

Original Article

Physicians' Knowledge Level, Sources of Information, and Clinical Smoking Cessation Practices Regarding Electronic Cigarettes: A Cross-sectional Study in Adana, Türkiye

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ABSTRACT

OBJECTIVE: Data on physicians' knowledge and clinical practices regarding electronic cigarettes (e-cigarettes) remain limited, particularly among physicians from diverse specialties within the same setting. This study assessed the knowledge level, information sources, and smoking cessation counseling practices regarding e-cigarettes of physicians in Adana province and examined associations with sociodemographic and occupational characteristics.

MATERIAL AND METHODS: A cross-sectional survey was conducted among 525 physicians in Adana between January 26 and February 16, 2026, using a 12-item e-cigarette knowledge scale (0–12) and a 5-item smoking cessation counseling practice scale (5–25). Between-group comparisons were performed using the Mann-Whitney U and Kruskal-Wallis tests; associations were assessed using Spearman's correlation; independent predictors of practice score were identified using multivariate linear regression.

RESULTS: Mean knowledge score was 9.40 ± 2.75 [95% confidence interval (CI): 9.17–9.64] and mean practice score was 20.71 ± 4.07 (95% CI: 20.36–21.06). Knowledge and practice scores were not correlated ($p = 0.063$; 95% CI: -0.022–0.148; $P = 0.148$). Practice score was associated with specialty, professional title, institution, age, and chronic disease (all $P < 0.05$). In multivariate regression, age, specialty, and physicians' own tobacco/nicotine use remained independent predictors ($B = -0.739$; $P = 0.041$ for tobacco/nicotine users). Social media were the most frequently reported information sources (40.2%; 95% CI: 36.1–44.4%).

CONCLUSION: Physicians' e-cigarette knowledge was moderate to high, but was not associated with general smoking cessation counseling practices, which were not assessed as e-cigarette-specific. Educational interventions should incorporate structured clinical protocols in addition to knowledge transfer.

KEYWORDS: Electronic nicotine delivery systems, smoking cessation, physicians, health knowledge, attitudes, practice, tobacco products

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INTRODUCTION

Tobacco use continues to be one of the leading causes of preventable disease and death worldwide.¹ Although tobacco control policies have reduced conventional cigarette use in many countries in recent years, the growing use of next-generation nicotine products—electronic cigarettes (e-cigarettes) and heated tobacco products—has added a new dimension to the tobacco epidemic.^{1,2} Although these products were initially marketed as lower-risk alternatives and smoking cessation aids, evidence regarding their role in smoking cessation remains debated. Some evidence indicates that e-cigarettes can be effective cessation aids in certain contexts but their long-term safety and net public health impact remain uncertain.³ In addition to nicotine, e-cigarette aerosol contains ultrafine particles, carbonyl compounds, volatile organic compounds, and heavy metals, all of which may adversely affect the cardiovascular and respiratory systems.^{2,4,5}

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The effectiveness of e-cigarettes in smoking cessation remains controversial. Although some randomized trials suggest that nicotine-containing e-cigarettes may increase cessation rates under certain conditions, limited long-term safety data, widespread dual use, and ongoing nicotine dependence have led the World Health Organization (WHO), the European Respiratory Society (ERS), and many national scientific organizations to recommend against the routine use of e-cigarettes in smoking cessation treatment.^{2,6,7} The Turkish Thoracic Society's position report on next-generation tobacco products similarly emphasizes that e-cigarettes should not be regarded as harmless alternatives, given their potential to increase nicotine dependence, particularly among young people.²

Physicians play a key role in the success of tobacco control efforts. Questioning tobacco use, assessing motivation to quit, offering evidence-based treatment options, and correcting misconceptions are among physicians' core responsibilities in clinical practice. Physicians' up-to-date and accurate knowledge of next-generation tobacco products, therefore, directly affects not only individual patient management but also societal risk perception regarding these products.^{2,7} At the same time, the rapid diversification of new and emerging nicotine and tobacco products, their intensive promotion on social media and digital platforms, and the continuously evolving scientific evidence necessitate regular assessment of healthcare workers' knowledge levels.

One of the most important Turkish studies examining physicians' knowledge and attitudes toward next-generation tobacco products was conducted by Bostan and Görek Dilektaşlı⁸ among members of the Turkish Thoracic Society. This cross-sectional study found that a substantial proportion of participants lacked sufficient knowledge, particularly regarding heated tobacco products, and that physicians who had received smoking cessation training or had worked in cessation clinics held more critical views regarding e-cigarette use for

cessation purposes. The authors emphasized that increasing physicians' knowledge of next-generation tobacco products and strengthening continuing medical education are important for national tobacco control.⁸ Additional Turkish studies have similarly examined physicians' and other healthcare professionals' knowledge, attitudes, and practices regarding e-cigarettes across different professional groups, including family physicians in Samsun and İstanbul,⁹⁻¹² and physicians, nurses, and midwives more broadly.¹³ A qualitative study exploring healthcare professionals' experiences with electronic nicotine delivery systems and heated tobacco products has further highlighted persistent gaps in structured knowledge and clinical guidance in this area in Türkiye.¹⁴

However, most studies published in Türkiye to date have focused on specific specialties or professional groups.^{9,10} Few studies have jointly assessed knowledge levels, information sources, and clinical practices among physicians from different specialties within the same study or examined the relationship between sociodemographic and occupational variables and these outcomes.

Physicians' knowledge and counseling practices directly shape patients' exposure to accurate information and their likelihood of receiving evidence-based cessation support. Although several single-specialty studies have characterized physicians' knowledge and attitudes toward e-cigarettes in Türkiye, a multi-specialty assessment examining knowledge, information sources, and clinical practices is needed to identify which physician subgroups may benefit most from targeted educational interventions. This study aimed to assess the knowledge level, information sources, and clinical smoking cessation practices regarding e-cigarettes among physicians working in different specialties in Adana province, and to examine the relationships of knowledge and practice scores with sociodemographic and occupational characteristics. We hypothesized that physicians' clinical smoking cessation practices would be positively associated with their e-cigarette knowledge levels.

MATERIAL AND METHODS

Study Design and Participants

This cross-sectional, descriptive study was conducted among physicians working in Adana province between January 26 and February 16, 2026. The target population consisted of 5,857 physicians registered with the Adana Provincial Health Directorate at the time of the study. The minimum required sample size, calculated with finite population correction (expected prevalence of 50%, confidence level of 95%, margin of error of 5%), was determined to be 361 physicians. The final sample of 525 participants exceeded this minimum. Convenience sampling was used. The online survey link, created on Google Forms, was distributed to physicians via e-mail and social communication applications; participation was voluntary. Two reminder messages were sent to encourage participation, and recruitment was further supported through professional WhatsApp groups. To prevent multiple submissions from the same individual, the survey was configured to limit responses to one per respondent (Google Forms "limit to 1 response" setting). A total of 557 responses were received (response rate of approximately 9.5%); 32 surveys with inconsistent response

Main Points

- Physicians' general knowledge of the harms of electronic cigarettes was good, but knowledge regarding regulatory and toxicological details was more limited.
- No significant relationship was found between knowledge level and clinical smoking cessation counseling practices.
- Multivariate analysis showed that the practice score was independently predicted by age and specialty, whereas the associations between practice score and professional title and chronic disease observed in univariate analyses reflected confounding.
- Social media were the most frequently reported source of information about e-cigarettes, more common than scientific articles or official guidelines, highlighting the need for more accessible professional educational materials.
- Physicians who used tobacco/nicotine products had significantly lower smoking cessation counseling practice scores, independent of age and specialty.

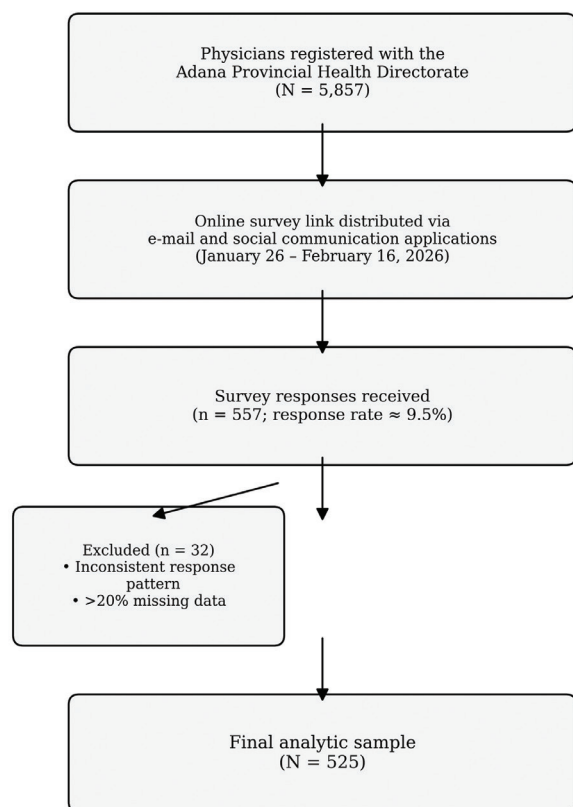


Figure 1. Flow diagram of participant selection

patterns or more than 20% missing data were excluded, leaving 525 physicians for the final analysis (Figure 1).

Data Collection Tool

The survey was developed by the researchers based on current literature, including the Turkish Thoracic Society's position report on e-cigarettes and heated tobacco products,² the study by Bostan and Görek Dilektaşlı⁸ on physicians' knowledge and attitudes toward next-generation tobacco products, and relevant WHO and ERS reports on electronic nicotine delivery systems.^{6,7} The content validity of the draft questionnaire was reviewed by a pulmonology specialist with expertise in tobacco control, whose feedback led to the inclusion of an item on heated tobacco products. The questionnaire was then piloted with 10 physicians to assess clarity and completion time; no further modifications were made following the pilot. Data from the pilot respondents were included in the final analytic sample, as no changes to the questionnaire were required following the pilot. The 12-item knowledge scale and 5-item practice scale were developed specifically for this study. They were not adapted from a previously published, externally validated instrument. Instead, their content was informed by the themes and messages emphasized in the cited Turkish Thoracic Society report, the study by Bostan and Görek Dilektaşlı,⁸ and WHO/ERS position statements. The survey consisted of 5 sections. Section 1 assessed sociodemographic and occupational characteristics (age, sex, specialty, professional title, institution of employment, years in the profession, and presence of chronic disease). Section 2 assessed lifetime use of cigarettes, e-cigarettes, and other tobacco/nicotine products; intention

to quit; sources of information about e-cigarettes; and self-reported level of knowledge. For univariate comparisons and the multivariate regression model, "tobacco/nicotine use" was defined as having ever used any tobacco or nicotine product (cigarettes, waterpipe, e-cigarettes, heated tobacco products, nicotine pouches, or pipe/cigar) in one's lifetime. Section 3 consisted of 12 items assessing e-cigarette knowledge; each correct answer was scored 1 point, and each incorrect or "not sure" answer was scored 0 points, with the total knowledge score ranging from 0 to 12. Four items ("e-cigarettes are not harmful to health," "e-cigarettes are a safe method for quitting smoking," "e-cigarettes are smokeless and therefore do not harm the environment," "e-cigarettes are less addictive than conventional cigarettes") were reverse-coded before analysis to standardize the scoring direction. Section 4 consisted of 5 items assessing smoking cessation counseling practices, scored on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree), with the total practice score ranging from 5 to 25; higher scores indicated greater engagement in cessation counseling. These items assessed general smoking cessation counseling behaviors rather than e-cigarette-specific counseling practices. Section 5 consisted of a multiple-choice question assessing the difficulties encountered during smoking cessation counseling (options: time constraints, patient reluctance, insufficient training or knowledge, not coming to mind during the examination, lack of a referral center, and reluctance due to physicians' own tobacco/nicotine use) and a single statement assessing physicians' perceived self-efficacy for smoking cessation counseling ("I feel competent enough to help my patients quit smoking," 1 = agree, 0 = disagree).

Ethical Approval

The study was approved by the Adana City Training and Research Hospital Non-Interventional Clinical Research Ethics Committee (approval date: January 15, 2026; approval no: 980) and was conducted in accordance with the principles of the Declaration of Helsinki. Participants were informed about the study's purpose on the first page of the online survey and provided electronic informed consent. The survey was anonymous, and no personal identifying information was collected. This study was conducted and reported in accordance with the STROBE guidelines for cross-sectional studies.

Statistical Analysis

The internal consistency of the knowledge and practice scales was assessed using Cronbach's α . The construct validity of the knowledge scale was assessed with principal axis factoring and Varimax rotation; sampling adequacy was assessed with the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity.

Analyses were performed using IBM SPSS Statistics, version 27.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed with the Kolmogorov-Smirnov and Shapiro-Wilk tests, histograms, Q-Q plots, and skewness coefficients. Descriptive statistics were presented as mean $\pm$ standard deviation and median [interquartile range (IQR)] for continuous variables, and number (%) for categorical variables. For continuous variables that were not normally distributed, the Mann-Whitney U test was used

for two-group comparisons and the Kruskal-Wallis test was used for multiple-group comparisons; Bonferroni-corrected pairwise comparisons were performed following significant Kruskal-Wallis results. Spearman correlation was used to assess relationships between continuous variables, and the Pearson χ^2 test was used for categorical variables. To account for potential confounding effects among specialty, professional title, institution of employment, age, chronic disease, and tobacco/nicotine use, multivariate linear regression was performed to determine independent predictors of the practice score. Variables that were significant in univariate analysis were considered for inclusion. However, years in the profession was excluded due to severe collinearity with age (Spearman's $\rho = 0.958$, $P < 0.001$), and institution of employment was excluded due to substantial overlap with specialty (Cramér's $V = 0.418$, $P < 0.001$), as their joint inclusion introduced redundancy without improving model fit. Tobacco/nicotine use, although not significant in univariate analysis ($P = 0.120$), was retained a priori in the model because of its established clinical relevance to counseling behavior. Collinearity diagnostics for the final model showed variance inflation factors ranging from 1.12 to 2.40, indicating no residual multicollinearity concerns. A two-tailed $P < 0.05$ was considered statistically significant.

RESULTS

Sociodemographic and Occupational Characteristics

The mean age of the 525 participating physicians was 44.26 ± 11.21 years (median, 45; IQR: 35–53; range, 24–69), and the mean duration in the profession was 19.00 ± 11.30 years (median, 20; IQR: 10–28; range, 1–46). Most participants were male (52.2%; $n = 274$), worked in family medicine or general practice (46.9%; $n = 246$), and were employed in primary care (40.0%; $n = 210$) (Table 1).

Tobacco/Nicotine Product Use and Information Sources

In total, 232 physicians [44.2%; 95% confidence interval (CI): 40.0–48.5%] reported having used at least 1 tobacco or nicotine product in their lifetime. This variable (ever use of any tobacco/nicotine product) was also used to define “tobacco/nicotine use” in subsequent univariate and multivariate analyses (Tables 2 and 3). Tobacco/nicotine use was more common among men than women (56.6% vs. 30.7%; $\chi^2(1) = 35.61$; $P < 0.001$). Social media were the most frequently reported sources of information (40.2%; 95% CI: 36.1–44.4%), followed by colleagues (33.7%; 95% CI: 29.8–37.9%), Ministry of Health guidelines (28.8%; 95% CI: 25.1–32.8%), scientific articles (24.2%; 95% CI: 20.7–28.0%), and congresses/courses (13.1%; 95% CI: 10.5–16.3%) (Table 4).

Knowledge and Practice Items

The mean 12-item knowledge score was 9.40 ± 2.75 (median, 10; IQR: 8–12); the distribution was markedly left-skewed. The highest rate of correct responses was observed for the item regarding the potential for e-cigarette use to initiate smoking among never-smokers (87.6%); the lowest rates were observed for items regarding restrictions on indoor use and flavor-related airway irritation (both 70.5%). Internal consistency was good (Cronbach's $\alpha = 0.802$); principal axis factoring with Varimax

Table 1. Sociodemographic and occupational characteristics of participants ($n = 525$)

Variable	n (%) or mean $\pm$ SD	Median (IQR)
Age, years	44.26 ± 11.21	45 (35–53)
Years in the profession	19.00 ± 11.30	20 (10–28)
Sex		
Female	251 (47.8)	
Male	274 (52.2)	
Specialty		
Family medicine/general practice	246 (46.9)	
Internal medicine specialties	130 (24.8)	
Surgical specialties	82 (15.6)	
Diagnostic specialties	32 (6.1)	
Emergency/critical care	35 (6.7)	
Professional title		
Specialist physician	246 (46.9)	
Academician	36 (6.9)	
General practitioner	179 (34.1)	
Resident physician	64 (12.2)	
Institution of employment		
State hospital	128 (24.4)	
Training and research hospital	145 (27.6)	
Primary care center	210 (40.0)	
Private health institution	16 (3.0)	
University hospital	26 (5.0)	
Chronic disease		
Present	151 (28.8)	
Absent	374 (71.2)	
SD: standard deviation, IQR: interquartile range		

rotation revealed a 2-factor structure explaining 37.7% of the variance (KMO = 0.816; Bartlett's $\chi^2_{66} = 1633.11$; $P < 0.001$).

The mean 5-item practice score was 20.71 ± 4.07 (median, 21; IQR: 18–24). Most participants reported recommending cessation (91.4%) and referring patients to cessation clinics (82.3%), whereas explaining pharmacological options was less common (65.1%). Internal consistency was excellent (Cronbach's $\alpha = 0.878$); a single-factor structure explained 60.3% of the variance. Item-level results are shown in Table 5.

Knowledge and Practice Scores by Participant Characteristics

The knowledge score did not differ significantly by sex, specialty, professional title, institution of employment, chronic disease, or tobacco/nicotine use (all $P > 0.05$). Age ($p = 0.094$; 95% CI: 0.009–0.179) and years in the profession ($p = 0.091$; 95% CI: 0.005–0.175) showed weak but significant positive correlations with the knowledge score (both $P < 0.05$). The practice score differed significantly by specialty, professional title, and institution (all $P < 0.05$), was higher among physicians with chronic disease ($P = 0.012$), and was positively correlated with age ($p = 0.208$; 95% CI: 0.125–

0.288) and years in the profession ($p = 0.203$; 95% CI: 0.120–0.284) (both $P < 0.001$). No significant correlation was found between knowledge and practice scores (Table 2).

Independent Predictors of the Practice Score

Because specialty, professional title, institution, age, chronic disease, and tobacco/nicotine use may be interrelated, a multivariate linear regression analysis was performed to determine independent predictors of the practice score (reference categories: family medicine/general practice; specialist title; no chronic disease; no tobacco/nicotine use). The model was statistically significant ($R = 0.338$; $R^2 = 0.115$; adjusted $R^2 = 0.097$; $F_{10,514} = 6.65$; $P < 0.001$; Durbin-Watson = 2.02). Age and all specialty categories remained independent predictors, whereas professional title and chronic disease lost significance after adjustment. Notably, tobacco/nicotine product use, although not significant in univariate analysis, emerged as a significant independent predictor ($B = -0.739$; 95% CI: -1.447 to -0.031; $P = 0.041$), indicating that physicians who themselves used tobacco/nicotine products had lower practice scores after adjustment for age and specialty (Table 3).

Information Source and Participant Characteristics

Physicians who reported social media as an information source did not differ significantly from those who did not in knowledge score ($P = 0.832$), in practice score ($P = 0.681$), or in specialty ($P = 0.607$). However, physicians reporting social media as a source were significantly younger (mean age 42.7 vs. 45.3 years; $P = 0.005$) and less likely to report tobacco/nicotine use themselves (38.4% vs. 48.1%; $P = 0.035$).

Difficulties Encountered in Counseling and Self-efficacy

When the difficulties encountered by participants during smoking cessation counseling were assessed, the most frequently reported barriers were time constraints ($n = 373$, 71.0%), followed by patient reluctance ($n = 355$, 67.6%). Approximately one-third of participants ($n = 172$, 32.8%) identified insufficient training or knowledge as a barrier, and 18.5% ($n = 97$) reported that the topic did not come to mind during the examination. Lack of a referral center and reluctance stemming from the physician's own tobacco/nicotine use were reported by 12.2% ($n = 64$) and 8.4% ($n = 44$) of participants, respectively. Because the question was multiple-choice,

Table 2. Comparison of knowledge and practice scores by participant characteristics

Variable	Knowledge score	Practice score
Sex	U = 33335.0; $P = 0.538$	U = 32045.5; $P = 0.173$
Specialty	H(4) = 5.95; $P = 0.203$	H(4) = 29.20; $P < 0.001^{*,c}$
Professional title	H(3) = 2.54; $P = 0.468$	H(3) = 13.86; $P = 0.003^{*,c}$
Institution	H(4) = 5.93; $P = 0.205$	H(4) = 33.97; $P < 0.001^{*,c}$
Chronic disease	U = 26845.5; $P = 0.369$	U = 24332.0; $P = 0.012^*$
Tobacco/nicotine use	U = 33317.0; $P = 0.693$	U = 31337.0; $P = 0.120$
Age, years (ρ)	$\rho = 0.094$; $P = 0.030^*$	$\rho = 0.208$; $P < 0.001^*$
Years in the profession (ρ)	$\rho = 0.091$; $P = 0.038^*$	$\rho = 0.203$; $P < 0.001^*$
Knowledge $\leftrightarrow$ practice score (ρ)	-	$\rho = 0.063$; $P = 0.148$

Tobacco/nicotine use refers to ever use of any tobacco/nicotine product (see Methods). U, Mann-Whitney U statistic; H (subscript = df), Kruskal-Wallis statistic; ρ , Spearman correlation coefficient. $^*P < 0.05$, ^{c} : in Bonferroni-corrected pairwise comparisons, family medicine/general practice physicians had significantly higher practice scores than internal medicine ($P = 0.007$), surgical ($P < 0.001$), and emergency/critical care ($P = 0.049$) specialists; general practitioners scored higher than resident physicians ($P = 0.004$); and physicians working in primary care scored higher than those in training/research hospitals ($P < 0.001$) and state hospitals ($P = 0.013$).

Table 3. Multivariate linear regression predicting practice score

Variable	B	95% CI	SE	t	P
Constant	19.675	17.920–21.430	0.893	22.023	$<0.001^*$
Age	0.063	0.029–0.097	0.017	3.609	$<0.001^*$
Chronic disease	0.126	-0.674 to 0.925	0.407	0.308	0.758
Tobacco/nicotine use	-0.739	-1.447 to -0.031	0.360	-2.052	0.041 *
Internal medicine ^b	-2.221	-3.339 to -1.103	0.569	-3.904	$<0.001^*$
Surgical ^b	-3.216	-4.515 to -1.916	0.662	-4.860	$<0.001^*$
Diagnostic ^b	-1.850	-3.468 to -0.231	0.824	-2.246	0.025 *
Emergency/critical care ^b	-1.784	-3.365 to -0.202	0.805	-2.216	0.027 *
Academician title ^c	0.417	-0.995 to 1.830	0.719	0.581	0.562
General practitioner ^c	-0.673	-1.755 to 0.410	0.551	-1.221	0.223
Resident physician ^c	0.207	-1.059 to 1.474	0.645	0.322	0.748

Tobacco/nicotine use refers to ever use of any tobacco/nicotine product (see Methods)

CI: confidence interval, SE: standard error, ^b: reference category: family medicine/general practice, ^c: reference category: specialist physician, $^*P < 0.05$

Table 4. Tobacco/nicotine product use, self-reported knowledge, and information sources

Variable	n (%)
Use of any tobacco/nicotine product ^a	232 (44.2)
Cigarette: current, daily	83 (15.8)
Cigarette: current, occasional	45 (8.6)
Cigarette: past use	104 (19.8)
Waterpipe use, ever	93 (17.7)
E-cigarette use, ever	63 (12.0)
Heated tobacco product use, ever	37 (7.0)
Nicotine pouch use, ever	5 (1.0)
Pipe/cigar use, ever	51 (9.7)
Considering quitting within 1 month ^b	57 (24.7)
Considering quitting, no specific timeframe ^b	126 (54.5)
Not considering quitting ^b	48 (20.8)
Self-reported knowledge of e-cigarettes/HTPs	
No knowledge	156 (29.7)
Limited knowledge	217 (41.3)
Knowledgeable	152 (29.0)
Information source: social media	211 (40.2)
Information source: colleagues	177 (33.7)
Information source: Ministry of Health guidelines	151 (28.8)
Information source: scientific articles	127 (24.2)
Information source: congresses/courses	69 (13.1)
HTP: heated tobacco product, ^a : percentages are based on the total sample (n = 525), ^b : valid percentage among the 231 participants who answered the question on intention to quit	

the percentages sum to more than 100%. In response to the self-efficacy statement ("I feel competent enough to help my patients quit smoking"), 46.7% of participants (n = 245) reported feeling competent, while 53.3% (n = 280) reported not feeling competent.

DISCUSSION

In this study of 525 physicians from different specialties in Adana province, the mean knowledge score was 9.40 ± 2.75 out of 12 (78.3% of the maximum possible score), but the level of knowledge was not associated with clinical smoking cessation counseling practices; practice scores were instead significantly associated with specialty, professional title, institution of employment, age, and years in the profession. Multivariate regression showed that some of these associations (professional title and chronic disease) reflected confounding by age and specialty, whereas age, specialty, and physicians' own tobacco/nicotine use were independent predictors of practice.

Knowledge Levels in the Context of the Literature

The vast majority of participants knew that e-cigarettes are not a safe cessation method (82.5%) and that they can cause nicotine dependence (85.5%). This finding is consistent with the WHO's and the ERS's stance against the routine use of e-cigarettes in smoking cessation.^{2,6,7} In contrast, correct response rates were

Table 5. Item-level knowledge and practice results

A. Knowledge items (correct response)	
Item	n (%)
E-cigarettes are harmful to health	420 (80.0)
E-cigarette use increases cardiovascular disease risk	389 (74.1)
E-cigarettes are not a safe method for quitting smoking	433 (82.5)
High-dose nicotine liquids can be fatal if taken orally/IV/SC	440 (83.8)
E-cigarette use in indoor spaces is legally restricted	370 (70.5)
E-cigarette use may lead never-smokers to start smoking	460 (87.6)
E-cigarette use can cause nicotine dependence	449 (85.5)
E-cigarette aerosols may release substances harmful to the environment	419 (79.8)
Exposure to e-cigarette aerosol causes secondhand exposure	415 (79.0)
Heating e-cigarette liquid can generate formaldehyde/acetaldehyde	383 (73.0)
E-cigarettes can be as addictive as conventional cigarettes	389 (74.1)
Cinnamon/cherry/mango flavors irritate the airways	370 (70.5)
B. Practice items (mean $\pm$ SD; agree/strongly agree n (%))	
Item	
Asking patients whether they smoke	4.14 $\pm$ 1.00; 408 (77.7)
Asking about desire to quit smoking	4.09 $\pm$ 1.02; 408 (77.7)
Explaining pharmacological options	3.78 $\pm$ 1.16; 342 (65.1)
Referral to a smoking cessation clinic	4.21 $\pm$ 0.96; 432 (82.3)
Recommending smoking cessation	4.49 $\pm$ 0.79; 480 (91.4)
Reverse-coded items are presented in the correct-knowledge direction. Practice items were scored from 1 (strongly disagree) to 5 (strongly agree); mean $\pm$ SD is followed by "agree/strongly agree, n (%)"	
IV: intravenous, SC: subcutaneous, SD: standard deviation	

lower for items requiring more specialized, regulatory, or toxicological knowledge, such as restrictions on indoor use and flavor-related airway irritation (both 70.5%). This pattern parallels the findings of Bostan and Görek Dilektaşlı⁸, who reported that physicians who were members of the Turkish Thoracic Society had a general awareness of harm but lacked knowledge of the technical and regulatory aspects of next-generation products.⁸

Our findings are also consistent with other Turkish studies examining physicians' e-cigarette-related knowledge and practices. Arslan et al.⁹ reported that although the large majority of family physicians in Samsun were aware of e-cigarettes, only a small minority were familiar with heated tobacco products, mirroring the relatively low knowledge scores we observed for more technical, product-specific items. Similarly, survey and qualitative studies among family physicians in İstanbul found generally cautious attitudes toward recommending e-cigarettes

for cessation, alongside gaps in structured counseling practices,¹⁰⁻¹² consistent with our finding that general harm awareness did not translate into structured, e-cigarette-specific clinical behavior. Broader assessments spanning physicians, nurses, and midwives,¹³ together with a qualitative study exploring healthcare professionals' experiences with electronic nicotine delivery systems and heated tobacco products,¹⁴ further indicate that e-cigarette-related knowledge gaps and the need for structured education extend beyond physicians to other healthcare professional groups in Türkiye.

Similarly, international studies show that physicians' knowledge, attitudes, and clinical approaches regarding e-cigarettes are limited and variable.¹⁵⁻¹⁷ Indeed, qualitative and quantitative research on physicians' beliefs about e-cigarettes and their behavior in recommending them as a cessation aid highlights this knowledge gap and the inconsistency in clinical practice.^{16,17} A systematic review of general practitioners' knowledge, attitudes, and prescribing practices regarding e-cigarettes also reported marked heterogeneity among studies and a lack of standardized educational interventions in the literature.¹⁸ In addition, a national follow-up survey among Australian general practitioners found persistently low knowledge scores that did not improve significantly after 12 months,¹⁹ indicating that one-time educational efforts do not produce lasting gains and that continuing education is essential.

The Disconnect Between Knowledge and Practice

A notable finding was the lack of a significant relationship between knowledge and practice scores ($p = 0.063$; $P = 0.148$), suggesting that knowledge alone is insufficient to predict clinical behavior and that practice is shaped by structural factors such as institutional workload, patient profile, time constraints, and perceived professional role. The practice score reflects general smoking cessation counseling behaviors rather than e-cigarette-specific counseling; therefore, this finding should not be interpreted as indicating that physicians fail to apply their e-cigarette knowledge in e-cigarette-specific clinical encounters, but rather as reflecting an absence of association between e-cigarette knowledge and general counseling engagement. A qualitative study among Australian general practitioners described the discomfort of assuming a "gatekeeper" role for e-cigarettes without adequate clinical evidence or institutional support,²⁰ and a United States qualitative study of physicians involved in cessation care similarly reported that recommendation decisions were driven more by personal experience and clinical intuition than by evidence-based knowledge.¹⁷ These findings suggest that knowledge-based interventions alone may be insufficient and that structured clinical protocols and institutional support are needed to change counseling behavior.

Differences by Specialty, Title, and Institution

Practice scores were significantly higher among family medicine/general practice physicians and those working in primary care; this is likely related to more frequent and continuous patient contact, which facilitates the integration of smoking-related counseling into routine practice. International studies have also highlighted physicians' important role in cessation interventions for tobacco and e-cigarette use.^{15,16} In

the multivariate model, specialty remained an independent predictor after adjustment for age, indicating that the specialty-based difference is not fully explained by age distribution and likely reflects an independent effect of routine clinical practice in primary care.

In contrast, the univariate association for professional title (practitioners scoring higher than residents) lost significance after adjustment, suggesting that residents' lower scores may be more related to younger age and different specialty distribution than to professional title itself; however, the possibility that smoking cessation counseling has not yet been sufficiently integrated into undergraduate and residency curricula should not be overlooked. This is consistent with a survey of Polish physicians reporting that cessation interventions were mostly limited to asking about smoking status and lacked a systematic follow-up routine.¹⁵ Similarly, the univariate association with chronic disease status lost significance after adjustment, likely reflecting the older age of those with chronic disease. Taken together, these findings suggest that univariate group differences frequently reported in the tobacco control literature may be misleading unless underlying age and specialty distributions are taken into account.

Another notable finding of the multivariate model was that physicians who themselves used tobacco/nicotine products had significantly lower practice scores after adjustment for age and specialty ($B = -0.739$; $P = 0.041$). This association was not detected in univariate analysis ($P = 0.120$). As defined in the Methods, this variable captured lifetime (ever) use of any tobacco/nicotine product rather than current use; the clinical implications of this association may differ for former versus current users, a distinction the present cross-sectional design could not fully disentangle. Statistically, this pattern suggests a suppression effect—that is, the relationship between tobacco use and specialty and age distributions may have masked the true effect in the crude comparison. Clinically, this may reflect lower perceived competence among physicians who themselves smoke or use nicotine products in providing cessation counseling, or avoidance of the topic by those physicians owing to cognitive dissonance. This association has not been examined in detail in previous Turkish studies and warrants confirmation in prospective research.

Relative Weakness in Pharmacological Counseling

Although rates of recommending cessation (91.4%) and referring to a smoking cessation clinic (82.3%) were high, explaining pharmacological options was less common (65.1%); this suggests that the earlier steps of the "5A" approach (Ask-Advise-Assess-Assist-Arrange) are more readily adopted in practice than the "Assist" step, which requires more specific pharmacotherapy knowledge. This pattern has been repeatedly reported in physician surveys across countries, with physicians recommending cessation but reporting lower competence in pharmacotherapy.^{15,16}

Information Sources and the Role of Social Media

Social media were the most frequently reported information sources (40.2%), ahead of scientific articles (24.2%) and the Ministry of Health guidelines (28.8%). This indicates that even

healthcare workers are substantially exposed to digital sources of varying reliability. Social media have been identified as important channels for the spread of e-cigarette misinformation and particularly influence the perceptions of young users.²¹ Physicians' exposure to this information ecosystem, which is similar to that of the general public, underscores the need to increase the accessibility and visibility of professional educational materials and official guidelines. Notably, physicians who reported social media as an information source were significantly younger and less likely to use tobacco/nicotine products, suggesting that these younger, non-using physicians may be more engaged with digital information channels—an important consideration when designing targeted educational outreach.

Effect of Age and Professional Experience

Both age and years in the profession showed positive correlations with knowledge and practice scores; the correlation with knowledge was weak, while the correlation with practice was stronger and remained an independent predictor in the multivariate model. This suggests that clinical experience strengthens counseling behavior over time, but that up-to-date knowledge of next-generation tobacco products does not increase proportionally with seniority, indicating an ongoing need for continuing education even among experienced physicians in this rapidly evolving field.

Counseling Difficulties and Self-efficacy

The difficulties reported by physicians provide complementary context to our finding of a disconnect between knowledge and practice. That time constraints were the most frequently reported barrier (71.0%) is consistent with physicians in busy outpatient settings, whose short examination times prevent allocation of sufficient time to smoking cessation counseling unrelated to the primary complaint. Patient reluctance, the second most frequently reported barrier (67.6%), indicates that counseling is not limited to a one-sided effort and that patient motivation plays a determining role in the process. This pattern is consistent with an international review identifying time constraints, high workload, insufficient training, physicians' own smoking/tobacco use, and low self-efficacy as the most commonly reported barriers to smoking cessation counseling.²² Notably, while one-third of participants reported insufficient training/knowledge as a barrier (32.8%), a higher proportion responded negatively to the self-efficacy statement (53.3%); this discrepancy suggests that perceived inadequacy may not stem solely from a lack of theoretical knowledge but may also reflect a felt lack of confidence in translating this knowledge into clinical practice. Considered together with the lack of a significant correlation between knowledge and practice scores ($p = 0.063$; $P = 0.148$), this finding indicates that educational interventions for smoking cessation counseling should not be limited to knowledge transfer alone but should also include components aimed at practical skills training and enhancing self-efficacy. The 12.2% of participants reporting a lack of a referral center support the need to strengthen referral networks at the health-system level, in addition to interventions at the individual physician level.

Clinical and Policy Implications

These findings suggest that continuing education programs for physicians should go beyond general harm-awareness messages to cover current regulations, pharmacotherapy options, and technical content specific to next-generation products. Because knowledge alone does not predict clinical behavior, educational interventions should be delivered together with structured counseling protocols embedded in the clinical workflow (e.g., electronic health record reminders, standardized 5A implementation). The persistence of specialty-based differences after adjustment highlights the value of targeted education and reminder systems for specialties outside primary care, particularly surgical and internal medicine. Practical strategies to address these gaps could include incorporating e-cigarette-specific content into continuing professional development programs, expanding structured smoking cessation training during residency, and developing the Ministry of Health's educational materials tailored to physicians.

Study Limitations

This study has several limitations. First, the cross-sectional design precludes causal inference regarding factors associated with knowledge and practice. Second, convenience sampling and the relatively low response rate (approximately 9.5%) may limit generalizability to all physicians in Adana and Türkiye; physicians who chose to respond may have been more interested in the topic, indicating response bias. Third, data were collected through online self-report, which may have inflated practice scores due to social desirability bias. Fourth, the variance explained by the multivariate model was limited (adjusted $R^2 = 0.097$); reported counseling difficulties were not included as independent variables in this regression model, indicating that other unmeasured factors, such as institutional workload and patient profiles, likely also contribute to practice behavior. The study was conducted in a single city, meaning that regional differences (e.g., rural-urban access to care, local educational opportunities) may have influenced the results. Additionally, the knowledge and practice scales were investigator-developed and have not been externally validated in other physician populations. Information bias is also possible, as physicians may have searched for answers while completing the online survey, potentially inflating knowledge scores. Important variables such as prior smoking cessation training or tobacco treatment certification were not collected and may have confounded the observed associations.

CONCLUSION

This cross-sectional study found that physicians in Adana had a mean knowledge score of 9.40 ± 2.75 out of 12 (78.3% of the maximum possible score) regarding e-cigarettes; however, this knowledge level was not significantly associated with physicians' general smoking cessation counseling practices, which in this study reflected overall counseling engagement rather than e-cigarette-specific counseling behavior. Practice scores were independently associated with age, specialty, and physicians' own tobacco/nicotine use. Given the cross-sectional design, these findings reflect associations rather than causal relationships. They nonetheless support the potential value of physician education programs that extend beyond knowledge

transfer to include structured, protocol-based interventions targeting counseling behavior.

Ethics

Ethics Committee Approval: The study was approved by the Adana City Training and Research Hospital Non-Interventional Clinical Research Ethics Committee (approval date: January 15, 2026; approval no: 980) and was conducted in accordance with the principles of the Declaration of Helsinki.

Informed Consent: Participants were informed about the study's purpose on the first page of the online survey and provided electronic informed consent. The survey was anonymous, and no personal identifying information was collected.

Footnotes

Authorship Contributions

Concept: Ç.E., A.T., Design: Ç.E., A.T., Data Collection or Processing: Ç.E., Analysis or Interpretation: Ç.E., A.T., Literature Search: Ç.E., A.T., Writing: Ç.E., A.T.

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