# User Perceptions of E-Cigarette Cessation Apps: A Content Analysis of App Reviews

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## *Abstract*

**Background:** Vaping rates in Canada are continuing to rise despite high interest in quitting among individuals who currently use electronic cigarettes (e-cigarettes). Existing cessation interventions are not resulting in the outcomes expected and smartphone apps have the potential to address this gap. With rates of smartphone usage continuing to rise globally, demand for health apps is increasing. Apps increase the equity and accessibility of interventions and individuals often prefer this means over traditional behavior change interventions (e.g., face-to-face counseling). Although limited, current evidence highlights that apps can be effective cessation support. A gap remains in understanding the user experience of vaping cessation apps, which is critical to informing their effectiveness for vaping cessation.

**Objective:** The purpose of this study is to explore the user experience of vaping cessation apps through an analysis of app reviews. More specifically, this study aims to identify both the positive and negative experiences of app users, as well as highlight recommendations from app users to improve the quality of these apps.

**Methods:** Vaping cessation apps were identified through searches on the Canadian and American versions of the Apple App Store and Android Google Play Store. Searches revealed a total of 11 vaping cessation apps, which resulted in a total of 310 reviews for analysis. Reviews were analyzed using a deductive content analysis approach.

**Results:** Our analysis resulted in reviews being coded into five primary categories: Content, Functionality, Esthetic, Cost, and Other, which were further divided into three secondary categories and various tertiary categories. Reviews most commonly discussed Content, Functionality and Cost. Comments regarding content tended to be positive, praising various features. In contrast, comments tended to criticize functionality, indicating issues with the functioning of an app. Reviews both praised and criticized cost with comments specifically referring to the payment required to download an app or upgrade an app to the premium version.

**Conclusions:** This study is the first of its kind to evaluate the user experience with vaping cessation apps via an analysis of app reviews. App developers may benefit from reading our novel findings to identify areas to focus on when developing and updating apps. Our study forms a basis for the development of future vaping interventions as well as future studies. Future research should be conducted on vaping cessation interventions with an emphasis on the user experience because there is limited research in this area for comparison.

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## Original Paper

# User Perceptions of E-Cigarette Cessation Apps: A Content Analysis of App Reviews

## Introduction

Vaping rates continue to rise in Canada despite efforts to prevent vaping uptake and support cessation efforts[1]. In 2022, 5.8% of the population reported using an electronic cigarette (e-cigarette) in the past 30 days, up from 4.7% in 2019 [1,2]. Vaping rates among youth and young adults are disproportionately higher compared to the adult population, with 13.6% of youth aged 15-19 and 19.7% of young adults aged 20-24 vaping in the past 30 days compared with 3.9% of Canadians aged 25 and older [1]. Despite these high rates, this population demonstrates great interest in cessation supports, with over 100,000 youth and young adults registering for a text-messaging support intervention ("This is Quitting") a year after it was introduced to the public [3]. Although limited, emerging evidence indicates that smartphone apps are a promising avenue to deliver vaping cessation support [4–9].

The use of smartphones continues to increase globally. According to a recent study, 85% of individuals from 19 economically-advanced countries in Europe, North America and Asia use a smartphone [10]. Among Canadians specifically, this rate is 84% [10]. Unsurprisingly, rates of smartphone usage increase among younger populations with 98% of Canadians aged 18-29 owning a smartphone [10]. There is a wide array of apps that can be installed onto smartphones, including thousands of apps to support various health behaviors, like exercise, diet, drug and alcohol use, and mental health [6]. Demand for mobile health (mHealth) apps is continuously increasing, with app usage spiking since the COVID-19 pandemic [11], and cessation apps are no exception. For instance, English-language smoking cessation apps have been downloaded over 33 million times since 2012 [12]. However, it is important to note that to the authors' knowledge, there is no available data on the number of downloads of vaping cessation apps specifically.

Health apps allow individuals to be active participants in their health and provide them with the resources needed to induce change in their behaviors [6]. Studies show that participants report the use of apps to be an overall positive experience and find them easy to use, with many preferring apps over traditional behavior change interventions [4,6,7]. Indeed, there are a variety of benefits to using apps over traditional interventions including reduced barriers to access, which enables apps to reach a wider audience [8,13–15]. When compared with in-person support interventions, apps are more cost-effective and can be used at one's convenience whenever needed [8,15]. As well, apps can be developed in a manner that enables the user to customize their experience [8]. Nevertheless, even though evidence shows apps have the potential to increase behavior change, many smartphone apps are only used once after being installed [14]. This highlights the importance of understanding what mechanisms and features are contributing to positive or negative experiences, and ultimately contributing to app retention [14].

There are few studies exploring the impact of vaping cessation apps; however, from the studies that do exist, it is known that vaping apps can be viable approaches to quitting [16,17]. A recent

study on a text-messaging intervention, which provided users with quitting strategies, found that abstinence rates of vaping increased by 6% with the use of this intervention [17]. Additionally, a study found that features that address the health effects of vaping and how to cope with withdrawal and difficult social situations, as well as those that provide alternative rewards to vaping and forms of social support, promote cessation [15]. However, there is still extensive research needed to determine how other vaping cessation app features and aspects of app content and functionality impact vaping cessation.

To date, studies have focused on evaluating vaping cessation apps' use of evidence-based guidelines [8,14]. Although valuable to vaping cessation and mHealth research, a gap persists in understanding the user experience. One aspect of apps that is often overlooked in cessation research are user reviews. App user reviews hold valuable information for app developers and other potential app users about user experiences [18,19]. As such, studying reviews is beneficial to better understand the target audience of these apps and what features on the app are contributing to a positive or negative experience [18].This study aims to explore the user experience of cessation apps that address vaping through an analysis of app user reviews. Specifically, this paper identifies the positive and negative experiences of app users, and recommendations from users to improve the quality of these apps.

## Methods

### *Overview*

Similar to other studies involving app reviews [20], the app reviews examined in this study are publicly available in the Apple App Store and Android Google Play Store. No personal information on reviewers was included in this study. As such, this study was classified by the University of British Columbia Okanagan's Behavioral Research Ethics Board as research not involving human subjects and was, therefore, not subject to institutional review board jurisdiction.

### *Data collection*

Searches were conducted on both the Canadian and American versions of the Apple App Store and Android Google Play Store to gather a list of vaping cessation support apps. The following search terms were used: "quit vaping", "vaping", "vaping cessation", "e-cigarette", and "quit e-cigarette". We intentionally used these search terms to reflect the search an individual seeking a cessation app would likely use. Apps needed to be available in English and specifically mention offering vaping cessation support within their description to be included. Exclusion criteria included apps that promoted vaping usage or solely addressed smoking cessation. Seventeen apps supporting vaping cessation were found, of which 11 had user reviews. All vaping cessation apps with user reviews were included in our study, for a total of 11 apps and 310 reviews (see Table 1). We did not download or explore the apps ourselves; all data used in this study came from the reviews posted to the included apps. Some apps were only available to Android or Apple users, or were only found on the Canadian or American store, while others were found in both stores and both countries. Of the 11 apps, 9 apps were specific to vaping cessation while 2 apps offered support for both vaping and smoking cessation. The app search was conducted in 2022. Of the 11 apps included in this study, 10 apps were first released between 2019-2022. It is unclear whether the 2 apps addressing smoking and vaping cessation always provided vaping cessation support, or if the vaping cessation component was added in a later version to what was once a smoking cessation app exclusively.

Table 1. Vaping and smoking cessation apps included in study, year of release, and number of corresponding reviews.

| App name | Year of release | Number of reviews (Android and Apple platforms, Canada and USA) |
|---|---|---|
| Aeris: Quit Smoking & Vaping | 2020 | 86 |
| Brave the Crave | 2019 | 1 |
| Easy Quit Smoking and Vaping | Apple: 2009 Android: 2011 | 99 |
| Escape the Vape | 2022 | 25 |
| No vape - Crush cravings | 2019 | 22 |
| Puff Count | 2019 | 20 |
| Quash - Quit Vaping | 2021 | 3 |
| Quit Vaping | 2020 | 20 |
| Quit Vaping Addiction Calendar | 2020 | 10 |
| Quit Vaping - For good | 2019 | 13 |
| Quuit - Quit Vaping Now | 2020 | 11 |
| **Total:  11** | | **310** |

## *Data analysis*

Two research assistants (RAs), DR and RN, reviewed and analyzed all the reviews. We used deductive content analysis, which is the process of coding data according to an existing categorization matrix, to organize and interpret the reviews [21]. The analysis framework used in this study was inspired by the framework employed by Milward and colleagues [20] in their study exploring alcohol cessation app reviews. We applied the same primary categories to organize the reviews, which included Content, Functionality, and Esthetics, and the same secondary categories, where reviews were further organized according to whether they included praise, criticism, or recommendations for the app. For the purpose of this study, Content refers to app features designed to support vaping cessation, such as time and e-cigarette use trackers, money counters, and online community forums. Functionality describes how the app operates and includes any technical problems that hindered app users' ability to engage with the app. Esthetics relates to the design and visual appearance of the app. Additionally, we adapted the Milward and colleagues [20] analysis framework by combining "general comments" and "other" into one larger "Other" category that included general, non-specific comments and specific comments that could not be categorized under Content, Functionality, or Esthetics.

Using NVivo 14 software, two RAs (DR and RN) independently coded a sample of reviews

using the adapted deductive analysis approach described above. Following this, both RAs met to confirm that this analysis approach was effective for analyzing the reviews. During this meeting, RAs agreed that, when analyzing the reviews, a fourth category emerged from the data relating to cost. An inductive approach was then used to analyze data related to cost. As such, reviews were organized into five primary categories: Content, Functionality, Esthetics, Cost, and Other, each of which was divided into three secondary categories: praise, criticism, and recommendation. After the addition of Cost as a primary category, the Other category became dedicated to comments that could not be classified under Content, Functionality, Esthetics, or Cost. Both RAs then independently analyzed all remaining reviews using this analysis approach. Once RAs had coded all the reviews, they met to discuss any discrepancies. Next, one RA (RN) further subdivided reviews within each secondary category; if two or more of the references voiced the same opinion, they were grouped under a tertiary category. In an effort to make the analysis concise and identify emerging patterns in the data, ideas voiced in only one reference were grouped into an "only mentioned once" tertiary category which can be found under most secondary categories. RN reviewed the organization of the data into tertiary categories with the research team and resolved any discrepancies.

Reviews often included multiple ideas that spoke to different categories, hence only the relevant section of the review was placed under the appropriate primary/secondary/tertiary category, with each unique section of a review making up one reference. As a result, one review often resulted in multiple references. Therefore, the total number of references used in this study is larger than the total number of reviews. References were placed directly under the appropriate secondary category, which is why there are no numbers associated with the primary categories.

## Results

There were 310 reviews relating to 11 vaping cessation apps. As mentioned in the methods section, there are more references than there are reviews since one review could generate multiple references. In the findings section, "n" refers to the number of references associated with each primary/secondary/tertiary category. This section describes the five primary categories: Content, Functionality, Esthetics, Cost, and Other, as well as their subsequent subcategories (see Table 2).

Table 2. Findings chart of primary, secondary, and tertiary categories and reference frequencies.

| Primary Category | Content | | | | | |
|---|---|---|---|---|---|---|
| Secondary category (n) | Praise | 103 | Criticism | 13 | Recommendation | 17 |
| Tertiary category (n) | Hypnosis audio sessions | 29 | Tracker limitations | 7 | Trackers | 6 |
| | Money saved counter | 20 | Content criticism mentioned once | 6 | Social support | 3 |
| | Health information | 15 | | | Widget | 3 |
| | Vape free timer | 15 | | | Content recommendation mentioned once | 6 |
| | Vape use tracker | 14 | | | | |
| | Social support | 13 | | | | |
| | Free quitline | 5 | | | | |
| | Personal advice | 2 | | | | |
| | Triggers diary | 2 | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | *Quit plan* | 2 | | | | |
| | *Games* | 2 | | | | |
| | *Nonspecific* | 13 | | | | |
| | *Content praise mentioned once* | 12 | | | | |
| **Primary category** | **Functionality** | | | | | |
| **Secondary category (n)** | Praise | 5 | Criticism | 58 | Recommendation | 8 |
| ***Tertiary category (n)*** | *Operating as intended* | 3 | *Whole app unusable* | 29 | *Functionality recommendation mentioned once* | 8 |
| | *Technical support* | 2 | *Specific features unusable* | 28 | | |
| | | | *Functionality criticism mentioned once* | 1 | | |
| **Primary category** | **Esthetics** | | | | | |
| **Secondary category (n)** | Praise | 8 | Criticism | 0 | Recommendations | 0 |
| ***Tertiary category (n)*** | *Design* | 4 | | | | |
| | *Layout* | 4 | | | | |
| **Primary category** | **Cost** | | | | | |
| **Secondary category (n)** | Praise | 27 | Criticism | 38 | Recommendations | 1 |
| ***Tertiary category (n)*** | *Satisfied with purchase* | 17 | *Not satisfied with purchase* | 15 | *Cost recommendation mentioned once* | 1 |
| | *Support free of charge* | 7 | *Not satisfied with free version* | 12 | | |
| | *Recommends premium version* | 3 | *Not transparent about cost* | 4 | | |
| | | | *States it costs money* | 4 | | |
| | | | *Cost criticism mentioned once* | 3 | | |
| **Primary category** | **Other** | | | | | |
| **Secondary category (n)** | Praise | 95 | Criticism | 8 | Recommendations | 1 |

# 1. Content

Content is the category with the highest number of references in this study, the majority of which are positive. In total, 103 references praised the content, 13 criticized the content, and 17 contained recommendations relating to content.

## 1.1 Praise

Of the 103 references praising app content and features, many comments simply stated that they "liked" the feature or found it "helpful" without specifying how. These were placed in the *non-specific* tertiary subcategory (n = 13). Overall, there were 11 different features that were mentioned and praised in more than one review, each making up a tertiary category. Here, we provide an overview of the most frequently praised features.

*Hypnosis audio sessions* (n = 29) were associated with the highest number of references. However, this feature was only available in two apps, Quuit – Quit Vaping Now and Easy Quit Smoking & Vaping, which are centered around using hypnosis to quit vaping. The reviews were long

and positive, usually mentioning being doubtful at first of the credibility of hypnosis as a cessation tool. However, multiple reviewers reported a noticeable change within the first few days. For example, one review stated: "I was not even that determined to quit!!! Listened to it once only and although the cravings were there they felt very distant. Feels very easy.".

Trackers or counters were found in most vaping cessation apps and were frequently praised in reviews. The *money saved counter* (n = 20) helped app users realize the financial impact of vaping. For example, one reference stated, "I never realized how much money I spent on pods until this app laid it all out for me. I'm living paycheck to paycheck not realizing that by cutting out vaping I'd save so much money!".

The *vape free timer* (n = 15) offered users motivation and encouragement to stay vape free. One reference described how the user would experience "a dopamine spike better than what nicotine can offer" upon seeing how many days they had been vape free and how much money they had saved since quitting. An additional two references compared the experience of using trackers on the app to playing a game, explaining how "it almost gives you the feeling of a game's high score that you're trying to beat yourself". In comparison to the *vape free timer*, reviews revealed that the *vape use tracker* (n = 14) can help those who still actively vape, regardless of their intention to quit, to track their consumption and get a clearer picture of their vaping habits: "Puff Count brought to my attention how much I was vaping, which ultimately helped me decrease the amount I was vaping".

## *1.2 Criticism*

The number of negative comments criticizing the content was drastically lower than the number of references praising the content. In total, 13 references criticized the content. Criticism mostly reflected what was lacking from the app, such as it "doesn't give you motivational updates", or obvious oversights, such as the news section being "stuck in 2019". The only tertiary category that emerged was *tracker limitations* (n = 7). Reviewers highlighted limitations on what they could track (i.e. not being customizable to JUUL), how they could track (i.e. no ability to delete false entries), and how the information collected is presented (i.e. not being able to see information from the day before).

## *1.3 Recommendations*

There were 17 references that featured recommendations relating to the content and features of the app. Similar to Content criticism, the tertiary category with the highest number of references related to improving the user's experience with *trackers* (n = 6). Reviewers wished they could track their vape use in more detail (i.e. the nicotine level of each puff), wished for more flexibility (i.e. being able to delete and re-enter false entries), and specified different ways they would like the collected data to be presented (i.e. "a metrics chart where you can look at the week or the month to see a top line view of your progress"). Reviewers also wanted a *widget* (n = 3) which would enable them to see the tracker data without having to open the app, while others suggested different ways *social support* (n = 3) on the app could be improved.

## *2. Functionality*

Many reviewers commented on the functionality of the app, specifically whether the app operated as intended or not. Additionally, some users described their experiences accessing technical support when needed. There were 5 references praising the functionality, 58 criticizing the functionality, and 8 references describing recommendations. Reviewers left short, general comments in the praise section and described in more detail the technical issues they encountered in the criticism section.

## 2.1 Praise

Five references praised the functionality of the apps. Three references praised the app for *operating as intended* (n = 3); two of them stated that the app was "working smoothly", while another reference explained how the recent updates streamlined downloading. An additional two references spoke positively about the *technical support* (n = 2) available on the app. For example, one reference stated, "if an app isn't acting right, chances are there's a conflict that isn't the [application's] fault. Contact the dev – he's very responsive".

## 2.2 Criticism

Complaints concerning the functionality of the app were featured in 58 references. Users encountered technical issues at various points while using the app, starting from the sign-in/log-in process to issues with specific features on the app such as audio files not downloading or inactive in-app links. Some issues rendered the *whole app unusable* (n = 29) while others rendered a *specific feature unusable* (n = 28). Regarding issues in the *whole app unusable* category, reviewers described glitches that prevented them from gaining further access to the app or utilizing any other feature on the app, for example, "I can't even open it to use it. It just gets stuck on the 'looking for resources to download' screen and nothing ever happens and I can't get any further into the app". In the *specific feature unusable* category, glitching only impacted one feature. Reviewers described a variety of problems such as trackers miscalculating or restarting count, chats being deleted, games not working, in-app links leading to an "Error" page, and more. One reference explained how malfunctions with one feature can render the app useless despite being able to navigate the rest of the app, for example a hypnosis app where the audio sessions do not work.

## 2.3 Recommendations

Eight references provided recommendations relating to the functionality of the app. No patterns emerged and no suggestion was repeated in more than one reference. Some requests were very general, such as requesting more "updates", "bug fixes", and asking the developers to "read [their] error logs". Other suggestions were more specific such as making the Apple version consistent with Android, a "haptic feedback upon pressing "log" so [users are] not left wondering if [they] pressed it while it loads", and more.

## 3. Esthetics

Overall, this category had the fewest references. There were 8 references praising the esthetics of the apps, specifically the *design* (n = 4) and the *layout* (n = 4) of the app. For example, one reference stated "it's beautifully designed". No criticism or recommendations specific to esthetics were made.

## 4. Cost

Cost was a matter of concern for many users of both free apps and apps that required an upfront payment or heavily relied on in-app purchases. It is important to note that not all comments criticizing aspects related to cost were directed towards apps requiring payment; similarly, not all comments praising cost were directed towards free apps. Of these references, 27 praised cost, 38 criticized cost, and 1 reference provided a recommendation.

## 4.1 Praise

There were 27 positive comments relating to cost. Some reviewers were *satisfied with their purchase* (n = 17) and others went ahead and *recommended the premium version* (n = 3) to other users in order to access additional features. Some reviewers believed it was worth the purchase since it freed them from a deadly habit: "After all the money I've spent trying to quit smoking, I can't

believe it only cost me 5 bucks to actually do it!". Other users highlighted how purchasing the premium version was "pretty cheap compared to buying a pack of cigarettes", making it a financially wise decision.

*Content that was free of charge* (n = 7), be it a free app or the free version of an app with in-app purchases, was also praised by many reviewers. Two references suggested that the cost of an app reflected the values of its developers, and thus a free app implied that the developers are "genuine" and aim to help others first before establishing a profitable business. For example, "you can tell they really care about the people they want to help, and they obviously aren't doing it for the money. No ads, no in-app purchases. Just folks wanting to help you get healthier!".

## 4.2 Criticism

There were 38 negative comments relating to cost. Some users who had paid for the app or in-app purchases were *unsatisfied with their purchase* (n = 15). These users expressed increased frustration when there was a technical issue with the app, some of whom demanded to be reimbursed. Others were *unsatisfied with the free version* (n = 12) of an app that included in-app purchases. The free version was often described as "very bare-bones". Some references simply *stated that the app costs money* (n = 4), however, there is a clear undertone of frustration, for example, " Monthly subscription? Come on". Furthermore, three references criticized the *lack of transparency* (n = 3) related to in-app purchases, for example, "I downloaded this because it said all of the content was free […] The first thing it did was ask me to sign up for a paid subscription, or a 7 day trial. Bye". Three references stated that charging a fee for an app intended to help quit an addiction reflected greed: "Greedy […] It's ridiculous they want us to quit then exploit us for money because we're desperate. There are people out there wanting to quit and most young teens (who are the ones who should be quitting) and they don't have the extra money to be able to use this app to try and [quit] nicotine".

## 4.3 Recommendations

There was only one reference that included a recommendation relating to cost. It asked for more transparency when it comes to in-app purchases: "Need to add to the description that this is a subscription-based app".

## 5. Other

Most reviews in this category were vague, not specifying which aspect of the app they were speaking to, while some reviews spoke of a specific aspect in the user's experience that did not fall under Content, Functionality, Esthetics, or Cost. There were 95 reviews that praised the app vaguely without providing much detail as to why it was beneficial. Reviewers often described how the app was "helpful" and "easy to use", sharing success stories of how they successfully cut down their use of e-cigarettes or quit vaping altogether. By contrast, 8 references criticized a specific aspect of the app that did not fit within Content, Functionality, Esthetics, or Cost, such as, "can't connect to google", "takes too long to install", or "not consistent with the corresponding android application". Complaints were random, no patterns emerged, and no complaint was voiced by more than one reference. One reference provided recommendations, suggesting that developers reduce the age limit to allow younger users the ability to access vaping cessation support as well as create a sister app for cannabis cessation.

## Discussion

This study focuses on the experiences of individuals using mobile vaping cessation apps from app reviews on the Apple App Store and Android Google Play Store. To date, there are no studies analyzing user reviews of apps developed to support vaping cessation. Our study addresses an

apparent gap in knowledge on vaping cessation interventions, particularly user evaluations of available vaping cessation apps as mHealth interventions.

## *Principal Results*

Individuals who use vaping cessation apps appear to be either most concerned with or most inclined to comment on aspects of apps that relate to content since the greatest number of reviews in this study referred to content. The majority of the comments regarding content were written in a positive tone with users praising various features available on the app. Comments criticizing content were minimal and included limitations of app features, strategies to improve these features, and features that had not been maintained and were out-dated. Our study findings suggest that developers should ensure app features are flexible, allow users to personalize them, and are updated frequently.

The first noteworthy feature, incorporated into 75% of vaping cessation apps, were trackers [8]. Tracking features in the apps were given particularly positive reviews. Based on reviews, apps contained trackers to evaluate various components of the quitting journey, including monetary benefits, days since last vape puff and vaping consumption in a given time frame for current vapers inquiring about their vaping frequency. Trackers were likely mentioned frequently in reviews because users found this feature exceptionally helpful. Our findings suggest that app users found trackers helpful for their cessation journey as trackers offered motivation to follow through with their goal. Our results align with findings from studies on smoking cessation apps, which found that users appreciate tracking features and find them helpful for monitoring their progress and smoking frequency [18,22]. Studies have also found that users desire additional tracking features, including tracking health improvements from cessation duration, nicotine avoided, and total e-juice avoided based on prior vaping habits [8,18]. This aligns with a review from our study suggesting the inclusion of a tracker for the amount of nicotine users are inhaling per puff. Overall, findings from this study are consistent with previous research suggesting that tracking features are a promising area for app developers to expand on. Specifically, developers should consider other aspects to track to better support vapers' cessation journeys. App users also provided suggestions on ways to further optimize the benefits tracking features can have for app users. For example, users drew attention to the value in the display of tracker data, such as through a monthly metrics chart. Furthermore, users from our study recommended the addition of a phone widget for tracking so they can record their vape puffs without having to open the app. Studies of smoking app reviews have highlighted similar app improvements, such as the importance of a visual display of tracker data [18], and a widget to overcome the barrier of remembering to input when they smoke on an app in real time [18,22].

The second feature that users raved about in reviews were hypnosis soundtracks. Guided-hypnotic sessions aim to put people in a trance allowing them to concentrate on weakening their urges to smoke/vape and increase their willpower to quit [23]. Users were so appreciative of these soundtracks that many thanked the app developer in their reviews. Users emphasized how surprised they were that this technique was so effective for cessation. However, although this feature received solely positive reviews, reviews came from only two apps. As such, it is unknown if this feature is available in other apps and not used, or not included in other apps. It is important to acknowledge that of the two hypnosis apps, one app was specifically vaping focused (Quuit - Quit Vaping Now) while one app was designed to address both vaping and smoking cessation (Easy Quit Smoking & Vaping). The app specific to vaping contained a total of 11 reviews, of which 10 reviews were positive and 3 of these positive reviews specifically praised the hypnosis feature. Given that hypnosis features are available in at least two vaping cessation apps, further research is needed to understand if and how these interventions are supporting vaping cessation. There is a need to explore the uptake and use of hypnosis amongst vapers attempting to quit, as well as to investigate the impact of hypnosis in supporting vaping cessation. Overall, the exploration of hypnosis practices for vaping

cessation may hold promising hope for e-cigarette users as new strategies for cessation are tested.

When commenting on the functionality of an app, reviews were typically critical. Issues noted with app functionality included those which prevented users from using specific features on the app and those which prevented app users from using the app overall. Although reviews identified issues with various features, it is important to note this included both trackers and hypnosis soundtracks. Users commented on tracker issues involving glitching and difficulty inputting data, as well as issues with hypnosis audio soundtracks not playing. Considering both these features were frequently mentioned in reviews as being helpful for quitting, improperly functioning features may impose a barrier to cessation for individuals using these apps. Similarly, concerns with trackers malfunctioning, and apps glitching and crashing were identified in a study of smoking cessation app reviews [18]. Issues concerning technological difficulties have been connected to decreased retention of app users [24,25]. In order to support app retention and prevent attrition, app developers should monitor user reviews for functionality issues and work with end users to address these issues. Our study identified that app users of a hypnosis app showed gratitude towards developers that helped them resolve their issues when they contacted the developer directly. This emphasizes both the importance of app developers working with end users to resolve issues and providing app users with a way to contact the developer for support. Contacting the developer directly may feel more personable and provide app users with more reassurance than relying on reviews to gain the attention of the developer.

A pattern emerged when comparing functionality and content. Comments regarding app functionality were primarily critical while comments about content primarily offered praise. This suggests that app users are inclined to comment on negative functionality experiences when the app is not functioning as expected. In contrast, app users may be less inclined to comment on negative experiences with content because users can ignore features they are uninterested in. This provides impetus for app developers to employ creative features that have not yet been explored when designing vaping cessation apps since, at best, these features will be appreciated and praised by users and at worst, not used and ignored. In line with this, future research can help to identify which features users find most effective and valuable as apps are developed and upgraded to include more innovative features.

The notion of cost, although not included in the original analysis framework designed by Milward and colleagues [20], was commented on so frequently in reviews that it necessitated its own theme. This suggests that the cost of an app, or lack thereof, holds great importance for app users. Cost is one of the main factors contributing to the usage of mHealth apps with barriers to app usage including the cost of the app itself as well as hidden costs apparent only after downloading the app [26,27]. In this study, multiple app users commented on the fact that it seemed contradictory for app developers, who designed an app to help others improve their health through vaping cessation, to be capitalizing on the needs of individuals requiring support for cessation. In this same manner, it was thought that app developers of free vaping cessation apps and those allowing advertisements to be removed for free were more genuine. Further, app users were frustrated when they downloaded a free app only to discover that most features were only accessible with the paid version of the app. Our findings align with a review of qualitative studies on mHealth apps which found that barriers to app usage include costs associated with full access to app features, free versions offering limited features, and having to pay to remove advertisements [28]. This emphasizes the importance for app developers to consider what limitations they may be imposing for users when apps are not free, which may pose a barrier to users' vaping cessation outcomes and subsequently counteract the fundamental purpose of the app. If the functioning of an app is contingent upon a cost, then app developers should consider what cost is appropriate given what the app has to offer. App developers should recognize they are

potentially implementing a barrier when requiring payment for an app or an upgrade to the full version that may limit access to vaping cessation support for some individuals. This emphasizes the importance of being transparent with the cost of an app and which features are available with the free version compared to the premium version.

## Strengths and Implications

This is the first study to analyze the experiences of users of vaping cessation apps via user reviews. However, more research needs to be conducted in this area to expand knowledge of user experiences and corresponding improvements to enhance apps' value and use. For example, future research should focus on how vaping cessation apps shape the individual experience of cessation. This will promote comparison between vaping and smoking cessation app user experiences and help identify what features may cross over well, including previously-noted benefits of smoking cessation apps. Given the lack of research on vaping cessation, up to this point, outcomes of vaping cessation apps can be speculated from the results studies of smoking cessation apps have showcased.

There are remarkably more apps developed for smoking cessation than vaping cessation. The low quantity of vaping cessation apps available on app stores today indicates a gap in current vaping interventions and an optimal area for app developers to pursue. Our novel findings emphasize how valuable these additions could be for individuals seeking vaping cessation. As previously outlined, reviews from vaping cessation apps show many similar findings to reviews from smoking cessation apps. Indeed, although similarities exist between the experiences of smoking cessation and vaping cessation, there are distinct barriers that exist for e-cigarette users. Barriers unique to vaping cessation include the enjoyment of flavors, discreteness of devices and lack of stigma [29]. App developers should take this into consideration when developing apps for vaping cessation as reviews demonstrate that current vaping cessation app features tend to mirror those previously developed for smoking cessation apps. Innovative features developed for vaping specifically may further enhance the benefits vaping cessation apps can have.

## Limitations

There are a few limitations of our study that should be noted. First, we were not able to analyze all apps available for vaping cessation because some apps did not have any reviews. However, it can be assumed that the number of reviews available increases somewhat proportionally to the number of users of the app. This implies that the most pertinent apps were likely analyzed by our study as apps without reviews are likely used by fewer people or are newer additions to the app store. Second, two of the eleven apps included were designed to address both smoking and vaping cessation. For these two apps, it was difficult to differentiate which reviews referred to smoking and which to vaping since some did not specify. Therefore, since all reviews were included, our findings contain some reviews discussing smoking cessation. However, this proved useful to identify possible differences in cessation, including identifying that one of the apps appears to be developed for dual cessation rather than individual smoking or vaping cessation. This suggests that apps can boost their viability by offering the option to select dual cessation. Third, reviews were often short and provided limited context. Given that researchers did not have the opportunity for follow up as they do when conducting interviews, our analysis was confined to our interpretation of the reviews. Our interpretation may have differed from what the app users had intended. However, rigor applied in analysis mitigated this limitation by coding reviews with similar words and phrases into the same categories. Fourth, despite being hopeful that all available app reviews are authentic, we acknowledge that false reviews may be included in our study. Finally, since apps undergo regular updates, criticism provided in reviews may no longer be relevant if that aspect has already been fixed or updated. However, the feedback itself in the review is still important as it highlights what aspects

are considered important, can impede app usage, and should be addressed first by app developers. If this limitation exists, this proves that app developers are responding to user concerns and recommendations.

## *Conclusions*

This study is the first of its kind to examine the user experience with vaping cessation apps via user reviews. We have identified novel findings regarding what aspects app users consider important for a cessation app to contain. Reviews commonly identified aspects of content and functionality as important to creating an effective cessation intervention. Comments regarding content tended to be positive and focus on aspects users appreciated, and recommend ways the apps could be enhanced. In contrast, comments regarding functionality tended to be negative and indicated issues with the functioning of an app. App users also commonly commented on the cost of an app and the payment required to download an app or upgrade an app to the premium version. Understanding the experiences of those using apps may help app developers better target and respond to the needs of those on their cessation journey. Vaping cessation apps and the user experience must continue to be studied so app stores can offer high quality interventions with evidence-based features that effectively support users in their vaping cessation journeys. Our study forms a basis for which future studies can expand on and continue to support the development of interventions in this field.

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### *Competing interests*

All authors declare there are no competing interests.

### *Author contributions*

DR led the study design and drafted the manuscript for publication. DR and RN conducted data analysis. RN contributed to drafting of the manuscript for publication. All authors (DR, RN, MT and LS) contributed to study conceptualization, read and approved the final manuscript. LS oversaw the study.

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## Conflicts of Interest

None declared.

## Abbreviations

e-cigarette: electronic cigarette
mHealth: mobile health

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