


Prevalence of Use of Electronic Nicotine Delivery Systems (ENDS) to Vape Recreational Drugs by Club Patrons in South London

Natalie Thurtle¹  · Rachelle Abouchedid¹ · John R. H. Archer^{1,2} · James Ho¹ · Takahiro Yamamoto¹ · Paul I. Dargan^{1,2} · David M. Wood^{1,2}

Received: 2 April 2016 / Revised: 5 August 2016 / Accepted: 17 August 2016 / Published online: 6 September 2016
© American College of Medical Toxicology 2016

Abstract

Introduction Electronic nicotine delivery systems (ENDS, often called e-cigarettes) are nicotine delivery devices that heat nicotine into vapour that is inhaled, a process called ‘vaping’. Use eclipsed nicotine-replacement therapy (NRT) in 2014 but ENDS role in smoking cessation remains controversial. Safety has not been proven and there have been reports to US poison centres regarding potential ENDS-related nicotine toxicity. A further concern is use of ENDS to vape recreational drugs, but there is limited data to substantiate this. The aim of this study was to report on ENDS use to vape recreational drugs in patrons of a South London nightclub where high prevalence of recreational drug use has previously been shown.

Methods A convenience sample of 101 participants was surveyed in March 2015 as part of a larger survey on drug use. Individuals were asked if they used ENDS to vape nicotine and/or other substances (and if so which substances).

Results Ninety (89.1 %) of respondents were male with median age of 28 years (IQR 23–34). Eighty (79.2 %) currently smoked cigarettes; 20 (19.8 %) currently used ENDS for

nicotine. Six (5.9 %) reported using ENDS to take other substances: 2 for ‘liquid cannabis’ and 4 did not elaborate on the substance(s) used. Of these 6, 3 were using ENDS to vape nicotine and 3 had never used them for nicotine.

Conclusion 5.9 % of individuals in this sample reported using ENDS to vape substances other than nicotine. Further work is required in larger populations to determine how common this is, evaluate which agents are being vaped and to inform appropriate public education.

Keywords E-cigarettes · Electronic nicotine delivery systems · Vaping · Recreational drugs

Introduction

Electronic nicotine delivery systems (ENDS, often referred to as e-cigarettes) are battery-operated devices designed to deliver nicotine. There is significant variation between devices but in principal, a battery is attached to a heating element, which heats nicotine-containing liquid into a vapour that is inhaled, a process named ‘vaping’. These are frequently marketed as having a role in smoking cessation. ENDS liquids contain nicotine, at least one solvent agent (usually propylene glycol and/or glycerin) as well as flavours [1]; however, they can contain any variety of compounds and may contain no nicotine. The make-up of the liquid, the power output of the device and the strength of user inhalation influence the yield of substance inhaled from a given ENDS aerosol [1].

In 2014, ENDS use eclipsed nicotine-replacement therapies (NRT) globally with sales of 6 billion USD [2]. In a US national survey by the Centers for Disease Control and Prevention (CDC), 13.4 % of high school students were using e-cigarettes in 2014 versus 1.4 % in 2011, superseding all

Previous Presentation of Data at Meetings or in Abstract Form An abstract of this data was previously presented at NACCT 2015 in San Francisco, CA.

✉ Natalie Thurtle
nat_thurtle@yahoo.com

¹ Clinical Toxicology, Guys and St Thomas’ NHS Foundation Trust and King’s Health Partners, London, UK

² Faculty of Life Sciences and Medicine, King’s College London, London, UK

other ‘tobacco’ products (the highest ‘tobacco’ product used was hookahs at 9.4 % of those surveyed, with cigarettes at 9.2 %) [3].

Growth of the sector has outpaced safety studies and regulation, with the latter confounded firstly by a polarised debate regarding potential harms versus potential harm reduction [4] and secondly by the initial framing of ENDS as tobacco products rather than pharmaceuticals or drug delivery devices [5, 6]. This regulatory dearth has enabled unmetred development of the industry with over 400 non-standardised ENDS brands now available [7]. The debate is fuelled by a lack of robust evidence and a 2014 Cochrane review did not find enough evidence to conclude on the safety and efficacy of ENDS [8].

There have been increasing calls to poisons centres regarding potential nicotine toxicity related to ENDS [9] and a recent US study found that teenagers using ENDS were transitioning to combustible tobacco more than non-ENDS using peers [10]. A recent mouse study showed that e-cigarette vapour is cytotoxic to airway cells, depresses the immune system and promotes inflammation [11].

The World Health Organisation (WHO) recognises possible harms from ENDS and recommends a stringent regulatory framework [7]. In 2016, the Medicines and Healthcare Products Regulatory Agency in the UK plans to license ENDS as medicines [12] and the US Food and Drug Administration (FDA) finalised a rule extending regulatory authority to ENDS [13].

Regulatory deficit of ENDS has coincided temporally in the USA with the decriminalisation of cannabis in some states. Devices are also being specifically marketed for vaping cannabis [14–16] and evidence is emerging of ENDS use to vape recreational drugs [17]. Several studies have shown that ENDS are being used to vape cannabis [18–20] with one study finding that vaporisers appealed to marijuana users, who perceive them as having harm-reduction, better taste and more effect from the same amount of marijuana. There are case reports of other drugs being vaped including acetylfentanyl [21, 22] and synthetic cannabinoid receptor agonists (SCRA’s) [23, 24] as well as a news report of students vaping new psychoactive substances (NPS) with 6 users of ‘Cloud 9’ e-liquid in Detroit reported hospitalised [25]. Detailed epidemiological evidence is elusive in this fast-moving trend, though analytical techniques utilising social media and search engines show promise in related areas [26–28].

Like tobacco use, ENDS use is more common in both men-who-have sex-with-men (MSM) and women-who-have-sex-with-women (WSW) [29] and studies have shown high prevalence of drug use and early adoption of drug trends among the MSM club-going community in South London [30]. The reasons for early adoption are not fully understood though high prevalence may, at least in part, be related to ‘chemsex’—the practice of seeking out sexual intercourse

whilst under the influence of recreational drugs [31]. The aim of this study is to report on the use of ENDS to vape recreational drugs in patrons attending a gay-friendly South London nightclub. To our knowledge, this has not been evaluated previously in this specific population.

Methods

Data Collection and Participant Inclusion

The study was performed over two weekends in March 2015 at a gay-friendly South London nightclub. Study investigators were based in the ‘chill out’ areas where patrons could approach/be approached with the chance to participate. If they showed interest, participants were provided with an information sheet and given the opportunity to ask questions. They were then asked to give written consent to participation. No identifiable data were collected and participation was anonymous. Participants were given an email address via which they could withdraw participation at a later date.

Individuals who met the following criteria were excluded from the study: those unable to speak English well enough to understand the nature of the study and those under 18 years; those unable to give informed consent.

Drug Survey

The surveys were administered by physicians working in a Clinical Toxicology department and collected the following data as part of a wider study into recreational drug use:

Demographic data: age, race, gender, gender of sexual partners, and broad categories of residence (London, elsewhere in UK, non-UK resident). No other identifiable information was collected to maintain confidentiality

On-night and lifetime prevalence of recreational drug use
Smoking (including e-cigarettes) as follows:

Participants were asked if they smoked cigarettes and/or ENDS and were given four categories for frequency: daily, non-daily, ex and never. They were then asked if they smoked e-cigarettes to take other substances and if so, what those substances were.

Ethics

The study was approved by the Kings College London Ethics Committee (Ref BDM/14/15-29). The study was funded in part by a grant from the UK Home Office Centre for Applied Science and Technology.

Results

Demographics

For the 101 participants, the median age was 28 years (IQR 23–34 years). Other demographic and sexual orientation data is contained in Table 1.

Smoking and ENDS

Eighty (79.2 %) participants currently smoked cigarettes and 20 (19.8 %) used ENDS currently for vaping nicotine, with 7 (6.9 %) using ENDS daily. Twelve (11.9 %) additional participants had previously used/tried ENDS. Six (5.9 %) respondents reported using ENDS to take other substances; 2 had used ENDS to vape ‘liquid cannabis’ and 4 did not elaborate on the substance used with ENDS. Of these 6, 3 (50 %) were also using ENDS to vape nicotine and 3 (50 %) had never used ENDS to vape nicotine (i.e. had only used ENDS to take cannabis and/or other recreational drugs/

NPS). Demographic and sexual orientation for these 6 participants is contained in Table 1. Median age was 22 years (IQR 21–27 years).

Reported recreational drug use, both on-night use and prevalence, of both those using ENDS to vape recreational drugs and those not is detailed in Table 2. The profiles of the two groups are similar with high prevalence of use and on-night use of many agents reported, particularly mephedrone (67 % ENDS-to-vape-drugs users, 72 % non-ENDS-to-vape-drugs users reporting on-night mephedrone use). A notable difference is that 67 % of ENDS-to-vape-drugs users reported on night gamma hydroxybutyrate/gamma butyrolactone (GHB/GBL) use compared to 28 % of non-ENDS-to-vape-drugs users.

Discussion

The prevalence of ENDS use for vaping recreational drugs in this population where recreational drug use is known to be

Table 1 Participant demographics

	Users of ENDS to vape drugs		Total study population ^a	
	Frequency	Percentage	Frequency	Percentage
Gender				
Male	4	67	90	89
Female	1	17	10	10
Did not say	1	17	0	0
Employment				
Studying	0	0	7	7
Studying/work	0	0	6	6
Working	6	100	86	85
Unemployed	0	0	2	2
Race				
Black	0	0	4	4
White	5	83	83	82
Asian	0	0	0	0
Mixed race	0	0	12	12
Other	1	17	2	2
Orientation				
MSM	4	67	79	78
WSW	0	0	2	2
Heterosexual	1	17	19	19
Did not say	1	17	1	1
Residence				
London	6	100	89	88
UK, not London	0	0	8	8
Overseas	0	0	2	2

^a Total study population refers to the 101 participants surveyed as part of a broader survey into recreational drug use from which the users of ENDS to vape drugs were identified

Table 2 Reported recreational drug use

Drug	Users of ENDS to vape drugs <i>n</i> = 6						Non-users of ENDS to vape drugs <i>n</i> = 95					
	Ever		On-night Use		Never		Ever		On-night Use		Never	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Cannabis	6	100	1	17	0	0	91	96	5	5	4	4
Amphetamine	3	50	1	17	3	50	48	51	4	4	47	49
Methamphetamine	4	67	1	17	2	33	30	32	7	7	65	68
MDMA	6	100	1	17	0	0	84	88	24	25	11	12
Cocaine	5	83	1	17	1	17	85	89	17	18	10	11
Ketamine	4	67	0	0	2	33	60	63	3	3	35	37
Mephedrone	5	83	4	67	1	17	84	88	68	72	11	12
GHB/GBL	5	83	4	67	1	17	55	58	27	28	40	42

high was 5.9 %. This population—primarily MSM in situ in a nightclub—has not been surveyed before regarding the prevalence of vaping drugs using ENDS, an area that remains in general sparsely reported. Half of the individuals who reported vaping recreational drugs had never used ENDS to vape nicotine. All participants reporting vaping recreational drugs were either using other drugs on the night in question or had used them in the past. While 2 reported vaping ‘liquid cannabis’, likely to mean cannabis oil, 4 did not elaborate on which agents they were vaping.

The demographic data and reported on-night drug use profile of the ENDS-to-vape-drugs users compared to those not using ENDS to vape drugs was similar apart from age (the ENDS users had a younger median age) and on-night GHB/GBL use which was higher in the ENDS-to-vape-drugs group. No conclusion can be drawn from this due to the small sample size.

Morean et al. surveyed over 5000 middle and high school children in Connecticut in 2014 and found that 5.4 % of students reported lifetime use of ENDS to take cannabis, suggesting a similar prevalence in this very different population [19], though the students were not asked about vaping other drugs.

In Schauer et al., 7.6 % of current marijuana users in a US adult general population survey reported using ‘vaporisers’ (whether ENDS or specific cannabis vaporisers) to take marijuana [20]; this translates to approximately 0.5 % of the total population surveyed which is much lower than the reported use in the population surveyed here (5.9 %).

The fledgling regulation and standardisation in the manufacture of ENDS and e-liquids corresponds temporally with a number of other important factors: decriminalisation of cannabis in some areas, the burgeoning use of the internet to distribute legal and illegal products globally and the proliferation of new psychoactive substances meaning that

users of ENDS to vape drugs may increase. At present, although population and sub-population level data is sparse, this sub-population level study suggests that this practice is occurring in a small but significant percentage of MSM in South London and confirms the need for further research. Further work may include a larger, more detailed survey on types, perceived effects and frequency of drugs vaped in this population as well as looking at vaping recreational drugs in different populations, including the use of newer social media and search engine analytical techniques to look at patterns of use.

Limitations

This small sub-population level sample means extrapolation to a more general population cannot be done. Sampling bias is possible as this was a convenience sample of interested participants. In addition, the fact that 4 participants did not elaborate on the drugs they were vaping means we cannot determine whether this was use related to cannabis or whether ENDS were being used to take other recreational drugs/NPS. The participants in this study are part of a larger survey study with matched oral fluid analysis. The survey here was not formally validated prior to deployment and the total number of subjects approached was not collected and thus the percentage of those who consented is not available.

Conclusion

5.9 % of individuals in this sample reported using ENDS to vape substances other than nicotine. Further work is required in larger populations to determine how common this is, to evaluate which agents are being vaped and to inform appropriate public education.

Compliance with Ethical Standards

Conflicts of Interest The authors declare no conflicts of interest.

Sources of Funding There was no specific funding for this study, though this study was conducted as part of a larger study that received funding from the UK Home Office Centre for Applied Science and Technology.

References

- Breland A, Soule E, Lopez A, Ramôa C, El-Hellani A, Eissenberg T. Electronic cigarettes: what are they and what do they do? *Ann N Y Acad Sci*. 2016. doi:10.1111/nyas.12977.
- Euromonitor International Market Research Group. Vapor Devices and E-cigarettes in the global tobacco market. June 2015. <http://blog.euromonitor.com/2015/06/vapor-devices-and-e-cigarettes-in-the-global-tobacco-market.html>. Accessed Jan 2016
- Arrazola RA, Singh T, Corey CG, Husten CG, Neff LJ, Apelberg BJ, et al. Centers for Disease Control and Prevention (CDC). Tobacco use among middle and high school students—United States, 2011–2014. *MMWR Morb Mortal Wkly Rep*. 2015;64(14):381–5.
- Chapman S. Should electronic cigarettes be as freely available as tobacco cigarettes? *No. BMJ*. 2013;346:f3840.
- Cobb NK, Abrams DB. E-cigarette or drug-delivery device? Regulating novel nicotine products. *N Engl J Med*. 2011;365(3):193–5.
- Etter JF. Should electronic cigarettes be as freely available as tobacco? *Yes. BMJ*. 2013;346:f3845.
- World Health Organisation. Electronic Nicotine Delivery Systems: Report by WHO. September 2014 http://apps.who.int/gb/fctc/PDF/cop6/FCTC_COP6_10Rev1-en.pdf?ua=1 Accessed Jan 2016
- McRobbie H, Bullen C, Hartmann-Boyce J, Hajek P. Electronic cigarettes for smoking cessation and reduction. *Cochrane Database Syst Rev*. 2014;12:CD010216.
- Chatham-Stephens K, Law R, Taylor E, Melstrom P, Bunnell R, Wang B, et al. Centers for Disease Control and Prevention (CDC). notes from the field: calls to poison centers for exposures to electronic cigarettes—United States, September 2010–February 2014. *MMWR Morb Mortal Wkly Rep*. 2014;63(13):292–3.
- Wills TA, Knight R, Sargent JD, Gibbons FX, Pagano I, Williams RJ. Longitudinal study of e-cigarette use and onset of cigarette smoking among high school students in Hawaii. *Tob Control*. 2016. doi:10.1136/tobaccocontrol-2015-052705.
- Hwang JH, Lyes M, Sladewski K, Enany S, McEachern E, Mathew DP, et al. Electronic cigarette inhalation alters innate immunity and airway cytokines while increasing the virulence of colonizing bacteria. *J Mol Med (Berl)*. 2016;94(6):667–79. doi:10.1007/s00109-016-1378-3.
- Torjesen I. E-cigarettes are to be regulated as medicines from 2016. *BMJ*. 2013;346:f3859.
- US Food and Drug Administration. Vaporizers, E-Cigarettes and other ENDS. Last updated January 2016 <http://www.fda.gov/TobaccoProducts/Labeling/ProductsIngredientsComponents/ucm456610.htm#regulation>. Accessed Jan 2016
- Cannastick™. 1600 Broadway, Denver CO United States. ©2015 <http://www.cannastick.com/cannastick-starter-kits/oil-kits.html> Accessed Jan 2016.
- Juju Joints™ - Seattle United States © 2015 <http://jujujoints.com/home> Accessed January 2016
- E-NJoint™ – E-N Joint BV Holland ©2015 <https://www.e-njoint.com/en/> Accessed Jan 2016.
- Budney AJ, Sargent JD, Lee DC. Vaping cannabis (marijuana): parallel concerns to e-cigs? *Addiction*. 2015;110(11):1699–704.
- Etter JF. Electronic cigarettes and cannabis: an exploratory study. *Eur Addict Res*. 2015;21(3):124–30.
- Morean ME, Kong G, Camenga DR, Cavallo DA, Krishnan-Sarin S. High school students' use of electronic cigarettes to vaporize cannabis. *Pediatrics*. 2015;136(4):611–6.
- Schauer GL, King BA, Bunnell RE, Promoff G, McAfee TA. Toking, vaping, and eating for health or fun: marijuana use patterns in adults, U.S., 2014. *Am J Prev Med*. 2016;50(1):1–8. doi:10.1016/j.amepre.2015.05.027.
- Rogers JS, Rehrer SJ, Hoot NR. Acetylfentanyl: an emerging drug of abuse. *J Emerg Med*. 2015 Nov 14. pii: S0736-4679(15)01148-8.
- Gasior M, Bond M, Malamut R. Routes of abuse of prescription opioid analgesics: a review and assessment of the potential impact of abuse-deterrent formulations. *Postgrad Med*. 2016;128(1):85–96.
- Debruyne D, Le Boisselier R. Emerging drugs of abuse: current perspectives on synthetic cannabinoids. *Subst Abuse Rehabil*. 2015;6:113–29.
- Castellanos D, Gralnik LM. Synthetic cannabinoids 2015: an update for pediatricians in clinical practice. *World J Clin Pediatr*. 2016;5(1):16–24.
- Gover C. 6 teens hospitalized so far from 'Cloud 9' drug. ©Click On Detroit News 23rd September 2014 <http://www.clickondetroit.com/news/6-teens-hospitalized-so-far-from-cloud-9-drug> Accessed Jan 2016.
- Aphinyanaphongs Y, Lulejian A, Brown DP, Bonneau R, Krebs P. Text classification for automatic detection of e-cigarette use and use for smoking cessation from twitter: a feasibility pilot. *Pac Symp Biocomput*. 2016;21:480–91.
- Daniulaityte R, Nahhas RW, Wijeratne S, Carlson RG, Lamy FR, Martins SS, et al. "Time for dabs": analyzing twitter data on marijuana concentrates across the U.S. *Drug Alcohol Depend*. 2015;155:307–11.
- Ayers JW, Ribisl KM, Brownstein JS. Tracking the rise in popularity of electronic nicotine delivery systems (electronic cigarettes) using search query surveillance. *Am J Prev Med*. 2011;40(4):448–53.
- Johnson SE, Holder-Hayes E, Tessman GK, King BA, Alexander T, Zhao X. Tobacco product use among sexual minority adults: findings from the 2012–2013 National Adult Tobacco Survey. *Am J Prev Med*. 2015. doi:10.1016/j.amepre.2015.07.041.
- Wood DM, Hunter L, Measham F, Dargan PI. Limited use of novel psychoactive substances in South London nightclubs. *QJM*. 2012;105(10):959–64.
- Bourne A, Reid D, Hickson F, Torres-Rueda S, Weatherburn P. Illicit drug use in sexual settings ('chemsex') and HIV/STI transmission risk behaviour among gay men in South London: findings from a qualitative study. *Sex Transm Infect*. 2015;91(8):564–8.