Acceptability of electronic cigarettes as an option to replace tobacco smoking for alcoholics admitted to hospital for detoxification

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ABSTRACT

AIM: A feasibility/acceptability trial was undertaken at Ward 5, Kenepuru Hospital, Porirua, to ascertain whether electronic cigarettes (e-cigarettes) were a useful option to replace or reduce smoking in the detoxification ward.

METHODS: Two groups of patients were studied. Tobacco use and dependency data were collected for each. The first group was surveyed on the usefulness of standard nicotine replacement therapy (NRT). The second group were offered e-cigarettes with the option of standard NRT as well. All were asked to record their use of cigarettes, e-cigarettes and NRT during their stay on the ward, and to comment on their experiences.

Outcomes monitored were self-reported use of NRT and of tobacco. Informal impressions of the nursing staff were also collected, where offered. For the e-cigarette group, a blood sample was taken on day 3 or 4 of their stay in hospital for nicotine/cotinine analysis, to confirm nicotine intake status.

RESULTS: E-cigarettes were well tolerated as a form of nicotine replacement, eliciting positive comments, though they were not effective for all. The average reduction in median cigarettes per day was very similar between the group given standard NRT and the e-cigarette group, at 80% and 86% respectively. There were no adverse effects reported.

CONCLUSION: The study showed that e-cigarettes were an acceptable form of nicotine replacement for these alcohol-dependent patients during their time in the ward. For heavily tobacco-dependent smokers, e-cigarettes may provide a useful aid to patient management within a hospital setting.

Smoking tobacco is an addiction which, for some, is very difficult to give up, even during hospital admissions.[1,2] In New Zealand and in many other countries smoking is banned within hospital buildings for health reasons. It is desirable that patients stop smoking and, ideally, hospital visits will be a trigger for smoking cessation. This is, however, particularly challenging for those entering hospital with complex mental health/addiction and physical disorders.[3]

This study concerns alcohol-dependent patients, many of whom are smokers. When they enter hospital, the immediate problem is not their tobacco dependence. Treating tobacco dependence is seen as secondary while the immediate task of helping the patient through the initial stages of alcohol withdrawal is undertaken.[4] Patients are thus allowed to smoke, but have to go outside the hospital building to do so, and this can jeopardise patient safety.

E-cigarettes have proved very popular overseas, and major reasons for this are that—as well as providing similar behavioural reinforcement—they provide

a more rapid nicotine uptake, better replicating the smoking experience overall.[5,6]

In New Zealand, as elsewhere, e-cigarettes are a controversial subject, with some excited by the prospect of their use for smoking cessation and for harm reduction,[7] whereas others fear a renormalisation of smoking, with e-cigarettes becoming a gateway to recruiting a new generation of smokers.[8]

In the case of those with addictions and associated mental health problems, the harm reduction arguments for allowing e-cigarettes are particularly strong, because this group is notoriously difficult to reach with conventional smoking cessation interventions.[2]

In this feasibility trial, we studied whether e-cigarettes would be acceptable to patients as a way of reducing or stopping smoking while they were in hospital, and how this compared to conventional approaches.

Methods

The study groups were drawn from alcohol-dependent patients consuming a mean of 20 standard drinks per day, admitted for an expected 5–6 days for medically supported alcohol withdrawal. The patients selected for hospital detoxification are at the more severe end of alcohol dependence. The mean 24-hour intake is 22 standard drinks. These patients often present with comorbidities associated with alcohol dependence, including alcoholic liver disease, nutritional deficiencies and other organ damage. Depression and anxiety disorders are also commonly encountered. They have high rates of tobacco dependence. In this project, all smokers who were considered capable of giving informed consent at the time of admission were included in the study.

Two groups of patients were recruited. The first (recruited July 2013—April 2014) were offered standard nicotine replacement therapy (NRT). Where patches were used, they were applied at 9am and removed at 9pm. Nicotine gum was available as required. They were asked to keep written records of their daily smoking and their use of NRT while they were in the ward and to comment on their experience of NRT.

The subsequent group (recruited May 2014–Feb 2016) were given access to an e-cigarette with the option of standard NRT as well. They were permitted to use the e-cigarette as a smoking replacement while on the ward and did not need to take it outside. Again, smoking and use of e-cigarettes and of standard NRT was recorded by the patients for each 24 hours. On day 3 or 4 of their stay, a blood sample was taken for measurement of serum nicotine and cotinine. Serum samples from the study were stored at under -20°C prior to testing. Nicotine/cotinine concentrations were measured by Canterbury Health Laboratories (Christchurch).

Samples were extracted with acetonitrile, with inclusion of an internal standard (D4-nicotine), followed by dilution with water. Dilutions were analysed on an Agilent 1200 series high-performance liquid chromatograph using a Phenomenex Synergi Polar-RP 80 A 4 mcm 150×4.6mm column. A solvent gradient was used for elution, with mass spectral detection (ABSciex 3200 QTrap mass spectrometer). Extraction efficiency was 95% and the limit of detection was 1ng/mL. The standard curve ranged from 5 to 50ng/mL for each analyte.

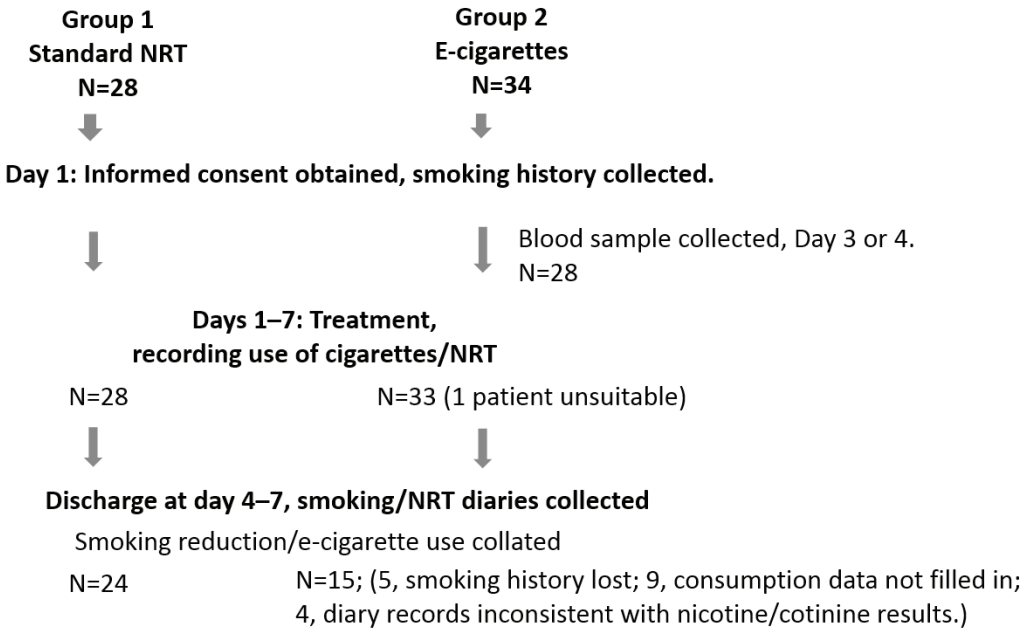
For each group, data pertaining to tobacco dependency (tobacco type used, cigarettes/day and time to first cigarette on waking (TTFC)) were collected.[9]

The e-cigarette brand chosen was one which was well established and which had been tested for quality, effectiveness and toxicity in a previous study.[10] The e-liquid chosen was “eskimo” (a very mild menthol flavour) at 18mg nicotine/mL. A rechargeable type of e-cigarette was chosen, using re-fillable tips (Liberro Realis), each patient being given their own re-fillable tips for use during their stay. During the course of the trial this product was discontinued, and the study moved to using a disposable e-cigarette from the same brand (Liberro Go, UK) as these remained within the terms of the ethical approvals given to the study. The e-liquid had the same nicotine concentration but was tobacco flavoured.

Reactions of the nursing staff were collected verbally and informally by all members of the team as opportunities arose.

Responses (including all comments) were tabulated into Excel. Dependence-related data (cigarettes per day, time to first cigarette on waking) were collected as

Figure 1: Flow chart summarising study structure.



ranges. Subsequent estimation of average cigarettes per day (to calculate median reduction in smoking) was conservative (eg, range >30cpd; estimated at 35cpd) and was consistent between groups.

All appropriate ethical approvals were obtained (13/CEN/111). The trial was registered with the Australasian Clinical Trials Network (ACTRN12614000370606) and had been granted approval by the HRC Standing Committee on Therapeutic Trials (TT50-9479 (1598)).

Results

All patients approached to be part of this study agreed to be included. Complete data from 24 controls and 19 e-cigarette group participants were collected, with partial data from a further four controls and 14 e-cigarette users also included, where appropriate.

Participants ranged in age from 24 to 54, the median age being 45, and slightly more men (58%) than women (42%) were admitted into the study. These characteristics were very similar between groups.

The alcohol withdrawal syndrome commonly presents with tremor, unsteadiness of gait, anxiety, insomnia, tachycardia, high blood pressure and nausea. These were well controlled with prescribed benzodiazepines. True delirium tremens did not develop in these project participants.

Table 1: Smoking characteristics of patients enrolled in the e-cigarette trial.

	Control group	**E-cigarette group**
	Number* (%)	**Number* (%)**
Roll-your-own use	18 (65%)	18 (72%)
Cigarette only	10 (36%)	7 (28%)
>30 cigs/day	6 (21%)	10 (40%)
20–30 cigs/day	20 (71%)	10 (40%)
<20 cigs/day	2 (7%)	5 (20%)
TTFC <5 min	15 (54%)	13 (52%)
TTFC 5–15 min	9 (32%)	7 (28%)
TTFC >15 min	4 (14%)	5 (20%)

*The variation in total number for each information group is a result of the missing data.

Table 2: Use of cigarettes, conventional NRT and e-cigarettes (median (range)) for each day of treatment.

	Control group		E-cigarette group		
	Cigarettes/day median (range)	NRT use (No./total*)	Cigarettes/day median (range)	E-cigarette uses/day median (range)	NRT use (No./total*)
Day 1	3 (0–19)	20/24	3.5 (0–10)	5 (0–20)	3/22
Day 2	4 (0–15)	17/21	2 (0–13)	6 (0–23)	4/18
Day 3	4 (0–15)	17/21	2 (0-17)	5 (0–20)	3/18
Day 4	6 (0–13)	16/20	3 (0–15)	3 (0–20)	3/14
Day 5	3 (0–13)	14/17	3 (0–14)	2 (0–8)	3/9
Day 6	3 (0–11)	11/11	4 (0–13)	3 (0–7)	2/7
Day 7	1 (0–6)	6/6	3 (0–6)	1 (0–10)	1/4

*Total number of patients declines across the week as patients leave, are discharged, or stop recording their smoking. The average duration of hospital stay was six days.

Tobacco dependence data for each group is shown in Table 1. The control and e-cigarette groups were very similar in all characteristics assessed.

As expected, the majority of patients were heavy smokers exhibiting high tobacco dependence, as expressed by their 'time to first cigarette on waking' (TTFC) scores and high tobacco usage. A high proportion (65%) in both groups were users of roll-your-own tobacco (either exclusively or with some use of cigarettes as well).

Serum cotinine concentrations in patients tested ranged from 15–300ng/mL with a median of 120ng cotinine/mL, and serum nicotine was in the range 1–24ng/mL with a median of 6.5ng nicotine/mL.

In the standard NRT group most smokers cut down on smoking significantly ($p<0.0001$, Wilcoxon signed ranks test) while in hospital. Most (83%) used 21mg patches, lozenges or both. Median reduction (self-reported smoking while on the ward, compared with self-reported smoking habits) was 80% (range 44–100%). The average number of cigarettes reported as being smoked per 24 hours while in hospital was five. Using conventional NRT, three patients said that they did not smoke at all during their time in hospital.

In the e-cigarette group most patients also cut down significantly ($p<0.0001$, Wilcoxon signed ranks test) on smoking tobacco cigarettes while on the ward, where the median reduction was 86% (range 0–100%). The average number of tobacco cigarettes reported smoked per 24 hours was four and the average number of uses of an e-cigarette was six. Two of the patients used e-cigarettes only (no tobacco use reported) and four did not report any use of either tobacco cigarettes or e-cigarettes after the first day. Although most of the e-cigarette group did not use conventional NRT so long as e-cigarettes were available to them, three users of disposable e-cigarettes reported some use of conventional NRT as a supplement to the e-cigarettes.

A major difference between the two groups was in the comments. Patients in the control group were politely positive about NRT, suggesting that it helped them cut down their smoking. One said that keeping the records of their smoking and NRT use was useful in itself.

Comments on the usefulness of e-cigarettes were more positive than those for conventional NRT ("they really helped me to cut down"; "liked not going outside to smoke"; "much better than patches and gum"). Another commented that he liked them but "needed a real cigarette after day 3" adding that he would try them again later when he was ready to quit smoking. Four complained of technical problems in keeping up the supply of nicotine-filled cartridges and charged batteries ("I only smoked when the battery ran out"; "technical issues frustrating"). At least four patients asked about the possibility of taking

their e-cigarette with them when they left. Three requested information on how to get hold of e-cigarettes via the internet.

At the beginning of the study there was some resistance from the nursing staff to patients being allowed to use e-cigarettes in the ward. Some were worried whether it was right to allow something that looked like smoking, and this project challenged the thinking of some around addiction and harm reduction. Some were worried about health aspects of the vapour. Once they had seen the e-cigarettes used, much of this worry dissipated.

Nurses much preferred giving out the disposable e-cigarettes compared to the rechargeable ones, as they did not require any technical expertise to maintain the supply, but when we swapped over to them, the enthusiasm of the patients diminished noticeably, as evidenced from a change in the comments ("I do not like these") and the need for additional NRT for some. At the end of the trial some staff expressed regret that the trial could not continue longer, and that this option would no longer be available to their patients.

Problems encountered

One patient lit the end of their e-cigarette with a lighter and was removed from the study.

Other problems encountered ranged from the difficulty of deciding whether an intoxicated or agitated and distressed patient was in a fit state to give informed consent, technical issues with the use of the e-cigarettes (particularly during night shifts) and the tendency of the e-cigarettes to vanish when the patients left the ward, combined with supply and communication delays in replacing them.

Discussion

E-cigarettes were well tolerated by this group of smokers. Patients entering hospital cut down their smoking significantly, whether they were given e-cigarettes or standard NRT, but the e-cigarettes were preferred ahead of patches and gum, seeming to encourage an interest in continued cessation or in switching away from tobacco use.

The serum cotinine results were in the mid-lower end of the expected concentrations for heavy smokers, consistent with some degree of smoking reduction while in hospital. However, wide variations in cotinine metabolism rates (half-life, 10–27h)[11] mean that where nicotine intake has recently changed, the results of a single serum cotinine test are indicative only. Nevertheless, it was possible to see that some under-reporting of smoking did occur. In particular, three of the four patients who reported no use of either e-cigarettes or of tobacco cigarettes had serum cotinine concentrations inconsistent with this (at 135–300ng/mL) corresponding with the observations of staff that at least four patients were using e-cigarettes and were not smoking, but were not keeping records of their e-cigarette use.

Limitations of this study include its small size, and that we did not systematically collect data about the experiences of the nursing staff. The study was made more difficult because of heavy workload demands on frequently changing staff. It proved difficult to maintain the staff's ability to keep the patients supplied with charged batteries and filled cartridges, or to encourage diary maintenance by the patients.

Recording of e-cigarette use was generally inconsistent, with some counting individual puffs and some counting vaping sessions. Uncertainty about how to record e-cigarette use may have contributed to some patients not recording their e-cigarette use.

While the disposable e-cigarettes were preferred by the nursing staff, they appeared to be less effective than the rechargeable variety. This type of e-cigarette is known to be less effective at nicotine delivery than are the later types, and so that result was not unexpected.[12]

Regardless of these limitations, the results showed that e-cigarettes provided a form of NRT that these alcohol-dependent patients, with psychological and physical illnesses, were prepared to use, either for cessation or as a smoking substitute. E-cigarette technologies are improving rapidly and, were this trial to be repeated, it should be possible to find a brand of e-cigarette which

is both easy for the nursing staff to supply and adequate in its nicotine delivery.

Further, our over-riding impression from the nursing staff was that management of these patients became easier with e-cigarettes being supplied. This project aimed simply to assess whether e-cigarettes would be used, if available. Future work should explore further the ways in which this innovation was helpful, both for the nursing staff and for the patients.

If the availability of e-cigarettes within a hospital ward reduces some stresses both on patients and on the nursing staff, this could make a significant difference to treatment of drug and alcohol patients or other heavily tobacco-dependent patients admitted for care. This is an important and recalcitrant public health issue, particularly for psychiatric and drug or alcohol-dependent patients.[3,4,13]

Competing interests:
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REFERENCES:

1. Henningfield JE, Fant RV. Tobacco use as drug addiction: the scientific foundation. Nicotine Tob Res. 1999; 1 Suppl 2:S31–S35.
2. Prochaska JJ, Delucchi K, Hall SM. A meta-analysis of smoking cessation interventions with individuals in substance abuse treatment or recovery. J Consult Clin Psychol. 2004; 72(6):1144–1156.
3. Thurgood SL, McNeill A, Clark-Carter D, Brose LS. A systematic review of smoking cessation interventions for adults in substance abuse treatment or recovery. Nicotine Tob Res. 2016; 18(5):993–1001.
4. Shi Y, Cummins SE. Smoking cessation services and smoke-free policies at substance abuse treatment facilities: national survey results. Psychiatr Serv. 2015; 66(6):610–616.
5. Benowitz NL. Pharmacology of nicotine: addiction, smoking-induced disease, and therapeutics. Annu Rev Pharmacol Toxicol. 2009; 49:57–71.
6. Ramoa CP, Hiler MM, Spindle TR, et al. Electronic cigarette nicotine delivery can exceed that of combustible cigarettes: a preliminary report. Tob Control. 2016; 25 (e1):e6–9. doi: 10.1136/tobaccocontrol-2015-052447
7. Glover M, McRobbie H. Electronic cigarettes appealing quit aids for young adult smokers. N Z Med J. 2015; 128(1417):59–60.
8. Fillon M. E-cigarettes may lead to youth tobacco use: evidence mounts. J Natl Cancer Inst. 2016; 108(2). pii: djw016. doi: 10.1093/jnci/djw016
9. Fagerstrom K. Time to first cigarette; the best single indicator of tobacco dependence? Monaldi Arch Chest Dis. 2003; 59(1):91–94.
10. Laugesen M. Nicotine and toxicant yield ratings of electronic cigarette brands in New Zealand. N Z Med J. 2015; 128(1411):77–82.
11. Jarvis MJ, Russell MA, Benowitz NL, Feyerabend C. Elimination of cotinine from body fluids: implications for noninvasive measurement of tobacco smoke exposure. Am. J. Public Health. 1988; 78(6):696–698.
12. Bullen C. Electronic cigarettes for smoking cessation. Curr Cardiol Rep. 2014; 16(11):538. doi: 10.1007/s11886-014-0538-8
13. Regan S, Viana JC, Reyen M, Rigotti NA. Prevalence and predictors of smoking by inpatients during a hospital stay. Arch Intern Med. 2012; 172(21):1670–1674.