

Impact of cannabis knowledge and attitudes on real-world practice



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ABSTRACT

Background: Increased cannabis consumption worldwide challenges allergists because of an upsurge in cannabis allergy and need to discuss cannabis with patients.

Objective: To determine the knowledge, attitudes, and practices regarding cannabis among allergists and their approach to recognizing and diagnosing suspected cannabis allergy.

Methods: The International Allergist Canna Knowledge, Attitudes, and Practices Survey was completed by members from 3 International Allergy Societies. Survey questions included the following: 13 on cannabis attitudes, 7 on cannabis knowledge, and 4 on real-world allergy practices. Knowledge level was dichotomized and Statistical Package for the Social Sciences TwoStep Cluster Analysis grouped participants by attitudes. Multivariate analysis determined the relationship of knowledge and attitude to practice delivery.

Results: Of 570 eligible surveys started, 445 (78.1%) were completed. Participants were 49.7% of female sex, 65.9% aged 24 to 56 years, approximately 70% in practice for more than or equal to 10 years, and 29.2% practicing in an area where cannabis use is illegal. Of the respondents, 43.1% reported consulting on patients with suspected cannabis allergy and 54.7% had undertaken skin prick testing, in vitro cannabis testing, or both. Statistically significant differences were found between the 3 societies for most variables analyzed. Analysis of attitudes revealed 3 clusters named Traditional, Progressive, and Unsure. Those with more progressive attitudes toward cannabis and who had more knowledge were more comfortable speaking to patients about cannabis and more often asked patients on how often and how they used cannabis (all $P < .001$).

Conclusion: Varying knowledge and attitudes toward cannabis affecting comfort communicating with patients about cannabis were found in members of 3 allergy societies supporting the need for more cannabis research and education.

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Introduction

Cannabis use has been increasing owing to changes in its legalization throughout the world. In the United States, the 2018 Farm Bill legalized hemp with cannabis levels of tetrahydrocannabinol (THC) less than 0.3% THC and legalization of marijuana (ie, cannabis with $\geq 0.3\%$ THC) was ratified either medically, recreationally, or both in 38 states. Nationally, cannabis is legal in Canada in all forms. In the European Union, several countries have medical cannabis programs with Malta the only country to legalize recreational cannabis, whereas other countries are soon to follow. The growing number of countries that have legalized cannabis reflects the changing attitudes toward cannabis.^{1–3} The rationale for the transformation in attitudes toward cannabis has long been speculated but not well understood; however, a recent study concluded “as to root causes, evidence suggests that a decrease in religious affiliation, a decline in punitiveness, and a shift in media framing all contributed to changing attitudes.”¹

Despite the increases in medical and recreational cannabis legalization and the changes in attitudes toward cannabis in the past decades, knowledge regarding cannabis among health care workers has lagged behind the increase in its use.^{3–6} Medical providers with more permissive attitudes toward cannabis were more inclined to recommend it to patients, many were not prepared to answer questions regarding cannabis,⁴ and medical, pharmacy, and social work students reported that they did not receive formal education regarding cannabis.^{3,5–7} Even physicians who have adequate knowledge about cannabis and think it can improve quality of life among chemotherapy patients are still challenged in prescribing it and do not fully understand their country's legislation.⁸ These situations create a disconnect between patients who are using cannabis for various reasons and the physicians who are caring for them.^{9–11}

A study of people with allergies and asthma exemplifies a patient population that consumes cannabis despite its potential harm.⁹ A survey of followers of the Allergy & Asthma Network reported that 2.5% did not consume cannabis because of a reported cannabis allergy. Of the survey respondents, 18% indicated that they used cannabis in the past 2 weeks. Survey respondents answered that 35% of their allergists inquired about cannabis use whereas only 17% of the survey respondents wanted to discuss cannabis with their allergist (however, this number jumped to 37% among current cannabis users). Smoking (57%) and vaping (29%) were the most common routes of administration of cannabis, even among those with uncontrolled asthma. Benefits from cannabis were reported markedly more frequently than adverse effects.⁹ Given that people with allergies and asthma use cannabis, and the fact that they are experiencing both positive and adverse impacts,⁹ it is imperative that their treating physicians, and particularly allergists, are aware of their cannabis use and the potential effects, both positive and harmful (ie, coughing among patients with uncontrolled asthma), in an effort to properly educate their patients on best cannabis use practices.

This study tested the knowledge, attitudes, and practices (KAP) model which maintains that practices (or behaviors) are established by the person's knowledge and attitudes toward cannabis.¹² This study also determined whether knowledge and attitudes regarding cannabis influenced practice in an allergy setting among active members of 3 International Allergy Societies. We hypothesized that allergists with more supportive attitudes toward cannabis would display more cannabis knowledge and would more likely converse with their patients about cannabis.

Methods

Study Population and Setting

Members more than or equal to 18 years of age from the American College of Allergy, Asthma and Immunology (ACAAI), Canadian

Society of Allergy and Clinical Immunology (CSACI), and European Academy of Allergy and Clinical Immunology (EAACI) who care for patients with allergies, asthma or both were eligible. Each society e-mailed their members with an invitation and separate link to complete online the identical comprehensive anonymous survey regarding cannabis on REDCap detailed in Figure 1, panel A. Because there is crossover membership between the societies, the instructions specified that the survey should only be taken one time. Each society had a different time frame for which the link was active owing to timing of e-mail blasts and participation success (Fig 1, panel A). The survey call-to-action (eTable 1) described the study, eligibility criteria, Institutional Review Board information, and study contacts along with the survey link. The University of Cincinnati Institutional Review Board gave the study exempt status.

Survey Questions

The survey is accessible in eTable 2. The survey was developed in the setting of a collaborative effort of physicians from the 3 International Allergy Societies surveyed. The senior author drafted the initial survey based on earlier surveys on athletes¹³ and followers on the Allergy Asthma Network.⁹ With input from the survey team of physicians, additional questions were added. The survey was piloted and refined by e-mailing to the members of the International KAP collaborative group (eTable 3). E-mail blasts were sent out to members of each society by means of the society itself. It is unknown how many allergists were reached by means of these e-mail blasts.

Demographic information was collected, including the following: sex, year of birth, years in practice, and type of practice. Respondents were also queried if they asked about cannabis use on intake form or verbally, whether they recorded cannabis use, whether they saw patients with suspected cannabis allergy and how many such patients they had seen, if they had tested for cannabis allergy, and whether they would be interested in learning more about cannabis.

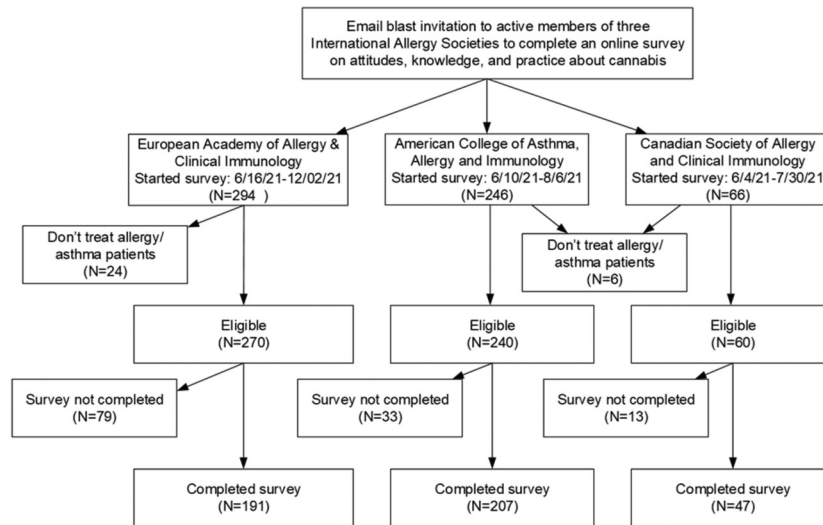
Knowledge about cannabis was assessed using a 7-item measure, some of which were used in previous studies but were modified to be more specific to the allergist.^{9,14} Each question had a single correct answer. The 7 questions were converted into a knowledge score by summing the answers, where a correct answer was “1” and an incorrect answer was “0,” with a minimum score of 0 and a maximum score of 7. Knowledge was dichotomized as low (≤ 3) and high (≥ 4) for the multivariate analysis based on the median knowledge score. Attitudes toward cannabis were determined using a 13-item, 3-choice (yes, no, unsure) questionnaire that was previously reported and provided useful information for a TwoStep Cluster analysis.^{1,2}

Practice approaches regarding cannabis were assessed with the following 4 questions: (1) “Are you comfortable talking to your patients about cannabis?”, (2) “For your patients who use cannabis, do you ask how often do you use it?”, (3) “For your patients who use cannabis do you ask how they use it?”, and (4) “Do you counsel cessation for patients who smoke and/or vaporize cannabis?”

Statistical Analyses

Fisher's exact test, χ^2 , and analysis of variance (ANOVA) were used for group comparisons. The Statistical Package for the Social Sciences (SPSS) TwoStep Cluster method was used to determine the number of attitudes clusters and to allocate subjects to their respective clusters as published previously.^{9,13,15} After cluster identification, post hoc ANOVA tests were conducted to determine whether there was adequate separation of the clusters to determine intercluster heterogeneity and intracluster homogeneity.^{9,13,16,17} Multivariate analysis using the SPSS generalized linear model procedure was used to evaluate whether there were associations between knowledge and attitudes clusters on practice using covariates that were statistically significant

Panel A



Panel B

Summary of statistical analyses

1. Statistical comparisons of survey responses regarding demographics, cannabis allergy, and attitudes, knowledge, and practice between members of the three Allergy Societies.
2. Cluster analysis of attitudes towards cannabis of the combined members of the three Allergy Societies resulted in 3 clusters named Traditional, Progressive, and Unsure. Statistical comparisons made between the 3 clusters and cannabis practice patterns and knowledge.
3. Multivariate analysis of combined members of the three Allergy Societies adjusted for society and other covariates to determine the relationship between cannabis attitudes and knowledge and practice patterns regarding cannabis.

Fig. 1. Consort diagram for the International Allergist Canna KAP Survey. Panel A illustrates the recruitment and final numbers for each society. Panel B illustrates the statistical analytical approach.

(eg, retaining the most parsimonious model). For the multivariate analysis, the 4 practice items were the dependent variables whereas knowledge (Knowledge model) and the attitudes (Attitudes model) clusters were the independent variables. The advantage of multivariate analysis is the ability to assess differences across multiple dependent variables simultaneously with a null hypothesis of equal means across groups.^{17,18} A multivariate F test (Wilks' lambda) and partial eta squared (a measure of effect size) were calculated. Post hoc Bonferroni tests were used to evaluate group differences. Covariates were fit to the model using several iterative steps. First, several potential covariates were identified: society, sex, year of birth, cannabis legal status, where the respondent practiced, history of cannabis use, and practice setting (academic or not academic). The covariates were added to the multivariate model singly and were considered for the full model if $P < .25$.¹⁹ The covariates that met the P value criteria were added to the full model and were retained to the model if they achieved $P < .10$ or if the covariate was a confounder (ie, related to the dependent or independent variable) regardless of statistical significance.¹⁹ This process was done for both multivariate models allowing for different covariates by model. Partial eta squared (the measure of effect size for the dependent variable) was reported. A small effect size is 0.01, medium effect size is 0.06, and a large effect size is 0.14 or higher (Fig 1, panel B).²⁰

As documented in other studies, 445 respondents provide sufficient power for the present study analyses.^{21,22} Sufficient statistical power has been found with relatively small samples ($N = 20$ per subgroup), provided cluster separation is large (which was found in this study).²² A post hoc power analysis using G*Power estimated power for the multivariate analysis at 99%. Double-sided $P < .05$ was considered significant. Surveys that were missing data on knowledge, attitudes, and practice were not included.

Analyses were computed using SPSS version 26 (IBM Corporation, Armonk, New York).

Results**Demographics**

A total of 445 surveys were completed and used in these analyses. The ACAAI had 240 eligible starters and 207 completed the survey (86.2%); the EAACI had 270 eligible starters and 191 completed the surveys (70.7%); the CSACI had 60 eligible starters with 47 completed the surveys (78.3%) (Fig 1, panel A). Overall, respondents were 49.7% of female sex, 65.2% born between 1946 and 1980, 54.8% practiced for less than 20 years, 53.2% practiced in a nonacademic or research setting, and 93.7% had an MD, DO, or PhD degrees (Table 1). There were significant differences between societies for all the demographic variables ($P < .001$) with CSACI having more female respondents (70.2%), ACAAI having the oldest respondents (52.2% born between 1928 and 1964) who have practiced the longest (59.9% ≥ 20 years), and the EAACI had the most respondents working in an academic setting (60.7%). Overall, 36.1% of the respondents indicated that they ever used cannabis with only small differences between societies ($P < .05$).

Cannabis Allergy

Patient complaints of cannabis allergy were reported by 43.1% of the respondents, highest among members of CSACI (74.5%) and lowest among the ACAAI (36.2%) ($P < .001$ between societies) (Table 2). Most respondents had seen between 1 and 10 patients with suspected cannabis allergy (85.4%) with no difference between the societies.

Table 1
Demographics From Members of 3 Allergy Societies.

Survey question	Response	ACAAI (N = 207)	CSACI (N = 47)	EAACI (N = 191)	Total (N = 445)
What is your sex? ^a	Female	78 (37.7)	33 (70.2)	110 (57.6)	221 (49.7)
	Male	125 (60.4)	14 (29.8)	78 (40.8)	217 (48.8)
	Prefer not to answer	4 (1.9)	0 (0)	3 (1.6)	7 (1.6)
What year were you born? ^a	1928-1945	13 (6.3)	0 (0)	3 (1.6)	16 (3.6)
	1946-1964	95 (45.9)	3 (6.4)	35 (18.3)	133 (29.9)
	1965-1980	60 (29)	21 (44.7)	76 (39.8)	157 (35.3)
	1981-1997	37 (17.9)	23 (48.9)	76 (39.8)	136 (30.6)
	Prefer not to answer	2 (1.0)	0 (0)	1 (0.5)	3 (0.7)
How many years have you been in practice? ^a	0-9	44 (21.3)	29 (61.7)	58 (30.4)	131 (29.4)
	10 to 19	39 (18.8)	11 (23.4)	63 (33.0)	113 (25.4)
	20-30	48 (23.2)	5 (10.6)	40 (20.9)	93 (20.9)
	>30	76 (36.7)	2 (4.3)	30 (15.7)	108 (24.3)
(Participants were able to select more than one answer) Practice setting ^a	Academic hospital	41 (19.8)	20 (42.5)	116 (60.7)	177 (39.8)
	Community hospital	6 (2.9)	3 (6.4)	36 (18.8)	45 (10.1)
	Multispecialty group	32 (15.5)	6 (12.8)	24 (12.6)	62 (13.9)
	Single specialty group	86 (41.5)	16 (34.0)	21 (11.0)	123 (27.6)
	Solo practice	54 (26.1)	12 (25.5)	30 (15.7)	96 (21.6)
	Research	4 (1.9)	2 (4.3)	25 (13.1)	31 (7.0)
	Other	3 (1.4)	0 (0)	4 (2.1)	7 (1.6)
(Participants were able to select more than one answer) Level of training ^a	MD or DO	181 (87.4)	40 (85.1)	106 (55.5)	327 (73.5)
	PhD	0 (0)	0 (0)	16 (8.4)	16 (3.6)
	MD/PhD	11 (5.3)	2 (4.3)	61 (31.9)	74 (16.6)
	NP/PA	13 (6.3)	0 (0)	3 (1.6)	16 (3.6)
	Other	3 (1.4)	5 (10.6)	7 (3.7)	15 (3.4)

Abbreviations: ACAAI, American College of Allergy, Asthma and Immunology; CSACI, Canadian Society of Allergy and Clinical Immunology; DO, doctor of osteopathy; EAACI, European Academy of Allergy and Clinical Immunology; MD, doctor of medicine; NP, nurse practitioner; PA, physician assistant; PhD, doctor of philosophy.

NOTE. Data provided as number (percentage). χ^2 P value < .001 for society differences.

^a P < .001.

Table 2
Suspected Cannabis Allergy Symptoms and Exposures.

Question	Response	ACAAI (N = 207)	CSACI (N = 47)	EAACI (N = 191)	Total (N = 445)
Have you seen patients with complaints of cannabis allergy? ^a	Yes	75 (36.2)	35 (74.5)	82 (42.9)	192 (43.1)
	No	126 (60.9)	11 (23.4)	103 (53.9)	240 (53.9)
	Do not know	6 (2.9)	1 (2.1)	6 (3.1)	13 (2.9)
Approximately how many patients have you ever seen with suspected cannabis allergy? ^a	0	0 (0)	1 (2.9)	1 (1.2)	2 (1.0)
	1-10	66 (88.0)	28 (80.0)	70 (85.4)	164 (85.4)
	11-20	4 (5.3)	2 (5.7)	7 (8.5)	13 (6.8)
	21-30	1 (1.3)	1 (2.9)	3 (3.7)	5 (2.6)
	31-40	0 (0)	0 (0)	0 (0)	0 (0)
	41-50+	2 (2.7)	3 (8.6)	1 (1.2)	6 (3.1)
	Do not know	2 (2.7)	0 (0)	0 (0)	2 (1.0)
What symptoms do your patients with suspected cannabis allergy report? ^b	Oral pruritus	24 (32.0)	15 (42.9)	31 (37.8)	70 (36.5)
	Contact dermatitis or eczema	21 (28.0)	12 (34.3)	21 (25.6)	54 (28.1)
	Urticaria/angioedema	29 (38.7)	22 (62.9)	48 (58.5)	99 (51.6)
	Rhinitis	36 (48.0)	18 (51.4)	33 (40.2)	87 (45.3)
	Nasal congestion	30 (40.0)	22 (62.9)	31 (37.8)	83 (43.2)
	Conjunctivitis	15 (20.0)	13 (37.1)	27 (32.9)	55 (28.6)
	Cough	35 (46.7)	20 (57.1)	25 (30.5)	80 (41.7)
	Shortness of breath	36 (48.0)	12 (34.3)	26 (31.7)	74 (38.5)
	Asthma exacerbation	26 (34.7)	20 (57.1)	29 (35.4)	75 (39.1)
	Anaphylaxis (severe systemic symptoms)	11 (14.7)	14 (40.0)	23 (28.0)	48 (25.0)
	I do not know	1 (1.3)	0 (0)	1 (1.2)	2 (1.0)
	Other	4 (5.3)	2 (5.7)	3 (3.7)	9 (4.7)
Which route(s) of cannabis exposure lead to the allergic reactions in your patient(s)? ^c	Direct cutaneous contact/topicals	26 (34.7)	18 (51.4)	26 (31.7)	70 (36.5)
	Smoking/vaping	53 (70.7)	29 (82.9)	58 (70.7)	140 (72.9)
	Oil/tincture	5 (6.7)	7 (20.0)	4 (4.9)	16 (8.3)
	Edibles	17 (22.7)	9 (25.7)	17 (20.7)	43 (22.4)
	Mucosal contact	10 (13.3)	9 (25.7)	14 (17.1)	33 (17.2)
	Inhaling airborne cannabis	18 (24.0)	10 (28.6)	21 (25.6)	49 (25.5)
	Occupational exposure	23 (30.7)	8 (22.9)	4 (4.9)	35 (18.2)
	Secondhand contact/exposure	9 (12.0)	4 (11.4)	7 (8.5)	20 (10.4)
	Do not know	2 (2.7)	0 (0)	2 (2.4)	4 (2.1)
	Other	3 (4.0)	0 (0)	2 (2.4)	5 (2.6)
Have you done any testing for patients with a history of suspected cannabis allergy? ^a	Skin prick testing	19 (25.3)	25 (71.4)	29 (35.4)	73 (38.0)
	In vitro testing	0 (0)	0 (0)	13 (15.9)	13 (6.8)
	Both	0 (0)	2 (5.7)	17 (20.7)	19 (9.9)
	Neither	55 (73.3)	8 (22.9)	22 (26.8)	85 (44.3)
	Other	1 (1.3)	0 (0)	1 (1.2)	2 (1.0)

Abbreviations: ACAAI, American College of Allergy, Asthma and Immunology; CSACI, Canadian Society of Allergy and Clinical Immunology; EAACI, European Academy of Allergy and Clinical Immunology.

^a χ^2 P < .001.

^b χ^2 P < .01.

^c χ^2 P < .05.

Table 3
Cannabis Knowledge by Society [N(%)].

Question	Response	ACAAI (N = 207)	CSACI (N = 47)	EAACI (N = 191)	Total (N = 445)
Which cannabinoid(s) is psychoactive? ^a	THC	180 (87.0)	36 (76.6)	115 (60.2)	331 (74.4)
	CBD	2 (1.0)	1 (2.1)	2 (1.0)	5 (1.1)
	Both	15 (7.2)	6 (12.8)	34 (17.8)	55 (12.4)
	Do not know	10 (4.8)	4 (8.5)	40 (20.9)	54 (12.1)
Which cannabinoid(s) has therapeutic benefits that may offer symptom relief for pain? ^a	THC	8 (3.9)	3 (6.4)	26 (13.6)	37 (8.3)
	CBD	74 (35.7)	27 (57.4)	76 (39.8)	177 (39.8)
	Both	108 (52.2)	13 (27.7)	40 (20.9)	161 (36.2)
	Do not know	17 (8.2)	4 (8.5)	49 (25.7)	70 (15.7)
Which cannabinoid(s) is attributed with reducing seizures in certain patients who suffer from epilepsy? ^b	THC	42 (20.3)	1 (2.1)	21 (11.0)	64 (14.4)
	CBD	75 (36.2)	25 (53.2)	70 (36.6)	170 (38.2)
	Both	22 (10.6)	5 (10.6)	20 (10.5)	47 (10.6)
	Do not know	68 (32.9)	16 (34.0)	80 (41.9)	164 (36.9)
Most cannabis strains available today have been selectively bred for high concentrations of which cannabinoid (s)? ^c	THC	102 (49.3)	25 (53.2)	70 (36.6)	197 (44.3)
	CBD	24 (11.6)	6 (12.8)	31 (16.2)	61 (13.7)
	Both	27 (13.0)	7 (14.9)	20 (10.5)	54 (12.1)
	Do not know	54 (26.1)	9 (19.1)	70 (36.6)	133 (29.9)
Is cannabis hyperemesis syndrome an allergic reaction to cannabis? ^c	Yes	3 (1.4)	1 (2.1)	6 (3.1)	10 (2.2)
	No	114 (55.1)	38 (80.9)	106 (55.5)	258 (58.0)
	Do not know	90 (43.5)	8 (17.0)	79 (41.4)	177 (39.8)
How many different cannabinoids are present in the cannabis plant?	2	3 (1.4)	0 (0)	2 (1)	5 (1.1)
	3–10	15 (7.2)	6 (12.8)	20 (10.5)	41 (9.2)
	11–50	11 (5.3)	2 (4.3)	9 (4.7)	22 (4.9)
	51–100	7 (3.4)	1 (2.1)	10 (5.2)	18 (4.0)
	>100	19 (9.2)	1 (2.1)	33 (17.3)	53 (11.9)
	Do not know	152 (73.4)	37 (78.7)	117 (61.3)	306 (68.8)
Hemp is federally legal in the United States? ^a	Yes	128 (61.8)	17 (36.2)	30 (15.7)	175 (39.3)
	No	25 (12.1)	1 (2.1)	14 (7.3)	40 (9.0)
	Do not know	54 (26.1)	29 (61.7)	147 (77)	230 (51.7)
Mean knowledge (SD) ^a		3.51 (1.59)	3.30 (1.61)	2.43 (1.63)	3.02 (1.69)

Abbreviations: ACAAI, American College of Allergy, Asthma and Immunology; ANOVA, analysis of variance; CBD, cannabidiol; CSACI, Canadian Society of Allergy and Clinical Immunology; EAACI, European Academy of Allergy and Clinical Immunology; THC, tetrahydrocannabinol.

NOTE. Correct responses are in bold. Mean knowledge by society computed by ANOVA.

^a $\chi^2 P < .001$.

^b $\chi^2 P < .01$.

^c $\chi^2 P < .05$.

The symptoms from reported cannabis allergy varied by society ($P < .001$), with the 4 most common symptoms among the societies being urticaria or angioedema (51.6%), nasal congestion (43.2%), rhinitis (45.3%), and cough (41.7%). Anaphylaxis was reported in 25.0% of the patients reporting suspected cannabis allergy. Testing patients for suspected cannabis sensitization varied by society ($P < .001$) with 71.4% of CSACI members doing skin prick testing compared with 25.3% of ACAAI members and 35.4% of EAACI members. In vitro testing for cannabis sensitization was infrequent (6.8% of the respondents), and 73.3% of the ACAAI members have not done any testing for cannabis sensitization.

Knowledge

The overall mean for knowledge was 3.0 (SD = 1.7). Knowledge scores differed by society: ACAAI (mean, 3.5; SD, 1.6); CSACI (mean, 3.3; SD, 1.6); and EAACI (mean, 2.4; SD, 1.6). There was no statistical difference between ACAAI and CSACI; however, EAACI was significantly different from ACAAI ($P < .001$) and CSACI ($P < .01$) (Table 3).

Attitudes

The SPSS TwoStep Cluster Analysis automatically designated a 3-cluster solution that were named Traditional (n = 138, 31.0%), Progressive (n = 215, 48.3%), and Unsure (n = 92, 20.7%). ANOVA with Bonferroni correction was used to evaluate whether there was adequate separation between groups for the 13 attitudes items that were input into the cluster analysis (Table 4). There was a statistically significant difference between all 3 cluster groups for all 13 questions ($P < .001$). However, a more granular evaluation of the items revealed

no statistically significant difference between Traditional and Progressive for the item “Do you feel that smoking cannabis is more harmful to your health than vaping?”, Traditional and Unsure for “Do you think legalizing cannabis makes it safer?”, Traditional and Unsure for “Do you think legalizing cannabis makes it seem safer?”, and “Do you think cannabis is beneficial for people with certain medical conditions?”. A significant difference was found in cluster membership by society ($P < .001$): ACAAI (Traditional, 22.7%; Progressive, 60.4%; Unsure, 16.9%), CSACI (Traditional, 10.6%; Progressive, 66.0%; Unsure, 23.4%), and EAACI (Traditional, 45.0%; Progressive, 30.9%; Unsure, 24.1%).

Practice

There was no difference between societies in how comfortable members were talking to their patients about cannabis (Table 5). Overall, 67.9% responded that they were comfortable talking to patients about cannabis (ACAAI: 67.6%; CSACI: 76.6%; EAACI: 66.0%). However, despite a relative comfort level talking to patients about cannabis, only 35.5% of the total respondents answered that they queried about cannabis use on intake form or verbally. Furthermore, 29.0% answered that in the past month they did not verbally ask patients about cannabis use even though 46.1% indicated that they noticed an increase in cannabis use among their patients (Table 6). Respondents who asked their patients about cannabis use most often inquired about how often they used it (58.7%) and how they used it (53.0%) with differences between societies existing about cannabis discussions ($P < .05$ and $P < .001$, respectively). For patients who indicated that they smoke or vaporize cannabis, 31.0% of the respondents always counseled cessation and 29.2% sometimes counseled

Table 4
Cannabis Attitudes by Society [N (%)].

Question	Response	ACAAI (N = 207)	CSACI (N = 47)	EAACI (N = 191)	Total (N = 445)
Do you think THC is addictive? ^a	Yes	127 (61.4)	28 (59.6)	135 (70.7)	290 (65.2)
	No	47 (22.7)	11 (23.4)	17 (8.9)	75 (16.9)
	Unsure	33 (15.9)	8 (17.0)	39 (20.4)	80 (18.0)
Do you think THC causes permanent neurologic deficits? ^b	Yes	83 (40.1)	17 (36.2)	91 (47.6)	191 (42.9)
	No	64 (30.9)	14 (29.8)	31 (16.2)	109 (24.5)
	Unsure	60 (29.0)	16 (34.0)	69 (36.1)	145 (32.6)
Do you think CBD is addictive? ^c	Yes	26 (12.6)	9 (19.1)	56 (29.3)	91 (20.4)
	No	133 (64.3)	24 (51.1)	76 (39.8)	233 (52.4)
	Unsure	48 (23.2)	14 (29.8)	59 (30.9)	121 (27.2)
Do you think CBD is damaging to the brain? ^c	Yes	17 (8.2)	1 (2.1)	45 (23.6)	63 (14.2)
	No	122 (58.9)	27 (57.4)	73 (38.2)	222 (49.9)
	Unsure	68 (32.9)	19 (40.4)	73 (38.2)	160 (36.0)
Do you think consuming edible cannabis is safer than smoking it? ^c	Yes	118 (57.0)	25 (53.2)	56 (29.3)	199 (44.7)
	No	46 (22.2)	13 (27.7)	79 (41.4)	138 (31.0)
	Unsure	43 (20.8)	9 (19.1)	56 (29.3)	108 (24.3)
Do you think cannabis is less harmful to one's health than alcohol? ^b	Yes	87 (42.0)	15 (31.9)	62 (32.5)	164 (36.9)
	No	65 (31.4)	14 (29.8)	87 (45.5)	166 (37.3)
	Unsure	55 (26.6)	18 (38.3)	42 (22.0)	115 (25.8)
Do you think smoking cannabis is less harmful to one's health than smoking tobacco? ^b	Yes	78 (37.7)	18 (38.3)	47 (24.6)	143 (32.1)
	No	93 (44.9)	20 (42.6)	109 (57.1)	222 (49.9)
	Unsure	36 (17.4)	9 (19.1)	35 (18.3)	80 (18)
Do you feel that smoking cannabis is more harmful than vaping cannabis? ^b	Yes	60 (29.0)	13 (27.7)	38 (19.9)	111 (24.9)
	No	82 (39.6)	18 (38.3)	65 (34.0)	165 (37.1)
	Unsure	65 (31.4)	16 (34.0)	88 (46.1)	169 (38)
Do you think legalizing cannabis makes it seem safer? ^a	Yes	138 (66.7)	32 (68.1)	96 (50.3)	266 (59.8)
	No	52 (25.1)	7 (14.9)	62 (32.5)	121 (27.2)
	Unsure	17 (8.2)	8 (17.0)	33 (17.3)	58 (13.0)
Do you think cannabis is beneficial for people with certain medical conditions?	Yes	171 (82.6)	42 (89.4)	148 (77.5)	361 (81.1)
	No	15 (7.2)	2 (4.3)	14 (7.3)	31 (7.0)
	Unsure	21 (10.1)	3 (6.4)	29 (15.2)	53 (11.9)
Do you think legalizing cannabis makes it more socially acceptable? ^c	Yes	191 (92.3)	44 (93.6)	126 (66.0)	361 (81.1)
	No	11 (5.3)	0 (0)	42 (22)	53 (11.9)
	Unsure	5 (2.4)	3 (6.4)	23 (12.0)	31 (7.0)
Do you support the legalization of cannabis for medical purposes?	Yes	159 (76.8)	40 (85.1)	138 (72.3)	337 (75.7)
	No	23 (11.1)	2 (4.3)	26 (13.6)	51 (11.5)
	Unsure	25 (12.1)	5 (10.6)	27 (14.1)	57 (12.8)
Do you support the legalization of cannabis for recreational purposes? ^c	Yes	91 (44.0)	31 (66.0)	49 (25.7)	171 (38.4)
	No	86 (41.5)	9 (19.1)	106 (55.5)	201 (45.2)
	Unsure	30 (14.5)	7 (14.9)	36 (18.8)	73 (16.4)

Abbreviations: ACAAI, American College of Allergy, Asthma and Immunology; CBD, cannabidiol; CSACI, Canadian Society of Allergy and Clinical Immunology; EAACI, European Academy of Allergy and Clinical Immunology; THC, tetrahydrocannabinol.

^a $\chi^2 P < .01$.

^b $\chi^2 P < .05$.

^c $\chi^2 P < .001$.

Table 5
Real-World Practices Among Allergists Regarding Cannabis Use in Their Patients [N(%)]

Question	Response	ACAAI (N = 207)	CSACI (N = 47)	EAACI (N = 191)	Total (N = 445)
Are you comfortable talking to your patients about cannabis?	Yes	140 (67.6)	36 (76.6)	126 (66.0)	302 (67.9)
	No	29 (14.0)	6 (12.8)	36 (18.8)	71 (16.0)
	Unsure	38 (18.4)	5 (10.6)	29 (15.2)	72 (16.2)
For your patients who smoke or vape cannabis, do you counsel them on cessation? ^a	Always	63 (30.4)	8 (17.0)	67 (35.1)	138 (31.0)
	Sometimes	70 (33.8)	17 (36.2)	43 (22.5)	130 (29.2)
	Rarely	29 (14.0)	9 (19.1)	12 (6.3)	50 (11.2)
	Never	16 (7.7)	11 (23.4)	9 (4.7)	36 (8.1)
	I do not discuss cannabis use or cessation with my patients	28 (13.5)	2 (4.3)	55 (28.8)	85 (19.1)
	Prefer not to answer	1 (0.5)	0 (0)	5 (2.6)	6 (1.3)
For your patients who use cannabis, do you ask how often they use it? ^b	Yes	119 (57.5)	36 (76.6)	106 (55.5)	261 (58.7)
For your patients who use cannabis, do you ask how they use it (edibles, smoking, vaporizer, etc.)? ^a	Yes	123 (59.4)	35 (74.5)	78 (40.8)	236 (53.0)

Abbreviations: ACAAI, American College of Allergy, Asthma and Immunology; CSACI, Canadian Society of Allergy and Clinical Immunology; EAACI, European Academy of Allergy and Clinical Immunology.

^a $\chi^2 P < .001$.

^b $\chi^2 P < .05$.

Table 6
Intake Information Provided by Allergists [N (%)]

Question	Response	ACAAI (N = 207)	CSACI (N = 47)	EAACI (N = 191)	Total (N = 445)
What is the legal status of cannabis where you practice? ^a	NOT LEGAL for either recreational or medical purposes	38 (18.4)	0 (0)	92 (48.2)	130 (29.2)
	Legal for BOTH recreational and medical purposes	69 (33.3)	46 (97.9)	22 (11.5)	137 (30.8)
	Legal for ONLY recreational purposes	1 (0.5)	0 (0)	6 (3.1)	7 (1.6)
	Legal for ONLY medical purposes	85 (41.1)	1 (2.1)	63 (33.0)	149 (33.5)
	I do not know	14 (6.8)	0 (0)	8 (4.2)	22 (4.9)
Does your new patient information form include questions about tobacco and/or cannabis or do you verbally ask? ^a	Tobacco use	110 (53.1)	4 (8.5)	82 (42.9)	196 (44.0)
	Cannabis use	0 (0)	0 (0)	2 (1.0)	2 (0.4)
	BOTH tobacco and cannabis use	82 (39.6)	20 (42.6)	54 (28.3)	156 (35.1)
	NEITHER tobacco nor cannabis use	2 (1.0)	1 (2.1)	11 (5.8)	14 (3.1)
	Do not know	3 (1.4)	2 (4.3)	4 (2.1)	9 (2.0)
	We do not use an intake form	9 (4.3)	19 (40.4)	37 (19.4)	66 (14.8)
	Prefer not to answer	1 (0.5)	1 (2.1)	1 (0.5)	3 (0.7)
Do you or your colleagues officially record your patients use of tobacco and/or cannabis use? ^a	Tobacco use only	85 (41.1)	3 (6.4)	88 (46.1)	176 (39.6)
	Cannabis use only	0 (0)	2 (4.3)	0 (0)	2 (0.4)
	BOTH tobacco and cannabis use	116 (56.0)	41 (87.2)	77 (40.3)	234 (52.6)
	NEITHER tobacco nor cannabis use	1 (0.5)	0 (0)	17 (8.9)	18 (4.0)
	Do not know	3 (1.4)	1 (2.1)	9 (4.7)	13 (2.9)
In the past month, what percentage of visits have you or your staff verbally asked patients about cannabis use? ^a	Prefer not to answer	2 (1)	0 (0)	0 (0)	2 (0.4)
	0	48 (23.2)	3 (6.4)	78 (40.8)	129 (29.0)
	1%-25%	80 (38.6)	7 (14.9)	54 (28.3)	141 (31.7)
	26%-50%	14 (6.8)	4 (8.5)	20 (10.5)	38 (8.5)
	51%-75%	18 (8.7)	8 (17.0)	10 (5.2)	36 (8.1)
	76%-100%	29 (14.0)	19 (40.4)	22 (11.5)	70 (15.7)
	Do not know	15 (7.2)	6 (12.8)	7 (3.7)	28 (6.3)
Have you noticed an increase in cannabis use in the past 2-3 years? ^a	Prefer not to answer	3 (1.4)	0 (0)	0 (0)	3 (0.7)
	Yes	119 (57.5)	23 (48.9)	63 (33.0)	205 (46.1)
	No	35 (16.9)	13 (27.7)	67 (35.1)	115 (25.8)
	Do not know	53 (25.6)	11 (23.4)	61 (31.9)	125 (28.1)
Does your state in the United States (or country if not in the United States) permit the prescription of cannabis? ^a	Yes	136 (65.7)	44 (93.6)	70 (36.6)	250 (56.2)
	No	36 (17.4)	0 (0)	93 (48.7)	129 (29.0)
	Do not know	35 (16.9)	3 (6.4)	28 (14.7)	66 (14.8)

Abbreviations: ACAAI, American College of Allergy, Asthma and Immunology; CSACI, Canadian Society of Allergy and Clinical Immunology; EAACI, European Academy of Allergy and Clinical Immunology.

^a χ^2 P value < .001 for society differences.

Table 7

Association Between Knowledge and Attitudes and the Real-World Practice Outcomes Determined by MVA

Outcome variable ^a	Yes response (%)	Significance of clusters in the MVA model	Effect size
Knowledge (independent variable)			
Are you comfortable talking to your patients about cannabis?	59.3	Low knowledge ^b	0.12
	80.2	High knowledge ^b	
For your patients who smoke or vape cannabis, do you always or sometimes counsel them on cessation?	56.7	Low knowledge ^b	0.11
	65.2	High knowledge ^b	
For your patients who use cannabis, do you ask how often they use it?	43.0	Low knowledge ^c	0.05
	67.6	High knowledge ^b	
For your patients who use cannabis, do you ask how they use it (edibles, smoking, vaporizer, etc.)?	43.7	Low knowledge ^c	0.07
	67.6	High knowledge ^b	
Attitudes clusters (independent variable)			
Are you comfortable talking to your patients about cannabis?	64.5	Traditional ^b	0.26
	80.5	Progressive ^b	
	43.5	Unsure ^b	
For your patients who smoke or vape cannabis, do you always or sometimes counsel them on cessation?	68.8	Traditional ^b	0.16
	60.5	Progressive ^b	
	46.8	Unsure ^b	
For your patients who use cannabis, do you ask how often they use it?	65.9	Traditional ^b	0.07
	60.9	Progressive ^b	
	42.4	Unsure ^a	
For your patients who use cannabis, do you ask how they use it (edibles, smoking, vaporizer, etc.)?	50.7	Traditional ^c	0.05
	61.9	Progressive ^c	
	35.9	Unsure	

Abbreviation: MVA, multivariate analysis.

Knowledge: Adjusted for practice setting, society, and history of cannabis use. Attitudes: Adjusted for practice setting, society, and sex. Significance level based on parameter estimates from the MVA model for the association between knowledge and attitudes and the 4 outcomes: ^a $P < .05$, ^b $P < .001$, and ^c $P < .01$. Effect size was the partial eta squared determined in the MVA: small = 0.01 to <0.06, medium = 0.06 to <0.14, and large ≥ 0.14 .

cessation. Finally, 40.8% of the EAACI members did not discuss cannabis with their patients compared with 23.2% from ACAAI and 6.4% from CSACI ($P < .001$).

Knowledge Attitudes and Practice Model

The KAP model was evaluated using multivariate analysis to determine whether there were associations between attitudes and knowledge on 4 real-world practice items (adjusted for covariates) and to obtain the effect sizes of each of the variables on practice (Fig 2).

Knowledge

For the knowledge part of the KAP model, covariate analysis returned 4 potential covariates: year born ($P = .07$), practice setting ($P < .01$), history of cannabis use ($P = .16$), and society ($P < .01$). When the model was run with all 4 covariates, only practice setting and society were statistically significant, but history of cannabis use was a confounder (ie, it was associated with knowledge and 2 of the outcomes' variables) and was therefore retained to the model; thus, the

model had 3 covariates: society, practice setting, and history of cannabis use. The model was significant, indicating the independent variable of knowledge was associated with the 4 practice outcomes (Wilks' lambda (0.7); $F(23.9)$, $P < .001$) (Table 7, top). Those with more knowledge were more apt to be comfortable speaking to their patients about cannabis, asked about frequency of cannabis use, how cannabis was used, and more often counseled their patients who were smoking, vaping, or both on cessation (all $P < .001$). The effect sizes were medium for all the outcome variables.

In addition, ANOVA revealed that knowledge was associated with attitudes clusters ($F(46.8,2)$, $P < .001$); the effect size (ie, partial eta squared) for knowledge was 0.26. Those with the most progressive attitudes had a higher mean knowledge score (3.7, SD = 1.6) compared with traditional attitudes (2.7, SD = 1.4) and unsure attitudes (1.9, SD = 1.6).

Attitudes

For the Attitudes part of the KAP model, 4 potential covariates were considered: year born ($P = .07$), practice setting ($P = .001$), sex ($P = .20$), and society ($P < .001$). When the model was run with all 4 covariates, only practice setting and society were statistically significant, but sex was a confounder (ie, sex was associated with the outcomes variables) and was therefore retained to the model. Attitudes clusters were significantly associated with the 4 practice variables (Wilks' lambda (0.6); $F(22.0)$, $P < .001$) (Table 7, bottom). The 3 clusters were statistically significantly associated with all 4 outcomes except for the Unsure cluster and "For your patients who use cannabis do you know how they use it?". There were statistically significant differences between the clusters with respect to the outcomes. Unsure attitudes led to less comfort speaking to patients about cannabis, whereas the Progressive cluster was most comfortable speaking to patients about cannabis ($P < .001$). The Unsure cluster was least likely to inquire about how often patients were using cannabis and how they were using cannabis compared with the Progressive cluster (both $P < .001$) and the Unsure group did less counseling on cessation of cannabis smoking and vaping compared with the Traditional and Progressive clusters ($P < .001$ and $P < .01$, respectively). Indeed, a high percentage of those with Unsure attitudes did not discuss cannabis with their patients at all (37% compared with 15% of Traditional attitudes and 14% of Progressive attitudes).

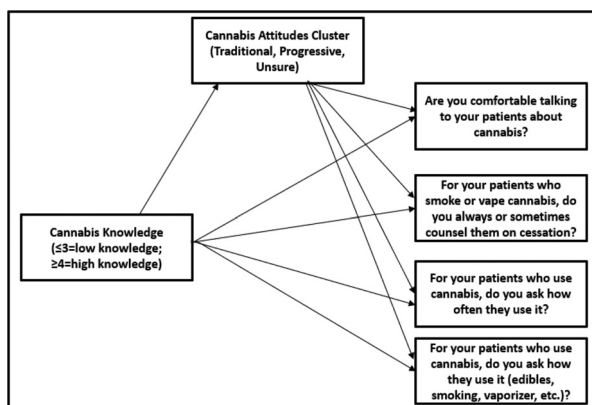


Figure 2. Path diagram of the proposed KAP models. KAP, knowledge, attitudes, and practice.

There were no statistically significant differences between the Traditional and Progressive clusters for the outcomes of asking patients about cannabis use and how patients use cannabis. There statistically were significant differences between the Traditional and Progressive, however. Those with Progressive attitudes were more comfortable talking to patients about cannabis ($P < .01$) and respondents with Traditional attitudes were more likely to counsel cessation for smokers, vapers, or both ($P = .05$). The effect sizes ranged from large for the outcomes of comfort talking to patients and counseling on cessation to medium for asking patients how often they use cannabis and how they are using cannabis.

Discussion

This International Survey of allergists from 3 International Allergy Societies found evidence that knowledge and attitudes regarding cannabis affect real-world practice (ie, comfort discussing cannabis with patients, asking how often cannabis is used and how cannabis is administered, and whether counseling cessation for those who are smokers, vapers, or both occurs). Cluster analysis uncovered 3 cannabis attitude clusters which differed by society and were named Traditional, Progressive, and Unsure. Knowledge regarding cannabis statistically significantly differed not only by society but also by attitude cluster, with the highest levels of knowledge found in those with the most progressive attitudes toward cannabis. In addition, allergists may be seeing more patients with suspected cannabis allergy; however, testing is infrequent and almost 30% of allergists do not discuss cannabis with their patients. Knowledge, attitudes, and real-world practice were different between the 3 societies, indicating an underlying influence of physician residence; however, the status of cannabis legality did not affect knowledge, attitudes, and real-world practice.

The KAP model has been used in a variety of domains.^{23–26} The KAP model is useful because “KAP questions tend to reveal not only characteristic traits in knowledge, attitude and behaviors about health related to religious, social, traditional factors, but also the idea that each person has of the body or of disease. These factors are often the source of misconceptions or misunderstandings that may represent obstacles to the activities that we would like to implement and potential barriers to behavior change.”²⁷ The KAP model has been used in cannabis research in both patients^{9,13} and physicians.^{6,28,29}

The novelty of this article is 2-fold. First, this is first report of KAP being assessed in a physician population in which a patient population was similarly assessed. Allergists who see cannabis-consuming patients should be mindful that in a study of asthma and allergy patients, most of the current cannabis users reported positive effects of improved sleep (75%), calm (68%), and reduced pain (68%) whereas there were fewer adverse effects of anxiety (22%), coughing (19%), and difficulty in concentrating (16%); thus, it will be challenging for counseling cannabis smoking and vaping cessation to this population.⁹ Furthermore, in the allergy and asthma patient population, knowledge and attitudes were associated with practice (cannabis use).⁹ Second, the practice items represent real-world practice that is occurring in the allergists' clinics rather than a “hypothetical practice” (eg, whether a physician would prescribe cannabis if allowed).^{8,30}

The current KAP model reveals that both knowledge and attitudes affect the 4 practice outcomes adjusted for covariates and knowledge separately affects attitudes. Even though attitudes have a stronger effect size on practice, attitudes are influenced by knowledge, thus improving knowledge may change attitudes.^{31,32} Major differences were observed between societies for the demographics, number of patients seen in clinic with suspected cannabis allergy, legal status, and type of practice setting; even after adjusting for these differences, knowledge and attitudes still affected practice, indicating knowledge and attitudes may supersede demographics, location, and cannabis legality when it comes to how physicians approach cannabis in their practice.

In this population, those with Unsure attitudes had the lowest knowledge and were least likely to engage their patients in discussions about cannabis, thus having a formulated attitude may be more important than the attitude itself. In addition, knowledge maybe the conduit to developing attitudes. Generally, cross-sectional surveys are not able to infer causality, and longitudinal studies are primarily used to determine causality. However, KAP has been studied cross-sectionally because it is believed that a causal relationship exists between knowledge and attitudes because before an attitude can be formed, knowledge of the topic must occur first.³³

Physicians are seeing a rise in patients who use cannabis but only consulting on a limited number of patients with suspected cannabis allergy except for the members of CSACI who saw more patients with suspected cannabis allergy; this could be because of the federal legality of cannabis and increase in occupational exposure in addition to increased use in Canada.^{34,35} The Canadians are also performing the most testing for cannabis sensitization, also presumably owing to looser federal regulations and greater access to cannabis testing materials, which are scarce in the United States and European Union. Even with the rise in cannabis use and suspected cannabis allergy, 23.2% of ACAAI, 6.4% of CSACI, and 40.8% of EACCI respondents did not inquire about cannabis use among their patients.

Cannabis education for physicians is a topic that is most often discussed.^{3,6,29,30} One of the most common barriers to knowledge and willingness to consult with patients is lack of training programs that specifically address cannabis and the endocannabinoid system.^{3,8,30} Programs are starting to emerge, with universities developing undergraduate, graduate, and certificate programs throughout the United States. However, these programs are likely too time consuming for most practicing physicians; therefore, societies need to create cannabis content for their members which provides general cannabis information and material that is geared to their specialty. Patients are using cannabis for its beneficial effects; however, adverse effects and drug-drug interactions are known to occur.^{36–40} In addition, physicians should understand the laws surrounding cannabis and medical cannabis in the area in which they practice. This will serve an unmet need for both the physician and patients they treat. In the KAP study population, when queried about education, 48.5% revealed that they wanted didactic learning, 46.7% checked pro or con learning, and 41.1% indicated that modules would meet their needs (more than 1 type of learning situation could be selected). In terms of learning setting, a vast majority opted for webinar (68.8%) and national meetings (56.4%).

Several limitations to this study exist. Owing to a number of parameters, it is not known how many people actually read the e-mails and whether the survey link was shared beyond the channels we distributed it on. Each society tracks their membership differently; thus, the information on how many e-mails were sent out and the demographic makeup of the society differ. ACAAI sent the survey link to their 3895 members 4 times with an average open rate of 30.4%. The ACAAI membership is 43% of female sex, and practice type is as follows: 51% group practice, 26% solo practice, 15% academic, and 8% other. CSACI sent the survey link to their 560 members; no further information is available. EAACI has 13,500 members with no other information on demographics. Potential bias may have occurred owing to those who started the survey but did not complete the survey. Survey completion was determined by the participant answering all the questions. All the questions were required. Because the demographics were at the end of the survey, and most dropouts occurred at the beginning of the survey, we do not have a manner of determining the difference between completers and non-completers. Dropouts were random across the 3 societies and not based on any particular question, perhaps because of survey fatigue rather than the subject matter. Those who responded to this survey may not be representative of other allergists and therefore may not be generalizable. However, a similar KAP relationship has been observed in other studies, which is reassuring, that the KAP model is stable across populations.^{8,9,14}

The strengths of the study are that an international group of physicians were surveyed and the questionnaire inquired about real-world practice rather than hypothetical situations. Furthermore, gaps in physician-patient cannabis conversations were revealed. Moreover, the comprehensive survey disseminated information that can help the societies develop educational materials that can aid in cannabis education. Finally, we have been able to aggregate the symptoms of cannabis allergy which are being seen by allergists thereby making it easier to consider cannabis allergy as a differential diagnosis for difficult-to-treat patients.

The International Allergist Canna KAP Survey suggests that knowledge and attitudes about cannabis affect practice regarding cannabis. The following are the 3 types of attitudes uncovered: Traditional, Progressive, and Unsure. Allergists who had more knowledge tended to have more progressive attitudes toward cannabis, and these physicians were most comfortable talking to patients about cannabis. The varying knowledge and attitudes toward cannabis affecting comfort communicating with patients about cannabis seen in members of the 3 allergy societies support the need for more cannabis education provided in part in a position statement recently submitted for publication by the International Allergist Canna KAP Consortium.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.anai.2022.04.021.

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