not described • Sample size calculation not described • *P* values not provided • Generalizability limited as appears to be a single centre study (N = 21)
Letada,[9] 2012, USA	• Objectives were clearly stated. • Inclusion criteria were stated. • Interventions and outcomes were described. • Randomized (for each patient, randomly one axilla was exposed to laser and the other not exposed) • All patients completed the study but lengths of follow up varied • Authors disclosed conflict of interest	• Exclusion criteria were not stated. • Lacked details of patient characteristics. • Randomization method not described • Sample size calculation not described • Results presented qualitatively not quantitatively • *P* values not provided • Generalizability limited as appears to be a single centre pilot study (N = 6)

First Author, Publication Year, Country	Strengths	Limitations
Non randomized study (NRS)		
Caplin,[7] 2014, USA	• Objectives were clearly stated. • Inclusion and exclusion criteria were stated. • Patient characteristics, interventions and outcomes were described. • Prospective study • *P* values provided in some instances • No patients were lost to follow up, however one patient did not attend the 12 month follow up visit. • Authors disclosed conflict of interest	• Not randomized • Sample size calculation not described • Not always clear how some results were calculated. • The study was funded by industry • Generalizability limited as a single centre study (N = 15)
Maletic,[10] 2011, Europe (Croatia and Slovenia)	• Objectives were clearly stated. • Inclusion and exclusion criteria were stated • Patient characteristics, interventions and outcomes were described. • No patients were lost to follow up, however all patients were not followed up to 24 months • No disclosure of conflict of interest	• Not randomized • Retrospective study • Sample size calculation not described • *P* values were not reported • Not all patients were followed up to 24 months (47% patients were followed up for 18 to 24 months) • Generalizability limited as a single centre study (N = 32)

APPENDIX 4: Main Study Findings and Authors' Conclusions

<table>
<tr><th>First Author, Publication Year, Country</th><th>Main Findings and Authors' Conclusion</th></tr>
<tr><td colspan="2">Randomized controlled trial (RCT)</td></tr>
<tr><td>Leclère,[6] 2015, Europe</td><td>
Main Findings:
Comparison of efficacy with four interventions for treating hyperhidrosis
<table>
<tr><th>Outcome</th><th>Time point</th><th colspan="4">Intervention</th></tr>
<tr><th></th><th></th><th>Laser-975</th><th>Laser-924/975</th><th>Curettage</th><th>Laser-924/975 + curettage</th></tr>
<tr><td rowspan="3">HDSS score</td><td>Baseline</td><td>3.88 ± 0.33</td><td>3.84 ± 0.37</td><td>3.84 ± 0.37</td><td>3.88 ± 0.33</td></tr>
<tr><td>1 month</td><td>3.40 ± 0.50</td><td>1.96 ± 0.68</td><td>2.20 ± 0.41</td><td>1.24 ± 0.44</td></tr>
<tr><td>12 months</td><td>3.44 ± 0.51</td><td>1.96 ± 0.61</td><td>2.32 ± 0.48</td><td>0.48 ± 0.51</td></tr>
<tr><td rowspan="3">Starch test score</td><td>Baseline</td><td>2.60 ± 0.48</td><td>2.60 ± 0.60</td><td>2.58 ± 0.48</td><td>2.64 ± 0.49</td></tr>
<tr><td>1 month</td><td>2.48 ± 0.51</td><td>1.36 ± 0.49</td><td>1.56 ± 0.51</td><td>0.40 ± 0.50</td></tr>
<tr><td>12 months</td><td>2.76 ± 0.44</td><td>1.48 ± 0.51</td><td>1.76 ± 0.60</td><td>0.44 ± 0.51</td></tr>
<tr><td rowspan="3">GAIS score</td><td>Baseline</td><td>NA</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>1 month</td><td>1.04 ± 0.35</td><td>2.36 ± 0.49</td><td>2.28 ± 0.46</td><td>3.72 ± 0.54</td></tr>
<tr><td>12 months</td><td>0.92 ± 0.28</td><td>2.72 ± 0.46</td><td>2.64 ± 0.49</td><td>3.76 ± 0.44</td></tr>
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Adverse events
<table>
<tr><th>Laser-975</th><th>Laser-924/975</th><th>Curettage</th><th>Laser- 924/975 + curettage</th></tr>
<tr><td>2 burns</td><td>1 sensation disorder</td><td>3 bruises</td><td>1 bruise,
1 loss of sensation</td></tr>
</table>
Authors' Conclusion:
"In this study, the laser at 924/975nm combined with curettage was determined to be the optimal treatment option of those tested for axillary hyperhidrosis. This treatment was safe, with few side effects and improvement that persisted to one year follow-up." P. 173
</td></tr>
<tr><td>Bechara,[8] 2012, Germany</td><td>
Main Findings:

Gravimetric assessment of sweat rate with and without laser treatment in hyperhidrosis
<table>
<tr><th rowspan="2">Study group</th><th colspan="2">Sweat rate (mg/min), (median [range])</th><th rowspan="2">P value (at FU vs before tx)</th><th rowspan="2">P value (laser vs no laser)</th></tr>
<tr><th>Before treatment (tx)</th><th>At follow up (FU)</th></tr>
<tr><td>Side exposed to laser</td><td>89 (42 to 208)</td><td>48 (17 to 119)</td><td><0.001</td><td rowspan="2">0.10</td></tr>
<tr><td>Side not exposed to laser</td><td>78 (25 to 220)</td><td>65 (24 to 399)</td><td>0.04</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>First Author, Publication Year, Country</th><th>Main Findings and Authors' Conclusion</th></tr>
<tr><td></td><td>Sweat rate change (assessed using VAS) with laser treatment in patients with hyperhidrosis
<table>
<tr><th>Category</th><th>After last laser treatment</th><th>At follow up</th></tr>
<tr><td>Reduction in sweating as perceived by the patient</td><td>32.4%</td><td>25%</td></tr>
<tr><td>Patient satisfaction with reduction in sweating</td><td>5.9</td><td>4.1</td></tr>
<tr><td>Hair reduction on the treated side as assessed by the patient</td><td>85.7%</td><td>65.3%</td></tr>
<tr><td>Patient satisfaction with hair reduction</td><td>8.1</td><td>6.8</td></tr>
</table>
Histology
No change in number or size of the eccrine or apocrine glands or any damage was observed.

Side effects
No serious complications resulted during the laser treatment</td></tr>
<tr><td></td><td>Authors' Conclusion:
"Although we observed a significant decrease in sweat rate on laser-treated sites, laser epilation was not able to reduce the sweat rate significantly more than on the untreated contralateral side. These results probably indicate a placebo effect rather than a direct therapeutic effect of laser epilation." P. 736</td></tr>
<tr><td>Letada,[9] 2012, USA</td><td>Main Findings:

Outcomes with laser treatment for hyperhidrosis
<table>
<tr><th>Category</th><th>Result</th></tr>
<tr><td>GAQ</td><td>Good to excellent subjective improvement in axillary sweating after treatment</td></tr>
<tr><td>Starch iodine test</td><td>Reduced sweating of the treated axilla compared to the control (untreated) axilla.</td></tr>
<tr><td>Histologic analysis</td><td>No noticeable change in sweat gland density, staining characteristics, or overall sweat gland morphology</td></tr>
<tr><td>Adverse events</td><td>No adverse events (such as blistering, hyperpigmentation, hypopigmentation, ulceration, and scarring) were reported</td></tr>
</table></td></tr>
<tr><td></td><td>Authors' Conclusion:
"Laser hair reduction using the 1064 nm Nd:YAG at laser hair removal settings provides subjective and objective improvements in patients with focal axillary hyperhidrosis." P. 59</td></tr>
<tr><td colspan="2">Non randomized study (NRS)</td></tr>
<tr><td>Caplin,[7] 2014, USA</td><td>Main Findings:

Sweat reduction (improvement in HDSS) laser treatment in patients with hyperhidrosis</td></tr>
</table>

<table>
<tr><th>First Author, Publication Year, Country</th><th>Main Findings and Authors' Conclusion</th></tr>
<tr><td></td><td>
<table>
<tr><th>Time point</th><th>HDSS score – change from baseline</th><th>HDSS score - Mode (min to max)</th><th>P value (Wilcoxon sign rank test)</th></tr>
<tr><td>3 months</td><td>2.2</td><td>3 (0 to 3)</td><td>NR</td></tr>
<tr><td>6 months</td><td>1.8</td><td>1.8 (0 to 3)</td><td><0.001</td></tr>
<tr><td>12months</td><td>1.9</td><td>1.9 (1 to 3)</td><td><0.001</td></tr>
<tr><td colspan="4">Note: Of the 15 patients, 14 had HDSS of 4 and one patient had HDSS of 3 at baseline. Of the 15 patients, 3 patients received a second treatment after the initial treatment.</td></tr>
</table>

Histology
Histological assessment of samples from the treated area demonstrated necrosis of the eccrine glands (glands involved in sweating) after laser treatment and this was considered to represent success of the laser treatment.

Side effects experienced after laser treatment in patients with hyperhidrosis
<table>
<tr><th>Side effect</th><th>Percentage of patients with side effects (%)</th><th>Average time to resolve side effect (days)</th></tr>
<tr><td>Numbness</td><td>100</td><td>2</td></tr>
<tr><td>Pain</td><td>93</td><td>3</td></tr>
<tr><td>Redness</td><td>93</td><td>2</td></tr>
<tr><td>Swelling</td><td>93</td><td>2</td></tr>
<tr><td>Bruising</td><td>87</td><td>2</td></tr>
<tr><td>Itching</td><td>73</td><td>3</td></tr>
<tr><td colspan="3">Note: No serious adverse events were reported</td></tr>
</table>

Authors' Conclusion:
"Treatment of axillary hyperhidrosis with the 1440nm Nd:YAG-pulsed laser combined with a targeted fiber and temperature-sensing device provides a safe and minimally invasive approach to the treatment of axillary hyperhidrosis with minimal side effects and long-term efficacy." P.449
</td></tr>
<tr><td>Maletic,[10] 2011, Europe (Croatia and Slovenia)</td><td>
Main Findings:

Change in axillary sweating after laser treatment for hyperhidrosis
<table>
<tr><th>Outcome</th><th>Time point</th><th>Result</th></tr>
<tr><td>Sweating area reduction[a] (average [range])</td><td>After treatment</td><td>93% (73% to 100%)</td></tr>
<tr><td rowspan="2">Proportion of patient experiencing ≥ 75% reduction in sweating[b]</td><td>1 month after treatment</td><td>37%</td></tr>
<tr><td>At final FU[c] (up to 24 months)</td><td>22%</td></tr>
<tr><td rowspan="2">Proportion of patients experiencing ≥ 50% reduction in sweating[b]</td><td>1 month after treatment</td><td>87%</td></tr>
<tr><td>At final FU[c] (up to 24 months)</td><td>84%</td></tr>
<tr><td>Proportion of patients experiencing increased sweating</td><td>Between 1 m after treatment and final FU</td><td>19%</td></tr>
<tr><td colspan="3">FU = follow up, m = month

[a]Measurements of sweat producing areas were conducted before and after treatment on 30 axillae of 15 patients with 1 to 3 months follow up visit.
[b]Reduction assessed using a 4-point scale: 0 (0% to 25%), 1 (26% to 50%), 2 (51 to 75%), and 3 (76% to 100%)
[c]FU (18 to 24 m) for 47% of patients; FU (12 to 18 m) for 22% of patients; FU (6 to 12m) for 16% of patients and FU (< 6m) for 16% of patients</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>First Author, Publication Year, Country</th><th>Main Findings and Authors' Conclusion</th></tr>
<tr><td></td><td>
Patient satisfaction with laser treatment
<table>
<tr><th>Degree of satisfaction[a]</th><th>Proportion of patients</th></tr>
<tr><td>Very satisfied</td><td>53%</td></tr>
<tr><td>Satisfied</td><td>22%</td></tr>
<tr><td>Somewhat satisfied</td><td>22%</td></tr>
<tr><td>Not satisfied</td><td>3%</td></tr>
<tr><td colspan="2">[a]Degree of satisfaction assessed using a 4-point scale: 0 (not satisfied), 1 (somewhat satisfied, 2 (satisfied), and 3 (very satisfied)</td></tr>
</table>
Adverse effects reported by patients during the post-op recovery period
<table>
<tr><th rowspan="2">Adverse effect</th><th colspan="4">Time point</th></tr>
<tr><th>at 48 hour</th><th>at 1 week</th><th>at 4 week</th><th>at 6 week</th></tr>
<tr><td>Pain</td><td>14</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>Edema</td><td>4</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>Hematoma</td><td>3</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>Pulling sensation</td><td>3</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>Partial skin erosion</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
</table>
Authors' Conclusion:
"This retrospective study of efficacy and safety of subdermal Nd:YAG laser treatment of axillary hyperhidrosis demonstrated very high efficacy in sweat reduction with minimal side effects. The sweating reductions proved to be stable over a period of up to 24 months after the treatment. Patient satisfaction with the treatment and its outcome, as well as their willingness to recommend this therapy to their relatives and friends, demonstrate the attractiveness of this novel technique for treatment of axillary hyperhidrosis." P. 42
</td></tr>
<tr><td colspan="2">GAIS = global aesthetic improvement scale, GAQ = global aesthetic questionnaire, HDSS = hyperhidrosis disease severity scale, NA = not applicable

Note:
For GAIS, higher scores indicate better outcome
For GAQ, HDSS and starch test, lower scores indicate better outcome</td></tr>
</table>