

Article

Medical Students' Knowledge, Attitudes, and Perceptions Toward Vaping and E-Cigarette Use: An Assessment of Their Education and Preparedness

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Abstract: The use of electronic cigarettes (e-cigarettes), or vaping, has risen significantly over the past decade as an alternative to traditional smoking. Despite growing evidence of vaping's adverse health effects, limited data exist on medical students' knowledge, attitudes, and behaviors regarding vaping, as well as the extent of education they receive on this topic. This study aimed to assess medical students' perceptions of vaping-related harms and their evaluation of vaping education in medical school. A cross-sectional online survey was conducted among currently enrolled students at St. George's University's School of Medicine ($n = 5794$) over a five-week period from February to March 2024. The survey focused on students' experiences, behaviors, attitudes, and perceptions toward e-cigarettes and vaping and their assessment of vaping-related education. Of 5794 invited students, 1400 (24%) responded, with 1193 (94%) completing the survey. While 82% had never used conventional tobacco cigarettes, 29% reported having vaped at least once. Nearly all respondents (97%) recognized vaping as a health risk; however, 75% reported receiving no formal education on vaping in their curriculum, and 68% rated their education on the topic as poor or very poor. Despite awareness of vaping's risks, a notable proportion of medical students have engaged in the practice. The findings highlight a gap in medical education, underscoring the need for improved curriculum coverage to equip future physicians with the knowledge necessary to address vaping-related health concerns.



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1. Introduction

E-cigarettes, battery-powered devices that heat liquid into an aerosol containing substances like nicotine, diacetyl, benzene, and heavy metals, have become increasingly popular, especially among young adults. The World Health Organization has noted that the rise in their use is largely attributed to the availability of over 16,000 unique flavors and compelling marketing strategies targeting younger demographics [1]. More than 85% of e-cigarette users aged 12–17 report that appealing flavors are a primary attraction of these products [2]. Additionally, targeted advertisements have reached approximately 18.3 million adolescents, fueled curiosity, and contributed to increased initiation rates of e-cigarette use [3].

Despite their popularity, the long-term health effects of e-cigarettes remain largely uncertain. The acute health risks, however, have been well-documented, particularly in the context of the 2019 e-cigarette or vaping product use-associated lung injury (EVALI)

epidemic, which resulted in 2807 hospitalizations and 68 deaths in the US [4]. Non-hospitalized individuals also experienced significant symptoms, including respiratory distress, gastrointestinal issues, and systemic symptoms like fever and weight loss [4]. Research has shown that vitamin E acetate, a common additive in THC-containing e-cigarettes which may contribute to lung injury, was present in bronchoalveolar-lavage fluid of EVALI patients, identifying it as a likely causative agent for the 2019 outbreak [5].

While e-cigarettes emit fewer toxicants than traditional tobacco products, their aerosol contains harmful substances such as volatile organic compounds and cancer-causing agents [6]. Beyond impaired respiratory health, e-cigarette use has been associated with cardiovascular and oral health concerns, including hypertension, impaired angiogenesis, periodontal disease, and nicotine stomatitis [7]. A major concern is the high nicotine content in e-cigarettes, often delivered through acidified nicotine salts that increase addiction potential and pose risks to young users' brain development [7].

Although some consider e-cigarettes a harm-reduction tool, they are not FDA-approved for smoking cessation. Misconceptions about their use persist, even among future health-care providers. A cross-sectional study conducted at a university hospital in Saudi Arabia found that 13.5% of medical students mistakenly believed e-cigarettes were FDA-approved for smoking cessation [8]. Furthermore, a meta-analysis of e-cigarette use and adult cigarette smoking cessation found inconsistent evidence supporting e-cigarettes as an effective cessation aid [9]. This uncertainty is further compounded by deficiencies in medical education. A study at the University of Minnesota found that 84.7% of medical students had not received formal instruction on e-cigarettes, and 95% felt they lacked sufficient knowledge on the topic [10].

Medical students' behaviors and perceptions of e-cigarettes warrant further investigation, as they will significantly shape future public health outcomes. Surveys have shown that medical students exhibit higher rates of e-cigarette use compared to the general population. At Nova Southeastern University's Dr. Kiran C. Patel College of Osteopathic Medicine, 37.5% of students reported having used an e-cigarette at least once, a rate significantly higher than the 14.9% reported among adults aged 18 and older [11,12]. Similarly, a cross-sectional study at Umm Al-Qura University found that 31.8% of medical students were regular e-cigarette users, despite having inadequate knowledge of the associated health risks [13].

Given the increasing prevalence of e-cigarette use and its associated health risks, this study aims to evaluate the knowledge, attitudes, and behaviors of medical students at St. George's University (SGU) toward e-cigarettes. With over 5000 enrolled students, SGU's School of Medicine, located in Grenada, contributes a significant number of health-care professionals to the global workforce. Understanding their perspectives will help identify educational gaps and enhance medical curricula to better address vaping-related health issues.

2. Materials and Methods

2.1. Participants and Setting

In accordance with the Declaration of Helsinki [14], ethical approval for this study was obtained from the Institutional Review Board (Application #323035) and St. George's University's Survey Committee (Application #04-Fall-2023). Invitations with a link to an online survey were emailed to all currently enrolled medical students in St. George's University's 4-year MD program, including those in clinical rotations ($n = 5794$). The survey was accessible from 13 February to 15 March 2024. During this period, three reminder emails were sent to students who had not yet completed the survey.

2.2. Survey Measures

The survey questions for this study were developed based on several similar studies involving medical students [8,10,11]. The survey was divided into the following categories: Demographics, Vaping Experience, Education on the Health Effects of Vaping, and Vaping Attitudes and Practices as a Medical Student and Future Physician. All respondents were assured that participation in the study was entirely voluntary and that no personal identifying information would be collected, ensuring that their responses could not be traced back to them. The survey was designed to take approximately 10 min to complete.

2.3. Analyses

Survey data were captured and extracted from the online survey software program Qualtrics <https://www.qualtrics.com> (accessed on 1 February 2024). The primary outcomes measured included students' smoking and vaping status, personal experiences with e-cigarettes, vaping behaviors among those who reported vaping, attitudes and perceptions toward vaping, accessibility of e-cigarettes, and students' evaluations of their education on e-cigarettes.

3. Results

3.1. Participants

Out of the 5794 emailed invitations, 1400 (24%) responded, with 1193 (94%) consenting to take and complete the survey. The majority of the respondents were aged 21–30 years (78%), with 59% being female (Table 1).

Table 1. Demographics of medical school survey respondents, smoking status, and vaping status.

Age (years)	<i>n</i> = 1158
<21	36 (3%)
21–25	387 (33%)
26–30	520 (45%)
31–35	125 (11%)
>35	90 (8%)
Gender	
Male	456 (39%)
Female	687 (59%)
Prefer not to say/Other	15 (2%)
Tobacco smoking status	
Never smoked	950 (82%)
Ex-smoker	115 (10%)
Occasionally (not daily)	74 (6%)
Smoke weekly	19 (2%)
E-cigarette use (vaping) status	
Never vaped using e-cigarettes	825 (71%)
Vaped in the past but not last 30 days	210 (18%)
Vaped in the last 30 days	123 (11%)
Predicted e-cigarette use (vaping) in next six months	<i>n</i> = 329
Definitely not	108 (33%)
Probably not	97 (29%)
Probably yes	86 (26%)
Definitely yes	38 (12%)

3.2. Smoking and Vaping Status

Among the respondents, 82% never smoked tobacco, while 71% never used e-cigarettes. Additionally, 18% had vaped in the past but not in the last 30 days, and 11% had vaped in the last 30 days (Table 1). Among the 329 respondents who reported that they vaped, 26% believe that they will probably use an e-cigarette in the next six months, with 12% stating that they definitely will.

3.3. Vaping Experience

Among the 329 respondents who vaped, most first started between 18 and 25 years of age (62%). The frequency of vaping varied, with 38% reporting vaping daily and 16% a few times per week. The top four reasons for vaping were recreational/social activity (59%), curiosity (39%), pleasurable feelings (32%), and stress relief (30%) (Table 2).

Table 2. Vaping experience and reasons for vaping.

Age (years) when first tried vaping	<i>n</i> = 329
<18	63 (13%)
18–25	204 (62%)
26–35	56 (17%)
>35	6 (2%)
How frequently have you vaped in your lifetime?	<i>n</i> = 329
Daily	124 (38%)
A few times per week	51 (16%)
A few times per month	33 (10%)
A few times per year	59 (18%)
Less than that	62 (19%)
In the past year, have you vaped, even occasionally?	<i>n</i> = 329
No	102 (31%)
Yes	227 (69%)
What are the reasons you first tried vaping (select up to 3 choices)?	<i>n</i> = 318
Anxiety	38 (12%)
Depression	13 (4%)
Peer pressure	40 (13%)
Habit	30 (9%)
Recreational/social activity	189 (59%)
Stress relief/relaxation	95 (30%)
Improved focus and attention	54 (17%)
Pleasurable feeling	103 (32%)
Appealing flavor/taste	83 (26%)
To help quit smoking and/or use of other tobacco products	30 (9%)
Curiosity	125 (39%)
How would you describe your e-cigarette usage since starting medical school?	<i>n</i> = 318
Increased	139 (44%)
Decreased	49 (15%)
No change	130 (41%)
If you currently vape, do you want to quit?	<i>n</i> = 127
Yes	66 (52%)
No	19 (15%)
Maybe	42 (33%)
If you do plan to stop vaping, how do you plan to do so?	<i>n</i> = 112
Cold turkey	60 (54%)
Gradually wean myself off	36 (32%)
Replacing vaping with a healthy habit	8 (7%)
Stop with the support of a friend	6 (5%)
Seek professional help	2 (2%)

3.4. Behavioral Insights

Since attending medical school, 44% reported an increase in their vaping, while 15% reported a decrease (Table 2). Of the 127 respondents who currently vape, 52% expressed a desire to quit, while 33% were considering it. Of the 112 respondents who stated that

they were planning to quit, 54% intended to quit “cold turkey”, while 32% planned to quit gradually (Table 2).

3.5. Attitudes and Perceptions

A significant majority (97%) believed that vaping poses some level of health risk, with 54% viewing it as harmful as smoking and 21% viewing it as more harmful. Regarding addictiveness, 55% believed e-cigarettes are as addictive as conventional cigarettes, and 39% considered them more addictive. Notably, 61% would not recommend vaping as a safer alternative to smoking (Table 3). Further, 64% think vaping impacts the health of others around the vaper, and of the 196 respondents who reported that they vaped, 39 (20%) would stop (Table 3).

Table 3. Survey respondents’ attitudes toward and perceptions of the health effects of vaping.

How do you view vaping compared to conventional cigarettes?	<i>n</i> = 1120
There is no harm associated with using (vaping) e-cigarettes	6 (1%)
E-cigarettes are less harmful than conventional cigarettes	279 (25%)
E-cigarettes are as harmful as conventional cigarettes	604 (54%)
E-cigarettes are more harmful than conventional cigarettes	231 (21%)
How do you view the addictive potential of vaping compared to conventional cigarettes?	<i>n</i> = 1120
E-cigarettes are not addictive	10 (1%)
E-cigarettes are less addictive than conventional cigarettes	60 (5%)
E-cigarettes are as addictive as conventional cigarettes	616 (55%)
E-cigarettes are more addictive than conventional cigarettes	434 (39%)
Overall, do you think vaping poses any dangers to a user’s health?	<i>n</i> = 1120
Yes	1084 (97%)
No	3 (0%)
Not sure	33 (3%)
Would you recommend vaping as a less dangerous alternative to smoking cigarettes?	<i>n</i> = 1111
Yes	234 (21%)
No	680 (61%)
Not sure	197 (18%)
Do you think vaping impacts the health of others around the vaper?	<i>n</i> = 1111
Yes	712 (64%)
No	134 (12%)
Not sure	265 (24%)
If you became convinced that vaping does pose material harm to a user’s health and wellbeing, would you continue to vape?	<i>n</i> = 1111
Yes	39 (4%)
No	103 (9%)
Not sure	54 (5%)
I do not currently vape	915 (82%)

3.6. Educational Aspects

A considerable number of respondents (75%) had not encountered any information about vaping in their MD curriculum, and 68% rated their education on vaping’s health effects as poor or very poor. The preferred formats for effective education included lectures (36%) and small group discussions (29%). Despite these preferences, 76% reported unchanged views on vaping since enrollment, while 23% developed more negative views (Table 4).

Table 4. Survey respondents' evaluation of their MD curriculum education on the health effects of vaping.

In the MD curriculum, are you provided with any information on the effects vaping has on a person's health?	<i>n</i> = 1099
Yes	145 (13%)
No, I have not come across any information as yet	825 (75%)
Not sure	129 (12%)
How would you rate your MD education on the effects vaping has on a person's health?	<i>n</i> = 1099
Very poor	272 (25%)
Poor	469 (43%)
Average	312 (28%)
Good	39 (4%)
Excellent	7 (1%)
What would be the most effective way SGU's curriculum can educate students on the impact vaping has on a person's health?	<i>n</i> = 1095
Lecture format	396 (36%)
Small groups	315 (29%)
Directed learning activity	211 (19%)
I do not think this topic needs to be incorporated into the MD curriculum	96 (9%)
Other	77 (7%)
Has the medical curriculum in any way impacted your current views on vaping?	<i>n</i> = 1095
No, my views on e-cigarettes and vaping as to their health effects prior to starting my studies are unchanged	831 (76%)
Yes, I have a more negative view of e-cigarettes and vaping	257 (23%)
Yes, I have a more positive view of e-cigarettes and vaping	7 (1%)
Have you ever tried to educate close family members or friends about the negative consequences of vaping in your lifetime?	<i>n</i> = 1095
No	461 (42%)
Yes, I did so before I started my studies at SGU	519 (47%)
Yes, I did so after I started my studies at SGU	115 (11%)

3.7. Role of Medical Practitioners

Over half of the respondents (51%) believed that physicians play a key role in evaluating the health impact of vaping. In patient interactions, 71% felt that it was essential to capture a patient's vaping status, and 62% would advise patients to quit vaping (Table 5).

Table 5. Attitudes and practices of respondents toward vaping.

Has being in a medical school affected your view and usage of e-cigarettes?	<i>n</i> = 1082
Yes, being in med school has increased my usage of e-cigarettes	92 (9%)
Yes, being in med school has decreased my usage of e-cigarettes	31 (3%)
No, being in my med school has not affected my usage of e-cigarettes	99 (9%)
Unsure	25 (2%)
I do not use e-cigarettes (vape)	835 (77%)
Do you think medical practitioners play a key role in helping their patients evaluate the impact vaping has on their health?	<i>n</i> = 1082
Definitely not	9 (1%)
Probably not	36 (3%)
Might or might not	156 (14%)
Probably yes	331 (31%)
Definitely yes	550 (51%)

Table 5. Cont.

Do you think patients would view their physician differently if they knew he or she vaped?	<i>n</i> = 1082
Definitely not	20 (2%)
Probably not	47 (4%)
Might or might not	261 (24%)
Probably yes	456 (42%)
Definitely yes	298 (28%)
Do you think a patient's vaping status is important information for their physician to capture?	<i>n</i> = 1072
Definitely not	6 (1%)
Probably not	15 (1%)
Might or might not	46 (4%)
Probably yes	244 (23%)
Definitely yes	761 (71%)
When you become a physician, will you advise your patients who vape to stop using e-cigarettes (vaping)?	<i>n</i> = 1072
Definitely not	5 (0%)
Probably not	9 (1%)
Might or might not	110 (10%)
Probably yes	283 (26%)
Definitely yes	665 (62%)
Do you think physicians are given enough education on vaping to properly advise their patients?	<i>n</i> = 1067
No	578 (51%)
Yes	113 (11%)
Not sure	406 (38%)
Do you think vaping is beneficial for certain patients?	<i>n</i> = 1072
No	697 (65%)
Yes	129 (12%)
It depends on the patient's chief complaint	246 (23%)
Would you recommend to your patient to quit vaping even if you vape?	<i>n</i> = 1067
Yes	58 (5%)
No	848 (79%)
Not sure	161 (15%)

4. Discussion

The findings from this survey indicate that a substantial proportion of SGU medical students have experimented with e-cigarettes, despite their advanced health education compared to the general population. While 97% of respondents acknowledged the health risks of vaping, and 71% believed it was important to inquire about a patient's vaping status during consultations, a notable proportion of participants reported current e-cigarette usage or openness to future vaping. Furthermore, only 62% stated they would actively encourage patients to quit vaping, underscoring potential gaps in the education of future healthcare providers.

Although the majority of respondents reported never smoking tobacco (82%) or using e-cigarettes (71%), 11% reported vaping within the past 30 days, and 26% were likely to start vaping in the next six months. This prevalence mirrors national trends showing increased e-cigarette usage among young adults, often due to misconceptions about reduced harm compared to combustible cigarettes [15]. Furthermore, the daily vaping behavior observed in 38% of respondents aligns with concerns regarding the addictive potential of e-cigarettes, particularly products containing nicotine salts that enhance absorption and addiction potential [3,4,7].

While 97% of respondents acknowledged the health risks of vaping, perceptions about its severity varied. A significant portion viewed vaping as equally harmful (54%) or even more harmful (21%) than smoking traditional cigarettes. This reflects an increased awareness of the risks associated with vaping, including pulmonary complications like e-cigarette, or vaping, product use-associated lung injury (EVALI). The 2019 EVALI outbreak, primarily associated with THC-containing products adulterated with vitamin E acetate, underscores the severity of vaping-related health risks [5]. Additionally, evidence continues to accumu-

late linking vaping to adverse cardiovascular and respiratory outcomes, contradicting the perception of e-cigarettes as a “safer alternative” [7].

The motivations for vaping among respondents—recreational use (59%), curiosity (39%), stress relief (30%), and pleasurable feelings (32%)—reflect broader psychosocial and behavioral drivers. Notably, 44% of participants reported increased vaping since entering medical school, suggesting that the stress of medical education may amplify reliance on vaping as a coping mechanism. Such patterns parallel national findings that highlight stress and social influences as key determinants of e-cigarette use [16]. Additionally, the co-use of nicotine and THC products, commonly associated with EVALI cases, warrants attention as dual usage compounds health risks [5].

These findings underscore the critical role of medical education in addressing vaping. Despite widespread awareness of health risks, 75% of respondents reported receiving little to no formal education on vaping and its effects, and 51% felt unprepared to counsel patients effectively. This knowledge gap aligns with broader calls to integrate vaping-related content into medical curricula, equipping future practitioners to recognize, manage, and counsel patients about vaping-related health issues [8,10]. Notably, 62% of respondents indicated they would advise their patients to quit vaping, reinforcing the need for evidence-based strategies to support cessation efforts.

While the health risks associated with e-cigarettes are well-documented, emerging research suggests potential benefits in specific contexts. For instance, e-cigarettes have shown promise as a tool for smoking cessation among adult smokers, particularly when combined with behavioral interventions [17]. Some studies even recommend e-cigarettes as a harm reduction strategy for patients with chronic obstructive pulmonary disease (COPD), particularly those unable to quit smoking by other means [18]. However, these benefits must be weighed against the risks of youth uptake and potential long-term health consequences. Further, a study which analyzed survey data from the Behavioral Risk Factor Surveillance System of more than 240,000 individuals aged 18 to 29 years found that flavored e-cigarette bans led to an 80% decrease in daily vaping among young adults but also resulted in a 22% increase in daily cigarette smoking, potentially offsetting public health gains [19]. The implication of these findings is that, while flavored e-cigarette bans reduce vaping among young adults, they may unintentionally lead to increased cigarette smoking, potentially offsetting the public health benefits of these policies [20]. Thus, policies aimed at reducing tobacco-related diseases by promoting the switch to e-cigarettes must be carefully evaluated and monitored to ensure they achieve genuine harm reduction.

The results of this study highlight the need for targeted interventions to address vaping behaviors among medical students. First, integrating comprehensive vaping education into medical curricula is essential to bridge knowledge gaps and equip students with the tools to counsel patients effectively. Second, stress management programs tailored to medical students may reduce reliance on vaping as a coping mechanism. Lastly, public health campaigns targeting young adults should emphasize the risks of vaping, including the potential for addiction and lung injury, while challenging misconceptions about safety relative to smoking [5,7,16].

As a cross-sectional survey, a key limitation of this study is the inability to determine the true incidence of e-cigarette use and the potential for response bias, as those who chose to participate may differentially differ from those who did not. Additionally, self-reported assessments of the adequacy of medical school curricula are subject to recall bias. There is also the possibility that self-reported tobacco and e-cigarette use may not fully reflect actual usage patterns. However, previous studies have indicated that self-reported tobacco use is a reliable measure of actual consumption [21]. Lastly, while St. George’s University has a diverse student body representing multiple countries, the majority of its medical

students are US citizens or intend to practice in the US. As a result, the findings may not be fully generalizable to medical students in other regions. Future research should explore longitudinal trends in vaping behaviors among medical students and assess the effectiveness of educational interventions in altering perceptions and practices.

5. Conclusions

Medical students' knowledge, attitudes, and behaviors regarding e-cigarette use play a crucial role in shaping their approach to patient care. Although most recognize the health risks and addictive nature of e-cigarettes, a significant proportion continue to engage in vaping. These findings underscore the urgent need for enhanced educational initiatives within medical curricula to better prepare future physicians for addressing vaping-related health concerns. Strengthening medical education in this area may not only reduce e-cigarette use among medical students but also improve the guidance they provide to patients, ultimately contributing to better public health outcomes.

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Abbreviations

The following abbreviations are used in this manuscript:

EVALI	E-cigarette or vaping product use-associated lung injury
SGU	St. George's University
THC	Tetrahydrocannabinol

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