

# User pathways of e-cigarette use to support long term tobacco smoking relapse prevention: A qualitative analysis

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## Abstract

**Background and aims:** E-cigarettes are the most popular consumer choice for support with smoking cessation in the UK. However, there are concerns that long-term e-cigarette use may sustain concurrent tobacco smoking or lead to relapse to smoking in ex-smokers. We aimed to explore vaping trajectories, establishing e-cigarette users' perspectives on continued e-cigarette use in relation to smoking relapse or abstinence.

**Design:** Qualitative longitudinal study collecting detailed subjective data at baseline and approximately 12 months later.

**Setting:** United Kingdom.

**Participants:** E-cigarette users (n=37) who self-reported that they had used e-cigarettes to stop smoking at baseline.

**Measurements:** Semi-structured qualitative interviews (face-to-face or telephone) collected self-reported patterns of e-cigarette use. Thematic analysis of transcripts and a mapping approach of individual pathways enabled exploration of self-reported experiences, motives, resources and environmental and social influences on vaping and any concurrent tobacco smoking.

**Findings:** Three broad participant pathways were identified: ‘maintainer’ (e-cigarette use and not smoking), ‘abstainer’ (neither smoking nor using e-cigarettes), and ‘relapser’ (dual-using, or relapsed back to tobacco smoking only). In each pathway, individual experiences with vaping nicotine appeared to play an important role and appeared to be related to psychological and social factors. A social context supportive of vaping was important for the maintainers, as was a belief in the need to overcome nicotine addiction for the abstainers, and dislike of the ‘vaping culture’ expressed by some in the relapser group. Dual-users held beliefs such as a need for cigarettes at time of acute stress that affirmed dependence on tobacco.

**Conclusions:** In a sample of UK e-cigarette users who report having used e-cigarettes to quit smoking, a social context that supports continued vaping was perceived to be helpful in preventing relapse to smoking.

## Introduction

In the UK, vaping nicotine is mainly confined to smokers or ex-smokers (1), and e-cigarettes are the most popular consumer choice to assist quitting tobacco smoking (2). There is support of vaping for smoking cessation by Public Health England (3), and health advisory bodies (1,4–6), and clear regulation permitting use of e-cigarettes by adult smokers (7) but limiting advertising (8) and restricting access for young people and never smokers (9). This is in contrast to other countries, where the regulatory environment has been less clear, and recent policy has taken a stricter prohibitory position (10), with potential consequential outcomes for smoking relapse prevention. Although long-term e-cigarette use as a substitute to tobacco smoking remains controversial due to unknown health harms, there is strong medical consensus that stopping smoking for good is the most efficacious health behaviour change that smokers can make in avoiding future cancer risk (11).

Our previous cross sectional data, from wave 1 of this study, demonstrated in-depth views and experiences of switching from tobacco smoking to e-cigarette use, suggesting that e-cigarette use might be a viable long term substitute for smoking, through meeting physical, psychological, cultural, social and identity related aspects of tobacco addiction that some ex-smokers struggle to overcome (12). This exploratory work also suggested that ‘lapses’ in the context of switching need not result in full blown smoking ‘relapse’ (13). Longitudinal analysis of survey data from other sources has suggested that e-cigarette characteristics and behaviours impact on relapse status (14). In this study we report longitudinal qualitative follow-up data (wave 2) to establish detailed trajectories over time.

Theoretically, our focus is integration of behaviour change maintenance, across psychological and social influences. Kwasnicka et al (15) provide an organising structure, with themes related to behaviour maintenance motives, self-regulation, resources, habits, environmental and social influences; a theoretical approach applied in previous studies of smoking trajectories (16). We foreground a ‘pathways’ narrative approach to understanding behaviour over the lifecourse. This assumes a human drive to maintain congruence in identity self-concept over time, externally observable via behaviour (17).

In this article we sought to understand user patterns of e-cigarette use and long-term smoking abstinence by exploring the research question: ‘what is the continued experience of e-cigarette use over time in the context of either tobacco smoking abstinence or relapse?’ Qualitative longitudinal data can illuminate nuances in individual trajectories though switching to e-cigarette use that might

inform understanding of long-term patterns of behaviour that best support complete tobacco cessation.

## Methodology

**Design:** Qualitative longitudinal study

**Participants:** A purposive sample of 40 UK e-cigarette users were initially recruited by responding to social media adverts for wave 1 data collection, matched by gender and age to a sampling frame of demographic characteristics from a representative sample of UK quitters (see (12)). Following ethical approval (FMH Reference:2017/18 -106), follow-up data were collected approximately 12 months later. 37 participants completed follow-up interviews (response rate 93%). One person declined for personal reasons, and two were not contactable. Semi-structured qualitative interviews were conducted between March and May 2018.

**Procedure:** All participants gave written consent for interviews (face-to-face or telephone). Semi-structured guides took a narrative approach to initially review baseline reports (T1) (a 'pen portrait' of their narrative was discussed), then focusing on self-reported patterns of e-cigarette use over the last 12 months approximately (range 12-19 months, with average follow up time 14 months). Participants described devices used and nicotine e-liquid flavours and strengths, including changes over time. Participants described any experiences of lapse or relapse to tobacco smoking, reflecting on future intentions and identity-related aspects of e-cigarette use (see supplementary information, qualitative topic guide). Interviews were transcribed verbatim and anonymised. Participant codes used for quotations refer to age and gender at baseline (e.g. '24F' for 'female aged 24'). Quotes are verbatim but edited for brevity.

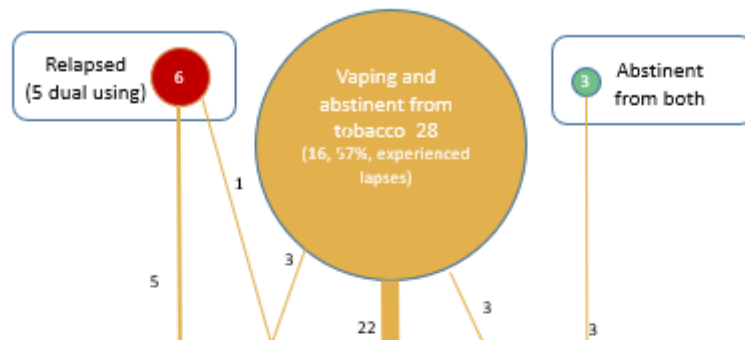
**Analysis:** Transcripts were thematically analysed (18) case-by-case by CN and EW. NVivo 12 software assisted analysis. Analysis was discussed at regular meetings, with anomalies agreed by consensus. Individual case summaries were updated from baseline, and a pathways diagram was plotted to illustrate participant trajectories.

## Results:

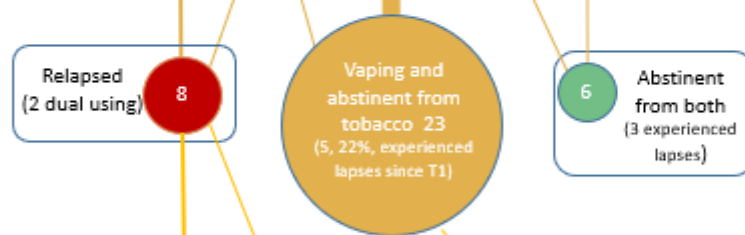
Participants' age at follow up interview ranged from 22 to 71 (mean = 42, SD 14.317). Baseline characteristics are reported elsewhere (12) but also summarised in Table 1, grouped by the three trajectories reported below. At T1, 28 participants were using e-cigarettes and abstinent from tobacco (16 had reported lapses), six participants had relapsed (five 'dual-using' both tobacco and e-cigarettes) and three were no longer either using e-cigarettes or smoking tobacco. At T2 follow-up, patterns of use remained reasonably consistent; 3/28 (9.7%) who were abstinent at T1 had relapsed by T2. Overall 8/37 had relapsed since trying to quit smoking by using e-cigarettes (21.6%). See Figure 1.

**Figure 1 – Long term trajectories of e-cigarette use and reported co-existing tobacco use**

### T1 Vaping/Tobacco Smoking Status



### T2 Vaping/Tobacco Smoking Status



### Future Intentions



We identified three trajectories of long-term e-cigarette use: maintainers, abstainers and relapsers (Table 2).

### Maintainer pathway (Using e-cigarettes and abstinent from tobacco n=23/37)

Most people who were using e-cigarettes and not smoking at T1 maintained that pattern at T2 (22/28, 79%). Reasons for continuation of e-cigarettes, as per T1, included maintenance motives such as replication of smoking, identity congruence, pleasure, and perceived health benefits (see (12)). Facilitative resources, including practicalities (e.g. cost, accessibility), also supported maintained smoking abstinence. Ongoing social connectedness facilitated through e-cigarette use was a key theme.

### *Sliding towards tobacco abstinence*

Only one person using e-cigarettes and not smoking at T2 had been doing something different at T1. This participant had been dual-using both tobacco and e-cigarettes at T1 to reduce smoking, but did not feel motivated to quit. By T2, this person had 'slid' from dual use to exclusive e-cigarette use. He had experienced an increase in motivation, and bought a better device. He had also developed a strategy integrating e-cigarette use into his morning routines to reduce cravings. Over time he had developed an aversion to the taste of tobacco:

*if I had the vape fairly early on, those thoughts about having a cigarette were much easier to manage...the less cigarettes I had, the more sort of disgusting it tasted. (49M)*

### **Future intentions to continue e-cigarettes**

Most maintainers had no intention to quit e-cigarettes at T2. They were comfortable with nicotine dependence, and concerned about vulnerability to smoking relapse:

*the vaping has been quite liberating... I'm reluctant to attempt to give it up because it's [nicotine] part of my psychic[...] I'm scared that if I didn't use it, erm, I would go back to smoking. (62F)*

At T1, four maintainers had been planning to quit e-cigarettes, but had not achieved it by T2. Two participants were now planning to continue e-cigarettes, that they were enjoying:

*I don't actually see an exit strategy because I actually quite enjoy - well I'm not sure if enjoy it, or it's the addiction to the nicotine, but I actually want to continue doing it at this present moment. (30M)*

The maintainers felt invested in a vaper identity and that it was socially acceptable. Nearly all participants in this group described continued e-cigarette use by adopting a harm reduction narrative:

*I feel more reassured to be honest because there's been lots more research been done since then... there is a research paper that came out and stated that it was 95% safer than smoking. (34F)*

### **Changes in e-cigarette patterns over time**

Most participants stated that frequency of e-cigarette use and habits (triggers, routines, locations) had remained largely unchanged since T1. Around half reported no change in nicotine strength e-liquid. Nine participants had reduced their nicotine strength. Most had actively reduced strength to test dependence. These e-cigarette were curious to know if reducing strengths would make a difference to e-cigarette frequency. Most reported no difference in craving:

*I've still not had any cigarettes and I've now switched from 12 milligrams to 6 milligrams, so I'm going down, hoping to go down again. The vaping amount is probably about the same. (46F)*

Only two participants had increased nicotine strength over time, both because they felt uncomfortable with e-cigarette use frequency:

*I was finding I was probably sort of vaping too much on the 3 milligram and I just wanted to get to the point where I would have kind of an occasional vape, you know, once or twice a*

*day max, and when I went onto the six then that was the sort of behavioural pattern, rather than sort of constantly wanting to vape. (39M)*

Most (21) participants from this group did not actively want to quit e-cigarettes. However, many had developed a belief that e-cigarette cessation might occur 'naturally' through gradual reduction:

*I can see it reducing and being maybe less important. (46F)*

### **Lapse and relapse**

For the maintainers, reported prevalence of brief tobacco lapse had reduced at T2 (22%) compared to T1 (57%). Reasons for not lapsing mirrored those reported at T1, including being satisfied by e-cigarette use and disgusted by smoking. Most reported that this was due to a reduction in craving and desire for tobacco (see extended case study 1).

Within this group, two people disclosed a life event occurring since T1 which had had a significant negative impact. One participant had suffered a sudden bereavement, and believed that if it had not been for easy access to his e-cigarette he would have relapsed:

*There was one or two times when I thought God yes, I could really do with that, yeah. There's a lot of complications around everything and erm, actually just being able to reach for a vape was just like brilliant. If I'd given up fully, I don't think I'd still be on the wagon. I think it was the type of thing that would have got me back. (53M)*

## **Abstainer pathway (Abstinent from both n=6)**

Of the six people who reported neither e-cigarette use or smoking at T2: three had maintained abstinence from both over time, and three had moved from e-cigarettes and not smoking to abstinence from both.

### **Cessation of e-cigarettes**

One participant, who had remained abstinent from both between T1 and T2, described quitting e-cigarettes as an unintentional process; *'It's faded away of its own accord'* (62F). At T1, she used her e-cigarette once a month in a specific social situation. At T2, she had only vaped once in several months:

*I absolutely wouldn't get rid of the e-cigarette...I use it a lot lot less though than the sort of once a month occasion. (62F)*

What sets this person apart from others in this group, is that she never intended to quit e-cigarettes, feeling that her addiction to nicotine and smoking was deeply ingrained. The reduction to nominal use had been surprising. The rest of the abstainers had always intended that e-cigarette use would be for smoking cessation, as other methods had not worked for them, eventually aiming to quit nicotine altogether. These participants were motivated to quit because they were uncomfortable with nicotine dependence:

*It wasn't like I was, there were times when I enjoyed it (vaping), when the novelty of it was quite interesting and fun and like, you know, but ultimately it was a substitute. (36M)*

### **Identity change**

One participant discussed lifestyle and image changes since T1, triggering e-cigarette cessation:

*I've kind of changed myself in the way I see myself. I would say I've changed my style as well, like the way I dress has changed. So maybe I've reinvented myself in a way and taken smoking and vaping out of that image (28MT2)*

At T2, in contrast to the maintainer group, the abstainers did not appear to be any more reassured about the health risks of e-cigarettes than they were at T1:

*I'm not really sure how safe they are to be honest. I don't think I'm any more knowledgeable about it than I was last time. (26M)*

Some abstainers no longer felt the urge to smoke. The data were supportive of an identity change:

*It's not like I'm consciously thinking I can't smoke because I'm here. It's just that I don't want to, like I think a lot of it is seeing yourself as a non-smoker and like wanting to make that change (22F)*

### **Brief tobacco lapse**

Despite the abstainers reporting no desire to smoke again, three participants reported a brief tobacco lapse, since T1, after they had quit both e-cigarettes and smoking. One participant had a one-off lapse triggered by stress and one had a purposive lapse. Both these participants found smoking disgusting, reaffirming their quit:

*I was like oh I'll just have a puff but then I'd have a puff of a cigarette and it would totally gross me out, it tasted horrible. I think because I hadn't had it for so long, I wasn't used to it anymore so it just made me feel sick. (22F)*

The other participant had experienced a negative significant life event. He had permissively lapsed a couple of times as a way of dealing with stress. He minimised this lapse by compartmentalising it:

*in September I threw away the cigarettes, I have lapsed a couple of times – it's always when I go and see my (family member) and it's just the feeling that I need something external because I can't really sort of deal with the situation, but it's not like, I wouldn't say I was smoking, I would say I was using, my...dependence on nicotine and cigarettes to deal with a very specific situation (36M)*

By allowing himself these lapses he was reinforcing his belief that he needed smoking in some situations. He felt in control of the lapses for the moment, but did not have the same confidence that the others from this group displayed for long term abstinence.

### **Strategies to avoid lapse and relapse**

Although nearly all the abstainers had achieved abstinence from smoking by using e-cigarettes, most commented that they would not vape again to avoid tobacco lapse or relapse. Instead, they planned to use other strategies:

*It's kind of talking to myself and just say I don't need it, you know and I think I know that if I did smoke, like the taste would just make me sick now...I just keep hold of that feeling and that idea and it helps. (22F)*

There was a sense that for these participants, using e-cigarettes again to avoid smoking relapse might signify failure. In addition, these participants had got rid of their e-cigarette devices:

*Yeah I guess as well like part of the whole thing is once you get rid of the e-cigarette is to go forward. I've spent a lot of money on it so I don't really want to spend more money, or waste money really. I don't need to. (26M)*

Only the participant who had not intended to quit e-cigarettes had kept her device as a backup for preventing lapse. The thought of getting rid of her e-cigarette made her anxious, and even though she hardly used it, she needed to know it was there, just in case:

*There have been times, there has been at least once where I thought I could really do with a cigarette but I've been able to say to myself yeah well the e one's at home, as soon as you get home, you can have it. (62F)*

## **Relapser Pathway (Dual using or smoking only n=8)**

At T1, only one participant had fully relapsed to smoking; she remained smoking only at T2 (but had had a period of abstinence between T1 and T2). Two participants who were dual using at T1 remained dual using at T2. Three people who were vaping only at T1, and two people who were dual using at T1, had fully relapsed to smoking and were not using an e-cigarette at T2. Relapsers were, on average, younger age than abstainers or maintainers (Table 1).

### ***Reasons for relapse***

#### ***Smoking triggers***

In most cases participants experienced more than one smoking trigger simultaneously. Three participants discussed an *intolerance* to e-cigarettes as contributing to their failed quit attempt. The participants had tried various different set-ups to try and resolve the issue, but these had not worked:

*When I finished one of the juice flavoured stuff I got, I went onto a different one and it made me cough and splutter loads and I kind of just fell out with it...*

*R: Okay so you stopped using that and bought tobacco cigarettes instead?  
Yes. (25M)*

Another trigger relating to e-cigarette function was the device breaking. Other than that, the other triggers mentioned were similar to triggers discussed by tobacco quitters using other methods. These included stress, alcohol use, or being in a social context of other smokers:

*I changed jobs...ironically it's full of smokers, so I haven't fared very well from about December to now. I don't smoke as much as I once did but I have not quit and I don't vape*



*very often but I do occasionally. So if anything, I've regressed. I'm surrounded... I've never met so many smokers in one place in my life. It's just that everybody smokes. (36F)*

### **Attitudes towards vaping**

Most triggers described by relapsers had also been faced by the maintainers, but had not resulted in relapse for them. The specific attitudes communicated by the relapsers were qualitatively different compared to those who had continued vaping only:

### **Future intentions: Uncomfortableness with vaping long-term**

Unlike most of the maintainers, at T1, six out of the eight relapsers stated that they eventually wanted to quit vaping following successfully quitting smoking. They were uncomfortable with nicotine addiction, feeling that vaping should only be used as a smoking cessation aid towards quitting nicotine completely.

Like some of the abstainers, the relapsers were uncomfortable with a 'grazing' pattern of e-cigarette use. They felt that frequent vaping compromised their quit attempt by continuing an addiction to nicotine:

*I find one of the worst things about it is you don't know when to stop (27F)*

### **Unsatisfied by e-cigarette**

At T1, most of this group held similar views about e-cigarettes and nicotine cessation as the abstainers. However, at T2 they had not been successful in quitting either e-cigarettes or smoking. What set this group apart from the abstainers is that at T1 nearly all the relapsed group had discussed their enjoyment of smoking and felt that e-cigarettes did not compare favourably to tobacco cigarettes in terms of nicotine hit, taste, or feel. At T2, most participants still maintained that e-cigarettes were inferior to the smoking experience:

*It doesn't quite hit the spot.(36F)*

In addition, some of these participants held strong beliefs based on past experience that in times of stress they needed tobacco to cope:

*I'm just probably not going to have one again until something happens or sort of, almost triggers me to have it... I've done that for years and years and sort of where my brain is stressed, I'm going to have a cigarette. (21M)*

Only one participant in this group had a different attitude. At T1, he had successfully quit smoking by using e-cigarettes (after several failed quit attempts using traditional methods), finding it to be an adequate replacement, and was intending to quit nicotine completely. Unfortunately, he had experienced an intolerance to e-cigarettes which had triggered his relapse:

*You know my aim from the outset with vaping to get off the nicotine altogether and vaping as a tool was working brilliantly, with exception to that build-up of an intolerance. If it hadn't*

*have been for that, I've got no doubt whatsoever that I would have achieved what I was seeking. (44M)*

### **Not identifying with vape culture**

For the relapsers, the 'culture' and identity of being an e-cigarette user were very different to the felt experience of belongingness described by maintainers. Instead of enjoying e-cigarettes, the relapsers felt that belonging to the 'vape culture' (defined as a community of people who vape), was not for them:

*I just really don't understand it (vape subculture).*

*R: Have you ever been into any vape shops or anything at all?*

*Yes I did – one in (place name)*

*R: Okay, and how did you find that?*

*An experience. Yeah I don't know, the guys were so bizarre and smug because I didn't know what I was on about or what I was getting and they were blowing 'smoke' at me and doing all these tricks and I just didn't like it. (25M)*

### **Views on health risks and benefits of e-cigarettes**

At T1, many from this group were concerned of the health risks of e-cigarettes. At T2, some had maintained this view or seemed apathetic:

*I mean in terms of my view of vaping, I don't know. I don't sit there and read research, I don't know if it's been proven to be bad for you or good for you, is there any research yet known? It's very new still. I don't know if it's worse. (36F)*

## **Discussion**

Using UK qualitative longitudinal data, we illuminate three key e-cigarette using pathways – the 'maintainer' pathway (e-cigarette use and not smoking), the 'abstainer' pathway (neither smoking nor using e-cigarettes), and the 'relapser' pathway (dual-using, or relapsed back to tobacco smoking only). We interrogated the trajectories to draw out individually influenced motives and habits, resources, environmental and social influences, mapping to Kwasnicka et al's integrated theory of behaviour change maintenance (15). Through each of the pathways, individual experiences with using nicotine are critical, but these are heavily influenced by social factors, such as a supportive vaping context for the maintainers, or dislike of the 'vaping culture' expressed by some in the relapser group. Treating the data as narratives, we are able to understand the process of vaping over time and patterns of use that link through accounts of identity to tobacco smoking or quitting. For many, particularly perhaps the 'abstainer' group who have moved to quitting both e-cigarettes and tobacco, a natural progression towards abstinence is apparent, that may be likened to a 'maturing out' effect previously reported in other addictive behaviours (19). This implies that smoking cessation by using e-cigarettes may be a *process* that evolves over time, as individuals disengage from a smoker identity, and might best be regarded as a positive step towards smoking cessation, rather than an instant switch (20–22). Indeed, the gradual 'slide' towards abstinence that the data supports, and the behavioural processes of occasional tobacco lapses that serve apparently to negatively reinforce ongoing tobacco abstinence, suggest that a period of time allowing experimentation and adaptation of behaviour, integrating the new non-smoker identity, is necessary

to fully switch from tobacco smoking to e-cigarette use. Previous studies of smoking cessation have similarly demonstrated how quitting can include elements of both spontaneity and preparation, that are especially pertinent in the context of e-cigarette use (23). For the largest 'maintainer' group, continued e-cigarette use may be protective against smoking relapse, a positive long term-maintained behaviour, and is accepted as an integrated part of identity.

An alternative hypothesis, that using e-cigarettes may leave people vulnerable to smoking relapse through maintaining nicotine addiction (24), is a prevalent concern in other policy contexts. This view is contradicted by recent cohort data (25). In our qualitative longitudinal data, we also observe some long-term e-cigarette users reporting experiencing a natural and easy reduction of dependence through reducing nicotine strengths over time, a reported reduction of cravings and tobacco lapse behaviour, and a belief that addiction to nicotine has waned.

The 'maintainers' may continue to use e-cigarettes long-term. They experience e-cigarettes as personally satisfying and enjoyable, and many also enjoy the social and identity related aspects of e-cigarette use, in a similar way to that identified by previous studies where e-cigarette use is presented as a positive social practice that opens up time and space (26). Although evidence consensus reviews suggest that e-cigarette use is much less harmful than tobacco smoking (27,28), there is as yet no public health consensus on the health consequences of long-term use. Others within our sample, the 'abstainers', had moved to quitting both tobacco and e-cigarettes. Clearly for some people continuing to use nicotine is not desirable, nor congruent with identity, and conceivably this may be a pathway that others may choose to take, over time. At present, there is no evidence-based advice on how to support people to stop using e-cigarettes, if that is their choice. There is a need for such advice, particularly in supporting people to avoid any possibility of relapsing back to tobacco smoking. Our data preliminarily suggest that strategies such as gradual weaning towards lower nicotine strength e-liquid may be successful for some people. Conversely to remain on a pathway towards full tobacco abstinence, the qualitative data suggest a need to support e-cigarette users to switch to higher nicotine strength e-liquid during times of stress, if necessary, to avoid cravings and risking smoking relapse.

Most of the relapsers and abstainers shared similar attitudes over time that contrasted with the maintainers: that they should only use e-cigarettes as a temporary measure; they were uncomfortable with long-term nicotine use, and were suspicious of e-cigarette safety. The maintainers, conversely, were comfortable with nicotine use. They enjoyed e-cigarette use as a pastime and felt invested with a 'vaper' identity. They also saw e-cigarettes as much less harmful than smoking, and felt supported by their social groups. Relapsers differed to both the abstainers and maintainers in that they were less motivated to quit – they enjoyed cigarette smoking, maintained a belief that cigarettes were necessary to cope with stress, and held more negative views about vape shops and vape culture that other groups saw conversely as a source of support. They were also of a younger age, on average.

Our findings are limited in that they are drawn from a small qualitative sample. Although the initial purposive sample reflected the general population of quitters, those from ethnic minorities and low socioeconomic groups are not well represented. It is also likely that the sample are skewed towards those most motivated to maintain smoking abstinence, and most willing to share their experiences. However, a strength is the in-depth perspectives gleaned, allowing detailed exploration of individual trajectories of e-cigarette use behaviour over time. This provides robust experiential data and allows us to illuminate major patterns of use, suggest areas of need, and hypothesise support that may be necessary for long term smoking cessation.

To promote tobacco smoking relapse prevention, our findings suggest that supporting continued e-cigarette use, as reported by the ‘maintainer’ group, might be beneficial. e-cigarette users require frequently updated evidence-based advice on the relative safety of e-cigarettes in comparison to tobacco smoking. For dual users or those who occasionally lapse to tobacco, there is a need to tackle beliefs about dependence on tobacco and offer alternative strategies for triggers such as stress. For those who struggle to find a satisfying and effective e-cigarette set-up, there is a great need for support, perhaps from peers, who are a valued source of advice (29,30). Particularly there is a need for information about increasing or reducing nicotine strengths, to prevent cravings and cope with stressors, and advice on using different flavours to suit preferences and aid sustained cessation (31). Those who eventually wish to quit e-cigarettes need evidence-based information about effective ways to do this, without increasing vulnerability to tobacco relapse.

In delineating three major pathways through e-cigarette use, our data demonstrate a clear role of e-cigarettes in smoking relapse prevention in the UK policy context. This suggests that policies supportive of vaping could be adopted by other jurisdictions concerned with smoking relapse. Once quit smoking, the majority pattern apparent in our data is a move towards exclusive, ongoing, e-cigarette use. For some, there is a move completely away from both smoking and e-cigarettes. For a minority, there are continued patterns of dual use or relapse back to tobacco smoking. Future research might focus on younger people who may be less motivated to ‘mature out’ of dual use or tobacco smoking behaviour. Health efforts need to prioritise intervention with this group, through targeting individual level beliefs and physical dependence needs, social level support, and cultural level reinforcement of reduced harm alternatives that might support complete smoking cessation.

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**Supplementary / linked information:**

**Figure 1: Maintainer Pathway (extended case example 1): Regular vaper with history of previous tobacco lapse reporting decreased desire to smoke tobacco at T1, maintaining abstinence at T2**

“I said to my other half I said you know what we’re on holiday I really just fancy just having some cigarettes just as, just because I’m on holiday as a treat sort of thing but I’m conscious of the fact that it might cause me to full relapse and go back to smoking and he said’ I don’t think so’, anyway, I had a cigarette and it was the most disgusting thing I’ve ever tasted in my... because I’d got so used to the vaping and, cos obviously since that first vape pen I had, I’ve kind of upgraded over the months and kind of got to where I am with device I’m using today, the one that I’m now happy with, and I’ve been using this one for about three or four months, and it’s absolutely awesome, so I’d got to the point where really, you know, just the whole flavour thing, it just didn’t really do it, so I had a few, so I think in the end I kind of smoked the box, I had a box of 20, I smoked the box of 20 over the week that we were there, (yes) but had absolutely, it almost like reaffirmed by decision to stop (ok), because it was like, I could smell it, and it was just, you know, when you’ve smoked for twenty years you don’t know what you smell like, you don’t know what cigarettes smell like, you don’t know all that kind of horribleness is going on you, stop, and you start again, and you’re like, but I think it was because this was giving me the nicotine, and I was able to just swap (yes) and so stopping real cigarettes, and then I haven’t touched one since (ok), so I had absolutely no desire when we came back off holiday to (right), to smoke a real cigarette again” (46M:T1)

*At 12 month follow up:*

“So I’m pleased to report absolutely no smoking whatsoever, I’ve even been away on holidays and stuff, no, no smoking, just bleurgh. No I don’t even fancy the idea anymore so I think probably last year I was still at the point where I could still be tempted to a cigarette but not cigarettes just generally, no interest whatsoever, even if I pass somebody in the street who’s smoking, I’m like oooh! I’ve turned into one of those people that I always thought I would never be, you know the people who always used to complain about people’s cigarette smoking. Now I am one! You know I don’t even like the smell of cigarette smell anymore. So still vaping, still using the same piece of kit I was actually using last year. It’s still working for me”(46M:T2)

**Abstainer pathway (extended case example 2): Regular vaper who has quit tobacco smoking at T1, moved to complete abstinence from both tobacco and vaping at T2**

*R: and you switched from cigarettes to e-cigs?*

*Pt: yes*

*R: was it easy to make that transition or was it difficult?*

*Pt: it was difficult at the start yes I would admit yes it was just a very it was something very different ...I mean you get the flavours with in the e-cigarette but you don’t it’s still you still crave the taste of the tobacco I mean I didn’t start on I didn’t use a tobacco e-liquid I didn’t really see the point I thought if I’m going to vape I’m going to vape something that’s going to be a little bit more flavoursome or have a different flavour to it but I was still craving that taste and feeling of a cigarette and it was also the aspect of rolling and all that lighting something up...you didn’t have any of that so that was very that was hard but I think I just knew that even when I had the cravings that I really needed a cigarette and this wasn’t*

working I just continued to use it and the cravings went down ...they got easier I think it's just the habit you get very used to a certain something switching to something else is always going to be difficult even if it does give you that little satisfaction from the nicotine it's always going to be weird because it's something new

R: *were you ever tempted did you have any have you had any kind of roll up or cigarettes since October?*

Pt: no I haven't smoked a single one no

R: *ok*

Pt: it's weird yes this is the longest time I've ever quit ....definitely gone down yes for me now it's weird the smell of cigarettes really doesn't appeal to me at all like it's really I find it really quite disgusting now but for a long time when people were smoking around me I would the smell would really draw me in like I really want a cigarette but now the smell you smell horrible like I feel like my senses and my smells have really improved and it makes me think like oh I must have stank

(26M:T1)

*At 12 month follow up:*

"since then I did gradually reduce my nicotine level and I went down to zero. And I was vaping on 0 for I don't know a couple of months until I completely stopped and I no longer smoke or vape at all now! So I did eventually fade it out. The thing was when I got down to 0 nicotine, the cravings really died down so I didn't really need it so much. I didn't feel the need to use it and it just kind of, I don't know it just kind of seemed to erm I just kind of, it kind of faded a little bit, the need to do it, it felt a little pointless. And yeah, I'm no longer smoking, I don't crave it anymore, I've been completely nicotine free for nearly a year now I think" (26M:T2)

**Relapser pathway (extended case example 3): Dual using at T1, relapsed to tobacco smoking at T2:**

Pt: and I did try and walk in a shop but it's just like all to wall they're like what kind of thing do you want I'm like I don't know and I had a feeling like it's a feeling of being a women going into the car mechanics like they assume you don't know so you sort of get fleeced a bit...I don't know which one I want

...

Pt: it feels lighter almost than smoking a cigarette even though it's still smoke well it's a different kind of thing it's not burning your lungs but yes I pick flavours that I purposely like in the hope that it will get me to do it more, but I think, apart from my lapse at the weekend....I've been in a thing where I haven't actually been using them like in my car every day and things like that I've been going through one of my natural like lows...so at least I know they're there although I've very annoyed at myself for smoking at the weekend

R: *and just so we're clear when you were using the ... cigarette type one? were you still smoking alongside?*



Pt: yes I was sort of as one went down as the real cigarettes went down I was trying to go up on the other ones....but they never quite satisfied me to the point that I think it sort of the smoking went down and the e-cigarette went up and then it just sort of went along together it really wasn't that satisfying...

R: *and when you switched to that device that you bought next is that when you managed to quit, you know, other than the occasional lapses?*

Pt: yes, yes, yes

R: *was that when you actually managed to stop?*

Pt: yes

R: *you're daily routine having tobacco cigarettes?*

Pt: I didn't stop like one day 'oh I've...' as one went down and the other went up

(36F:T1)

*At 12 month follow up:*

"I had a vape thing, I had a stick one and then I got a slightly more expensive one and I just found it incredibly fiddly to refill and it was just a real faff. I've got it somewhere but I just erm yeah. And it doesn't hit the spot, which I know sounds terrible because smoking is bad for you but unfortunately I sort of quite like it. I'm sort of feeling fairly..."

*C1 Well don't worry, obviously there's no judgement there. Like I said, there's no right or wrong answers so don't worry. So I mean – so when did you go back to smoking, about December time did you say?*

"Yeah it was a lot of Christmas parties and I just started at a new place and everyone was smoking and I'm like I'll have one. I can have one. Oh no, you can't have just one. But I never really stopped so...I had the occasional one through the summer so, because I worked through an incredibly busy period at my previous employer, all through the summer so like all through the assessment period with like half my normal size and working sort of like 13 hour days. So that was my break really to have a cigarette." (36F:T2)

**Table 1: Participant demographic characteristics at baseline**

	Abstainer	Maintainer	Relapser	Total
Gender				
Male	2 (33.3%)	13 (56.5%)	4 (50%)	19 (51.4%)
Female	4 (66.7%)	10 (43.5%)	4 (50%)	18 (48.6%)
Ethnicity				

White British	6 (100%)	22 (95.7%)	6 (75%)	34 (91.9%)
White European	0	1 (4.3%)	2 (25%)	3 (8.1%)
Location				
Urban	5 (83.3%)	17 (73.9%)	6 (75%)	28 (75.7%)
Rural	1 (16.7%)	6 (26.1%)	2 (25%)	9 (24.3%)
Managerial, professional, or technical occupations	1 (16.7%)	11 (47.7%)	2 (12.5%)	14 (37.8%)
Baseline smoking status				
Relapse or dual using	0	1 (4.3%)	5 (62.5%)	6 (16.2%)
Abstinent and vaping	3 (50%)	22 (95.7%)	3 (37.5%)	28 (75.7%)
Abstinent from both	3 (50%)	0	0	3 (8.1%)
Baseline age in years				
Range	22-62	21-70	21-44	21-70
Mean	35.2 (14.865)	46 (SD 12.937)	28.5 (7.838)	41 (SD 14.41)
Baseline approx. years since first e-cig use				
Range	0-4	0-7	0-7	0-7
Mean	2 (1.41)	3.3 (SD 1.917)	1.8 (SD 2.252)	2.8 (SD 2.016)

**Table 2: Three trajectories of long-term vaping**

	<b>Maintainer (Vaping and abstinent from tobacco n=23/37)</b>	<b>Abstainer pathway (Abstinent from both n=6)</b>	<b>Relapser Pathway (Dual using or smoking only n=8)</b>
<b>Behaviour maintenance theoretical concepts</b>			

<b>Motives</b> – outcome enjoyment/satisfaction	Nicotine dependence acceptance Unintentional/effortless ecig quit belief Biopsychosocial replication of smoking Perceived health benefits Vaping pleasure/preference	Nicotine dependence discomfort Temporary measure to quit smoking Physiological vaping intolerance	Nicotine dependence discomfort Temporary measure to quit smoking Physiological vaping intolerance Smoking pleasure/preference
<b>Example data</b>	<i>I mean obviously I smoked for a very very long time so I guess I have a little bit of a nicotine dependency but the vaping that I have, I've got the right piece of kit, it's serving my needs.</i>	<i>I did need it to like transition. Like it helped with something to do with your hands, that feeling of smoking but not smoking and then, it's like that transitioning period.</i>	<i>It doesn't quite hit the spot. I don't know it's the taste, none of the e-cigarettes particularly taste nice. It's not like something I was really ever 100% happy with.</i>
<b>Self-regulation</b> – behavioural monitoring and strategies	Reduced smoking desire	E-cig weaning off Traditional quit methods Unintentional/effortless ecig quit	Traditional relapse triggers E-cig specific relapse triggers
<b>Example data</b>	<i>Last year I was still at the point where I could still be tempted to a cigarette. Now no interest whatsoever, even if I pass somebody in the street who's smoking, I'm like ugh!</i>	<i>I've thought about it but it's just not worth it. You kind of sit and have a few breaths, just doing deep breaths and walk away from it really.</i>	<i>I tried various different [eliquid] ratios but I just could not get rid of this persistent cough. So in the end I did abstain from the vaping and within about a week, that cough cleared up! It did mean I then went and relapsed to smoking and I'm still smoking now.</i>
<b>Resources</b> – psychological/physical	Tobacco abstinence confidence Vaping accessible/cheap Harm reduction reduces cognitive dissonance	Tobacco abstinence confidence Stress tobacco lapse trigger E-cig safety distrust	Tobacco quit scepticism E-cig safety distrust/apathy
<b>Example data</b>	<i>They're odds I'm prepared to take because what's the alternative? When you've had a habit as established as mine I'd have probably above 50% chance of dying with smoking related disease. So if I now have a 30% chance of dying of a vaping related disease, I'm still 20% up!</i>	<i>I felt pretty confident. I still think I won't be able to ever go back [to smoking].</i>	<i>I'm not sure I'll ever quit the cycle of stopping and starting.</i>
<b>Habits</b> – habitualisation	Vaping habit maintenance	Vaping equipment removal	Situational tobacco habits

	Continuation/reduction nicotine strength	Vaping equipment retainment	Unable to replicate smoking habits
<b>Example data</b>	<i>If I am somewhere where I didn't used to originally smoke, then I wouldn't vape. I think it just became a habit. And because it's quite enjoyable I suppose.</i>	<i>[E-cig's] actually sat by my computer for I don't know how many months now and so in that period of time, I've used it once.</i>	<i>I'm back to smoking. I feel bad, I smell bad, I hate it, but it's just sort of something that I know will keep me calm when nothing else will.</i>
<b>Environmental and social influences – support</b>	Increasingly visible Socially acceptable Public Health message reassurance	Increasingly visible Not socially acceptable Public health message suspicion	Increasingly visible Not socially acceptable Public health message suspicion/apathy Vape culture rejection
<b>Example data</b>	<i>I think maybe the public in general have got used to seeing it so it's not such a strange looking thing anymore. I think in general in society, I think it's become more acceptable.</i>	<i>It's the sign of a personal weakness rather than one of like, you know, self-destruction. It's more of a moral judgment that you get from people.</i>	<i>I just really don't understand it. The [vape shop] guys were so bizarre and smug. They were blowing smoke at me and doing all these tricks and I just didn't like it.</i>