



# Informing the development of interventions for e-cigarette use and prevention of transition to cigarette smoking in young adults: A qualitative study

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## ARTICLE INFO

### Keywords:

Electronic cigarettes  
Young adults  
Focus groups  
Smoking  
Cigarettes  
Nicotine  
Intervention

## ABSTRACT

E-cigarette use in young individuals may increase risk for cigarette smoking initiation. Over half of young adults who use e-cigarettes voiced their desire to quit e-cigarettes. Mobile-based interventions may allow for an easy-to-use platform to engage young adults in cessation services and reduce risk for cigarette uptake. To inform development of such programs, this study sought to gather information about what young adults want to see included in e-cigarette cessation interventions that also target future smoking risk. Nine online focus groups ( $n = 33$ ) were conducted in July and August 2022 with young adults who either (1) currently used e-cigarettes, (2) formerly used e-cigarettes, or (3) initiated nicotine use with e-cigarettes but subsequently smoked cigarettes (dual use). Two research team members independently coded the transcripts and identified themes. A third researcher independently reviewed the coding and thematic analysis. Participants believed that mobile-based interventions should include peer support, ways to track cessation progress, education about the harms of e-cigarettes, gamification, and incentivization. They also believed that to prevent future cigarette smoking, interventions need to include education about the harms of smoking, teach refusal skills for offers to smoke, and incorporate personal anecdotes from former smokers. To increase their readiness, motivation, and self-efficacy to quit, participants who continue to use e-cigarettes reported needing effective substitutions to replace e-cigarettes, barriers to hinder their access to e-cigarettes, and social support. Findings from this study may be useful to incorporate when developing interventions designed to reduce e-cigarette use and risk of progression to smoking for young adults.

## 1. Introduction

Rates of e-cigarette use (or “vaping”) are highest among individuals ages 18 to 24, representing 2.8 million young adults who use e-cigarettes (Mirbolouk et al., 2018; Vallone et al., 2020). Although e-cigarettes may be used to reduce or quit combustible cigarette smoking (Etter and Eissenberg, 2015; Hajek et al., 2014), such benefits are less applicable to young adults who typically do not use e-cigarettes to quit cigarettes. Rather, e-cigarettes are often young adults’ first introduction to nicotine (Jensen et al., 2019), and there is evidence that young adults who use e-cigarettes are at risk for progressing to combustible cigarettes (Dunbar

et al., 2019; Primack et al., 2018). Young adults are also more vulnerable to the potential health effects of vaping than older adults, including to structural and functional effects on the brain from nicotine exposure (Kamat and Van Dyke, 2017) and cardiovascular and respiratory harm (Gotts et al., 2019; Qasim et al., 2017). Thus, efforts that address both high rates of e-cigarette use and subsequent smoking risk in young adults are essential.

Despite high rates of use among young adults, many who use e-cigarettes want to stop using. A recent study reported that among a sample of young adults who currently use e-cigarettes, over half (54.2%) expressed a desire to quit (Cuccia et al., 2021). Another study reported

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<https://doi.org/10.1016/j.pmedr.2023.102332>

Received 2 March 2023; Received in revised form 13 July 2023; Accepted 17 July 2023

Available online 19 July 2023

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the most common reason to quit was the negative impact of e-cigarettes on health and well-being (Cuccia et al., 2021). While prevention programs geared at preventing young people from using e-cigarettes exist (Liu et al., 2020; Liu et al., 2022), evidence-based e-cigarette cessation interventions designed to prevent the transition to cigarette smoking among young adults who have already started vaping do not.

To address the needs of young adults who use e-cigarettes, it is first important to review the existing e-cigarette cessation intervention literature to identify which efficacious components are found in current interventions designed for other groups, such as adolescents, who are also known to use e-cigarettes at high rates (Office of the U.S. Surgeon, 2016). It is also important to consider the intervention literature that addresses the use of other substances (e.g., alcohol or combustible cigarettes) which could serve as a foundational base for efforts to reduce young adult vaping.

Second, it is important to identify what components young adults who use e-cigarettes would like to see in e-cigarette cessation interventions. Such information would be useful in developing interventions from the bottom up, where preferences for treatment can be factored in when building programs off established evidence-based practices. Efforts to gather qualitative data to inform the development of school-based e-cigarette cessation interventions have been effectively completed with middle and high school adolescents who use e-cigarettes (Bold et al., 2022; Kong et al., 2021); however, such efforts have yet to be completed with young adults.

Third, young adults are more likely than older adults to attempt tobacco cessation (Curry et al., 2007) but are less likely to seek tobacco cessation services (Solberg et al., 2007); thus, having a brief intervention available to them that is both easy to use and engaging is essential. Given that young adults often do not seek treatment for tobacco cessation, there are efforts toward developing online or mobile interventions that are brief and accessible for combustible cigarette smoking (Villanti et al., 2020). Internet-based interventions may eliminate key barriers to seeking care, as they are often cost effective, can be accessed conveniently (e.g., at home), are available at any time, offer more anonymity than in-person or phone-based counseling, eliminate transportation barriers to treatment, and have the potential to reach young adults who might otherwise not seek treatment because of perceived stigma (Taylor et al., 2017). With 96% of young adults owning smartphone devices (Pew Research Center, 2021), mobile health (mHealth) interventions, which are programs implemented online and accessible on phones, may be ideal for engaging a large, diverse group of young adults in e-cigarette cessation programs.

Though there is much promise for mHealth approaches with young adults, most of the work examining the efficacy of mHealth e-cigarette interventions have been conducted with programs designed specifically for adolescents (Liu et al., 2020). Still, one study reported on the efficacy of a text messaging-based program for young adults (Graham et al., 2021); however, the program did not address risk for future cigarette smoking, nor did it incorporate feedback from the young adults who trialed the program. Although it is important to include evidence-based components in intervention development, including consumer involvement through a collaborative process may be equally as important for reach and uptake by intended audiences (Nilsen et al., 2006).

To address current gaps and to inform the development of a mobile-based intervention that targets both e-cigarette use and risk for future smoking progression among young adults, we conducted focus groups with young adults who either (1) currently use e-cigarettes, (2) formerly used e-cigarettes, or (3) initiated nicotine use with e-cigarettes but now also simultaneously smoke combustible cigarettes (henceforth referred to as dual use). We specifically focused on features pertinent to cessation intervention development, such as factors that may increase readiness, motivation, and self-efficacy for quitting e-cigarettes (Lindson-Hawley et al., 2015); preferred components to be included in an intervention that would aid in initiating a cessation attempt and remaining abstinent; and preferred intervention components that may help prevent

progression to dual use tailored for young adults.

## 2. Methods

### 2.1. Participants

A total of 40 young adults were recruited by responding to online advertisements on social media sites (Facebook, Instagram, Reddit) and completing our online survey. Those who completed the survey were 67.5% female sex, 42.5% white, 22.5% Hispanic, 17.5% Black, 32.5% Asian, 2.5% American Indian or Alaska Native, and 7.5% other race, with a mean age of 21.98 ( $SD = 1.49$ ). Participants were recruited nationally with 27.5% from the Pacific Coast, 7.5% from the Southwest, 2.5% from the Rocky Mountains, 12.5% from the Midwest, 15.0% from the Southeast, 25.0% from the Mid-Atlantic, and 10.0% from the New England regions. We also recruited both college attending (52.5% attending full-time, 7.5% attending part-time) and non-college attending young adults (40.0%). Of them, 33 participated in one of nine focus groups, which were conducted in July and August 2022. Each focus group consisted of 3 or 4 participants. Four groups consisted of current users (i.e., indicated use in the past 30-days and have never used combustible tobacco;  $n = 14$ ), two groups consisted of dual users ( $n = 8$ ), and three groups consisted of former users (i.e., indicating no use in at least the past 30-days;  $n = 11$ ). Among current and dual users, participants reported using e-cigarettes on an average of 15.5 days ( $SD = 10.26$ ) in the past 30-days. Participants reported initiating e-cigarette use at a mean age of 17.13 ( $SD = 1.91$ ; range 13–21). See Table 1 for additional demographic information for our entire sample ( $N = 40$ ).

### 2.2. Procedures

After seeing online advertisements, interested participants completed a screening survey to assess for eligibility to participate. Prospective participants had to be between the ages of 18 to 24 and report current (use within the past 30-days) or former e-cigarette use (lifetime use, but no use within the past 30-days). Those who met eligibility criteria through the screening survey were contacted by email and/or phone by a research team member to review the accuracy of their responses to ensure that those who truly met eligibility criteria were enrolled and review study procedures and limits of confidentiality.

Individuals who agreed to participate were emailed the consent form to e-sign along with a 15-minute survey via Qualtrics in which they also indicated their availability to participate in the focus group. Survey questions assessed e-cigarette use and a free response option asking participants about their preferences for a mobile-based e-cigarette use

**Table 1**  
Sample characteristics.

	All Participants N = 40	
	N/Mean	%/SD
<b>Age</b>	21.98	1.49
<b>Race/ethnicity</b>		
American Indian/Alaska Native	1	2.5%
Asian	13	32.5%
Black	7	17.5%
Hispanic	9	22.5%
White	17	42.5%
Other race	3	7.5%
<b>Gender</b>		
Man	13	32.5%
Woman	26	65.0%
Gender-neutral	1	2.5%
<b>E-cigarette Use Status</b>		
Current Use	14	35.0%
Former Use	15	37.5%
Dual Use	11	27.5%

intervention. Participants who indicated dual use also reported their preferences for an e-cigarette use intervention that specifically targeted prevention of smoking initiation as well. The purpose of these two free response items were to allow participants to preview topics of discussion and generate possible responses prior to initiating focus groups. Participants were sent a \$25 electronic gift card for completing the survey.

For the final portion of the study, nine one-hour focus groups were conducted via a secure online platform (Zoom). Of the 40 participants who were recruited and completed the online survey, 1 indicated no longer being interested in participating while 6 did not attend their scheduled focus group for unknown reasons. Thus, we had a total of 33 young adults who completed focus group discussions. See Table 2 for a list of predetermined questions that were asked during focus groups.

Focus groups were led by two facilitators, audio recorded, and conducted until researchers reached saturation of concepts discussed. Participants were informed that many of the focus group questions would be like the ones they responded to in the online surveys, and they will be given the opportunity to provide more context and details to their responses. Focus group questions were semi-structured and again asked participants to share their thoughts about what intervention components would be most helpful for e-cigarette cessation, relapse prevention, and preventing the transition to cigarette smoking for young adults. Each participant was provided with an opportunity to respond to these prompts. Audio recordings were transcribed by an independent transcription service and were then cross-checked for accuracy by research team members. After participating in focus groups, participants were compensated with a \$50 electronic gift card. All procedures met guidelines for protection of human subjects and were approved by the university’s internal review board.

2.3. Data analysis

Qualitative analyses were conducted using NVIVO 20, a qualitative data analysis software that allows team coding (NVivo, 2020). The coding team independently coded one focus group using a codebook created based on the interview protocol and subsequently met to discuss any discrepancies. Once themes were agreed upon by all coders, the remaining half of the focus groups were coded by one coder while the other half were coded by a second coder. A third researcher independently reviewed the coding and thematic analysis process. This process, referred to as the triangulation of researchers, minimizes bias in qualitative data analysis (Miles et al., 2014).

Table 2  
Focus group script.

For current and dual users only	What are some things that would help you feel more ready to quit vaping? What are some things that would help you feel more motivated to quit vaping? What are some things that would help you feel more confident to quit vaping?
For all participants	Imagine there was a free, brief, and anonymous program to help young people your age quit vaping. This program could be accessed at any time through a mobile device, like a phone, iPad, or laptop – similar to an app or website. What do you believe the program must include that would actually help young people your age quit vaping? What do you believe the program must include that would actually help young people your age stay quit once they’ve been able to successfully quit vaping? What do you believe the program must include that would motivate young people your age to actually use it?
For dual users only	What do you believe the program must include that would help prevent young people your age from starting smoking cigarettes?
For all participants	Before we wrap things up, is there anything else you would like to share regarding your experiences with vaping or quitting vaping?

3. Results

3.1. Factors to increase readiness, motivation, and self-efficacy for quitting e-cigarettes

Young adults who currently use and dual use e-cigarettes discussed factors that they believe would increase their readiness, motivation, and self-efficacy to quit e-cigarettes (see Table 3). The most reported factor, which was discussed among participants with current use, was obtaining knowledge about effective behavioral substitutions that they could engage in to replace their use of e-cigarettes. For example, participants reported needing information to help them replace “the habit (vaping) with a good habit” and wondering whether oral substitutions (e.g., chewing gum) or having other forms of distractions may be helpful. Participants from both the current use and dual use groups also reported the need for increased barriers to using e-cigarettes. Participants shared that despite having age restrictions for the sale of tobacco products to individuals under the age of 21, underage participants have encountered few (if any) difficulties with purchasing e-cigarette products (e.g., have not had to verify their age during purchase). Given their reported experiences with having easy and frequent access to e-cigarettes, participants reported that having stricter barriers in place that would limit their ability to purchase e-cigarettes (e.g., having e-cigarettes unavailable at frequented gas stations), may be helpful in increasing their motivation and readiness to quit. Dual use participants also reported needing more social support from their friends, such as agreeing to quit e-cigarettes together and no longer offering each other e-cigarettes.

3.2. mHealth e-cigarette cessation intervention preferences

Intervention preferences to help with quitting and staying quit.

All participants discussed their preferences for an e-cigarette use intervention (see Table 4). The most reported preferences, which were discussed by all three groups of participants, were a desire to receive peer support (e.g., through online discussion boards to seek advice for managing withdrawals) and for the intervention to include progress tracking (e.g., a way to keep track of how long the individual has been vape-free; a way to calculate the amount of money being saved from quitting e-cigarettes). Other commonly endorsed preferences were education about the harms of e-cigarettes, gamification (e.g., having a

Table 3  
Factors to increase readiness, motivation, and self-efficacy to quit e-cigarettes.

Theme	Example Quotations
Finding behavioral substitutions	“I really use it as a social crutch, especially when I go out. It’s like something in my hand, something to do, especially if I don’t wanna spend money on a drink. So...I would have to find something like maybe ordering a glass of water or like a soda instead to have something [else] in my hand.”
Increased barriers to using e-cigarettes	“I think the first thing that comes to mind is more barriers. Having the age barrier is really nothing because I can find somebody else to get it for me. The cost barrier, people usually offer it so I don’t always have to buy my own. So if there was a way to make it more difficult for me to get access to it, then I would eventually say, oh, that’s too much work. I’m not gonna do it.”
Quitting other substances simultaneously	“I think I would have to stop using all other substances in general.”
Social support	“I would say a strong support group because a lot of my friends do smoke. Whenever I tried to quit, I would always get lured back into it because they’d offer me a hit as well. So I figured if we all tried to quit [vaping] together, that would help me.”

**Table 4**  
Intervention preferences to help with quitting e-cigarettes and staying quit.

Theme	Example Quotations
Peer support	“I think [it] would be really cool to give anonymous support to your peers who are also going through the program or just some kind of encouragement. You could post on a board under an anonymous name and be like, oh, well I just hit X amount of days or whatever and get like feedback and support. Just to know that you’re going through [it] with them [would] be really neat.”
Progress tracking	“I think having reminders of milestones or something could be helpful, like you’ve been one week clean or you haven’t bought a vape this week. Just seeing how much time has passed in being able to do it like day by day.”  “Another thing that might be helpful would maybe if the app included some type of short-term, long-term goal tracking. So you can set up, like when I get to the 30-day mark, I’m going to take myself out to this favorite restaurant and treat myself to a nice dinner or something. Then maybe you could set up if I get to like the year mark, then this will be what I will do. So you kind of have something to look forward to, constant encouragement.”
Education	“It’s very hard for people our age, like young people, to see past what’s going on right now and into the future because I think everyone knows vaping and smoking cigs is definitely gonna hurt me when I’m like 60, 70, but I don’t think anybody’s really thinking about how it’s impacting us right now. It’s like, oh, we’re young, we’re healthy. Like nothing can hurt us. So I think like really emphasizing this isn’t just something that’s gonna hurt you in the future. These are the impacts that you’re undergoing now because you do this. I think that would be something useful just within like this demographic in particular.”
Gamification	“I think adding some little milestone achievements would be cool. Just cute little badge[s] or something simple. Just to give you some dopamine for reaching at like 30 days [vape free], however long it may be. I feel like that’s something simple and easy that could just subconsciously help people want to continue on what they’re quitting.”
Incentivization	“I think another thing that might be helpful would maybe if the app included some type of short-term, long-term goal tracking. So when I get to the 30 day mark, I’m going to take myself out to this favorite restaurant and treat myself to a nice dinner. Then if I get to the year mark, then this will be what I will do. So you kind of have something to look forward to kind of like constant encouragement.”
Alternative behaviors	“I’m wondering if there could be targeted resources or like informational pamphlets or something for specifically the 18 to 24 age range. Just to talk about alternatives to what you can do in these social settings, aside from vaping to be friends with people rather than kind of feeling this pressure to do what others are doing. Like what are some alternatives to fitting in or socializing with other people.”
Accountability	“I think...you definitely need someone to hold you accountable. Not just for your slipups, but also for the things that you’re doing. So if I had someone who was like: Hey, you haven’t bought a vape this week. Hey, you haven’t even been craving anything. You know, just someone hold me accountable, in both a positive and negative aspect. I think would be really nice and necessary for a young teen [or]

**Table 4 (continued)**

Theme	Example Quotations
Reminders of reasons for quitting	for a young adult in general, because a lot of times, people my age are not accountable for their decisions.” “Just a reminder of why you’re quitting [vaping]. Like, why did you decide [to quit]? Is it for your health? Is it for money to save money? Is it because someone’s helping you?”
Frequent check-ins	“I think it would be helpful for the app or [intervention] to have daily reminders and daily check-ins...Somebody that works on the app development team to actually check-in with you, whether that be a bot or real person, and ask about your temptations or if you were able to not vape that day. I think that would be a cool feature.”
Identifying triggers of e-cigarette use	“If there’s a journal while you’re in the process of quitting, that’s like, I vaped today because [of] X, Y, Z. Because I was anxious, because my stomach hurt, because whatever it is. And [then] you can come up with your own solutions because it is so personal. So next time I feel like I want to vape because I’m anxious I’m going to do whatever. Because I feel like sometimes, when you’re that stressed in the moment, it’s hard to think clearly and having it written out for yourself ahead of time and having those reminders from yourself so that they are completely personal...I think could be really useful.”
Professional support	“If the app [or intervention] was somehow [linked] to a trained counselor who worked with nicotine addicts or at least give you resources to [find one].
Access to NRT or other quitting resources	“One thing that I’ve always found annoying is how alternative nicotine delivery products tend to be very pricey. Stuff like nicotine gum or nicotine patches. If there was a way where they could help you find access to lower cost alternatives, whether that be through your insurance or through nonprofit organizations or some other means where you can get access to alternative delivery methods without spending \$40 on a box of gum or \$60 for nicotine patches.”
Resources for significant others to provide support for quitting	“One thing I was gonna add is potentially a resource for how to ask people that you’re close to for help or how to get them involved. Because I know for me, I kept it a secret from my family through the whole, like they still don’t know. Um, and so I think it would’ve been helpful for me to have their support.”
Refusal skills in response to offers to use e-cigarettes	“There’s a theme of social pressure[s to vape]. So maybe [providing] some techniques on how to deal with that because that’s like one of the biggest reasons. Everyone around me is like maybe I should [vape]. So [offering] techniques [for] to how to divert from that and learning how to say no.”
Personalization	“I think being able to add some sense of personalization would be good...Obviously it’s a very hard habit to quit, but not everyone is going to respond to how to quit that habit the same. I personally need lots of tough love and someone to just be real with me, even if it’s not positive. But other people may not be like that and want more care and softer support. So being able to tell the app or the program what style of help works best for you would be good.”

Note. NRT = Nicotine replacement therapy.

virtual plant grow or earning a badge for reaching milestones during cessation attempt), and incentivization, such as an incentive program that included earning gift cards for reaching milestones during cessation attempts (e.g., \$5 gift card to a vendor of their choice for being 30 days

vape-free). These themes were endorsed by all three groups.

All three groups also discussed the need for a list of alternative behaviors to replace using e-cigarettes. Participants who were currently using or formerly used discussed providing accountability to the individual making the quit attempt and offering frequent (e.g., daily) check-ins about progress with cessation. Those who engaged in current or dual use discussed presenting reminders of reasons for quitting. Current and dual use participants reported that gathering their reasons for quitting e-cigarettes at the start of the program and then presenting this information during their cessation attempts may be useful in sustaining their motivation to continue remaining vape-free, particularly during challenging moments (e.g., during cravings or in the presence of stressors). Current and former use participants also reported that frequent check-ins about their progress with cessation, such as through in-app notifications, may help those engaged in the intervention to stay on track with quitting.

Current and former use participants also reported wanting help with identifying triggers for e-cigarette use, access to nicotine replacement therapy or other forms of support for quitting, and assistance with obtaining refusal skills for offers to use e-cigarettes. Unique to just the dual use group, participants wanted the ability to personalize the intervention based on the individual's needs. In just the current and dual use groups, participants indicated the desire for professional support (i.e., ability to call or text with a counselor). Finally, unique to just the former use groups, participants spoke about resources for significant others to provide support for the individual quitting.

**Intervention preferences to help prevent progression to smoking.** Participants who reported dual use discussed what they believe the intervention should include that may help prevent dual use (see Table 5). The most frequently endorsed theme was the need for education about smoking-related harms, including health effects that smokers can experience in the short-term (e.g., decreased physical endurance, shortness of breath) rather than solely focusing on longer-term health effects (e.g., cancer, mortality). Participants shared that focusing on the harmful effects of smoking that young adults can experience now or in the near future may be more relatable to this age group and that providing this education early on (e.g., in school settings) is preferred. Other themes discussed included the need to teach refusal skills for offers to smoke and showcasing testimonials from actual smokers who have quit or are in the process of quitting. Although the need for more education about the immediate and short-term harms of smoking was

**Table 5**  
Intervention preferences to help prevent progression to smoking (dual users only).

Theme	Example Quotations
Education about smoking-related harms	"I think exposure to firsthand sources and proof and firsthand accounts of the lifelong problems that people have [from smoking] especially showing accounts of it happening to people our age. A lot of people just assume that, oh, I'll get lung cancer one day from this, but you can have many other complications besides just cancer at a very young age from smoking cigarettes. I feel like that fact is not as well ingrained in our head as it should be."
Refusal skills in response to offers to smoke	"I was in the DARE program... and I knew the concept of peer pressure. I knew that I shouldn't let it get to me, but when I actually get in the moment in a situation, it goes out the window. So in my opinion, I don't really feel like it [was] effective."
Testimony of real smokers who quit	"Videos or just content from actual people that actually was quit or working towards quitting. I see a lot of anti-smoking commercials, and they're always actors that are paid. So it would be cool to actually see someone actually doing it instead of just being an actor."

reported by several participants, one participant, who recently lost a grandparent due to cigarette smoking, reported that providing anecdotes from family members or friends who have lost a loved one due to smoking-related health problems may also dissuade young adults from considering smoking. They shared that simply listing or describing long-term harms of smoking is not enough and that hearing from individuals with lived consequences of smoking may be more convincing.

#### 4. Discussion

Our study provides unique insight into the types of intervention components young adults want included in a mobile-based e-cigarette cessation intervention that also targets prevention of cigarette smoking. Given that young adults who use e-cigarettes are at risk for future cigarette smoking initiation and progression to daily smoking (Dunbar et al., 2019; Primack et al., 2018), research that informs the development of these interventions is timely. We expanded upon previous work with adolescents (Bold et al., 2022; Kong et al., 2021) by conducting surveys and focus groups with young adults, including those who dual use e-cigarettes and cigarettes. Little is known about the personal experiences of youth who initiate nicotine use with e-cigarettes but have since progressed to dual use, which is a growing and critical public health concern (Soneji et al., 2017). This study is among the few, or perhaps the first, to provide a closer look into factors that contributed to this progression to dual use in young adults. Although previous work also gathered qualitative data from former users (Bold et al., 2022), these users were mostly experimenters of e-cigarettes, while we were able to gather important insights from former heavy e-cigarette users. We also expanded on previous work by gathering information on factors that may facilitate cessation attempts.

Young adults reported that e-cigarette cessation interventions need to connect participants to peers who have already quit or are in the process of quitting for support. Although we found no reported evidence about whether peer support interventions for e-cigarette cessation are effective, a review described some evidence for the efficacy of peer support in smoking cessation for disadvantaged groups (Ford et al., 2013) with a more updated review underway (Seo et al., 2021). Further assessment is needed before conclusions can be made about whether including peer support in e-cigarette cessation interventions improves outcomes. Participants also wanted support from friends and family. Specifically, some have voiced the need for being held accountable during quit attempts from their support networks. Knowledge around the role of accountability as a mechanism in nicotine cessation is limited (Kenny et al., 2021). The Supportive Accountability model illustrates the role of accountability from supportive individuals in adherence to behavioral interventions (Mohr et al., 2011). Further exploration of supportive accountability in both e-cigarette and smoking cessation is warranted. Others called for resources that teach support persons ways to best help someone who is quitting e-cigarettes. Indeed, programs that train support persons to help loved ones during cigarette smoking cessation attempts have shown to be feasible and acceptable (Patten et al., 2012; Patten et al., 2004; Patten et al., 2011). Such efforts are not yet known to exist for those wanting to quit vaping; thus, future research on how to best train support persons for vaping cessation attempts is encouraged.

Participants also preferred the ability to document and monitor their progress. Both nicotine dependence treatment providers and smokers have also indicated the importance of allowing users to track their progress during cessation attempts (McClure et al., 2016), with some mobile-based smoking cessation interventions including progress tracking capabilities showing promise (Bindoff et al., 2016; Crane et al., 2018).

Participants also believed that offering incentives and gamification are essential for encouraging young adults to engage in e-cigarette cessation interventions. Although no studies have been identified that examine the effects of incentives and gamification in e-cigarette

cessation interventions, a *meta-analysis* on the use of incentives for cigarette smoking cessation reported strong evidence supporting the use of incentives for improving long-term smoking cessation outcomes based on mixed population studies (Notley et al., 2019). Fewer reports have been identified outlining the effects of gamification on smoking cessation outcomes; however, there is early evidence to suggest that gamification delivered through technology-based interventions may be a low-cost method for increasing self-efficacy and motivation to quit smoking (Rajani et al., 2021) as well as engagement in smoking cessation intervention (El-Hilly et al., 2016).

Participants also reported either being unaware of or underestimating the health consequences of e-cigarettes and did not become aware of them until they started experiencing negative effects from their own use. This is consistent with several other reports that young individuals tend to underestimate the harms of e-cigarettes (Cooper et al., 2016; Cooper et al., 2017). Discussions about the need for interventions to include education about the harms of e-cigarettes were had across current, former, and dual users, which is consistent with qualitative work among adolescent e-cigarette users (Bold et al., 2022).

We also gathered important insights from young adults who dual use and reported their feedback regarding approaches that may help prevent other young individuals from smoking. Dual users spoke about the need for preventive education about the harms of smoking cigarettes as an integral intervention component for the prevention of smoking initiation. One unique perspective from these focus groups was participants' desire for early education about the immediate and short-term harms of smoking albeit past efforts toward harms education has primarily focused on describing the long-term effects of smoking, such as mortality and morbidity (National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health, 2014; Omare et al., 2022). Our findings indicate that these efforts may not completely resonate with the majority of young people. Rather, focusing on providing information about the immediate and short-term effects may prove more fruitful for this particular age group.

Participants who dual use also wanted the intervention to foster refusal skills in response to offers to smoke cigarettes. Much work on the importance of refusal skills and refusal self-efficacy to smoke has been conducted among adolescents, indicating that prevention and intervention programming that addresses resisting social pressures to smoke can indeed increase refusal skills (Hiemstra et al., 2011; Katz et al., 1989). Participants also called for the inclusion of personal anecdotes from former smokers, which is in line with previous qualitative work with adolescents (Bold et al., 2022), as participants felt the need to hear firsthand from others with similar experiences and struggles. Participants felt that traditional education in which they were simply told about the long-term effects of smoking were not enough and did not resonate with them. They declared that, in addition to emphasizing the shorter-term effects of smoking, including testimonials from those affected by the negative consequences of smoking, either by personally experiencing these harms themselves or by losing a loved one from smoking, would make the education component of smoking prevention programs more relatable and compelling.

Although not a primary focus of our study, several young adults noted that age restrictions for the sales of e-cigarettes did not hinder them from having access to e-cigarette products, emphasizing that easy access to e-cigarettes often served as a hindrance to their quitting. Numerous policies at the federal, state, and local level have been implemented in reaction to the rising number of young individuals who use e-cigarettes, but few have been formally evaluated for their effectiveness in reducing e-cigarette accessibility and use among youth (O'Connell and Kephart, 2022). Focus groups suggest that increased efforts in creating and enforcing policy that would deter youth from obtaining access to e-cigarettes and e-cigarette products are necessary.

## 5. Limitations

There are limitations to this study. For example, we did not include assessment of whether young adults preferred the intervention materials to be presented in a specific format (e.g., via an app or website, videos or text-based). Second, we recruited a primarily female sample, limiting the generalizability of our reports. However, this study also has many strengths. We were able to gather informative insights from an ethnically diverse sample that included both college and non-college attending young adults as well as individuals from all seven U.S. regions. This study also included key personal insights from individuals who formerly used e-cigarettes heavily and were able to successfully quit e-cigarettes. Their personal experiences with successful cessation may ultimately help other young adults who wish to quit. Young adults who initiated their nicotine use via e-cigarettes but now dual use were also included, offering a unique perspective to help others from transitioning, and thus, bridging a wide gap in the literature.

## 6. Conclusions

In this study, young adults with current or prior experiences using e-cigarettes, as well as those who dual use, expressed their preferences for an e-cigarette cessation intervention that also targets future smoking risk. Participants called for the development of interventions that offer peer support (including in an anonymous format), progress tracking, education about the harms of e-cigarette use and smoking, incentives, and gamification. Components that teach refusal skills and testimony from former cigarette smokers may also be crucial for addressing future smoking risk among young adults who use e-cigarettes.

### CRediT authorship contribution statement

**Denise D. Tran:** Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Funding acquisition. **Jordan P. Davis:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Colin Ring:** Investigation, Data curation, Writing – review & editing. **Keegan Buch:** Investigation, Data curation, Writing – review & editing. **Reagan E. Fitzke:** Writing – review & editing. **Eric R. Pedersen:** Conceptualization, Methodology, Writing – review & editing, Supervision.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Data availability

Data will be made available on request.

### Acknowledgements

This research was funded by the University of Southern California Institute for Addiction Science Pilot Grant Program.

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