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Examining the Efficacy of Project ECHO to Improve Clinicians' Knowledge and Preparedness to Treat Adolescent Vaping

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Abstract

As adolescent vaping reaches epidemic rates in the United States, it is imperative that pediatric clinicians have access to medical knowledge on best practices for screening, assessing, and treating vaping-related substance use. The Teen Vaping ECHO (Extension for Community Healthcare Outcomes) program was developed to offer practical learning sessions focused on clinical management of adolescent vaping. This study describes the development, implementation, and evaluation of the program's impact on participants' knowledge, attitudes, and practices regarding treatment of adolescent vaping from registration to the end of the series. Participants were generally knowledgeable about vaping at registration and reported significant increases in comfort talking with patients about vaping, counseling patients on nicotine replacement products, and frequency of implementing best-practice screening strategies at the end of the series. This study suggests ECHO programs focused on improving clinical management of adolescent vaping may increase accessibility of evidence-based care and reduce harms associated with vaping in youth.

Keywords

adolescents; vaping; primary care; Project ECHO; continuing medical education

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Author Contributions

All authors contributed to the drafting, review, and final approval of the manuscript. AO and JA performed data analysis. ZA, LH, and JA were responsible for developing the concept and overseeing program implementation and data collection.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Institutional Ethics Statement

This study complied with the ethical standards of the university's Institutional Review Board, and was deemed exempt under categories 2 and 4.

Introduction

Prevalence and Outcomes of Adolescent Vaping

Use of electronic nicotine delivery systems, or vaping, among adolescents has grown to epidemic proportions in the United States over the past decade.[1] In 2020, 13.1% of United States' 6th to 12th grade students endorsed current (past 30-day) vaping,[2] down from 20% in 2019[3] but a stark increase from 1.1% in 2011.[4] Vaping has been associated with adverse changes in blood pressure, hindered creation of antiviral proteins by epithelial cells, disrupted cellular signaling, and maladaptive cellular destruction.[5] Chronic vaping puts users at risk for nicotine addiction and may increase risk for use of other substances.[6,7] One of the most severe negative consequences of vaping is e-cigarette, or vaping, product use–associated lung injury (EVALI).[5,6,8] Within the United States, 2807 hospitalizations were attributed to EVALI between 2019 and 2020, and 68 EVALI-related deaths had been recorded as of February 2020.[8] The rapid increase in the prevalence of adolescent vaping and corresponding health problems has spurred calls for a coordinated public health response to prevent or reduce this risky health behavior.[9]

Limits and Approaches to Treatment and Mitigation

Despite growing evidence that vaping puts adolescents at risk for adverse health consequences[5–8] and the establishment of EVALI practice guidelines,[10] there are no concise guidelines for population-level screening, assessment, and treatment of vaping-related nicotine/tobacco use disorders for adolescents in primary care.[11,12] Proven methods for smoking cessation among adults have not been found to translate directly to the treatment of adolescent smokers,[13] though pharmacotherapy and behavioral therapies have been proposed as viable options for adolescent vaping.[11] Squeglia et al[14] reviewed the literature on use of nicotine replacement therapies (NRTs) to treat adolescent tobacco use disorder and found that NRTs are most effective when combined with behavioral therapies and should not be prescribed to adolescents unless tobacco dependence is present. Hence, providers will need to learn developmentally tailored approaches for clinical management of vaping in adolescent patients.

Investment in clinical research—and associated trial registrations and publications—on adolescent vaping has increased steadily in recent years.[15] As evidence grows for how adolescent vaping should be addressed clinically, it will be critical to have mechanisms for rapidly disseminating new medical knowledge among community-based health care providers. This is especially true given limited exposure to adolescent vaping in medical training programs. A recent study among medical students at a large university found that 84.7% of students reported they received no education on e-cigarettes and vaping during medical school.[16] Furthermore, primary care clinics play an important role in mitigating harm from adolescent vaping, as they are among the first to screen adolescents for substance use and vaping, emphasizing the need for continued education on the topic to adapt and best serve patients.[17] Screening adolescents for vaping does not have to be within the purview of specialists per se, as nurses and other frontline health care workers will generally screen for use; however, a patient's course of treatment may be dictated by information collected at the initial screening, and treating providers need to know how to interpret results accordingly.

To fill these gaps and to help keep practicing clinicians abreast of the rapidly evolving literature on how to address adolescent vaping in their practices, it is important to create timely, interactive learning opportunities where providers can share their observations and questions about addressing vaping in their clinics while also obtaining consultation and mentorship from specialists with expertise spanning behavioral health, pediatrics, pulmonology, and other relevant disciplines.

Specialized Clinical Learning Through Project ECHO

Project ECHO (Extension for Community Healthcare Outcomes) is a burgeoning model framework to enhance clinicians' knowledge on complex health conditions and to explore effective modalities for treatment. The model was initially created in 2003 at the University of New Mexico to enhance treatment options for people diagnosed with hepatitis C and to facilitate the dissemination of specialty clinical expertise outside of academic medical settings where capacity was limited.[18] This innovative approach provides learners (spokes) with continuing case-based education to facilitate improved management of a vast array of complex medical issues through a series of virtual clinics hosted by a hub of experts from academic institutions via videoconferencing technology.[18,19] Project ECHO has become prominent in the global mission to improve health outcomes; there are currently more than 1000 active ECHO programs being conducted in 60 countries, including at least 600 in the United States.[20]

The frequency and length of an ECHO session varies depending on the topic and institution hosting the ECHO series. However, the general format of an ECHO session is set by the ECHO Institute[21]; attendees observe a brief didactic presentation and discuss one or more deidentified patient cases from a community clinician's local practice. Experts on the ECHO panel facilitate the learning process for attendees by fielding audience questions, reviewing cases, and providing best-practice recommendations to resolve the issues at hand using the guiding principle "all teach, all learn."[18] While more research is needed on the long-term impacts of Project ECHO on participants' retention of knowledge and skills,[22–24] implementing Project ECHO appears to be an efficacious and cost-effective method to enhance provider knowledge, patient treatment outcomes, and access to care in rural and underserved communities.[18,19]

Indiana's Teen Vaping ECHO Program

ECHO programs and accompanying publications have covered treatment of substance use disorders (ie, opioids), including in Indiana.[25] However, as of August 2021, no ECHO programs have directly addressed adolescent vaping.[20] To bridge this gap in application of up-to-date learning approaches to an important clinical and public health concern, the Indiana Teen Vaping ECHO program was developed in 2020 and led by a partnership between clinical specialists at the Indiana University School of Medicine (IUSM) and the Indiana State Department of Health (IDOH)[26]. Indiana is an ideal location to launch such a venture, as statewide rates of adolescent vaping reflect national trends.[27]

The purpose of the present study is to describe the development and initial implementation of this innovative program, as well as to report exploratory findings on changes in participants' attitudes and knowledge pertaining to treatment and management of adolescent vaping by the program's conclusion compared with baseline.

Methods

Design

This study is a secondary analysis[28] of a data set collected for quality improvement evaluation of the Indiana Teen Vaping ECHO. The data set included pre-series and post-series data on participants' knowledge, behaviors, and attitudes toward adolescent vaping and treatment options. Use of these data for this secondary analysis was approved by the university's Institutional Review Board.

Setting and Program

From August 3, 2020 to May 21, 2021, two 13-session and one 12-session Teen Vaping ECHO clinics were conducted. All of the sessions took place virtually (using Zoom software), once weekly, and lasted 1 hour beginning at noon local time. An interdisciplinary hub team with expertise in addressing adolescent vaping was assembled for each session that included a registered nurse, a mental health counselor, a thoracic surgeon, a licensed psychiatrist, a clinical pharmacist, a licensed social worker, and a certified pediatric pulmonologist. Guest presenters included epidemiologists, psychologists, and other public health professionals.

A didactic curriculum was drafted through discussions between personnel at IUSM, officials at IDOH, and leaders of select primary care organizations within Indiana. A list of proposed topics was circulated via e-mail to pediatric primary care physicians in spring 2020, and final topics (Table 1) were selected based upon respondents' interest ratings. ECHO Hub team members and other local experts prepared and delivered the didactic presentations. All sessions followed the prescribed ECHO best-practice agenda,[21] beginning with introductions of the hub team and attendees, followed by a didactic presentation, and finally a participant-led deidentified case discussion that was preapproved by program staff. Sessions were recorded for quality assurance and made available to participants upon request.

Participants were recruited through promotional e-mails distributed to relevant professional groups and associations, advertising at ongoing continuing medical education (CME) and continuing education (CE) programs, and sign-up sheets at state and local conference exhibit booths. Participants had the opportunity to claim no-cost CME/CE credits for logging their attendance at each session. Program registration was free, voluntary, and open to anyone with interest in attending. Participants could attend without prior registration (though this was not advertised, since preregistration was preferred and encouraged).

Data Collection

All survey instruments were developed and distributed using QualtricsXM (Seattle, Washington). Pretest questions for this study were embedded in the program registration form, though participants were only required to complete fields for their name and contact information. The posttest questionnaire was sent to participants on October 7, 2021 and remained open until October 28, 2021. Participants who completed the posttest survey received a $10 US digital Amazon gift card through e-mail delivery but not additional CME/CE credits or other program benefits. Finally, attendance data were tracked "live" during each session by program staff during introductions and by inspection of the attendee list throughout each session.

Determination of the Study Sample

Pretest.—A total of 611 registrations were created for the Indiana Teen Vaping ECHO program. Of those, 93 were blank (user quit immediately after accessing the form), 105 cases were removed due to duplicate registration (ie, earliest complete case for each individual was retained and cross-validated using names and e-mail addresses), and 3 registrations by hub team members were removed. This resulting data set included 410 unique registrations with at least some pretest data available. An additional 37 individuals attended at least 1 session but did not provide any information associated with a registration case (eg, attended using a nickname or phone number). We cannot verify that those 37 individuals represented unique cases (eg, attendees may have joined a session using a telephone rather than Zoom without notifying program staff) and so they were excluded from most analyses.

There were 268 individuals who both registered for the program (eg, completed at least part of the pretest) and attended at least 1 session of the program. These individuals composed the analytic pretest sample. Beyond including only individuals who attended the program at least once, we did not use any exposure cut-off to eliminate cases.

Posttest.—A total of 87 individuals accessed the posttest survey. Of those, 6 were blank (user quit immediately after accessing the survey), 1 was from an expert panelist, and 1 included only a first name; those cases were removed. Using the same duplicate removal heuristic as the pretest, 16 additional cases were excluded. Pretest and posttest data were matched using names and e-mail addresses, and 7 cases had completed posttests but had never registered for the program. Furthermore, 11 cases completed both a pretest and a posttest but did not appear to attend any sessions. These may have been individuals attending with a phone number or nickname (ie, the 37 "nonregistrant" attendees), but we cannot know with certainty. In keeping with an intent-to-treat approach, we included them in analyses. Thus, the final analytic posttest sample was 56 cases.

Measures

At pretest only, participants were asked to indicate their *current profession, years of practice in their current profession*, and whether they *currently treated patients in a clinical capacity*. The latter question was also used to determine which questions to populate, as nonclinical providers cannot provide valid information on their current clinical practices. Clinical practitioners were asked whether they Used 9 different *treatment approaches* (eg, "recommend non-nicotine therapies"), which were compiled and reviewed by members of the Indiana Teen Vaping ECHO expert panel.

At both pretest and posttest, participants were asked 2 sets of questions that were adapted from research by Pepper et al.[29] The first was only asked to clinical practitioners and inquired about *comfort level* with 7 different behaviors, such as "talking to a patient about vaping/e-cigarettes," with responses ranging from 1: Least comfortable to 4: Most comfortable. The second set was asked to all participants and focused on more general *beliefs and attitudes* about e-cigarettes, such as "e-cigarettes are safer to use than smokeless tobacco." Responses to those questions ranged from 1: Strongly disagree to 4: Strongly agree. Participants could also respond that they "Don't Know," and these responses were excluded from calculation of means and comparisons because such an assertion is not ordinally related to the Likert-type scale.

Clinically practicing participants were also asked about a variety of *screening methods* at pretest and posttest, such as "ask adolescent patients about vaping/e-cigarette use" Using response options ranging from 1: 0% of the time to 6: 100% of the time. These items were generated by the Indiana Teen Vaping ECHO expert panel and were informed by a similar set of items used in prior research to assess substance-related clinical behaviors.[30]

Finally, *objective knowledge* about EVALI was measured using 2 multiple-choice items. Responses were coded to 0: Incorrect and 1: Correct.

Statistical Approaches

Comparison of differences in attendance based on whether participants registered or did not register was completed using a Mann-Whitney *U* test. All paired sample (pre-/post-) comparisons Were made using Wilcoxon signed-rank tests, except objective knowledge, where a McNemar test was used since the data were dichotomous. In principle, statistical significance testing was 2-sided using a baseline alpha of .05. However, the study used a multitude of pairwise comparisons. Aligning with recent recommendations by the American Statistical Association, all significance values were reported in the tables, and the Discussion section highlights broad interpretations of what might be reasonable to conclude given the overall set of data, including limitations and strengths, presented here.[31]

Results

Program Attendance

Among the full sample (N = 447), participants attended an average of 3.13 (SD = 4.04) sessions during the program. Approximately, 20.4% attended only 1 session, 60.1% attended up to 10 sessions, and 8.2% attended 11 or more sessions. The mean for the full sample is affected by zero-inflation of nonattendees (ie, very high frequency of zero values in the distribution based on participants that attend 0 sessions). Though this was somewhat counterbalanced by the 37 nonregistering attendees, there was still meaningful inflation observed. No participant attended more than 20 of the 38 sessions offered. Attendance data for participants who registered and attended 1 or more sessions are summarized in Table 1. Number of attendees at specific sessions ranged from 10 (session 13, round 2) to 80 (session 4, round 1). Repeat attendance prevalence for the Teen Vaping ECHO was similar to other ECHO programs designed for clinicians in Indiana; approximately, 68.3% of unique participants attended more than 1 session. In comparison, Adams et al[32] reported that 62.0% of unique participants attended more than 1 session of the Indiana Jail-Based Opioid Use Disorder (OUD) Treatment ECHO.

Among participants who registered for the ECHO program (n = 410), 268 attended at least 1 session (Table 1). Of these 268 participants, the average number of sessions attended was 4.86 (SD = 4.28). A Mann-Whitney U test indicated that the median number of sessions attended was greater among participants who registered for the ECHO program (Mdn = 3.00, n = 268) than for those who did not (Mdn = 2.00, n = 37; $U = 3411.50$, $z = -3.13$, $P = .002$). The maximum number of sessions attended by unregistered participants was 11, compared with 20 for those who registered. Mean numbers of attendees at each session varied by program round; average attendance per session was 58.15 (SD = 11.47) in round 1, 14.23 (SD = 3.32) in round 2, and 29.08 (SD = 15.16) in round 3 (see Table 1).

Professional Characteristics

Table 2 presents sample characteristics collected at registration (ie, pretest) separately by 3 groups of overlapping participants: all registrants (n = 410), attending registrants (n = 268), and registrants with both pretest and posttest data (n = 56). For each group, social workers were the most prevalent single profession (16.3%-24.1%), though roughly half of participants selected “other” and wrote in a variety of health-related careers such as “certified tobacco treatment specialist.” Participants reported roughly a decade of practice in their current profession (M = 10.99, 9.83, and 12.91, respectively).

Across groups, 44.9% to 51.9% of participants indicated that they currently treated patients in a clinical capacity. Of those clinicians, the most frequently used treatment approaches for addressing suspected adolescent vaping (from among 10 listed options, see Table 2) were “education about the risks of vaping/e-cigarettes” and “brief motivational intervention.”

Knowledge, Comfort Level, Screening Methods, and Attitudes

Means and standard deviations are presented in Table 3 for the analytic Sample (pretest and posttest) and for all registrants (pretest only). Information on statistical comparisons is provided for each pairwise contrast among the analytic sample.

A high level of *objective knowledge* (0: Incorrect; 1: Correct) about symptoms and suspected causes of EVALI was observed at pretest, with 92% and 91% of the sample responding correctly, respectively, with few, nonsignificant differences at posttest. For measures of *beliefs and attitudes* (1: Strongly disagree to 4: Strongly agree), respondents in the analytic sample generally disagreed that e-cigarettes are safer than smokeless or combustible tobacco (M = 1.38 and M = 1.43, respectively), and generally agreed that using e-cigarettes may cause adolescents to initiate use of tobacco or other psychoactive substances (M = 3.59 and M = 3.37, respectively). Clinicians also agreed that it is important to discuss e-cigarettes with adolescents and that parents of adolescents need to know about e-cigarettes (M = 3.78 and M = 3.80, respectively). No significant changes were observed in these beliefs and attitudes at posttest.

Two other sets of questions were only asked to participants who were currently treating patients in a clinical capacity. At pretest, such respondents indicated *comfort levels* (1: Least comfortable to 4: Most comfortable) near the midpoint, with the highest reported item being "talking to a patient about cigarette/tobacco use" (M = 3.18). There was some evidence of improved comfort levels at posttest among this subsample for "talking to a patient about vaping/e-cigarettes" $z = -2.67$, $P = .008$) and "counseling adolescent patients on nicotine replacement products" ($z = -2.00$, $P = .046$).

For *frequency of screening methods in practice* (1: 0% of the time to 6: 100% of the time), pretest data suggested that formal screening about vaping and tobacco was the least common (M = 2.04 and M = 2.07, respectively), while asking adolescent patients about tobacco/cigarette use was the most common (M = 4.00). Posttest data indicated significant increases in frequency of all screening approaches except asking parents/caregivers about adolescent patients' vaping and cigarette use.

Discussion

This article provides an in-depth description and analyses from one of the first ECHO programs for adolescent vaping to be offered in the United States. In this section, several data points regarding people who register for these types of programs and reasonably expected outcomes are discussed.

Registrants

Slightly less than half of the registrants for the program worked with patients in a clinical capacity, indicating relatively broad interest in this topic outside of such settings. Among clinicians who registered, education about the risks of vaping and use of motivational interviewing were widely reported to be used (>50% of clinician registrants), suggesting the ongoing importance of the program continuing to offer a session specifically focused on motivational interviewing. Registrants also displayed excellent pretest knowledge about EVALI, suggesting that basic information about that phenomenon may not be a good way to assess objective knowledge among people who are interested enough in vaping-associated care, to choose to attend a program similar to the Indiana Teen Vaping ECHO program.

The pretest frequency values for "asking" about different; substances were higher, in some, cases by nearly 2 points on a 6-point scale, than frequencies for "administering a formal screening tool" for those same substances. This closely mirrors findings from the 2018 study on "asking" and "screening" on which the questions were based[30] suggesting that clinicians are often interested in patients' substance use but may not use evidence-based approaches such as formal screening to solicit information.

Outcomes

This was a retrospective cohort study and should not be used as the sole means of ascribing causality to any changes observed. Nevertheless, there is some evidence that clinical provider attendees of a vaping ECHO become more comfortable with certain types of interaction, especially talking with patients about vaping. There is also some evidence that such providers might be more likely to attempt to elicit information about adolescent patients' substance use.

These apparent changes in provider behavior suggest the possibility that interactive, educational, case-based virtual programs like Project ECHO are an effective way to influence provider decision-making around screening and treatment practices for adolescent vaping. There have been limited rigorous studies comparing interactive forms of education like ECHO with other didactic methods of CME,[33] but findings from this study are consistent with the conclusions from a review, suggesting that interactive sessions including case discussion, role-play, or hands-on practice have enhanced ability to change physician practices compared with other forms of CME like traditional didactic sessions, conferences, meetings, and lectures.[34]

Limitations

As a descriptive exercise—that is, in terms of describing the Indiana Teen Vaping ECHO program and the people who registered for it—the research team is confident in the work. However, there are a few limitations that should influence interpretation of the pretest and posttest comparisons. First, the analysis was done retrospectively with evaluation data, and many participants did not complete posttests, even when incentivized. Second, while the questions about treatment approaches and objective knowledge were relatively straightforward, they were developed by the expert panel for this project; thus, they have some face validity but have not been validated in other ways. Third, there were multiple points of attrition, and the analytic sample likely differed in one or more latent ways from the registering sample, though we have provided data for both in all cases to allow others to make determinations about validity. Furthermore, the posttest was offered at a single time following all 3 sessions, creating potentially meaningful but unmeasured variability in the time between exiting the program and completing the posttest. There were also a large number of pairwise comparisons, increasing the likelihood that one or more apparently significant differences were the result of inflated type I error. Future efforts to study the impact of similar programs would benefit from investment in more extensive data collection procedures to increase the sample size.

In addition, all participants voluntarily chose to register for the program. As noted, there were a number of characteristics that were common to registrants, including high levels of knowledge about EVALI. In some cases, this precluded the usefulness of null hypothesis significance testing for changes by introducing a ceiling effect. Solutions to measure the effects of ECHO on these or similar variables may include use of different questions and efforts to include a more diverse sample of participants (especially those not inherently interested in vaping). The former could be accomplished using mixed-methods approaches,[35] whereas the latter might be achieved by providing CME credit, possibly in combination with statewide requirement for training, similar to what has been done for OUD. Finally, all changes in behavior were elicited via self-report, which could limit their veracity due to social desirability bias. Future evaluation of changes in provider behavior related to similar educational modalities would benefit from other more objective metrics to evaluate provider behavior change such as chart review of documentation of discussion/

counseling regarding vaping, observed clinical encounters, or performance on Objective Structured Clinical Examinations.

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References

1. US Food and Drug Administration. FDA takes new steps to address epidemic of youth e-cigarette use, including a historic action against more than 1,300 retailers and 5 major manufacturers for their roles perpetuating youth access [press release]. Silver Spring, Maryland: US Department of Health and Human Services, Food and Drug Administration; 2018. Accessed July 23, 2021. https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm620184.htm.
2. Gentzke AS, Wang TW, Jamal A, et al. Tobacco product use among middle and high school students—United States, 2020. MMWR Morb Mortal Wkly Rep. 2020;69(50):1881–1888. doi:10.15585/mmwr.mm6950a1. [PubMed: 33332300]
3. Wang TW, Gentzke AS. Creamer MR. et al. Tobacco product use and associated factors among middle and high school students—United States, 2019. MMWR Surveill Summ. 2019;68(12):1–22 doi:10.15585/mmwr.ss6812a1.
4. Centers for Disease Control and Prevention. Notes from the field: electronic cigarette use among middle and high school students—United States, 2011-2012. MMWR Morb Mortal Wkly Rep. 2013;62(35):729–730. [PubMed: 24005229]
5. Venkata AN, Palagiri RDR, Vaithilingam S. Vaping epidemic in US teens: problem and solutions. Curr Opin Pulm Med. 2021;27(2):88–94. doi:10.1097/MCP.0000000000000757. [PubMed: 33395115]
6. Temple JR, Shorey RC, LU Y, Torres E, Stuart GL Le VD. E-cigarette use of young adults motivations and associations with combustible cigarette alcohol, marijuana, and other illicit drugs. Am J Addict. 2017;26(4):343–348. doi:10.1111/ajad.12530. [PubMed: 28370717]
7. Patterson M, Williams-Jones P, Lewis TP. Consequences of the vaping epidemic on adolescents. Nursing. 2020;50(7):30–37. doi:10.1097/01.NURSE.0000668600.70206.8f.
8. Centers for Disease Control and Prevention. Outbreak of lung injury associated with the use of e-cigarette, or vaping, products. Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion. Updated August 3, 2021. Accessed August 6, 2021. https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease.html.
9. U.S. Department of Health and Human Services. Surgeon General's Advisory on E-cigarette Use Among Youth. 2018. Accessed August 6, 2021. https://e-cigarettes.surgeongeneral.gov/documents/surgeon-generals-advisory-on-e-cigarette-use-among-youth-2018.pdf.
10. Siegel DA, Jatlaoui TC, Koumans EH, et al. Update: interim guidance for health care providers evaluating and caring for patients with suspected e—cigarette, or vaping, product use associated lung injury—United States, October 2019. MMWR Morb Mortal Wkly Rep. 2019;68(41):919–927. doi:10.15585/mmwr.mm6841e3. [PubMed: 31633675]
11. Burt B, Li J. The electronic cigarette epidemic in youth and young adults: a practical review. JAAPA. 2020:33(3):17–23. doi:10.1097/01.JAA.0000654384.02068.99.

12. Selph S, Patnode C, Bailey SR, Pappas M, Stoner R, Chou R. Primary care-relevant interventions for tobacco and nicotine use prevention and cessation in children and adolescents: updated evidence report and systematic review for the US preventive services task force. JAMA. 2020;323(16):1599–1608. doi:10.1001/jama.2020.3332. [PubMed: 32343335]
13. Farber HJ, Walley SC, Groner JA, Nelson KE; Section on Tobacco Control. Clinical practice policy to protect children from tobacco, nicotine, and tobacco smoke. Pediatrics. 2015;136(5):1008–1017. doi:10.1542/peds.2015-3108. [PubMed: 26504137]
14. Squeglia LM, Fadus MC, McClure EA, Tomko RL, Gray KM. Pharmacological treatment of youth substance use disorders. J Child Adolesc Psychopharmacol. 2019;29(7):559–572. doi:10.1089/cap.2019.0009. [PubMed: 31009234]
15. U.S. National Library of Medicine. Clinicaltrials.gov: Search results. U.S. National Library of Medicine. Updated August 31, 2021. Accessed August 31, 2021. https://clinicaltrials.gov/ct2/results?cond=&term=e-cigarette%2C+youth&entry=&state=&city=&dist=.
16. Hinderaker K, Power DV, Allen S, Parker E, Okuyemi K. What do medical students know about e-cigarettes? A cross-sectional survey from one U.S. medical school. BMC Med Educ. 2018;18(1):32. doi:10.1186/s12909-018-1134-1. [PubMed: 29499682]
17. Palmer J, Nativio D. Screening for adolescent use of electronic nicotine delivery systems. J Addict Nurs. 2020;31(2):119–123. doi:10.1097/JAN.0000000000000337. [PubMed: 32487938]
18. Arora S, Kalishman SG, Thornton KA, et al. Project ECHO: a telementoring network model for cotinuing professional development. J Contin Educ Health Prof. 2017;37(4):239–244. doi:10.1097/CEH.0000000000000172. [PubMed: 29189491]
19. Zhou C, Crawford A, Serhal E, Kurdyak P, Sockalingam S. The impact of Project ECHO on participant and patient outcomes: a systematic review. Acad Med. 2016;91(10):1439–1461. doi:10.1097/ACM.0000000000001328. [PubMed: 27489018]
20. The University of New Mexico. ECHO Data Marketplace. Project ECHO. Updated August 3, 2021. Accessed August 6, 2021. https://hsc.unm.edu/echo/data-marketplace/inter-active-dashboards/.
21. ECHO. News and information. University of New Mexico. Accessed December 10, 2020. https://hsc.unm.edu/echo/.
22. Lewiecki EM, Rochelle R. Project ECHO: telehealth to expand capacity to deliver best practice medical care. Rheum Dis Clin North Am. 2019;45(2):303–314. doi:10.1016/j.rdc.2019.01.003. [PubMed: 30952400]
23. Faherty LJ, Rose AJ, Chappel A, Taplin C, Martineau M, Fischer SH. Assessing and expanding the evidence base for Project ECHO and ECHO-like models: findings of a technical expert panel. J Gen Intern Med. 2020;35(3):899–902. [PubMed: 31925737]
24. McBain RK, Sousa JL, Rose AJ, et al. Impact of Project ECHO models of medical tele-education: a systematic review. J Gen Intern Med. 2019;34(12):2842–2857. [PubMed: 31485970]
25. Agley J, Adams ZW, Hulvershorn LA. Extension for Community Healthcare Outcomes (ECHO) as a tool for continuing medical education on opioid use disorder and comorbidities. Addiction. 2019;114(3):573–574. [PubMed: 30397977]
26. Indiana University. Teen Vaping ECHO. Accessed August 6, 2021. https://vapingecho.iu.edu/.
27. Jun M, Gassman R, Agley JD, King R, Samuel S, Lee J. Indiana Youth Survey - 2020. Bloomington, IN: Institute for Research on Addictive Behavior; 2020. https://inys.indiana.edu/docs/survey/indianaYouthSurvey_2020.pdf.
28. Glass GV. Primary, secondary, and meta-analysis of research. Educ Res. 1976;5:3–8.
29. Pepper JK. McRee AL. Gilkey MB; Healthcare providers' beliefs and attitudes about electronic cigarettes and preventive counseling for adolescent patients. J Adolesc Health. 2014;54(6):678–683. doi:10.1016/j.jadohealth.2013.10.001. [PubMed: 24332394]
30. Agley J, Carlson JM, McNelis AM, et al. "Asking" but not 'Screening': assessing physicians' and nurses' substance-related clinical behaviors. Subst Use Misuse. 2018;53(11):1834–1839. [PubMed: 29447544]
31. Wasserstein RL, Lazar NAThe ASA statement on p-values: context, process, and purpose. Am Stat. 2016;70(2):129–133.

32. Adams ZW, Agley J, Pederson CA. et al. Use of Project ECHO to promote evidence based care for justice involved adults with opioid use disorder. Subst Abus. 2022;43(1):336–343. doi:10.1080/08897077.2021.1941518. [PubMed: 34283701]
33. Forsetlund L, O'Brien MA, Forsen L, et al. Continuing education meetings and workshops: effects on professional practice and healthcare outcomes. Cochrane *Database Syst Rev*. 2021;9:CD003030. doi:10.1002/14651858.CD003030.pub3. [PubMed: 34523128]
34. Davis D, O'Brien MA. Freemantle N, Wolf FM Mazmanian P, Taylor-VaiSey A. Impact of formal continuing medical education: do conferences, workshops, rounds, and other traditional continuing education activities change physician behavior or health care outcomes? JAMA. 1999;282(9):867–874. doi:10.1001/jama.282.9.867. [PubMed: 10478694]
35. Andrew S, Salamonson Y, Everett B, Halcomb EJ, Davidson PM. Beyond the ceiling effect: using a mixed methods approach to measure patient satisfaction. Int J Mult Res Approaches. 2011;51(1):52–63.

Public Health Implications

Programs like the Indiana Teen Vaping ECHO described in this work may facilitate increased inquiry about and screening for e-cigarette use, vaping, and similar behavior. They also display some promise in increasing providers' comfort level talking about vaping and e-cigarettes in general. Such impacts could theoretically lead to population-level changes in identification and adequate treatment of at-risk adolescents and subsequent reductions in associated harms, such as acute EVALI, chronic lung injury, and addiction. Thus, additional study of such programs is warranted. We remind researchers who do so that participants may self-select in such a way that attendees may enter the program with some prevalence of evidence-based beliefs attitudes, and information, and therefore it may be important to use pretest data to consider whether participants in any given program might benefit from more advanced content.

Table 1.

Registered Participant Attendance by Session and Cumulative Attendance Rates.

	Attendance		
Didactic presentation topic	**Round 1**	**Round 2**	**Round 3**
Screening, diagnosing, and monitoring for vaping/e-cigarette use	54	15	54
Latest trends on teen vaping	65	18	54
THC and vaping	66	15	44
Brain effects of vaping/nicotine use	80	20	43
VALI/EVALI	72	18	25
Pharmacological interventions for SUD (including nicotine)	70	17	21
Indiana Statewide Nicotine/Tobacco Cessation Programs and Resources[a]	56	11	—
Motivational interviewing/brief motivational interventions	56	15	16
Behavioral/nonpharmacological interventions for nicotine use	54	11	16
Legal considerations related to teen vaping/e-cigarette use	45	11	16
Nicotine replacement therapies for vaping/e-cigarette use	46	13	16
Addressing caregiver nicotine use[a]	47	11	23
Adolescent vaping in school	45	10	21
Mean (SD)	58.15 (11.47)	14.23 (3.32)	29.08 (15.16)
Number of sessions attended	**No. (%)[b]**	**Cumulative (%)**	
1	73 (27.2)	27.2	
2	47 (17.5)	44.8	
3	27 (10.1)	54.9	
4	17 (6.3)	61.2	
5	5 (1.9)	63.1	
6	15 (5.6)	68.7	
7	13 (4.9)	73.5	
8	14 (5.2)	78.7	
9	10 (3.7)	82.5	
10	11 (4.1)	86.6	
11-20	36 (13.4)	100.0	

	Attendance		
Didactic presentation topic	**Round 1**	**Round 2**	**Round 3**
21-38	0 (0.0)	100.0	
Mean (SD)	4.86 (4.28)		

Abbreviations: THC, tetrahydrocannabinol; SUD, substance use disorder; EVALI, e-cigarette, or vaping, or product use–associated lung injury; VALI, vaping-associated lung injury.

[a]Didactic presentations combined during the third round of the program.

[b]Values based on percent of participants who registered and attended at least I session (n = 268).

Table 2.

Participant Profession, Years of Experience, and Clinical Treatment Approaches for Vaping at Pretest.

Variable	All registrants (n = 410)		Attending registrants (n = 268)		Have pretest and posttest data (n = 56)	
	No. of observations	%	No. of observations	%	No. of observations	%
Current profession	392	—	264	—	54	—
Advanced nurse practitioner	19	4.8	7	2.7	1	1.9
Certified prevention specialist	4	1.0	3	1.1	1	1.9
Clinical psychologist	2	0.5	2	0.8	0	0.0
Community health worker	29	7.4	24	9.1	5	9.3
Licensed clinical addiction counselor	1	0.3	0	0.0	0	0.0
Physician assistant	2	0.5	0	0.0	0	0.0
Primary care physician	22	5.6	15	5.7	1	1.9
Psychiatrist	2	0.5	1	0.4	0	0.0
Recovery coach	5	1.3	4	1.5	1	1.9
Registered nurse	40	10.2	24	9.1	3	5.6
Social worker	72	18.4	43	16.3	13	24.1
Other[a]	194	49.5	141	53.4	29	53.7
Currently treating patients in a clinical capacity	395	—	265	—	54	—
Yes	187	47.3	119	44.9	28	51.9
No	208	52.7	146	55.1	26	48.1
Treatment approaches	187	—	119	—	28	—
Education about the risks of vaping/e-cigarettes	142	75.9	89	74.8	24	85.7
Recommend nicotine replacement therapies	39	20.9	25	21.0	6	21.4
Recommend non-nicotine therapies	18	9.6	15	12.6	2	7.1
Brief motivational intervention	112	59.9	78	65.5	18	64.3
Refer to behavioral health therapy services within your health system	49	26.2	33	27.7	4	14.3
Refer to behavioral health therapy services outside of your health system	17	9.1	13	10.9	1	3.6
Refer to the Indiana Tobacco/Nicotine Quit Line	56	29.9	37	31.1	11	39.3
Refer to a pharmacist	11	5.9	11	9.2	2	7.1
Recommend a text messaging/SMS program	28	15.0	24	20.2	8	28.6
Other[b]	12	6.4	7	5.9	1	3.6

Variable	All registrants (n = 410)		Attending registrants (n = 268)		Have pretest and posttest data (n = 56)	
	No. of observations	%	No. of observations	%	No. of observations	%
	No. of observations	Mean (SD)	No. of observations	Mean (SD)	No. of observations	Mean (SD)
Years of practice in current profession	358	10.99 (11.39)	238	9.83 (10.95)	47	12.91 (11.20)

Abbreviations: SMS, short message service.

[a] For example, health educator, licensed mental health counselor, pharmacist.

[b] For example, vaping cessation programs.

Table 3.

Objective Knowledge, Screening Methods, and Attitudes: All Registrants (Pretest Only) and Analytic Sample (Pretest and Posttest With Statistical Comparison).

Variable	Pretest (all registrants, n = 410)		Pretest analytic sample (n = 56)		Posttest analytic sample (n = 56)			
	Mean (SD)	No. of observations	Mean (SD)	No. of observations	Mean (SD)	No. of observations	*z*	*P*
Objective knowledge[a]	—	395	—	56	—	56	—	—
Symptoms of EVALI	0.91 (0.29)	375	0.92 (0.27)	52	0.95 (0.23)	56	—	.687
Suspected link to cases of EVALI	0.91 (0.29)	376	0.91 (0.30)	53	0.91 (0.29)	56	—	1.000
Comfort level[b]	—	182	—	28	—	22	—	—
Talking to a patient about vaping/e-cigarettes	2.98 (0.75)	182	2.79 (0.69)	28	3.27 (0.77)	22	−2.67	.008*
Talking to a patient about cigarette/tobacco use	3.33 (0.67)	181	3.18 (0.82)	28	3.36 (0.95)	22	−0.32	.750
Distinguishing between nicotine use and nicotine use disorder	2.64 (0.76)	182	2.71 (0.71)	28	3.23 (0.81)	22	−1.35	.177
Treating nicotine use disorder	2.59 (0.84)	181	2.48 (0.80)	27	3.05 (0.84)	22	−1.75	.080
Counseling adolescent patients on nicotine replacement products	2.51 (0.79)	182	2.36 (0.78)	28	2.91 (0.61)	22	−2.00	.046*
Starting adolescent patients on a nicotine replacement product	2.12 (0.78)	182	1.96 (0.74)	28	2.32 (0.78)	22	−1.89	.059
Tapering patients on a nicotine replacement product	2.20 (0.84)	181	2.11 (0.88)	28	2.36 (0.73)	22	−1.00	.317
Frequency of screening methods in practice[c]	—	174	—	28	—	22	—	—
Ask adolescent patients about vaping/e-cigarette use	3.62 (1.75)	174	3.81 (1.64)	27	4.45 (1.65)	22	−2.03	.042*
Ask adolescent patients about tobacco/cigarette use	3.91 (1.76)	174	4.00 (1.66)	27	4.68 (1.59)	22	−2.34	.019*
Ask adolescent patients about alcohol use	3.83 (1.82)	173	3.89 (1.85)	27	4.86 (1.53)	21	−2.21	.027*
Ask adolescent patients about cannabis/marijuana use	3.79 (1.83)	174	3.78 (1.87)	27	4.91 (1.51)	22	−2.54	.011*
Ask adolescents about the substances they put in vaping devices	3.03 (1.73)	173	3.07 (1.71)	27	4.36 (1.76)	22	−2.97	.003*
Administer a formal screening tool about vaping/e-cigarette use to adolescent patients	1.92 (1.61)	174	2.04 (1.63)	27	3.32 (1.76)	22	−2.96	.003*
Administer a formal screening tool about tobacco/cigarette use to adolescent patients	2.14 (1.72)	174	2.07 (1.62)	27	3.41 (1.76)	22	−2.89	.004*
Administer a formal screening tool about alcohol use to adolescent patients	2.24 (1.68)	173	2.67 (1.73)	27	3.59 (1.84)	22	−2.14	.033*
Administer a formal screening tool about cannabis/marijuana use to adolescent patients	2.13 (1.67)	171	2.41 (1.78)	27	3.64 (1.87)	22	−2.88	.004*
Ask patients/caregivers about an adolescent patient’s vaping/e-cigarette use	2.90 (1.78)	174	2.89 (1.72)	27	3.45 (1.60)	22	−1.81	.070

Variable	Pretest (all registrants, n = 410)		Pretest analytic sample (n = 56)		Posttest analytic sample (n = 56)			
	Mean (SD)	No. of observations	Mean (SD)	No. of observations	Mean (SD)	No. of observations	*z*	*P*
Ask patients/caregivers about an adolescent patient's tobacco/ cigarette use	3.11 (1.83)	173	3.11 (1.67)	27	3.68 (1.73)	22	−1.99	.046[*]
Ask patients/caregivers about an adolescent patient's alcohol use	3.09 (1.83)	174	3.04 (1.72)	27	3.67 (1.74)	21	−2.09	.037[*]
Ask patients/caregivers about an adolescent patient's cannabis/ marijuana use	3.08 (1.82)	173	3.04 (1.70)	27	3.77 (1.77)	22	−2.07	.038[*]
Beliefs and attitudes[d]	—	395	—	56	—	56	—	—
E-cigarettes are safer to use than smokeless tobacco	1.56 (0.69)	340	1.38 (0.64)	47	1.57 (0.74)	54	−1.32	.188
E-cigarettes are safer to use than combustible tobacco cigarettes	1.64 (0.75)	335	1.43 (0.62)	46	1.60 (0.74)	53	−1.12	.265
Using e-cigarettes may cause adolescents to initiate use of other tobacco products	3.54 (0.65)	349	3.59 (0.67)	51	3.59 (0.57)	54	−0.28	.978
Using e-cigarettes may cause adolescents to initiate use of other psychoactive substances	3.42 (0.68)	332	3.37 (0.83)	46	3.43 (0.61)	53	−0.84	.403
It is important to discuss e-cigarettes with adolescents	3.73 (0.66)	342	3.78 (0.59)	49	3.79 (0.54)	52	−0.16	.874
Parents of adolescents need to know about e-cigarettes	3.76 (0.65)	342	3.80 (0.58)	49	3.79 (0.54)	52	−0.16	.874

Abbreviation: EVALI, e-cigarette, or vaping, or product use–associated lung injury.

[a](0: Incorrect, 1: Correct); values are expressed as proportion correct. For these questions only, contrasts used McNemar tests since data were dichotomous.

[b](1: Least comfortable; 4: Most comfortable); only asked to clinical practitioners.

[c](1: Never [0%]; 6: Always [100%]); only asked to clinical practitioners.

[d](1: Strongly disagree; 4: Strongly agree). Respondents could also respond (5: Don't know) but these responses were removed prior to computing and contrasting scores since there is no clear ordinal relationship.

[*]$p < .05$.