

KENAI LEGISLATIVE INFORMATION OFFICE

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WRITTEN TESTIMONY

NAME: Steve Gossman
REPRESENTING: Self
BILL # or SUBJECT: SB 1
COMMITTEE: Senate State Affairs **DATE:** 4-2-15

Dear Senators,

I'm writing you to oppose SB1: Regulation of Smoking.
This is an unnecessary assault on private property, business and association rights.
It also appears to be a backdoor effort to undermine Measure 2.

Business owners and citizens don't need to government making decisions for them...that's why most of us Alaskans came up here in the first place - to escape all the nanny-state BS going on right now down in the states.

SB1 isn't just UN-Alaskan, it's also UN-American.
Freedom of choice is one of the pillars of this great country and should not be messed with.

Sincerely,
Steve Gossman

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WRITTEN TESTIMONY

NAME: Gary Superman

REPRESENTING: Self / business owner

BILL # or SUBJECT: SB 1

COMMITTEE: Senate State Affairs **DATE:** 4-2-15

This is a story of crusaders pushing their will through the brute force of the state. Their narrative is based primarily on the pretense of this issue being one of ‘settled science’. Folks, this is about as much settled science as is the origin of the universe or our understanding of todays climate change.

“The statistical evidence does not appear to support a conclusion that there are substantial health effects of passive smoking.....even at the greatest exposure levels.....very few or even no deaths can be attributed to ETS.” This is the 1995 conclusion arrived at by the Congressional Research Service after detailed analysis of the EPA study Environmental Tobacco Smoke and Lung Cancer Risk. This was further reinforced when a 1998 U.S. Federal Court Decision threw the study out finding it had been manipulated to arrive at the desired result. Crusading movements are seldom stopped by facts.

After years of being involved in this fight at the local level and with the legislature last year I’ve grown to understand the driving forces and the tactics they’ve employed in their pursuit. MY LIFE AND PROPERTY ARE NOT JUSTIFIABLY AT YOUR DISPOSAL.

I concede that the proximity of tobacco smoke makes some uncomfortable. Hence, we already have bans in 99% of the locations outlined in SB1. We, as that segment of society who smoke are accustomed to those bans and realize that there are compelling reasons for people to enter those locations whether it be for travel, health care, a government service, shopping, eating etc., etc., etc. There is no compelling reason to go into a bar, it is simply a choice. A choice that deserves preservation of rights for the patrons who only wish to relax and enjoy themselves in the last public sanctuary available to them if they smoke. SB1 is utterly disingenuous as it is defacto already without the bars. And this is about the few bars that allow smoking. What harm is being done to society by allowing them to remain so?

Daniel George

From: Andy Lundquist <yndot@gci.net>
Sent: Thursday, April 02, 2015 3:47 PM
To: Sen. Bill Stoltze
Subject: SB 1 Smoking Bill

Dear Senator Stoltze:

I was encouraged to hear you say that this bill is not going anywhere until everyone has had his/her time to testify. Thank-you—please do not be bullied by the non-smoking politically correct industry financed by the” tobacco settlement industry”.

First of all—I’m against this bill. This bill represents another example of the left nanny state driving a false narrative to support the politically correct assumption that ANY trace of second hand smoke is lethal and we need to protect everyone from this dreadful toxin at any cost. These do gooders think that every ill of society can be prevented with another law and no one should take responsibility for themselves.

Lets face it—there is no smoking in public buildings, grocery stores, day care centers, most places of employment—about the only enclosed places where you will encounter second-hand smoke is in those few bars where their owners have decided to maintain a place of business where their customers can enjoy a cigarette (a legal substance). Many bar owners in every city in Alaska have made the personal business decision of whether to allow or not allow smoking on their premises. This is an economic decision and should be left up to the owner of each establishment. Whether a business allows smoking, whether a customer chooses to enter a smoking or non-smoking establishment, and whether an employee chooses to work at one of these places is a **PERSONAL CHOICE!** In addition, all employees working in places serving alcohol are 21 years of age and **ADULTS.**

Second hand smoking in open air venues like parks, open air stadiums—the science behind this analysis is pure speculation and junk. I don’t want to argue whether second hand smoke is good or bad for you but common sense tells you that toxic levels of anything when diluted to undetectable levels is absurd.

I owned a bar for over twenty-five years. I do not smoke. Please do not let these non-smoking zealots tell you a non- smoking law will be good for business. I will make that decision—thank-you.

I think most Alaskans are wise enough to make up their minds for themselves on whether they want to go into bars which allow smoking. The legislature would do better spending more of its time figuring out how to stem the use of meth and heroin (a smoking substance) which is tearing at the social fabric of every town in Alaska . Someone needs to tell Alaska Tobacco Alliance and similar groups to take a break and **LIGHTEN UP.** (sort of like **LIGHT UP**)

Sincerely,

Andy Lundquist, Kodiak

Daniel George

From: Guinness64 . <jmfinney64@gmail.com>
Sent: Tuesday, April 07, 2015 7:24 AM
To: Sen. Bill Stoltze
Subject: Regarding SB1
Attachments: Levels of selected carcinogens.pdf

Senator Stoltze,

After listening to the audio from the HSS committee hearing on SB1, I am writing you to give you some insight to a few things that are not being mentioned about the sponsor's information. I have included a copy of one study that has been cited by the supporters of this bill, to prove a specific point regarding personal vaporizers, or e-cigarettes. The supporters have been taking bits and pieces of studies, and not fully casting light on what those studies have shown.

Firstly, the supporters LOVE to shout from the rooftops that their cited study shows that trace metals were found in personal vaporizers. What they won't tell you, is that the study actually says that trace metals were detected, at comparative levels to Nicorette inhalers and the air blanks used. "The same metals in trace amounts were detected in Nicorette inhalator and in blank samples." This shows that the ambient air in the room was the actual cause for those trace metals to be discovered.

Formaldehyde is another large selling point for supporting this bill. I know that I wouldn't be as keen on using a product that was filled with embalming fluid. So, they cite the same studies that state formaldehyde is present in the vapor from a personal vaporizer. But wait, that's not all that they said about it. "Formaldehyde was also found in the vapour of medicinal inhalators, at levels that overlapped with those found in e-cigarette vapour." It doesn't fit the narrative, so it is left out.

Finally, let's just get to the conclusions of the study. What about in general? What level of "potentially", not factually, toxic compounds in a complete aspect are we looking at? And I quote again, "The vapour generated from e-cigarettes contains potentially toxic compounds. However, the levels of potentially toxic compounds in e-cigarette vapour are 9–450-fold lower than those in the smoke from conventional cigarettes, and in many cases comparable with the trace amounts present in pharmaceutical preparation." It's amazing what they have left out of their speeches when reaching to limit the use of a life saving device.

In closing, I would like to thank you for your time regarding the inclusion of personal vaporizers in SB1. As a 20 year smoker, now smoke-free for 14 months due to personal vaporizers, these devices have saved my life. The knee-jerk reaction to set limits on these devices puts more people in the pathway of potential harm than good. And, with the supporters using studies that state specifically, "Our findings support the idea that substituting tobacco cigarettes with electronic cigarettes may substantially reduce exposure to tobacco-specific toxicants. The use of e-cigarettes as a harm reduction strategy among cigarette smokers who are unable to quit, warrants further study", why would anyone in their right mind considered legislating them in the way they are trying to?

Thank you,

Jason Finney

North Pole, AK

907-322-1301

Levels of selected carcinogens and toxicants in vapour from electronic cigarettes

Maciej Lukasz Goniewicz,^{1,2,3} Jakub Knysak,³ Michal Gawron,³ Leon Kosmider,^{3,4} Andrzej Sobczak,^{3,4} Jolanta Kurek,⁴ Adam Prokopowicz,⁴ Magdalena Jablonska-Czapla,⁵ Czeslawa Rosik-Dulewska,⁵ Christopher Havel,⁶ Peyton III Jacob,⁶ Neal Benowitz⁶

► Additional material is published online only. To view please visit the journal online (<http://dx.doi.org/10.1136/tobaccocontrol-2012-050859>).

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Received 24 October 2012
Accepted 31 January 2013

To cite: Goniewicz ML, Knysak J, Gawron M, *et al.* *Tob Control* Published Online First: [please include Day Month Year] doi:10.1136/tobaccocontrol-2012-050859

ABSTRACT

Significance Electronic cigarettes, also known as e-cigarettes, are devices designed to imitate regular cigarettes and deliver nicotine via inhalation without combusting tobacco. They are purported to deliver nicotine without other toxicants and to be a safer alternative to regular cigarettes. However, little toxicity testing has been performed to evaluate the chemical nature of vapour generated from e-cigarettes. The aim of this study was to screen e-cigarette vapours for content of four groups of potentially toxic and carcinogenic compounds: carbonyls, volatile organic compounds, nitrosamines and heavy metals.

Materials and methods Vapours were generated from 12 brands of e-cigarettes and the reference product, the medicinal nicotine inhaler, in controlled conditions using a modified smoking machine. The selected toxic compounds were extracted from vapours into a solid or liquid phase and analysed with chromatographic and spectroscopy methods.

Results We found that the e-cigarette vapours contained some toxic substances. The levels of the toxicants were 9–450 times lower than in cigarette smoke and were, in many cases, comparable with trace amounts found in the reference product.

Conclusions Our findings are consistent with the idea that substituting tobacco cigarettes with e-cigarettes may substantially reduce exposure to selected tobacco-specific toxicants. E-cigarettes as a harm reduction strategy among smokers unwilling to quit, warrants further study. (To view this abstract in Polish and German, please see the supplementary files online.)

INTRODUCTION

An electronic cigarette, also known as e-cigarette, is a type of nicotine inhaler, imitating ordinary cigarettes. Although the majority of e-cigarettes look similar to other tobacco products, such as cigarettes or cigars, certain types resemble pens, screwdrivers or even harmonicas. E-cigarettes contain nicotine solution in a disposable cartridge. The cartridge is replaced when the solution is finished or might be refilled by the e-cigarette user. In contrast with ordinary cigarettes, which involve tobacco combustion, e-cigarettes use heat to transform nicotine solution into vapour. Processed and purified nicotine from tobacco leaves, suspended in a mixture of glycerin or propylene glycol with water, is vapourised. Nicotine present in such vapour enters the respiratory tract, from where it is absorbed to the bloodstream.^{1–4}

Distributors of e-cigarettes promote the product as completely free of harmful substances. The basis for

the claim of harmlessness of the e-cigarettes is that they do not deliver toxic doses of nicotine and the nicotine solution lacks harmful constituents. E-cigarettes are new products and, as such, require further testing to assess their toxic properties. Currently, the scientific evidence on the lack or presence of toxic chemicals in the vapour generated from e-cigarettes, and inhaled by their users is very limited. In August 2008, Ale Alwen, the Assistant Director-General for Non-communicable Diseases and Mental Health, stated that ‘the electronic cigarette is not a proven nicotine replacement therapy. WHO has no scientific evidence to confirm the product’s safety and efficacy. However, WHO does not discount the possibility that the electronic cigarette could be useful as a smoking cessation aid. The only way to know is to test.’⁵ Douglas Bettcher, Director of the WHO’s Tobacco Free Initiative stated that only clinical tests and toxicity analysis could permit considering e-cigarettes a viable method of nicotine replacement therapy.⁶

The majority of tests carried out on e-cigarettes until now consist of analysing the chemicals in the cartridges or nicotine refill solutions.^{7–18} The current tests show that the cartridges contain no or trace amounts of potentially harmful substances, including nitrosamines, acetaldehyde, acetone and formaldehyde. However, using e-cigarettes requires heating the cartridges and under such conditions chemical reactions may result in formation of new compounds. Such a situation takes place in the case of ordinary cigarettes, where a number of toxic compounds are formed during combustion. The US Department of Health and Human Services of the Food and Drug Administration agency carried out tests which showed the presence of trace amounts of nitrosamines and diethylene glycol in e-cigarette vapour. These tests were conducted in a manner which simulated the actual use of the products.¹⁹

We developed analytical methods and measured concentrations of selected compounds in the vapour generated by different brands and types of e-cigarettes. We focused our study on the four most important groups of toxic compounds present in the tobacco smoke: carbonyl compounds, volatile organic compounds (VOCs), tobacco-specific nitrosamines and metals (table 1).

MATERIALS AND METHODS

Electronic cigarettes and reference product (Nicorette inhalator)

Since the internet is currently the main distribution channel for the products, we searched price

Table 1 Selected toxic compounds identified in tobacco smoke^{20–23}

Chemical compounds	Toxic effects
Carbonyl compounds	
Formaldehyde*, acetaldehyde*, acrolein*	Cytotoxic, carcinogenic, irritant, pulmonary emphysema, dermatitis
Volatile organic compounds (VOCs)	
Benzene*, toluene*, aniline	Carcinogenic, haematotoxic, neurotoxic, irritant
Nitrosamines	
N'-nitrosanornicotine (NNN)*, 4-(methylnitrosoamino)-1-(3-pyridyl)-1-butanone (NNK)*, N'-nitrosoethylmethyloamine	Carcinogenic
Polycyclic aromatic compounds (PAHs)	
Benzo(a)pyrene, benzo(a)anthracene, dibenzo(a)anthracene	Carcinogenic
Free radicals	
Methyl radical, hydroxyl radical, nitrogen monoxide	Carcinogenic, neurotoxic
Toxic gases	
Carbon monoxide, hydrogen sulfide, ammonia, sulfur dioxide, hydrogen cyanide	Cardiovascular toxicants, carcinogenic, irritant
Heavy metals	
Cadmium (Cd)*, lead (Pb)*, mercury (Hg)*	Carcinogenic, nephrotoxic, neurotoxic, haematotoxic
Other toxicants	
Carbon disulfide	Neurotoxic

*Indicates compounds analysed in this study.

comparison websites, online marketplace (Allegro.pl auction service) and internet discussion forums for e-cigarette users to identify the most popular brands of e-cigarettes distributed from within Poland. The searching was limited to web pages from Poland, and only Polish language was allowed for in retrieval options. Some 30 brands were identified. The brands were entered into Google.pl, and ranked according to the number of hits they generated. The number of hits in the search engine for the selected 30 models allowed selection of the 11 most popular e-cigarettes brands. Additionally, one e-cigarette model purchased in Great Britain was used in the study. All e-cigarette models selected for the study were purchased online. Characteristics of the product tested in the study are shown in table 2.

The suitable cartridges of the same brand name were used for the study. They were purchased from the same sources as that of the e-cigarette and were matched to selected models. All cartridges were characterised by high nicotine content (16–18 mg). As a reference product the medicinal nicotine inhalator was used (Nicorette 10 mg, Johnson&Johnson, Poland). The

inhalator for the study was purchased in one of the local pharmaceutical warehouses.

Generation of vapour from e-cigarettes and reference product

Vapour from e-cigarettes was generated using the smoking machine Palaczbot (Technical University of Lodz, Poland) as described previously.³ This is a one-port linear piston-like smoking machine with adjustable puffing regimes in a very wide range, controlled by computer interface.

Pilot samples demonstrated that it was impossible to generate vapour from e-cigarettes in standard laboratory conditions assumed for conventional cigarettes testing (International Organization for Standardization (ISO) 3808).²⁴ Inhalation of a volume of 35 ml anticipated in conventional cigarette standard is insufficient for activation of most of the e-cigarettes. Thus, we decided to generate vapour in conditions reflecting the actual manner of e-cigarettes using, determined based on the results of inhalation topography measurement among 10 'e-smokers', who declared that they regularly use e-cigarettes for a period

Table 2 Characteristics of products tested in the study

Product code	Brand name	Model	Cartridge type	Flavour	Labelled nicotine content (mg or mg/ml)	Measured nicotine content (mg) ³	Retailer	Country
EC01	Joye	510	Cartridge	Marlboro	4	4	Inspired s.c.	Poland
EC02	Janty	eGo	Cartridge	Marlboro	16	5	Janty	Poland
EC03	Janty	Dura	Cartridge	Marlboro	16	5	Janty	Poland
EC04	DSE	901	Cartridge	Regular	16	9	Fausee	Poland
EC05	Trendy	808	Cartridge	Trendy	18	2	Damhess	Poland
EC06	Nicore	M401	Cartridge	Marlboro	18	5	Atina Poland	Poland
EC07	Mild	201	Cartridge	Marlboro	18	19	Mild	Poland
EC08	Colinss	Age	Cartomizer	Camel	18	11	Colinss	Poland
EC09	Premium	PR111	Cartomizer	Tobacco	16	12	Premium	Poland
EC10	Ecis	510	Cartridge	Menthol	11	5	Arcotech	Poland
EC11	Dekang	Pen	Cartridge	Regular	18	18	Ecigars Polska	Poland
EC12	Intellicig	Evolution	Cartridge	Regular	8	8	Intellicig	UK

longer than 1 month.³ All testing procedures in this work were carried out using the same averaged puffing conditions: puff duration of 1.8 s, intervals between puffs of 10 s, puff volume 70 ml and number of puffs taken in one puffing session was 15. A total of 150 puffs were taken from each e-cigarette in 10 series of 15 puffs with intervals between series of 5 min each. Each e-cigarette was tested three times on three following days after batteries were recharged during nights. A fresh cartridge was placed on the e-cigarettes each day they were tested. Vapour was visibly being produced during the full 150 puffs taken from each product tested.

Analytical chemistry

Note: The details of the sample preparation and analysis are given in the online supplementary materials.

It was planned to absorb the analysed vapour components in bulbs containing an organic solvent (extraction to liquid) or on suitable sorbents (extraction to solid phase). This required the modification of the system described above, in such a manner to enable quick connection of desirable sorption system. Carbonyl compounds and organic compounds due to their volatility were trapped in tubes packed with solid adsorbent. Metals and nitrosamines in turn, which are characterised by lower volatility, were to be absorbed in two gas washing bottles with methanol (50 ml in each bottle). Both washing bottles were immersed in acetone-dry ice bath in order to avoid any losses of volatile solvent. A picture of the set for vapour generation from e-cigarette and metals or nitrosamines absorption is presented in online supplementary figure S2.

The samples, after the preparation and condensation procedure, were analysed using analytical methods with high specificity and sensitivity allowing detection of even trace amounts of analysed compounds. Figure 1 shows the sample preparation procedure; and all analytical methods are described in details in the online supplementary materials. The following carbonyl compounds were analysed in this work using high-performance liquid chromatography with diode array detector (HPLC-DAD): formaldehyde, acetaldehyde, acrolein, acetone, propionic aldehyde, crotonaldehyde, butanol, benzaldehyde, isovaleric aldehyde, valeric aldehyde, m-methylbenzaldehyde,

o-methylbenzaldehyde, p-methylbenzaldehyde, hexanal, 2,5-dimethylbenzaldehyde. VOCs included benzene, toluene, chlorobenzene, ethylbenzene, m,p-xylene, o-xylene, styrene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichlorobenzene, naphthalene and were analysed with gas chromatography-mass spectrometry. Among tobacco-specific nitrosamines two compounds were measured: N'-nitrosornicotine (NNN) and 4-(methylnitrosoamino)-1-(3-pyridyl)-1-butanone (NNK) with ultra-performance liquid chromatography-mass spectrometry. An inductively coupled plasma mass spectrometry technique was used to quantify following metals: cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), cadmium (Cd), lead (Pb), arsenic (As), chromium (Cr), selenium (Se), manganese (Mn), barium (Ba), rubidium (Rb), strontium (Sr), silver (Ag), thallium (Tl) and vanadium (V). All analytical methods used in this work were validated as per the International Conference on Harmonisation guideline Q2(R1).²⁵

Statistical analysis

Results were presented as mean±SEM levels of selected compounds in vapour generated from e-cigarettes (per 150 puffs). The study aimed to compare the results obtained for aerosol from Nicorette inhalator with the results obtained for all examined e-cigarette models. Due to the small size of the groups, the difference between the mean from two groups was assessed based on Student's t test. All statistical analyses were conducted using the software for statistical data analysis Statistica V9.0 (StatSoft, Tulsa, USA). The significance level was established as $p < 0.05$.

RESULTS

Carbonyl compounds

Among 15 carbonyls analysed, only 4 were found in vapour generated from e-cigarettes (table 3); and these compounds were identified in almost all examined e-cigarettes. The exception was one e-cigarette marked with code EC09, where acrolein was not detected. Three of the carbonyls have known toxic and irritating properties: formaldehyde, acetaldehyde and acrolein. The content of formaldehyde ranged from 2.0 µg to 56.1 µg, acetaldehyde from 1.1 µg to 13.6 µg, and acrolein from 0.7 µg to 41.9 µg per one e-cigarette (150 puffs). Trace amounts of formaldehyde, acetaldehyde and o-methylbenzaldehyde were also detected from the Nicorette inhalator. None of these compounds were detected in blank samples.

Volatile organic compounds

Among 11 VOCs analysed, only two were found in samples of vapour generated from e-cigarettes (table 3), and these compounds were identified in almost all examined e-cigarettes. The only one exception was e-cigarette marked with code EC02, where toluene and m,p-xylene were not detected. The content of toluene ranged from 0.2 µg to 6.3 µg per one e-cigarette (150 puffs). Although the m,p-xylene levels found in analysed samples of e-cigarette vapours ranged from 0.1 µg to 0.2 µg, it was also found on the same level in blank samples. In Nicorette inhalator in turn, none of the compounds analysed in that group were noted.

Tobacco-specific nitrosamines

Both nitrosamines analysed in the study were identified in all but three vapours generated from e-cigarettes (table 3). NNN was not found in e-cigarettes marked with codes EC01, EC04 and EC05 and NNK was not identified in products EC04, EC05 and EC12. The content of NNN ranged from 0.8 ng to 4.3 ng, and NNK from 1.1 ng to 28.3 ng per one e-cigarette

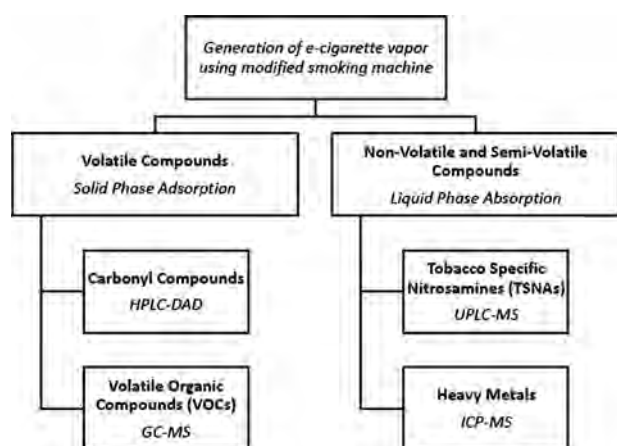


Figure 1 Analytical procedures applied in the study to test carcinogens and selected toxicants in vapour from e-cigarettes. GC-MS, gas chromatography-mass spectrometry; HPLC-DAD, high-performance liquid chromatography with diode array detector; ICP-MS, inductively coupled plasma-mass spectrometry; TSNA, tobacco-specific nitrosamine; UPLC-MS, ultra-performance liquid chromatography-mass spectrometry; VOC, volatile organic compound.

Table 3 Levels of selected compounds in vapour generated from e-cigarettes (per 150 puffs)

Compound	BS	Levels in vapour from electronic cigarettes†												Reference product
		Product code												
		EC01	EC02	EC03	EC04	EC05	EC06	EC07	EC08	EC09	EC10	EC11	EC12	Inhalator
Carbonyl compounds (µg)														
Formaldehyde	ND	44.2±4.1*	23.6±8.7*	30.2±2.3*	47.9±0.2*	56.1±1.4*	35.3±2.7*	19.0±2.7*	6.0±2.0	3.2±0.8	3.9±1.5	23.9±11.1	46.3±2.1*	2.0±1.1
Acetaldehyde	ND	4.6±0.2*	6.8±3.2	8.2±2.5*	11.5±2.0*	3.0±0.2*	13.6±2.1*	11.1±3.3*	8.8±1.6*	3.5±0.3*	2.0±0.1	3.7±1.5	12.0±2.4*	1.1±0.6
Acrolein	ND	41.9±3.4*	4.4±2.5	16.6±2.5*	30.1±6.4*	22.0±1.6*	2.1±0.4*	8.5±3.6	0.7±0.4	ND	2.7±1.6	1.1±0.6	7.4±3.2*	ND
o-methylbenzaldehyde	ND	1.9±0.5	4.4±1.2*	3.2±1.0*	4.9±1.2*	1.7±0.1*	7.1±0.4*	1.3±0.8	5.5±0.0*	6.0±0.7*	3.2±0.5*	5.1±0.1*	2.2±0.6*	0.7±0.4
Volatile Organic Compounds (VOCs) (µg)														
Toluene	ND	0.5±0.1*	ND	0.2±0.0*	0.6±0.1*	0.2±0.0*	ND	0.3±0.2	0.2±0.1	6.3±1.5*	0.2±0.1*	0.5±0.1*	0.5±0.0*	ND
p,m-xylene	0.1	0.1±0.0*	ND	0.1±0.0*	0.2±0.1*	0.1±0.0	ND	0.1±0.1	0.1±0.0	0.1±0.0*	0.1±0.0*	0.1±0.1*	0.1±0.0	ND
Tobacco-Specific Nitrosamines (TSNAs) (ng)														
NNN	ND	ND	2.7±2.2	0.8±0.8	ND	ND	0.9±0.4	4.3±2.4	1.9±0.3*	1.2±0.6	2.0±1.1	3.2±0.6*	1.3±0.1	ND
NNK	ND	2.0±2.0	3.6±1.8	3.5±1.8	ND	ND	1.1±1.1	21.1±6.3*	4.6±0.4*	28.3±13.2	2.1±2.1	13.0±1.4*	ND	ND
Metals (µg)														
Cd	0.02	0.17±0.08	0.15±0.03*	0.15±0.05	0.02±0.01	0.04±0.01	0.22±0.16	0.02±0.01	0.08±0.03	0.01±0.01	0.17±0.10	0.03±0.03	ND	0.03±0.01
Ni	0.17	0.28±0.22	0.29±0.08	0.21±0.03	0.17±0.07	0.14±0.06	0.11±0.06	0.23±0.09	0.26±0.10	0.19±0.09	0.12±0.04	0.11±0.08	0.11±0.05	0.19±0.04
Pb	0.02	0.06±0.01	0.06±0.03	0.07±0.01	0.03±0.01	0.05±0.01	0.03±0.01	0.04±0.01	0.57±0.28	0.09±0.04	0.06±0.02	0.04±0.03	0.03±0.03	0.04±0.01

Values are mean±SEM.

*Significant difference with Nicorette inhalator (p<0.05).

†Units are µg, except for nitrosamines units are ng.

BS, blank sample; ND, not detected; NNK, N'-nitrosanornicotine (NNN) and 4-(methylnitrosoamino)-1-(3-pyridyl)-1-butanone; NNN, N'-nitrosanornicotine; DL, detection limit.

(150 puffs). In Nicorette inhalator or in blank samples in turn, none of these compounds was noted.

Metals

Among 12 metals analysed in the study, cadmium, nickel and lead were identified, and were present in all vapours generated from e-cigarettes (except cadmium, which was not detected in a product of code EC12; table 3). The content of cadmium ranged from 0.01 µg to 0.22 µg, nickel from 0.11 µg to 0.29 µg and lead from 0.03 µg to 0.57 µg per one e-cigarette (150 puffs). The same metals in trace amounts were detected in Nicorette inhalator and in blank samples.

DISCUSSION

We examined vapours generated from 12 models of e-cigarettes for the presence of four groups of toxic compounds found in tobacco smoke. The Nicorette inhalator was used as a reference product. Such a choice was dictated by the premise that a therapeutic product like Nicorette inhalator should fulfil specified safety standards and should not contain significant levels of any of the analysed toxic compounds.

Our results confirm findings from the previous studies, in which small amounts of formaldehyde and acetaldehyde were detected in cartridges.^{9 18} However, the presence of acrolein in a cartridge or nicotine solution has not been reported so far. Formaldehyde and acetaldehyde were also found in vapour exhaled to test chamber by volunteers who used e-cigarette filled with three various nicotine solutions.²⁶ Recently, Uchiyama *et al*²⁷ demonstrated that vapour generated from a single brand of e-cigarette contained low levels of formaldehyde, acetaldehyde and acrolein. There is a possibility that acrolein is present in vapour only, since this compound may be formed as a result of heating glycerin which is a component of the solution. Pyrolysis of glycerin has been studied in steam with acrolein, formaldehyde and acetaldehyde observed as the major products.^{28 29} These products appear to result from dehydration and fragmentation of glycerin. Although energy calculations of the dehydration of glycerin by the neutral mechanisms indicate that these processes can only occur at relatively high temperatures such as in pyrolysis or combustion, the addition of acids allows substantially lower dehydration temperatures.³⁰

All three carbonyl compounds found in the study and discussed above have been shown to be toxic in numerous studies: formaldehyde is classified as carcinogenic to humans (group 1 by International Agency for Research on Cancer, IARC)³¹; acetaldehyde as possibly carcinogenic to humans (group 2B),³¹ and acrolein causes irritation to the nasal cavity, and damage to the lining of the lungs and is thought to contribute to cardiovascular disease in cigarette smokers.³² Exposure to carbonyl compounds found in vapour might cause mouth and throat irritation which

is the most frequently reported adverse event among e-cigarette users.^{1 33} A study by Cassee *et al*³⁴ showed that sensory irritation in rats exposed to mixtures of formaldehyde, acetaldehyde and acrolein is more pronounced than that caused by each of the compounds separately. Future studies should evaluate possible adverse health outcomes of short term and long term exposure to these compounds among users of e-cigarettes and people involuntarily exposed to exhaled vapours.

We found that the vapour of some e-cigarettes contains traces of the carcinogenic nitrosamines NNN and NNK, whereas neither was detected in aerosol from the Nicorette inhalator. The studies conducted previously reported the presence of NNN and NNK in e-cigarette cartridges in amounts of 3.9–8.2 ng per cartridge,^{18 19} which corresponds with the results on vapour obtained in the present paper. However some other studies have reported that some cartridges are free of nitrosamines.¹² This inconsistency of findings of various studies might be due to different analytical methodologies of variable sensitivity applied in the studies discussed above.

Two of the analysed VOCs were detected: toluene and m, p-xylene. None of the studies conducted until now reported the presence of these compounds in a cartridge, nicotine solution or e-cigarette vapour. None of these compounds were found in a study by Schripp *et al*²⁶ on passive exposure to e-cigarette vapours. Three toxic metals, cadmium, nickel and lead, were detected in the vapour of analysed e-cigarettes. Since the same elements were also detected in trace amounts in Nicorette inhalator and in blank samples it is possible that there were other sources of these metals. This limitation of the study does not allow us to conclude whether e-cigarette alone may be a significant source of exposure to these chemicals.

Recently, we published a study on tests for nicotine delivery of Polish and UK e-cigarette brands.³ Many of the same brands in that paper have also been included in this study and tested for toxicants delivery. It should be mentioned that the leading brands with the highest nicotine delivery did not have the highest yields for toxicant delivery. This is important as while selecting the brands for nicotine the worst brands for toxicants generally can be avoided.

The results allowed us to compare the content of harmful substances between various e-cigarette models and conventional cigarettes (based on literature data).³⁵ To compare levels of selected toxins in e-cigarette vapour and mainstream smoke of a conventional cigarette we assumed that users of e-cigarettes take on average 15 puffs during one session of product use, and it would correspond to smoking one conventional cigarette. In our study the vapours from e-cigarettes were generated from 150 puffs (10 series of 15 puffs each). For comparison purposes, we assumed that 150 puffs of an e-cigarette correspond to smoking 10 cigarettes. The comparison of toxic substance levels between conventional cigarettes and e-cigarettes is presented in table 4.

Table 4 Comparison of toxins levels between conventional and electronic cigarettes

Toxic compound	Conventional cigarette (µg in mainstream smoke) ³⁵	Electronic cigarette (µg per 15 puffs)	Average ratio (conventional vs electronic cigarette)
Formaldehyde	1.6–52	0.20–5.61	9
Acetaldehyde	52–140	0.11–1.36	450
Acrolein	2.4–62	0.07–4.19	15
Toluene	8.3–70	0.02–0.63	120
NNN	0.005–0.19	0.00008–0.00043	380
NNK	0.012–0.11	0.00011–0.00283	40

NNK, N'-nitrosornicotine (NNN) and 4-(methylnitrosoamino)-1-(3-pyridyl)-1-butanone; NNN, N'-nitrosornicotine.

As shown in table 4 levels of selected toxic compounds found in the smoke from a conventional cigarette were 9–450-fold higher than levels in the vapour of an e-cigarette. Smoking an e-cigarette (also referred to as ‘vaping’) can result in exposure to carcinogenic formaldehyde comparable with that received from cigarette smoking. Formaldehyde was also found in the vapour of medicinal inhalators, at levels that overlapped with those found in e-cigarette vapour. Exposure to acrolein, an oxidant and respiratory irritant thought to be a major contributor to cardiovascular disease from smoking, is 15 times lower on average in e-cigarette vapour compared with cigarette smoke. The amounts of toxic metals and aldehydes in e-cigarettes are trace amounts and are comparable with amounts contained in an examined therapeutic product.

The results of the study support the proposition that the vapour from e-cigarettes is less injurious than the smoke from cigarettes. Thus one would expect that if a person switched from conventional cigarettes to e-cigarettes the exposure to toxic chemicals and related adverse health effects would be reduced. The confirmation of that hypothesis however, requires further studies involving people using e-cigarette devices.

The primary limitation of our research is that the puffing profile we used may not reflect actual user puff topography. Hua *et al*³⁶ reported that e-cigarette users take longer puffs, and that puff duration varied significantly among e-cigarette brands and users. This suggests that actual doses of toxicants inhaled by e-cigarette users might be higher than measured in our study. Similarly to results of tobacco cigarette testing with smoking machines (International Organization for Standardization (ISO), Federal Trade Commission (FTC)) the values obtained in our study should be interpreted with caution. The other limitation of our research is that we have tested only 12 brands of e-cigarettes. There are numerous different brands in the market, and there is little information on their quality control.

CONCLUSIONS

The vapour generated from e-cigarettes contains potentially toxic compounds. However, the levels of potentially toxic compounds in e-cigarette vapour are 9–450-fold lower than those in the smoke from conventional cigarettes, and in many cases comparable with the trace amounts present in pharmaceutical preparation. Our findings support the idea that substituting tobacco cigarettes with electronic cigarettes may substantially reduce exposure to tobacco-specific toxicants. The use of e-cigarettes as a harm reduction strategy among cigarette smokers who are unable to quit, warrants further study.

What this paper adds

- ▶ Distributors of e-cigarettes promote the product as completely free of harmful substances. Currently, there is no comprehensive research on the presence of toxic chemicals in the vapour generated from e-cigarettes and inhaled by their users.
- ▶ This study of chemical composition of vapour generated from 12 brands of e-cigarettes revealed that the vapour contained some toxic substances.
- ▶ The levels of potentially toxic compounds in e-cigarette vapour were found to be from ninefold to almost 450-fold lower compared with smoke from conventional cigarettes, and in many cases comparable with trace amounts present in pharmaceutical preparations.

Contributors MLG and NB designed the study and wrote the paper. JK, MG and LK tested the products using smoking machine. AS and JK developed the analytical method and measured carbonyl compounds and VOCs. AP, MJC, and CRD developed the analytical method and measured metals. CH and PJ developed the analytical method and measured TSNAs. MLG and JK analysed the data. All contributors approved the final version of the manuscript.

Funding This study was conducted while the first author was at Medical University of Silesia, Poland and was supported by the Ministry of Science and Higher Education of Poland under grant number N N404 025638. The study sponsor had no involvement in the study design, collection, analysis and interpretation of data, the writing of the manuscript or the decision to submit the manuscript for publication. Analysis of nitrosamines at the University of California, San Francisco was supported by grants P30 DA012393 and S10 RR026437 from the National Institutes of Health.

Competing interests MLG received research funding from Pfizer, manufacturer of stop smoking medication and is currently funded by the UK Centre for Tobacco Control Studies (UKCTCS), UK Public Health Centre of Excellence. UKCTCS receives its funding from the Economic and Social Research Council (ESRC), British Heart Foundation (BHF), Cancer Research UK, National Institute for Health Research (NIHR), and Medical Research Council (MRC). Dr Benowitz is a consultant for several companies that market smoking cessation medications and has been a paid expert in litigation against tobacco companies. The other authors declare they have no actual or potential competing financial interests.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement Data could be made available to qualified researchers by request to the corresponding author.

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Daniel George

From: Amber Wright <amberchucky@gmail.com>
Sent: Monday, April 06, 2015 5:40 PM
To: Sen. Bill Stoltze
Subject: Please Oppose SB 1 and HB 40 and any other effort to treat e-cigarettes like smoking.

Amber Wright
46405 Shawna Ln.
Kenai, AK 99611

April 6, 2015

Dear Bill Stoltze,

I am writing to express my deep concern and opposition regarding HB 40 and SB 1 which would include the use of smoke-free vapor products (e-cigarettes) in Alaska's smoking law.

Smoking laws are ostensibly enacted to protect the public from the harm of secondhand smoke, but smoke-free e-cigarettes have not been shown to cause harm to bystanders. In fact, all evidence to date shows that the low health risks associated with e-cigarettes are comparable to other smokeless nicotine products. A comprehensive review conducted by Dr. Igor Burstyn of Drexel University School of Public Health (and published in a peer-reviewed journal earlier this year - <http://www.biomedcentral.com/1471-2458/14/18/abstract>) examined over 9,000 observations of e-cigarette liquid and vapor and found "no apparent concern" for bystanders exposed to e-cigarette vapor, even under "worst case" assumptions about exposure.

Lawmakers must beware of unintended consequences from well-intentioned laws. There is clear evidence of a phenomenon called "accidental quitting," wherein many of the smokers who initially choose e-cigarettes to use just where smoking is prohibited go on to quit smoking conventional cigarettes completely. Prohibiting the use of e-cigarettes in public spaces completely eliminates that incentive to even try e-cigarettes. Unfortunately, the health risks of every one smoker who doesn't quit because e-cigarette use is prohibited (and the risks to the children and others who live with them) cumulatively outweigh any good done by eliminating the miniscule exposures to even hundreds of bystanders in public spaces.

Clearly, the benefits of allowing smokers to use e-cigarettes in public--and thereby increasing the likelihood of "accidental quitting" and reducing the known, extremely high health risks of smoking--outweigh the very low risks of insignificant exposures to bystanders. So, not only is there no genuine public health reason to prohibit e-cigarette use in public spaces, but, in fact, allowing e-cigarettes to be used in public spaces will actually improve public health by inspiring other smokers to switch and reduce their health risks by an estimated 99%. Moreover, private businesses in Alaska are already setting their own policies, and they should retain the right to allow or disallow usage since there is no proven health threat to bystanders.

While I understand some have expressed a fear about these products acting as a "gateway" to traditional cigarettes for youth, there is no evidence to suggest this is really happening, and research actually shows it is unlikely to happen to any substantial extent. Teen smoking rates are at their lowest point since smoking became popular and continue to drop, but there are adults who will continue to smoke until they die unless we provide attractive alternatives.

I urge you to oppose these bills and any legislation that would limit where smoke-free products like e-cigarettes can be used. It is imperative that existing adult smokers become aware of all the alternatives currently available and that access to these products remains unimpeded.

I look forward to your response on this issue. I, along with my fellow members of CASAA (Consumer Advocates for Smoke-free Alternatives Association), thank you for considering my comments and hope you will oppose misguided attempts to limit adult use of smoke-free e-cigarettes.

Sincerely,
Amber Wright

Daniel George

From: Anthony Lugo <lugo.anthony1987@gmail.com>
Sent: Friday, April 03, 2015 12:23 AM
To: Sen. Bill Stoltze
Subject: Please Oppose SB 1 and HB 40 and any other effort to treat e-cigarettes like smoking.

Anthony Lugo
5111 Merle Circle
Anchorage, AK 99507

April 3, 2015

Dear Bill Stoltze,

I am writing to express my deep concern and opposition regarding HB 40 and SB 1 which would include the use of smoke-free vapor products (e-cigarettes) in Alaska's smoking law.

Smoking laws are ostensibly enacted to protect the public from the harm of secondhand smoke, but smoke-free e-cigarettes have not been shown to cause harm to bystanders. In fact, all evidence to date shows that the low health risks associated with e-cigarettes are comparable to other smokeless nicotine products. A comprehensive review conducted by Dr. Igor Burstyn of Drexel University School of Public Health (and published in a peer-reviewed journal earlier this year - <http://www.biomedcentral.com/1471-2458/14/18/abstract>) examined over 9,000 observations of e-cigarette liquid and vapor and found "no apparent concern" for bystanders exposed to e-cigarette vapor, even under "worst case" assumptions about exposure.

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Sincerely,
Anthony Lugo

Daniel George

From: Billie Longfellow <bittysue@live.com>
Sent: Wednesday, April 01, 2015 10:09 PM
To: Sen. Bill Stoltze
Subject: Please Oppose SB 1 and HB 40 and any other effort to treat e-cigarettes like smoking.

Billie Longfellow
15816 N. Glenn Hwy #102
Sutton, AK 99674

April 2, 2015

Dear Bill Stoltze,

I am writing to express my deep concern and opposition regarding HB 40 and SB 1 which would include the use of smoke-free vapor products (e-cigarettes) in Alaska's smoking law.

Smoking laws are ostensibly enacted to protect the public from the harm of secondhand smoke, but smoke-free e-cigarettes have not been shown to cause harm to bystanders. In fact, all evidence to date shows that the low health risks associated with e-cigarettes are comparable to other smokeless nicotine products. A comprehensive review conducted by Dr. Igor Burstyn of Drexel University School of Public Health (and published in a peer-reviewed journal earlier this year - <http://www.biomedcentral.com/1471-2458/14/18/abstract>) examined over 9,000 observations of e-cigarette liquid and vapor and found "no apparent concern" for bystanders exposed to e-cigarette vapor, even under "worst case" assumptions about exposure.

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Sincerely,
Billie Longfellow

Daniel George

From: James Manakis <jmanakais@gmail.com>
Sent: Wednesday, April 01, 2015 2:13 AM
To: Sen. Bill Stoltze
Subject: Please Oppose SB 1 and HB 40 and any other effort to treat e-cigarettes like smoking.

James Manakis
349 Park Street
Anchorage, AK 99508

April 1, 2015

Dear Bill Stoltze,

HB 40 and SB 1 which would include the use of smoke-free vapor products (e-cigarettes) in Alaska's smoking law.

Just think if you ban you will collect more in taxes in generating the taxes we get from the smokers, which in turn are causing a health standard nightmare. I suggest the government get out of the public sector drop anarchy methods allow the people to grow up and become adults and choose what they feel is right. (And wrong) If you should pass another bill as such, remember how unconstitutionally biased as demi gods would act. We are not children and are supposed to by law have free thinking and acting. In so much as idyllic methods just look in a mirror and see what you are or want to be. We DO not work for you. YOU work for us. At least this is what I was taught. Yes I agree there are a few places that it should probably not be done. However let the owner choose the proper method to what customers and employers can and cannot do. This is not your job! Sorry to say I have just started doing e- cigarettes after through research I too do not want to see in a movie theater the vapor. However this is not your place to enforce or enact any law when the establishments are the ones to do. You will find 99% will abide by their requests. Simple or they can be asked to leave. Remember the right to choose to serve whomever they want. There are already laws on the books for this if they do not abide.

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Sincerely,
James Manakis

Daniel George

From: Jim Davis <jd4x4@jd4x4.net>
Sent: Wednesday, April 01, 2015 9:29 PM
To: Sen. Bill Stoltze
Subject: Please Oppose SB 1 and HB 40 and any other effort to treat e-cigarettes like smoking.

Jim Davis
c/o Avey
Anchorage, AK 99508

April 2, 2015

Dear Bill Stoltze,

Honorable Alaska State Legislators,

Regarding Senate Bill 01 and House Bill 40, 2015 Session

I am a 63 year old father of a daughter who is a resident of Anchorage, and grandparent of a granddaughter living there as well. I am also a 47 year tobacco smoker who is 3 years abstinent due only to the availability and efficacy of e-cigarettes. During my 47 smoking years I failed to quit using most all of the “sanctioned” and “approved” cessation methods. Electronic cigarettes profoundly changed my life.

The proposed legislation SB 1 and HB 40 affects me personally with regard to my welcomeness in your State and more importantly, affects the approximately 162,000 current tobacco users in Alaska.(1 2)

I am OPPOSED to SB 1 and HB 40 for the following reasons:

1. Not all e-cigarettes contain nicotine. E-cigarettes that do contain nicotine do not contain tobacco and their vapor (or aerosol, if you prefer) is not smoke(3 4 5).
2. The judgment of harm from e-cigarettes is premature and unwarranted by current research (6).
3. Language in legislation equating E-Cigarettes to Smoking sends an inaccurate, disingenuous, and harmful message to the public. At a minimum, e-cigarettes provide a previously unavailable and unique opportunity for cessation (7) and/or harm reduction for the 162,000 current smokers, and the associated public health benefit (8 9 10).
4. For those that use nicotine for any of it's established benefits (11 12 13 14), and for those like myself who wish to use it in a vastly harm-reduced (15 16 17 18) yet effective (7 19) delivery vehicle, prohibitions equal to that of smoking will undoubtedly have unconscionable future effects (20 21).

While a complete prohibition of e-cigarette use in public spaces is an easy answer to potential yet unestablished public harm, bystander objections, and is effective in the (in my opinion, misguided) continuation of tobacco “denormalization”, I urge you to weigh the potential public good that can be served by accepting e-cigarette benefits and seek a common sense balance for all concerned.

Should you still consider some type of public prohibition, I urge you to adopt an exemption that considers both non-users and users by allowing e-cigarette use in venues that post required “E-Cigarettes Allowed” signage. This simple solution should accommodate all parties concerned, especially if such venues are age restricted unless with parent or guardian approval or attendance.

Respectfully,
Jim Davis

References:

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- 2 'U.S. Census QuickFacts' <<http://www.census.gov/quickfacts/table/PST045214/00>> [accessed 1 April 2015].
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Respectfully
Jim Davis

Daniel George

From: Steven Mapes <akgofast@gmail.com>
Sent: Thursday, April 02, 2015 9:30 AM
To: Sen. Bill Stoltze
Subject: Please Oppose SB 1 and HB 40 and any other effort to treat e-cigarettes like smoking.

Steven Mapes
47870 Interlake Drive
Kenai, AK 99611

April 2, 2015

Dear Bill Stoltze,

I am writing to express my deep concern and opposition regarding HB 40 and SB 1 which would include the use of smoke-free vapor products (e-cigarettes) in Alaska's smoking law.

Smoking laws are ostensibly enacted to protect the public from the harm of secondhand smoke, but smoke-free e-cigarettes have not been shown to cause harm to bystanders. In fact, all evidence to date shows that the low health risks associated with e-cigarettes are comparable to other smokeless nicotine products. A comprehensive review conducted by Dr. Igor Burstyn of Drexel University School of Public Health (and published in a peer-reviewed journal earlier this year - <http://www.biomedcentral.com/1471-2458/14/18/abstract>) examined over 9,000 observations of e-cigarette liquid and vapor and found "no apparent concern" for bystanders exposed to e-cigarette vapor, even under "worst case" assumptions about exposure.

Lawmakers must beware of unintended consequences from well-intentioned laws. There is clear evidence of a phenomenon called "accidental quitting," wherein many of the smokers who initially choose e-cigarettes to use just where smoking is prohibited go on to quit smoking conventional cigarettes completely. Prohibiting the use of e-cigarettes in public spaces completely eliminates that incentive to even try e-cigarettes. Unfortunately, the health risks of every one smoker who doesn't quit because e-cigarette use is prohibited (and the risks to the children and others who live with them) cumulatively outweigh any good done by eliminating the miniscule exposures to even hundreds of bystanders in public spaces.

Clearly, the benefits of allowing smokers to use e-cigarettes in public--and thereby increasing the likelihood of "accidental quitting" and reducing the known, extremely high health risks of smoking--outweigh the very low risks of insignificant exposures to bystanders. So, not only is there no genuine public health reason to prohibit e-cigarette use in public spaces, but, in fact, allowing e-cigarettes to be used in public spaces will actually improve public health by inspiring other smokers to switch and reduce their health risks by an estimated 99%. Moreover, private businesses in Alaska are already setting their own policies, and they should retain the right to allow or disallow usage since there is no proven health threat to bystanders.

While I understand some have expressed a fear about these products acting as a "gateway" to traditional cigarettes for youth, there is no evidence to suggest this is really happening, and research actually shows it is unlikely to happen to any substantial extent. Teen smoking rates are at their lowest point since smoking became popular and continue to drop, but there are adults who will continue to smoke until they die unless we provide attractive alternatives.

I urge you to oppose these bills and any legislation that would limit where smoke-free products like e-cigarettes can be used. It is imperative that existing adult smokers become aware of all the alternatives currently available and that access to these products remains unimpeded.

I look forward to your response on this issue. I, along with my fellow members of CASAA (Consumer Advocates for Smoke-free Alternatives Association), thank you for considering my comments and hope you will oppose misguided attempts to limit adult use of smoke-free e-cigarettes.

Sincerely,
Steven Mapes

Daniel George

From: Travis smith <alyseskatravis@hotmail.com>
Sent: Tuesday, April 07, 2015 1:44 PM
To: Sen. Bill Stoltze
Subject: Please Oppose SB 1 and HB 40 and any other effort to treat e-cigarettes like smoking.

Travis smith
35173 Rockwood drive
soldotna, AK 99669

April 7, 2015

Dear Bill Stoltze,

I am writing to express my deep concern and opposition regarding HB 40 and SB 1 which would include the use of smoke-free vapor products (e-cigarettes) in Alaska's smoking law.

Smoking laws are ostensibly enacted to protect the public from the harm of secondhand smoke, but smoke-free e-cigarettes have not been shown to cause harm to bystanders. In fact, all evidence to date shows that the low health risks associated with e-cigarettes are comparable to other smokeless nicotine products. A comprehensive review conducted by Dr. Igor Burstyn of Drexel University School of Public Health (and published in a peer-reviewed journal earlier this year - <http://www.biomedcentral.com/1471-2458/14/18/abstract>) examined over 9,000 observations of e-cigarette liquid and vapor and found "no apparent concern" for bystanders exposed to e-cigarette vapor, even under "worst case" assumptions about exposure.

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