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Long-term efficacy and safety of topical glycopyrronium tosylate for the treatment of primary axillary hyperhidrosis: Post hoc pediatric subgroup analysis from a 44-week open-label extension study

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Abstract

Background/Objectives: Glycopyrronium tosylate (GT) cloth, 2.4% is a topical anticholinergic approved in the United States for primary axillary hyperhidrosis in patients ≥9 years. This post hoc analysis evaluated long-term response (efficacy and safety) in pediatric patients (≥9 to ≤16 years) to GT in the 44-week, open-label extension (NCT02553798) of two, phase 3, double-blind, vehicle-controlled, 4-week trials (NCT02530281, NCT02530294).

Methods: In the double-blind trials, patients ≥9 years with primary axillary hyperhidrosis were randomized 2:1 to once-daily GT:vehicle. Those who completed the study could receive open-label GT for up to an additional 44 weeks. Safety assessments included treatment-emergent adverse events (TEAEs) and local skin reactions (LSRs). Descriptive efficacy assessments included gravimetrically measured sweat production, Hyperhidrosis Disease Severity Scale response (≥2-grade improvement), and Children's Dermatology Life Quality Index.

Results: Of 43 pediatric patients completing either double-blind trial, 38 (88.4%) entered the open-label extension (age, years: 9 [n = 1], 12 [n = 2], 13 [n = 7], 14 and 15 [n = 9 each], 16 [n = 10]). The safety profile observed was similar to the double-blind trials. Most TEAEs (>95%) were mild/moderate, related to anticholinergic activity, and infrequently led to discontinuation (n = 1/38 [2.6%]). No pediatric patients experienced a serious TEAE. Most anticholinergic TEAEs did not require a dose modification and resolved within 7 days. Approximately, one-third of patients (n = 13/38 [34.2%]) had LSRs; most were mild/moderate in severity. Improvements in efficacy measures were maintained from the double-blind trials.

Conclusions: Long-term, once-daily GT for up to 48 weeks (4-week double-blind plus 44 week open label) provides a noninvasive, well-tolerated treatment option for pediatric patients with primary axillary hyperhidrosis.

KEYWORDS

anticholinergic, axilla, glycopyrronium tosylate, hyperhidrosis, sweat

1 | INTRODUCTION

Hyperhidrosis, a chronic condition that occurs in children and adults, is characterized by sweat production exceeding that which is necessary to maintain normal thermal homeostasis.[1] This condition affects an estimated 4.8% of the United States (US) population (approximately 15.3 million people) and 2.1% of those under 18 years of age.[1,2] The significant negative burden of hyperhidrosis on quality of life has been well established,[1,3-5] and equated as comparable to, and in most cases greater than, the impact of psoriasis, eczema, or acne.[6] In pediatric sufferers specifically, negative impacts on psychological and social development and well-being trigger profound emotional and social distress.[5]

The topical anticholinergic glycopyrronium tosylate (GT) is approved in the United States for the treatment of primary axillary hyperhidrosis in patients ≥9 years of age (QBREXZA® [glycopyrronium] cloth, 2.4%, for topical use).[7] Two randomized, double-blind, vehicle-controlled, phase 3 studies of GT in primary axillary hyperhidrosis (ATMOS-1, N = 344 [NCT02530281] and ATMOS-2, N = 353 [NCT02530294]) were used to support regulatory approval and have previously been reported.[8] In these 4-week, double-blind trials, GT was generally well tolerated, significantly reduced disease severity and sweat production, and improved dermatology health-related quality of life versus vehicle. Similar findings were observed in pediatric (≥9 to ≤16 years) and adult patients in a pooled post hoc analysis.[8,9]

The two, phase 3 studies led into a 44-week open-label extension (OLE; ARIDO, NCT02553789), which evaluated long-term safety and descriptive efficacy.[10] Long-term safety results were consistent with the safety profile observed in the 4-week, phase 3, and lead-in trials of GT, with no new or unexpected findings. Reductions in sweat production and disease severity, as well as dermatology health-related quality of life improvements, were maintained throughout the OLE. To characterize the long-term response to GT in pediatric patients (≥9 to ≤16 years), safety and descriptive efficacy data were evaluated in a post hoc analysis of the OLE.

2 | MATERIALS AND METHODS

2.1 | Study design

Detailed descriptions of trial methodology and approval by local institutional review boards have been reported for the double-blind and OLE studies.[8,10] In the double-blind trials, patients were randomized 2:1 to GT (3.75% topical solution) or vehicle applied once daily for 4 weeks. Patients completing the four-week double-blind trials with ≥80% treatment compliance were eligible to continue into the OLE and receive GT for up to 44 weeks or until early termination by the study sponsor. Patients entering the OLE had assessments in clinic on Day 1 (double-blind Week 4) and Weeks 2, 4, 8, 12, 16, 20, 28, 36, and 44 or end of treatment (Table S1). Patients were contacted via telephone for safety follow-up at Week 45 (end of study).

2.2 | Study patients

Detailed inclusion and exclusion criteria for the double-blind trials and OLE have been fully reported in the primary and OLE publications, respectively.[8,10] In the double-blind trials, patients were male or non-pregnant females ≥ 9 years with primary axillary hyperhidrosis for ≥6 months, gravimetrically measured sweat production ≥ 50 mg/5 min in each axilla, Axillary Sweating Daily Diary (ASDD)/ASDD-Children (ASDD-C) severity item (Item 2) score ≥ 4 (11-point scale),[10-12] and Hyperhidrosis Disease Severity Scale (HDSS) grade ≥ 3 (4-point scale).[13]

2.3 | Safety and efficacy assessments

This post hoc analysis reports safety and descriptive efficacy findings in pediatric (≥9 to ≤16 years) patients in the OLE. The primary objective of the study was to evaluate the long-term safety of GT, which was assessed through treatment-emergent adverse events (TEAEs), local skin reactions (LSRs), laboratory tests, vital signs, and physical examinations. Detailed description of safety assessments, including management of adverse events, has been reported.[10] TEAEs were evaluated through Week 45 and were defined as those events having an onset date on/after the first GT application in the OLE. The duration of adverse events could be self-reported or noted as part of a symptom-directed physical exam. All patients were assessed at each clinic visit for LSRs, including burning/stinging, pruritus, edema, erythema, dryness, and scaling. Each LSR was scored as 0 (none), 1 (mild), 2 (moderate), or 3 (severe), and evaluated through Week 44.

Descriptive efficacy assessments included three outcomes that were among those used in the double-blind trials.[8,9,14] Sweat

production was gravimetrically measured on Day 1 (double-blind Week 4) and Week 44 or ET. The HDSS, a hyperhidrosis-specific, patient-reported outcome,[13] was used to assess sweating severity by measuring sweat impact on daily activities using a 4-point scale (1 [never noticeable/never interferes with daily activities] to 4 [intolerable/always interferes with daily activities]). The Children's Dermatology Life Quality Index (CDLQI; patients ≥4 to ≤16 years) was used to assess quality of life; higher scores (0 to 30 numeric rating scale) indicate lower quality of life.[15,16]

2.4 | Statistical analysis

All analyses of the OLE data were performed on the safety population (patients who received ≥1 confirmed dose of GT and had ≥1 study assessment) according to the pediatric subgroup definition (9 to ≤16 years), which was consistent with that defined in the pooled post hoc analysis of efficacy and safety findings by age in the double-blind trials.[9] Specifically, the pediatric subgroup was defined based on the rigid age cutoffs for CDLQI/DLQI questionnaire administration (CDLQI: ≤16 years; DLQI: >16 years).

No inferential testing was performed as these comparisons were post hoc and not designed or powered to detect differences between subgroups. Further, no imputations for missing data were performed, and efficacy analyses were performed using observed data at Week 44 or ET. Median values were included for gravimetrically measured sweat production given the pediatric sample size and skewness of the data, which can be highly variable despite measurements under temperature- and humidity-controlled conditions.[17] For efficacy assessments, Baseline was Week 0 of the double-blind trials.

3 | RESULTS

3.1 | Patient disposition, demographics, and baseline disease characteristics

Of the 44 pediatric patients who entered the double-blind trials (GT, n = 25; vehicle, n = 19), 43 completed; 38 (88.4%) entered the OLE. The age composition of the pediatric group was 9 years (n = 1), 12 years (n = 2), 13 years (n = 7), 14 and 15 years (n = 9 each), and 16 years of age (n = 10; Table S2). A total of 16 (42.1%) patients completed through Week 44. The most common reason for discontinuation reflected the protocol-required early study termination once the study objective (ie, minimum of 100 patients receiving GT treatment for at least 12 months) was achieved (n = 11). Additional reasons for discontinuation included lost to follow-up (n = 6), withdrawal of consent (n = 3), noncompliance (n = 1), and adverse event (n = 1). Patient disposition by 1-year age increments is provided in Table S2. The median study duration was 287 days (mean, 220 days; range, 18 to 342).

TABLE 1 Baseline patient demographics and disease characteristics for patients who entered the open-label extension (Week 0 of double-blind trials)

	GT, n = 38
Baseline demographics	
Age (years)	
Mean (SD)	14.3 (1.5)
Median	14.5
Range	9-16
Sex, n (%)	
Male	6 (15.8)
Female	32 (84.2)
White, n (%)	30 (78.9)
Weight (kg)	
Mean (SD)	68.0 (16.4)
Median	64.2
Range	47.2-117.9
Body mass index (kg/m^2)	
Mean (SD)	25.1 (5.8)
Median	23.3
Range	17.3-39.5
Baseline disease characteristics	
Years with axillary hyperhidrosis, mean (SD)	4.8 (3.9)
Sweat production (mg/5 min),[a]	
Mean (SD)	140.1 (119.9)
Median	98.6
Min-max	51.3-606.3
HDSS, n (%)	
Grade 3	24 (63.2)
Grade 4	14 (36.8)
CDLQI, mean (SD)	8.9 (5.4)[b]

Note: OLE safety population (patients who received ≥1 confirmed dose of GT and had ≥1 study assessment).

Abbreviatins: CDLQI, children's Dermatology Life Quality Index; GT, glycopyrronium tosylate; HDSS, Hyperhidrosis Disease Severity Scale; SD, standard deviation.

[a]Gravimetrically measured average from the left and right axillae.

[b]n = 37.

OLE pediatric patients (n = 38) were predominantly female (84.2%) and white (78.9%), with mean age of 14.3 ± 1.5 (SD) years, and mean duration of axillary hyperhidrosis for 4.8 years at Baseline in the double-blind trials (Table 1). At the start of the OLE (double-blind Week 4), pediatric patients experienced lower sweat production, HDSS scores, and CDLQI scores versus the start of double-blind treatment (Table S3), which was not unexpected as the majority had undergone 4 weeks of double-blind GT treatment (n = 22/38 [57.9%] pediatric patients randomized to double-blind GT treatment).

TABLE 2 Safety overview and treatment-emergent adverse events

	Pooled double-blind trials to Week 4[9] (4-week double-blind only)		OLE to Week 45/EOS[a] (44-week OLE only)
	Vehicle, n = 19	GT, n = 25	GT, n = 38
Any TEAE, n[b] (%)	2 (10.5)	11 (44.0)	22 (57.9)
Number of events	4	37	52
Any serious TEAE, n[b] (%)	0	0	0
Number of events	0	0	0
Discontinuations due to TEAE, n[b] (%)	0	1 (4.0)	1 (2.6)
Number of events	0	5	2
Deaths, n[b] (%)	0	0	0
TEAE by intensity, n[b] (%)			
Mild	2 (10.5)	6 (24.0)	14 (36.8)
Moderate	0	4 (16.0)	7 (18.4)
Severe	0	1 (4.0)	1 (2.6)
TEAEs reported in ≥5% of patients in any treatment arm in any trial, n[b] (%)			
Acne	0	0	2 (5.3)
Application site dermatitis	0	0	2 (5.3)
Application site pain	1 (5.3)	2 (8.0)	2 (5.3)
Dry mouth[c]	0	6 (24.0)	6 (15.8)
Epistaxis	0	2 (8.0)	0
Headache	0	1 (4.0)	2 (5.3)
Influenza	1 (5.3)	0	0
Mydriasis[c]	0	4 (16.0)[d]	3 (7.9)[e]
Nasopharyngitis	0	0	0
Nausea	0	2 (8.0)	0
Oropharyngeal pain	0	2 (8.0)	0
Pain	1 (5.3)	0	0
Upper respiratory tract infection	0	0	2 (5.3)
Vision blurred[c]	0	3 (12.0)	4 (10.5)
Anticholinergic TEAEs reported in >2% of patients in any treatment arm in any trial, n[b] (%)			
Mydriasis[c]	0	4 (16.0)[d]	3 (7.9)[e]
Vision blurred[c]	0	3 (12.0)	4 (10.5)
Dry eye	0	1 (4.0)	0
Dry mouth[c]	0	6 (24.0)	6 (15.8)
Urinary hesitation	0	0	1 (2.6)
Urinary retention	0	1 (4.0)	0
Nasal dryness	0	1 (4.0)	1 (2.6)
Constipation	0	0	1 (2.6)
Summary of post-Baseline[f] local skin reactions			**OLE to Week 44 or ET[g] (44-Week OLE Only)**
Any skin reaction, n (%)	6 (31.6)	7 (28.0)	13 (34.2)
Burning/stinging, n (%)	2 (10.5)	2 (8.0)	7 (18.4)
Number of events	5	5	21
Dryness, n (%)	0	1 (4.0)	2 (5.3)
Number of events	0	1	4
Edema, n (%)	0	0	2 (5.3)

(Continues)

TABLE 2 (Continued)

Summary of post-Baseline[f] local skin reactions			OLE to Week 44 or ET[g] (44-Week OLE Only)
Number of events	0	2	5
Erythema, n (%)	4 (21.1)	4 (16.0)	10 (26.3)
Number of events	10	14	35
Pruritus, n (%)	2 (10.5)	0	3 (7.9)
Number of events	9	2	11
Scaling, n (%)	0	1 (4.0)	3 (7.9)
Number of events	0	2	5
Any LSR by maximum severity, n (%)			
None	13 (68.4)	18 (72.0)	25 (65.8)
Mild	5 (26.3)	7 (28.0)	9 (23.7)
Moderate	1 (5.3)	0	3 (7.9)
Severe	0	0	1 (2.6)

Note: Double-blind safety population (all randomized patients who received ≥1 confirmed dose of study drug) and OLE safety population (patients who received ≥1 confirmed dose of GT and had ≥1 study assessment).

A patient was counted as having a local skin reaction if any post-Baseline[f] assessment was mild, moderate, or severe; percentages represent the proportion of patients who had LSR events with a maximum post-Baseline[f] severity of mild, moderate, or severe.

Abbreviations: EOS, end of study; ET, end of treatment; GT, glycopyrronium tosylate; LSR, local skin reaction; OLE, open-label extension; TEAE, treatment-emergent adverse event.

[a]Patients were contacted via telephone for a safety follow-up at Week 45 (end of study).

[b]Numbers represent the number of patients reporting ≥1 TEAE, not number of events.

[c]Dry mouth, mydriasis, and vision blurred appear twice in the table as they meet criteria for common TEAEs and are also associated with anticholinergic use.

[d]4 patients reported 1 unilateral event and 3 bilateral events.

[e]3 patients reported 3 unilateral events.

[f]For the double-blind trials, Baseline was Week 0 of those studies; for the OLE, Baseline was Day 1 (Week 4 of the double-blind trials).

[g]ET refers to Week 44 for patients who completed the OLE and end of treatment for those who did not.

3.2 | Safety

3.2.1 | TEAEs

The pediatric subgroup had a similar safety profile in the double-blind[9] trials and OLE (Table 2). Over 44 weeks of open-label treatment, 22/38 (57.9%) of pediatric patients reported ≥1 TEAE; most were mild or moderate in severity. Notably, only 1 pediatric patient discontinued due to TEAEs (12 years old; dry mouth [related to treatment] and concurrent upper abdominal pain [unrelated]). The most frequently reported TEAEs in the OLE among pediatric patients were dry mouth (15.8%), vision blurred (10.5%), and mydriasis (7.9%). No pediatric patients experienced a serious TEAE. One pediatric patient, a 14-year-old male, who was randomized to vehicle in the double-blind trials, reported treatment-related, severe application site dermatitis in the OLE. Study drug was interrupted on day of onset and concomitant medication was administered on the second and fifth day after onset (1 dose of a topical triple-antibiotic containing neomycin, bacitracin, and polymyxin and a topical antifungal/steroid cream containing clotrimazole and betamethasone dipropionate [1%/0.05%], respectively); the event resolved in 20 days, the patient resumed study drug after resolution, and completed study.

3.2.2 | Anticholinergic TEAEs

In the double-blind trials and OLE, the majority of TEAEs reported in the pediatric GT group were related to anticholinergic activity; most were mild or moderate in severity and infrequently led to study discontinuation (Table 2). The frequency and type of anticholinergic TEAEs were similar among the pediatric patients in the double-blind trials and OLE. Across trials and treatment arms, the most frequently reported anticholinergic TEAE was dry mouth. A similar proportion of pediatric patients reported dry mouth in the double-blind trials (pooled vehicle- and GT-treated patients, n = 6/44 [13.6%]) and the OLE (n = 6/38 [15.8%]).

With the exception of one event (mild, bilateral vision blurred in 16-year-old male), all anticholinergic TEAEs were considered related to GT treatment. Management of anticholinergic TEAEs in pediatric patients included dose interruption (2 patients), dose frequency alteration (1 patient), drug withdrawal (1 patient), and

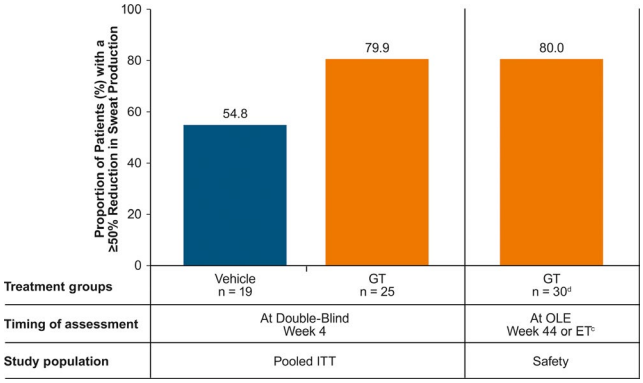

FIGURE 1 Sweat production[a] improvement: Grav-50 responder rate (≥50% reduction in sweat production from Baseline[b]) at Week 4 of the double-blind trials[9] and Week 44 or ET[c] of the OLE. [a]Gravimetrically measured average from the left and right axillae. [b]Baseline for the OLE is Baseline of the double-blind trials for vehicle-treated and GT-treated patients who continued into the OLE and received GT treatment thereafter. [c]ET refers to Week 44 for patients who completed the OLE and end of treatment for those who did not. [d]Age of pediatric patients in 1-y increments at Week 44 or ET: 9 y, 12 y: n = 1 each; 13 y: n = 4; 14 y, 15 y, 16 y: n = 8 each. *P*-values were not calculated for this post hoc analysis. In the double-blind trials, multiple imputation (MCMC) was used to impute missing values; no imputation of missing values was performed in the OLE. ET, end of treatment; GT, glycopyrronium tosylate; ITT, intent-to-treat; MCMC, Markov chain Monte Carlo; OLE, open-label extension; y, years

no dose modification (8 patients). TEAEs infrequently led to drug withdrawal; most did not require any dose modification and resolved within one week of onset (based on patient self-report and/or physical exam). One pediatric patient discontinued due to moderate dry mouth; study drug was withdrawn, and the event resolved 19 days after onset. No anticholinergic TEAEs were severe.

3.2.3 | Local skin reactions and laboratory findings

The proportion of pediatric patients reporting LSRs was similar between double-blind trials and OLE (Table 2). Of approximately one-third of pediatric patients reporting LSRs, erythema (26.3%), burning/stinging (18.4%), and pruritus (7.9%) were the most common. LSRs were predominantly mild or moderate in intensity. No clinically meaningful changes were observed with respect to laboratory tests, vital signs, or physical examinations during the OLE.

3.3 | Descriptive efficacy measures

Through Week 44 or ET in the OLE (up to 48 weeks of GT from the start of the double-blind trials), improvements in efficacy measures, including sweat production (Figure 1), HDSS responder rate (Figure 2), and CDLQI (Figure 3), were maintained.

4 | DISCUSSION

The importance of treating hyperhidrosis in children and adolescents should not be overlooked; left untreated, hyperhidrosis can have a profound negative impact in young people at a time when they may be most susceptible to social pressure.[5] When considering treatment for pediatric patients, including for chronic

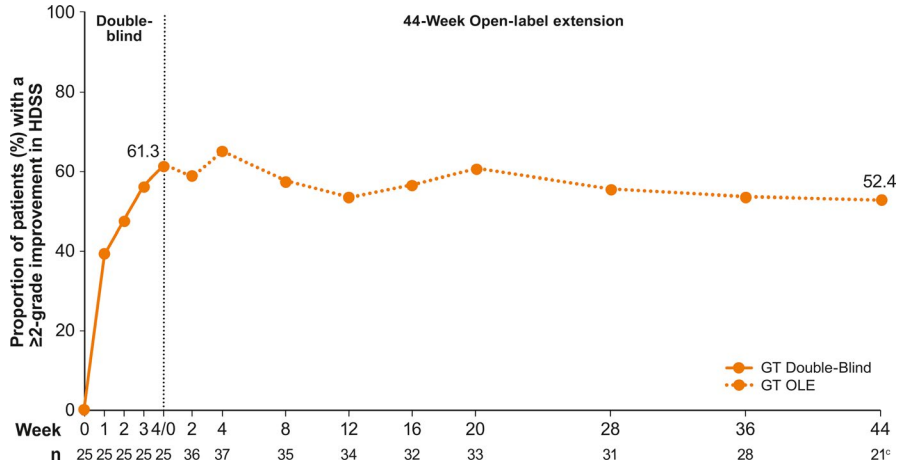

FIGURE 2 HDSS responder rate (≥2-grade improvement from Baseline): Week 0 of the double-blind trials[9] (GT-treated patients only) to Week 44[a,b] of the OLE (for all patients who continued into the OLE and received GT treatment thereafter). [a]Week 44 data include observed cases at Week 44 (n = 21). [b]Most patients discontinued due to the protocol-required study termination (study objective met). [c]Age of pediatric patients in 1-year increments at Week 44: 13 y: n = 4; 14 y: n = 5, 15 y: n = 5, 16 y: n = 7. *P*-values were not calculated for this post hoc analysis. Baseline for the OLE is the Baseline of the double-blind trials for vehicle-treated and GT-treated patients who continued into the OLE and received GT treatment thereafter. In the double-blind trials, multiple imputation (MCMC) was used to impute missing values; no imputation of missing values was performed in the OLE. GT, glycopyrronium tosylate; HDSS, Hyperhidrosis Disease Severity Scale; ITT, intent-to-treat; MCMC, Markov chain Monte Carlo; OLE, open-label extension; y, years

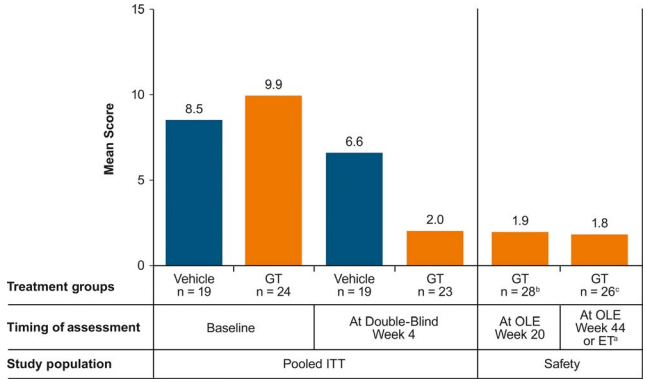

FIGURE 3 Mean CDLQI scores at Baseline (Week 0 of double-blind trials) and Week 4 of the double-blind trials,[9] Week 20 and 44 or ET[a] of the OLE. [a]ET refers to Week 44 for patients who completed the OLE and end of treatment for those who did not. [b]Age of pediatric patients in 1-year increments at Week 20:12 y: n = 1; 13 y, 14 y: n = 7 each; 15 y: n = 8; 16y: n = 5. [c]Age of pediatric patients in 1-y increments at Week 44 or ET: 9 y, 12y: n = 1 each; 13y: n = 4; 14y: n = 8; 15 y: n = 7; 16 y: n = 5. The CDLQI questionnaire is validated for use in patients ≥4 to ≤16 y.[16] *P*-values were not calculated for this post hoc analysis. Baseline for the OLE is the Baseline of the double-blind trials for vehicle-treated and GT-treated patients who continued into the OLE and received GT treatment thereafter. No imputation of missing values in the double-blind trials or OLE. CDLQI, children's Dermatology Life Quality Index; ET, end of treatment; GT, glycopyrronium tosylate; ITT, intent-to-treat; OLE, open-label extension; y, years

conditions like hyperhidrosis, a drug's safety profile is of particular interest. The phase 3, double-blind, GT trials, along with the subsequent OLE, are the only trials to date in primary axillary hyperhidrosis to enroll pediatric patients, allowing for unique insights into this underserved population. This post hoc analysis of the 44-week OLE (ARIDO) demonstrated that GT was well tolerated for up to 48 weeks in pediatric patients. No trends were observed with respect to reasons for early termination, and the most common reason for discontinuation reflects the protocol-required early study termination once study objectives were met. Only 1 pediatric patient discontinued due to TEAEs. Overall, the long-term TEAE profile was similar between pediatric and older patients and consistent with that observed in the 4-week, double-blind, and lead-in trials.[9]

In a previous post hoc analysis of the double-blind trials, once-daily GT improved disease severity, sweat production, and dermatology health-related quality of life versus vehicle, with similar findings in children, adults, and the pooled population.[8,9] These improvements were maintained or increased throughout long-term treatment with GT (up to 48 weeks), with similar efficacy findings observed in both pediatric and older patients.[10]

A number of study limitations should be recognized. Foremost, the pediatric sample size was small, and although assessments showed consistent results between pediatric and older[10] patients, further studies in real-life settings would be useful to confirm findings. Also, 11/38 (28.9%) of pediatric patients did not reach the 44-week visit due to early study termination by the sponsor once the primary study objective was achieved. Lastly, as with most open-label studies, interpretation of efficacy and safety outcomes was limited by lack of a vehicle control. Only a subset of efficacy outcomes from the double-blind trials was evaluated in this trial; those included were analyzed descriptively, limiting the ability to make direct comparisons with the double-blind trial results.

In summary, the availability of topical, once-daily GT provides a new, noninvasive treatment option for both adults and pediatric patients with primary axillary hyperhidrosis that is well tolerated over the long-term.

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CONFLICT OF INTEREST

Dr Hebert is a consultant for Dermira, Inc. and an employee of the UTHealth McGovern Medical School, Houston, which received compensation from Dermira, Inc. for study participation. Dr Hebert has also been an investigator for Brickell Biotech, Inc. All research funds are paid to the medical school. Dr Glaser is a consultant for Dermira, Inc., and an investigator for Allergan, Atacama Therapeutics, Brickell Biotech, Inc., Galderma, and Revance Therapeutics, Inc. She has received honoraria for consulting with Allergan and Dermira, Inc. Dr Green is an investigator for Brickell Biotech, Inc., and a consultant, investigator, and speaker for Dermira, Inc. Dr Hull is an investigator for Northwestern Arkansas Clinical Trials Center which receives compensation from Dermira, Inc. for study participation. Dr Cather is an investigator and advisory board member who has received honoraria from AbbVie, Inc., Celgene Corporation, Eli Lilly and Company, and Regeneron Pharmaceuticals, Inc. She is an investigator for Dermira, Inc. Ms Drew and Dr Gopalan are employees of Dermira, Inc. Dr Pariser received honoraria for consulting for Atacama Therapeutics, Brickell Biotech, Inc., Biofrontera AG, Celgene Corporation, Dermira, Inc., DUSA Pharmaceuticals, Inc., LEO Pharma, Inc., Novartis Pharmaceuticals Corporation, Promius Pharma, LLC, Regeneron Pharmaceuticals, Inc., Sanofi, TDM SurgiTech, Inc., TheraVida, Inc., and Valeant Pharmaceuticals International, Inc. He received honoraria for advisory board participation for Pfizer, Inc. He received grants/research funding for serving as an investigator for Abbott Laboratories, Amgen, Inc., Asana BioSciences, LLC, Brickell Biotech, Inc., Celgene Corporation, Dermavant Sciences, Inc., Eli Lilly and Company, LEO Pharma, Inc., Merck & Company, Inc., Novartis Pharmaceuticals Corporation, Novo Nordisk A/S, Ortho Dermatologics, Inc., Peplin, Inc., Photocure ASA, Promius Pharma, LLC, Regeneron Pharmaceuticals, Inc., Stiefel Laboratories, and Valeant Pharmaceuticals International, Inc. He received honoraria for serving as an investigator for LEO Pharma, Inc. and Pfizer, Inc.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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