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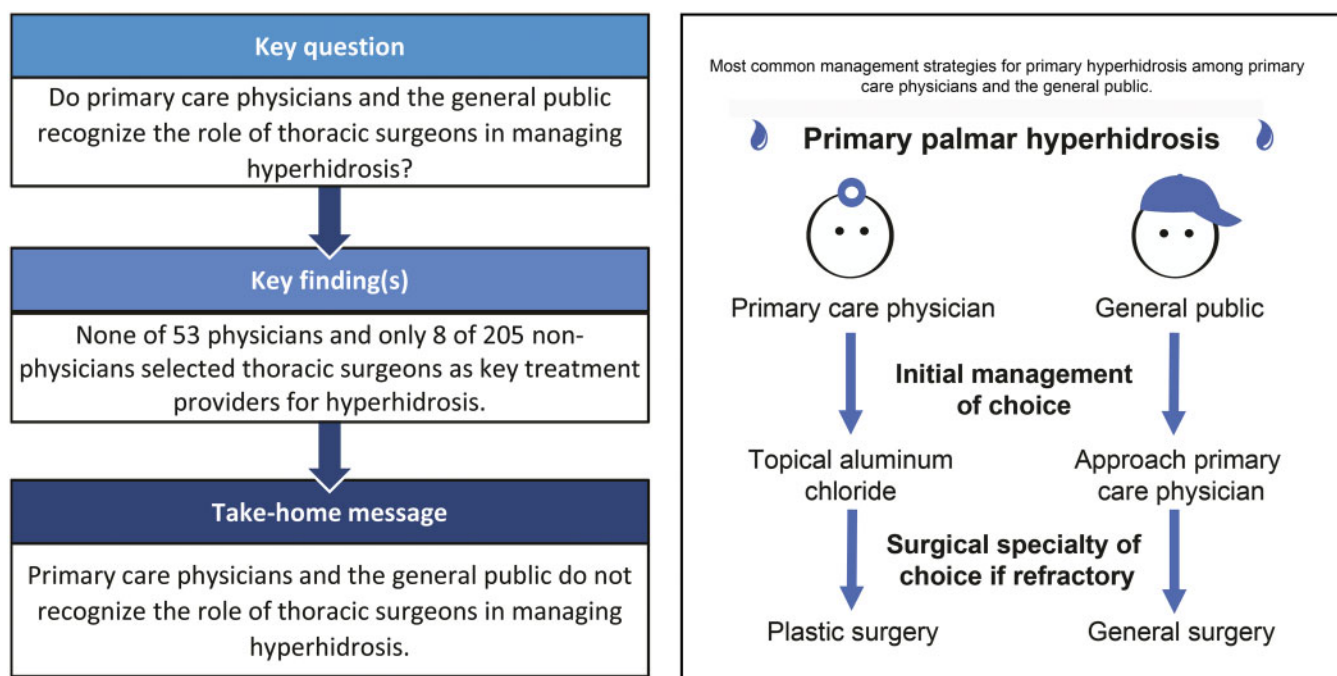
Knowledge of surgical management of hyperhidrosis among primary care physicians and the general public

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Abstract

OBJECTIVES: Our study examined attitudes towards initial management of hyperhidrosis, willingness to seek surgical consultation and knowledge of an appropriate specialty for surgical consultation among primary care physicians and the general public.

METHODS: An online survey was sent to all general medicine and paediatric residents and attending physicians at our academic medical centre. Participants were provided with a clinical scenario of palmar hyperhidrosis and were asked to select among initial management options and preferences for surgical consultation if patients failed non-operative management. To assess the general public's perspective, workers from Amazon Mechanical Turk were recruited to complete a similar survey.

RESULTS: The majority of primary care physicians (31/53; 58%) would prescribe topical aluminium chloride for palmar hyperhidrosis, whereas 28 of 53 (53%) would refer such patients to dermatology. Twenty-three of 53 (43%) physicians would refer such patients to surgery if conservative management failed: 18 (78%) to plastic surgery, 4 (17%) to general surgery and none to thoracic surgery. The majority of workers (130/205;

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63.4%) would seek primary care treatment for palmar hyperhidrosis. Over half (113/205; 55%) would seek surgical consultation if conservative management failed: 65 (58%) general surgery and 15 (13%) neurosurgery, with only 8 (7%) selecting thoracic surgery.

CONCLUSIONS: Neither primary care physicians nor the general public recognize the role of thoracic surgeons in managing primary focal hyperhidrosis when medical management fails. Education of physicians and the public may mitigate this knowledge gap.

Keywords: Primary palmar hyperhidrosis • Sympathectomy • Sympathotomy • Medical education

INTRODUCTION

Primary focal hyperhidrosis is an idiopathic condition characterized by excessive sweating, usually of the hands, axillae and/or feet, well beyond physiological demands. Excessive sweating can profoundly negatively influence physical, emotional and psychosocial functioning [1].

It is estimated that the prevalence of hyperhidrosis in the USA is 4.8% [2]. Interestingly, only 51% of hyperhidrosis sufferers have discussed their condition with healthcare providers. As many as 61% of affected individuals do not think hyperhidrosis is a medical condition, whereas 47% believe that there is nothing that can be done to treat their condition. These findings indicate a need for greater awareness of the condition among the general public and its diagnosis and treatment options among medical professionals.

The Society of Thoracic Surgeons recently published an expert consensus practice guideline for the management of hyperhidrosis, including both conservative and surgical options and characterized ideal candidates for endoscopic thoracic sympathectomy [3]. Whereas conservative management alleviates symptoms only transiently, surgical therapy usually provides a permanent solution [4]. Survey-based evaluations of patients undergoing endoscopic thoracic sympathectomy have demonstrated the procedure to be safe and efficacious, with long-lasting benefits to patients with primary focal hyperhidrosis [4, 5].

Despite the effectiveness of treatments, up to 50% of people self-identified as suffering from excessive sweating waited 10 or more years prior to seeking medical help [6]. The prolonged wait to seek proper medical help suggests the need to increase awareness of the disease among the general public. In addition, only half of patients diagnosed with hyperhidrosis received a prescription strength antiperspirant within 12 months of their diagnosis, and fewer than 17% received other non-surgical treatment [7]. The low percentage of patients suffering from hyperhidrosis who received proper therapy suggests a substantial knowledge gap among physicians about conservative treatment options and timing of referral to surgery.

This study examines whether primary care specialty physicians are familiar with the initial medical management of primary focal hyperhidrosis, are willing to refer patients to surgery when medical management fails and whether they are aware of the appropriate surgical specialties for management of primary focal hyperhidrosis. This study also examines whether the general public is aware of the different treatment options for primary focal hyperhidrosis and whether they are willing to seek out surgical consultation when medical management fails.

MATERIALS AND METHODS

Ethics statement

The study was approved by the Institutional Review Board at the University of Chicago (ID IRB20-1641) on 16 October 2020. The

requirement for formal consent was waived because of the low risk involved.

Physician survey

An email containing a link to a REDCap [8] online survey was sent to all primary care specialty residents and attendings (general medicine, general paediatrics, medicine-paediatrics) at the University of Chicago Medical Center, a tertiary academic centre staffed by 3 full time general thoracic surgeons and where outpatient thoracoscopic sympathectomy is performed regularly for primary focal hyperhidrosis. A description of the study and the risks, benefits and alternatives of the study were presented to the participants. Informed consent was assumed when physicians voluntarily entered the survey. The primary care specialty physicians were queried regarding their gender, current training level or post-training status, and specialty area of practice. Physician participants were presented with a clinical case of primary focal palmar hyperhidrosis and were asked to select their initial management of choice (Supplementary Material, Table S1). The participants were then asked whether they would refer the patient to surgical consultation if non-operative management failed, and if yes, the preferred surgical specialty for referral. At the completion of the survey, physician participants were asked to indicate their previous experience with patients who had primary focal hyperhidrosis and their personal history of hyperhidrosis, if any.

General public survey

We recruited Amazon Mechanical Turk workers to complete a similar survey by providing a link to a REDCap online survey in the Amazon Mechanical Turk website. Amazon Mechanical Turk (MTurk) is a crowdsourcing website for businesses (known as Requesters) to hire remotely located 'crowdworkers' to perform discrete on-demand tasks that computers are currently unable to do [9]. MTurk workers of all races, and all educational backgrounds, aged 20–70 years, who had higher than 90% approval and reimbursed rate of their prior work on Amazon Mechanical Turk website were presented with a consent script that described the study, and the risks, benefits and alternatives to the study. Informed consent was assumed when MTurk workers voluntarily entered the survey. All MTurk workers were queried regarding their gender, age, ethnicity and country of origin. MTurk workers were asked if they have any medical training background. MTurk participants were then presented with a clinical case of primary focal palmar hyperhidrosis pertaining to a hypothetical family member, and were asked to select their initial management of choice. The participants were then asked whether they would take this family member to surgical consultation if symptoms persist for 1 year, and if yes, their surgical specialty of choice. At the completion of the survey, MTurk workers were asked to

Table 1: Physician demographics

	Number	Per cent
Total number	53	100.0
Female	35	66.0
Level of training/attending		
PGY1	11	20.8
PGY2	8	15.1
PGY3	13	24.5
PGY4	6	11.3
PGY \geq 5	1	1.9
Attending	14	26.4
Specialty		
General medicine	25	47.2
General paediatrics	17	32.1
Medicine-paediatrics	11	20.8
Previous exposure to surgery		
Neurosurgery	4	7.5
Ear, nose, throat	10	18.9
General surgery	48	90.6
Plastic surgery	7	13.2
Cardiac surgery	9	17.0
Thoracic surgery	7	13.2
Orthopaedic surgery	12	22.6
Urology	12	22.6
None	2	3.8
Personal history hyperhidrosis		
Axillae	3	5.7
Hands	4	7.5
Feet	2	3.8
None	44	83.0
Previous experience with hyperhidrosis patients		
No	35	66.0
Yes, 1–10	16	30.2
Yes, >10	2	3.8

PGY: postgraduate year.

indicate their personal history of excessive sweating (Supplementary Material, Table S2). Each worker was compensated with 1 \$USD upon completion of the survey.

Statistical analysis

Categorical data are presented as number (percentage). Continuous data are presented as median (IQR). Univariable analyses of potential predictors of management choice and referral choice were performed with Pearson's Chi-squared test or Fisher's exact test (if frequency was <5) for categorical variables using Minitab software (Version 19.2020.1; State College, PA, USA). Statistically significant level was set at $P < 0.05$. Data from the surveys are available at <https://uchicago.box.com/s/0x5drlk9vcwx7ofnrjo5kyje3c5tqg0l>.

RESULTS

Physician survey

Fifty-three of 237 (22%) primary care physicians participated in the survey. Fourteen of 53 (26.4%) were of attending status, with the rest being resident or fellow trainees. Fifty-one (96.2%) primary care physicians reported having had previous exposure to surgery rotations as medical students, with the majority (48/53; 90.6%) being general surgery. Five (9.4%) of the primary care

physicians reported having a personal history of hyperhidrosis. Eighteen (34.0%) primary care physicians had experience taking care of hyperhidrosis patients (Table 1).

When an initial diagnosis of primary palmar hyperhidrosis was made, the most common initial therapies prescribed were topical aluminium chloride (31/53; 58.5%) and antiperspirants (21/53; 39.6%; Table 2). Twenty-eight (52.8%) of the primary care physicians would refer patients to dermatology when an initial diagnosis of primary palmar hyperhidrosis was made, while 4 (7.6%) would refer patients to surgery (Table 2).

Primary care physicians who had treated patients with primary palmar hyperhidrosis had a significantly lower rate of selecting botulinum toxin as initial management of choice compared to those who had not had experience with primary palmar hyperhidrosis patients ($P = 0.018$). Primary care trainees in the first 2 postgraduate years of training were more likely to refer patients with palmar hyperhidrosis to surgery at the initial encounter than primary care senior trainees and attendings ($P = 0.021$; Table 2). Physicians in paediatric and medicine/paediatric specialties were more likely than physicians in medicine to pursue topical glycopyrrolate and botulinum toxin for patients with palmar hyperhidrosis (Table 2). Primary care physicians' gender and personal history of hyperhidrosis were not related to their initial management of primary palmar hyperhidrosis or referral patterns. Primary care physicians' prior experience with patients with palmar hyperhidrosis, training level and primary specialty did not correlate with referral to dermatology and prescription of topical aluminium chloride and antiperspirant for primary palmar hyperhidrosis at the initial encounter (Table 2).

If conservative therapy failed and a patient continued to experience severe symptoms, 23 (43%) physicians would refer such patients to surgery. Most primary care physicians would select plastic surgery as the surgical specialty of choice, with none of the primary care physicians selecting thoracic surgery as the surgical specialty for referral (Fig. 1). Primary care physician gender, previous experience with patients with primary palmar hyperhidrosis, personal history of hyperhidrosis, level of training and primary specialty were not related to their willingness to refer patient to surgery after failing conservative therapies (Fig. 2).

General public survey

Two hundred and five online MTurk workers were recruited who had a median age of 32 (range 22–69). Nearly 90% of the MTurk workers had a college level of education or higher. Almost half of the MTurk workers reported a personal history of hyperhidrosis. A similar percentage of MTurk workers reported having previous medical training or experience (Table 3).

When a theoretical family member was afflicted by symptoms of primary palmar hyperhidrosis, more than half of MTurk workers would approach their primary care physician with their concerns. MTurk workers who had a personal history of excessive sweating had a significantly higher likelihood of purchasing over the counter antiperspirant for symptoms of excessive sweating than those who did not. MTurk workers who had prior medical training had a significantly lower likelihood of performing internet searches for home remedies to treat symptoms of excessive sweating than those who did not. MTurk workers having either a high school or college degree were significantly more likely to continue to observe symptoms of excessive sweating, assuming it may be seasonal, than those with either a graduate or

Table 2: Primary care physicians' initial management for palmar hyperhidrosis ($n = 53$)

Initial management of choice (total number of physicians = 53)	Total		Gender		P-value	Have evaluated patient with palmar hyperhidrosis			Personal history of hyperhidrosis ^a		
	N	Percentage	Male (N = 18)	Female (N = 35)		Yes (N = 18)	No (N = 35)	P-value	Yes (N = 5)	No (N = 44)	P-value
Topical aluminium chloride	31	58.5%	9	22	0.368	12	19	0.386	2	27	0.615
Antiperspirant	21	39.6%	8	13	0.607	8	13	0.607	2	17	0.906
Topical glycopyrronium	5	9.4%	2	3	0.765	1	4	0.488	1	3	0.359
Botulinum toxin	9	17.0%	1	8	0.112	0	9	0.018	0	8	0.575
Microwave thermolysis	2	3.8%	1	1	1.00	0	2	0.076	0	1	1.00
Oral glycopyrrolate	1	1.9%	1	0	0.340	1	0	0.340	1	0	0.102
Oral oxybutynin	2	3.8%	1	1	1.00	1	1	0.346	0	2	1.00
Iontophoresis	1	1.9%	1	0	0.340	0	1	1.00	0	1	1.00
Referral to dermatology	28	52.8%	9	19	0.767	8	20	0.380	4	22	0.441
Referral to surgery	4	7.6%	2	2	0.481	0	4	0.136	1	3	0.359

Initial management of choice (total number of physicians = 53)	Training level				P-value	Primary specialty			
	PGY 1-2 (N = 19)	PGY ≥ 3 (N = 20)	Attending (N = 14)			Medicine (N = 25)	Paediatrics (N = 17)	Medicine/Paediatrics (N = 11)	P-Value
Topical aluminium chloride	9	14	8		0.355	14	9	8	0.549
Antiperspirant	6	10	5		0.472	10	5	6	0.413
Topical glycopyrronium	3	2	0		0.307	0	1	4	0.002
Botulinum toxin	5	4	0		0.124	1	4	4	0.040
Microwave thermolysis	1	1	0		N/A	1	1	0	N/A
Oral glycopyrrolate	1	0	0		N/A	1	0	0	N/A
Oral oxybutynin	1	0	1		N/A	1	1	0	N/A
Iontophoresis	0	1	0		N/A	0	1	0	N/A
Referral to dermatology	9	12	7		0.710	11	9	8	0.282
Referral to surgery	4	0	0		0.021	0	3	1	N/A

^aFour participants did not report presence or absence of history of hyperhidrosis.

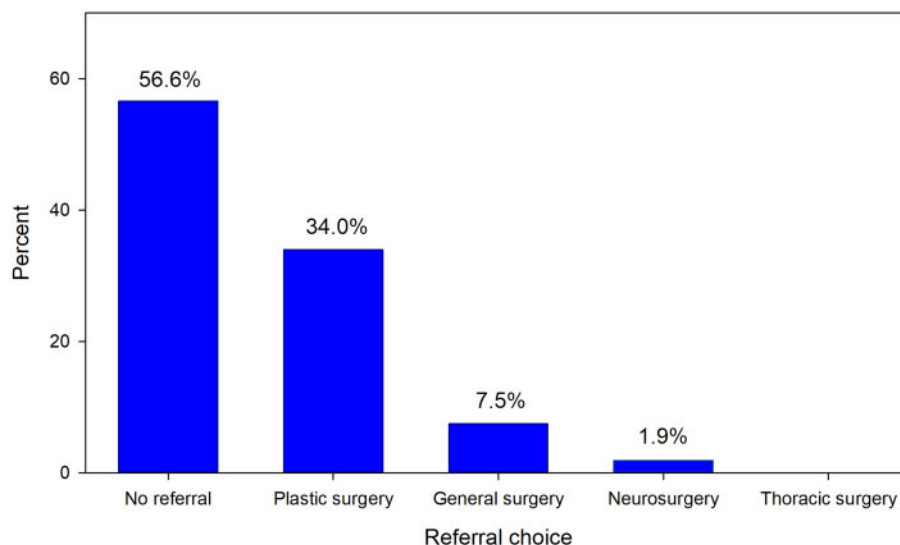


Figure 1: Surgical specialty referral by primary care physicians for medically refractory palmar hyperhidrosis.

professional degree (Table 4). Interestingly, having a professional degree or having had previous medical training significantly decreased MTurk workers' willingness to consult with primary care physicians for symptoms of primary palmar hyperhidrosis. A personal history of excessive sweating did not impact MTurk workers' choice to consult with primary care physicians (Table 4).

If the family member's symptoms continued for 1 year, more than half of MTurk workers would encourage them to seek surgical consultation. General surgery was the most popular referral surgical specialty for medically refractory palmar hyperhidrosis among the MTurk workers, with thoracic surgery being the fourth specialty of choice (Fig. 3). An increased level of education, a self-reported history of excessive sweating, and a self-

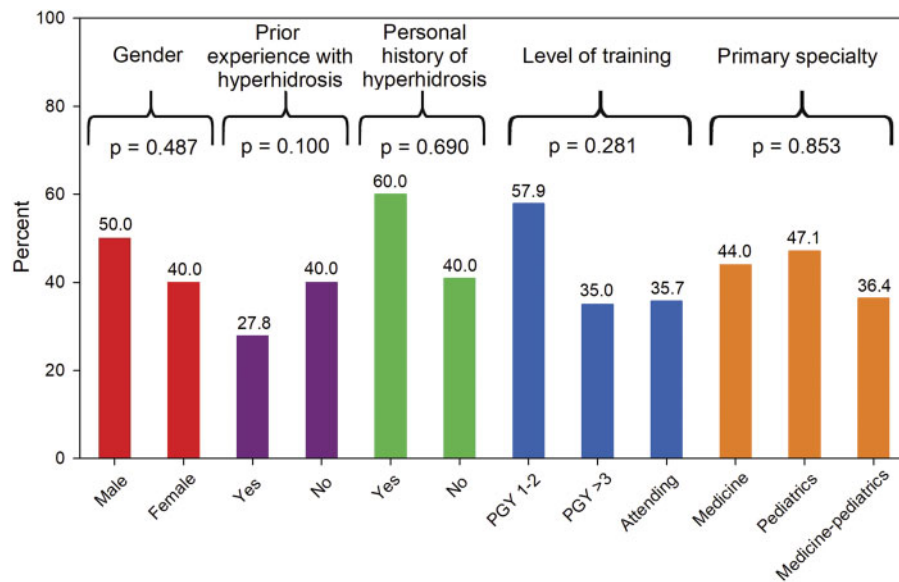


Figure 2: Primary care physicians' willingness to consult surgery for palmar hyperhidrosis after failing conservative therapy, assessed by physician characteristics. PGY: postgraduate year.

Table 3: Non-physician demographics

	N	Per cent
Total number	205	100.0
Female	72	35.1
Age (years)		
20-29	65	31.7
30-39	75	36.6
40-49	38	18.5
50-59	18	8.8
60-69	9	4.4
Level of education		
College	69	33.7
Graduate school	38	18.5
High school	24	11.7
Professional degree	74	36.1
Any medical training	95	46.3
Ethnicity		
White	157	76.6
Black	16	7.8
Hispanic	7	3.4
Asian	20	9.8
Other	5	2.4
Country of origin		
USA	179	87.3
Brazil	5	2.4
Canada	2	1.0
China	1	0.5
India	15	7.3
Unknown	3	1.5
Personal history of hyperhidrosis		
Face	43	21.0
Axillae	21	10.2
Hands	42	20.5
Feet	19	9.3
None	115	56.1

reported history of previous medical training significantly increased MTurk workers' willingness to seek surgical consultation when excessive sweating persisted more than a year despite medical management (Fig. 4). Among workers who were willing

to seek surgical consultation, a higher level of education was significantly associated with an increased likelihood of consulting plastic surgery, neurosurgery and thoracic surgery and a significantly lower likelihood of consulting general surgery and other surgical specialties compared to lower level of education (Table 5). MTurk worker age, gender, race and country of origin did not affect worker choices when managing symptoms of excessive sweating.

DISCUSSION

Hyperhidrosis leads to psycho-social, professional and financial burdens on the individual sufferers. However, a relatively low percentage of patients receive medical therapy or undergo surgery [7], suggesting that awareness of this condition by the general public and medical providers may be limiting factors in its effective treatment. Hyperhidrosis has historically been under-treated because of the lack of accessible, scientifically accurate information within patient and medical communities. Fortunately, this has been much improved in recent years with the development of internet-based resources and the establishment of various patient awareness groups [10]. However, the awareness of the proper surgical intervention and the optimal surgical specialty for consultation for medically refractory primary hyperhidrosis remain to be explored.

This study examined whether primary care specialty physicians were familiar with the initial medical management of primary focal hyperhidrosis, were willing to refer patients to surgery when medical management fails and whether primary care physicians were aware of the appropriate surgical specialties for management of primary focal hyperhidrosis. This study also examined whether the general public was aware of the different treatment options for primary focal hyperhidrosis and whether they were willing to seek out surgical consultation when medical management fails.

Our study confirmed previous findings regarding the lack of awareness of primary hyperhidrosis as a disease entity among

Table 4: Non-physicians' initial management for primary palmar hyperhidrosis (N = 53)

Initial management of choice (total numbers of workers N = 205)	Total		Gender		Personal history of hyperhidrosis			Prior medical training		Level of education				P-value		
	N	Per cent	Male (N = 133)	Female (N = 72)	P-value	Yes (N = 90)	No (N = 115)	P-value	Yes (N = 95)	No (N = 110)	P-value	High School (N = 24)	College (N = 69)		Professional School (N = 74)	Graduate School (N = 38)
Purchase over the counter antiperspirant	104	50.7	69	35	0.655	55	49	0.009	51	53	0.432	13	28	43	20	0.201
Approach primary care physician	130	63.4	84	46	0.917	53	77	0.234	50	80	0.003	16	49	37	28	0.026
Internet search for home remedies	101	49.3	60	41	0.106	40	61	0.222	37	64	0.006	14	39	29	19	0.154
Continue to observe	48	23.4	28	20	0.278	18	30	0.307	21	27	0.681	7	24	9	8	0.013

the general public [6, 7]. We found that only 63% of the general public would approach their primary care physician for symptoms of excessive palmar sweating, which mirrored the only 51% of hyperhidrosis sufferers having discussed their condition with healthcare providers [2]. Furthermore, almost half of our non-physician cohort would first attempt home remedies, while almost a quarter of the cohort would keep observing the symptoms of excessive sweating, which confirmed previous findings that almost half of people self-identified as suffering from excessive sweating waited 10 or more years prior to seeking medical help [6].

Our study expanded upon findings regarding the lack of awareness by both physicians and non-physicians on diagnosis and management of hyperhidrosis reported previously. First-line treatment of all primary focal hyperhidrosis, regardless of severity, is topical 20% aluminium chloride [11–14]. Yet, our study showed that fewer than 60% of primary care physicians would prescribe this for patients with symptoms consistent with primary palmar hyperhidrosis. Iontophoresis is a cost-effective, safe therapy approved by the United States Food and Drug Administration that is most appropriate for primary palmar hyperhidrosis and can be administered at home [15]. Yet, only 2% of the primary care specialty physicians would select this treatment modality from among the options listed in our survey.

Referral for endoscopic thoracic sympathotomy may be indicated when less invasive therapies are ineffective [3, 12, 16–18]. Endoscopic thoracic sympathotomy is indicated for palmar, craniofacial and axillary hyperhidrosis [15]. The preferred patients include those whose symptoms that began at an early age, have focal increased sweating, do not exhibit generalized sweating, have excessive sweating that arises daily and often spontaneously, and whose sweating adversely affects professional, social and/or intimate aspects of their daily lives. Interestingly, none of the primary care physicians who participated in our study selected thoracic surgery as the specialty of choice for referral. This may suggest that primary care physicians who participated in our study were either not aware of the procedure or of the surgical specialty that offers this procedure. The lack of such awareness may negatively affect patients' quality of life, as endoscopic sympathotomy for primary focal hyperhidrosis has minimal postoperative morbidity and mortality, and the vast majority of patients experience symptom relief (98.1%) and overall satisfaction (95.5%) following the procedure [19].

Excision of subcutaneous tissue, curettage, liposuction or a combination of these techniques may be other options for primary focal hyperhidrosis [15]. This may explain the high referral rate to plastic surgery (34.0%) and general surgery (7.5%) by our primary care physician survey participants. However, such treatments are mostly indicated for primary axillary hyperhidrosis [17], which is not the case scenario depicted in our clinical vignette. The failure to appreciate the indication of different surgical treatment modalities for various types of primary focal hyperhidrosis may suggest primary care physicians are not fully aware of the underlying pathophysiology and treatment algorithm for primary focal hyperhidrosis.

There are several potential limitations of the present study. The study was performed at a single academic centre and was therefore only a snapshot of what was happening at our hospital. Our study may reflect specific institutional referral patterns, which may affect the generalizability of the findings. However, there has been very limited literature investigating knowledge about hyperhidrosis among primary care physicians and the general public,

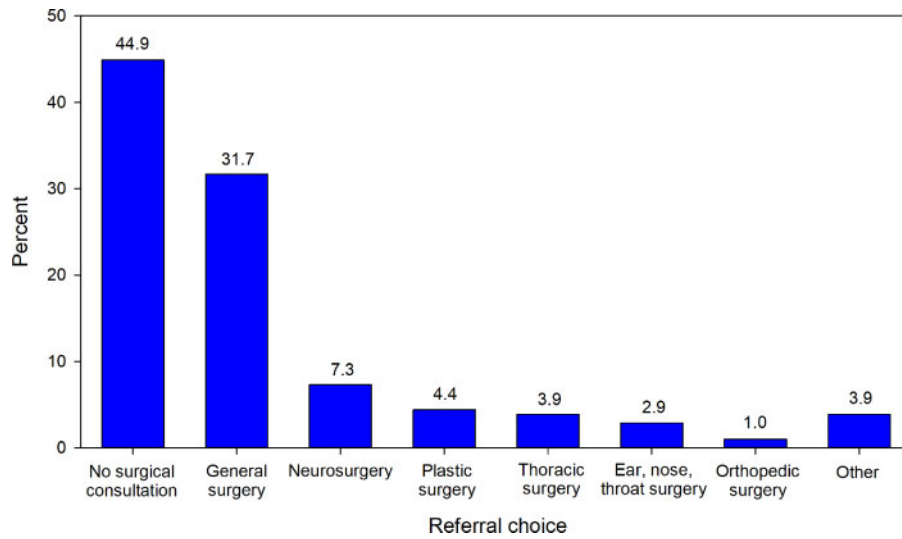


Figure 3: Surgical specialty of choice of the general public for medically refractory palmar hyperhidrosis.

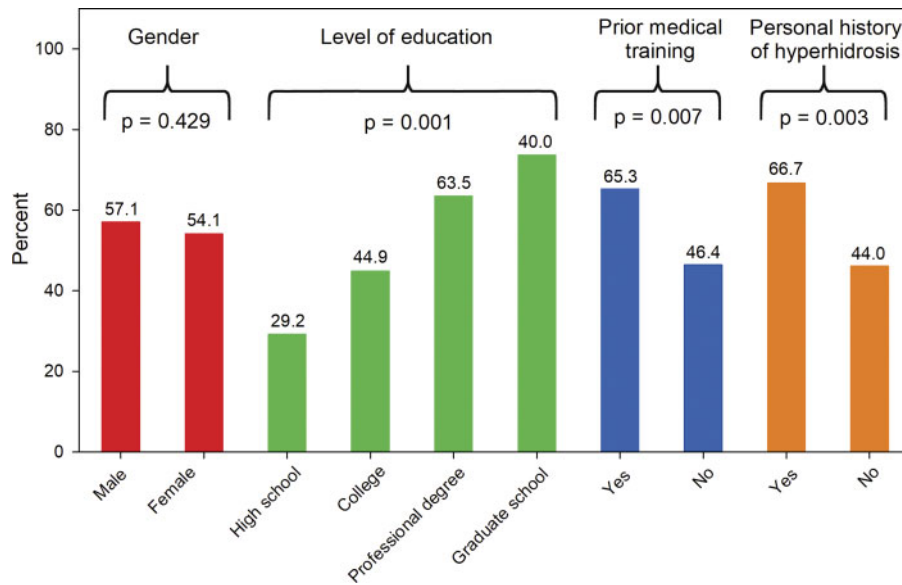


Figure 4: Willingness among the general public to seek surgical consultation for medically refractory palmar hyperhidrosis, assessed by level of education and personal history.

Table 5: Non-physicians' surgical referrals for hyperhidrosis

Specialty of choice	Past medical training		Level of education				Personal history of hyperhidrosis					
	Yes (N = 62)	Per cent (100%)	No (N = 51)	Per cent (100%)	High school or college (N = 38)	Per cent (100%)	Graduate school or professional school (N = 75)	Per cent (100%)	Yes (N = 60)	Per cent (100%)	No (N = 53)	Per cent (100%)
General surgery	34	54.8%	31	60.8%	25	65.8%	40	53.3%	34	56.7%	31	58.5%
Neurosurgery	10	16.1%	5	9.8%	3	7.9%	12	16.0%	7	11.7%	8	15.1%
Plastic surgery	4	6.5%	5	9.8%	0	0.0%	9	12.0%	5	8.3%	4	7.6%
Thoracic surgery	6	9.7%	2	3.9%	1	2.6%	7	9.3%	6	10.0%	2	3.8%
ENT	5	8.1%	1	2.0%	2	5.3%	4	5.3%	5	8.3%	1	1.9%
Other	3	4.8%	7	13.7%	7	18.4%	3	4.0%	3	5.0%	7	13.2%
P-value	0.208		0.016				0.290					

and the results of our study may suggest a larger scale study investigating knowledge about hyperhidrosis among physicians worldwide may be needed. The small sample size of our physician cohort may limit the power of our statistical analysis to identify significant trends. The proportions of Amazon MTurk workers reporting a graduate and professional level of educational attainment were higher than in the general US population [20]. As such, the workers may not be representative of the general public with regard to these characteristics.

Education will be necessary to improve familiarity of patients and primary care physicians with the disease of hyperhidrosis. This topic is sufficiently important to warrant inclusion in medical school and primary caregiver residency curricula. Targeted marketing and review articles published in journals aimed at primary caregivers may help inform the public and primary caregivers who have completed their training. Another possible solution to increase awareness of thoracic surgeons' role in managing this condition among general public may include increased internet presence of our specialty in the modern era, an approach our medical centre is currently taking.

CONCLUSION

In conclusion, fewer than half of primary care physicians would refer patients to surgical specialties when medical management failed to control symptoms of palmar hyperhidrosis. Most importantly, these physicians appeared unaware of thoracic surgeons as being the most common surgical specialty to treat focal hyperhidrosis. The study may suggest the failure of thoracic surgeons in informing our colleagues about this field of interest. This may prevent affected patients from getting optimal care as thoracic surgeons who manage hyperhidrosis are usually also skilled in non-surgical management and could be the first referral for every hyperhidrosis patient. With additional education for primary care physicians and outreach by thoracic surgeons who perform surgery for hyperhidrosis, proper referral to thoracic surgeons by primary care physicians for medically refractory palmar hyperhidrosis may be feasible.

SUPPLEMENTARY MATERIAL

[Supplementary material](#) is available at *ICVTS* online.

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Author contributions

Andy Chao Hsuan Lee: Conceptualization; Data curation; Formal analysis; Investigation; Writing—original draft. **Mark K. Ferguson:** Methodology; Supervision; Writing—review & editing.

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