Taneeka Hansen

From: Alison Halpin <halpinan@yahoo.com>
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To: House Health and Social Services
Subject: HB328 Opposition E-cigs poised to save medicaid billions
Attachments: E-Cigarettes Poised to Save Medicaid Billions Publications State Budget Solutions.pdf; ATT00001.htm

My name is Alison Halpin and I am a member of Smoke Free Alternative Trade Association, and would like this document to be documented as opposition for HB328.

March 7, 2016

FDA Reveals First Wave of E-Cig, Tobacco Study

Results show little evidence of consistent electronic cigarette use

Published in *CSP Daily News*

By Melissa Vonder Haar, Tobacco Editor, CSP

CHICAGO -- Last week's Society for Research on Nicotine and Tobacco Conference included numerous tobacco and nicotine-related presentations, most notably select data from the first wave of the U.S. Food and Drug Administration (FDA) and National Institute of Health's Population Assessment of Tobacco and Health (PATH) study. 94

"E-cigs were a big topic in the PATH study, along with many other presentations, as the regulatory and scientific communities try to get a better grasp of the implications from this innovation, Vivien Azer, a tobacco analyst at the New York-based Cowen Group, wrote in a research note.

PATH is a longitudinal study, first mandated in 2011, in order for the FDA to gain a better understanding of tobacco use. About 46,000 U.S. tobacco and nontobacco users participate, all above the age of 12. The first wave of the study began in 2013 and was presented at the conference.

The data suggested regular use of electronic cigarettes is still very low, with just 5.5% of adults and 3.1% of 12- to 17-year-olds having used e-cigs in the past month. Azer added that daily e-cig users make up a very small percentage of these 30-day e-cig users.

"In fact, among current adult e-cig users, more than 40% had only used an e-cig less than three times in the past 30 days," she said. "We believe [this] points to the continued lack of consumer adoption of the products."

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The data also seemed to dispute claims that e-cigs act as a gateway to other tobacco products, as the majority of e-cig users in the study were already consumers of other tobacco products.

"Overall, 15.9% of adult current e-cig users were nicotine naive," Azer said. "While a smaller 8.5% of daily e-cig users had not previously used tobacco."

In terms of flavors in e-cigs and other tobacco products, PATH researchers found the use of flavors was most prominent in e-cig users across the board. For e-cig consumers 25 years and older, 63% reported using flavors, while 85% of e-cig users ages 12 to 17 reported using flavors (though Azer noted this youth group exhibited a strong flavor preference across all tobacco categories).

Azer said the Wave 1 database is currently only available for restricted use, but full dataset will be available later this year. The second wave of data is currently being reviewed, and Wave 3 is 40% complete. PATH researchers announced last week that the study will be extended four years and will now include seven waves, with the final wave set to be completed in 2022.

"We view the extension of the study as a positive (given the agency will take time to evaluate findings from the study and could potentially push back any incremental regulations)," Azer said.

KEYWORDS: cigarettes, electronic cigarettes

By Melissa Vonder Haar, Tobacco Editor, CSP

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STATE BUDGET SOLUTIONS POLICY ANALYSIS

MARCH 31, 2015

E-Cigarettes Poised to Save Medicaid Billions

J. Scott Moody, Chief Executive Officer and Chief Economist

Electronic cigarettes (e-cigs) have only been around since 2006, yet their potential to dramatically reduce the damaging health impacts of traditional cigarettes has garnered significant attention and credibility. Numerous scientific studies show that e-cigs not only reduce the harm from smoking, but can also be a part of the successful path to smoking cessation.

The term "e-cig" is misleading because there is no tobacco in an e-cig, unlike a traditional, combustible cigarette. The e-cig uses a battery-powered vaporizer to deliver nicotine via a propylene-glycol solution–which is why "smoking" an e-cig is called "vaping." The vapor is inhaled like a smoke from a cigarette, but does not contain the carcinogens found in tobacco smoke.

Unlike traditional nicotine replacement therapy (NRT), such as gum or patches, e-cigs mimic the physical routine of smoking a cigarette. As such, e-cigs fulfill both the chemical need for nicotine and physical stimuli of smoking. This powerful combination has led to the increasing demand for e-cigs–8.2% use among nondaily smokers and 6.2% use among daily smokers in 2011.[1]

The game-changing potential for dramatic harm reduction by current smokers using e-cigs will flow directly into lower healthcare costs dealing with the morbidity and mortality stemming from smoking combustible cigarettes. These benefits will particularly impact the Medicaid system where the prevalence of cigarette smoking is twice that of the general public (51% versus 21%, respectively).

Based on the findings of a rigorous and comprehensive study on the impact of cigarette smoking on Medicaid spending, the potential savings of e-cig adoption, and the resulting tobacco smoking cessation and harm reduction, could have been up to $48 billion in Fiscal Year (FY) 2012.[2] This savings is 87% higher than all state cigarette tax collections and tobacco settlement collections ($24.4 billion) collected in that same year.

Unfortunately, the tantalizing benefits stemming from e-cigs may not come to fruition if artificial barriers slow their adoption among current smokers. These threats range from the Food and Drug Administration regulating e-cigs as a pharmaceutical to states extending their cigarette tax to e-cigs. To be sure, e-cigs are still a new product and should be closely monitored for long-term health effects. However, given the long-term fiscal challenges facing Medicaid, the prospect of large e-cigs cost savings is worth a non-interventionist approach until hard evidence proves otherwise.

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Poster 5-11, Society for Research on Nicotine and Tobacco (SRNT) Dublin, April 30, 2009; updated 27 May

Ruyan® E-cigarette Bench-top tests

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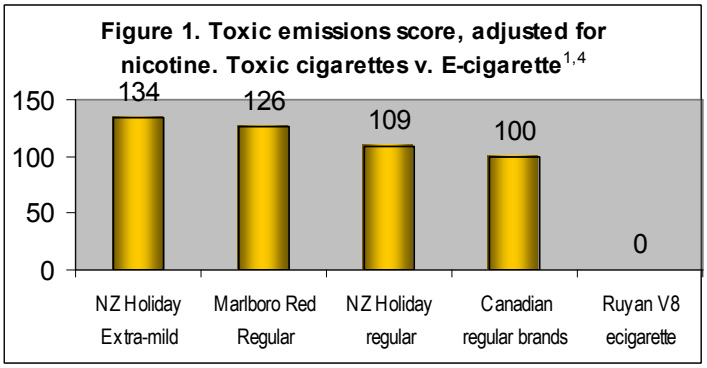
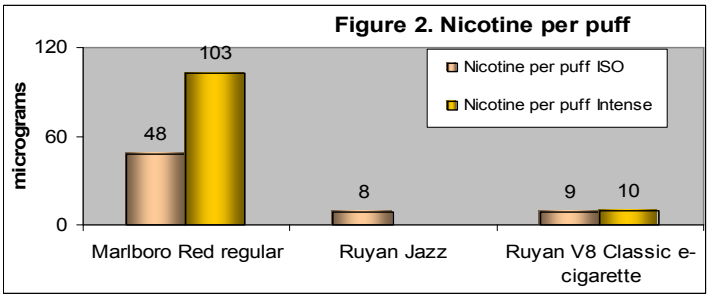


Background Electronic cigarettes, without tobacco, flame or smoke, claim to be cigarette substitutes and to deliver nicotine safely, without smoke toxicants. Are these claims justified?

Aim To assess the Ruyan® e-cigarette and its mist for safety, emissions, and nicotine dose.



Participating laboratories, methods, materials

1) Environmental Science and Research, Porirua NZ. *Cartridge liquid*: Monoamine oxidase inhibition (Kynur-amine substrate method); Nicotine (GCMS); Heavy metals (by ICP-MS)
2) Hill Laboratories, NZ. *Mist:* GCMS, Type II ATD, qualitative. 3) Hort Research, NZ. *Liquid* for 34 PAHs, by GCMS. 4) Labstat International ULC,Canada. *Liquid:* TSNAs, by LC-MS/MS. *Mist:* 14 PAHs and azarenes, Vinyl Chloride, acetamide, 7 volatile TSNAs. 5) Lincoln University, NZ. *Liquid:* HS-SPME & GCMS, qualitative. 6) National Radiation Lab. NZ For Pb210 gamma emitting nucleotides.
7) Syft Ltd NZ *Mist,Liquid* VOCs SIFT-MS
8) Duke University CNSCR Bioanalytical Lab. USA: *Mist:* Nicotine by GC MS.
9) British American Tobacco, Group R&D, (UK) *Liquid, mist:* Chemistry, smoke tests by ISO method. Nicotine in puffs, particle size (TSI 3090 MN USA), pressure drop.[1]

Test materials Ruyan in Beijing supplied V8 Classic e-cigarettes and 16 mg nicotine-labeled cartridges ex-factory to test laboratories, directly, or via distributors. Most were manufactured in 2008 and tested in 2008-9. Batteries were re-charged before testing, and fresh cartridges used. Shelf life at time of testing varied. An ISO machine smoked 1 mg tar cigarette provided smoke toxicants.[1]

Selection of toxicants for testing of e-cigarette mist. Selection was based on published priority lists of cigarette smoke toxicants:
9 recommended by WHO TobReg committee for mandatory lowering:[5]
37 prioritised by toxicological risk assessment by Fowles & Dybing[6] additional to the above 9;
13 additional to the above 46, priority tested on brands sold by British Columbia,[7] known loosely as the Hoffman analytes.
Not tested: acetaldehydes (delayed, due to world shortage of reagent); hydrazine, chlorinated dioxans, oxides of nitrogen, and urethane.

TECH & SCIENCE

E-CIGARETTES HELP SMOKERS QUIT, STUDY SAYS

BY VICTORIA BEKIEMPIS ON 5/20/14 AT 1:06 PM

A new study says that e-cigs might be better at helping smokers quit than patches or gum.

MARIO ANZUONI/REUTERS

TECH & SCIENCE E-CIGARETTES

VAPING SMOKING TOBACCO

A new study might clear some of the air in the e-cigarette debate: Researchers in the U.K. claim that e-cig users are 60 percent more likely to quit smoking than smokers who use traditional methods such as nicotine patches or gum.

The research, published in the journal *Addiction*, also found that e-cigarette users were nearly 60 percent more likely to quit tobacco than smokers who go cold turkey.

Researchers surveyed 5,863 smokers from 2009 and 2014 and found that of those who switched to e-cigs, 20 percent said they quit smoking with the

help of these devices.

“E-cigarettes could substantially improve public health because of their widespread appeal and the huge health gains associated with stopping smoking,” the senior author of the study, professor Robert West of University College London’s Department of Epidemiology and Public Health, said in a statement.

West does have one caveat: Smokers in the U.K. are most likely to quit when using the National Health System’s cessation services, which include counseling and free prescription medication. These services “almost triple a smoker’s odds of successfully quitting, compared with going it alone or relying on over-the-counter products,” he said.

Non-U.K. experts also widely recognize smokers are most likely to quit with a combination of medications and counseling. While people who try to quit without medications or support have a success rate of approximately 5 percent, those using a combination approach might have a success rate of 40 to 50 percent.

The study comes amid increased scrutiny of e-cigarettes across the U.S., including indoor vaping bans and the Food and Drug Administration’s push to regulate e-cigs like tobacco cigarettes. The

Results

Toxicology and safety In Ruyan V8 e-cigarette mist tested for over 50 priority-listed cigarette smoke toxicants so far, no such toxicant was found. A possible exception was mercury, detected in trace quantity of 0.17 ng per e-cigarette. However, this was barely above the reporting limit of 0.13 ng, and within the reported 38% coefficient of variation.

Chemistry The cartridge (labeled 16 mg), contained 13 mg[1] to 14 mg[3] nicotine and 1.1g propylene glycol (PG), and yielded >300 35 mL puffs of mist: 82% PG, 15% water, 1% free-based nicotine, 2% particulates and flavours.[1] Vaporisation occurred at 54˚C, powered by 0.1 mW per puff from lithium-ion battery.[1] Pressure drop was 152 mmWG, compared with 80-120 mmWG for a tobacco cigarette.[1] Particle size 0.04 micron (count median diameter), was about one-fifth of that for tobacco smoke.[1]

Nicotine delivery per puff A 35 mL puff from the Ruyan® V8 delivers only 10% of the nicotine obtained from a similar puff of a Marlboro regular cigarette. Deeper 50 mL puffs from the Ruyan V8 delivers only slightly more nicotine.

Site of nicotine absorption No deposition of aerosol nicotine occurred on pulling mist through a cascade impactor.[2]

Discussion

Main finding. Testing for over 50 cigarette key smoke toxicants found none in any but trace quantity, in Ruyan V8 mist.

Safety of e-cigarettes as a product class Safety results refer to the Ruyan® V8 Classic. However the low operating temperature (54˚C) of the atomiser - 5 to 10% of the temperature of a burning cigarette - suggests e-cigarettes as a class are unlikely to emit cigarette toxicants in their mist.

Nicotine dose (Figure 2) An e-cigarette user will need to take more puffs more often, and deeper puffs confer no advantage for V8 users. Six puffs every 5 minutes would deliver the same dose of nicotine delivered by shallow inhaling (10 puffs of 35 mL per puff) from one tobacco cigarette every hour, but would not achieve the high immediate nicotine boost which many smokers crave. Nicotine overdose is unlikely, even though nicotine delivery may vary between brands.

Nicotine absorption site The nicotine dose and particle size are too small to ensure deposition in the alveoli or bronchioles and rapid nicotine absorption as in cigarette smoking.

Limitations of study The results apply only for the products tested. Extrapolation to all product sold assumes production only from internationally-certified good manufacturing sites, and trademark enforcement.

Conclusion

Ruyan® V8 nicotine e-cigarette users do not inhale smoke or smoke toxicants. The modest reductions recommended in 2008 by WHO's Tobacco Regulation committee for 9 major toxicants in cigarette smoke, in line with Articles 9 and 10 of the FCTC (WHO Framework Convention Tobacco Control treaty), are already far exceeded by the Ruyan® e-cigarette, as it is free of all accompanying smoke toxicants. Absolute safety does not exist for any drug, but relative to lethal tobacco smoke emissions, Ruyan e-cigarette emissions appear to be several magnitudes safer. E-cigarettes are akin to a medicinal nicotine inhalator in safety, dose, and addiction potential.

E-cigarettes are cigarette substitutes. If they can take nicotine market share from cigarettes, and that is the big question, they will improve smoker and population health. They may also have a secondary role as medicinal nicotine inhaler quitting aids. Further trials of acceptability, addiction potential, clinical safety, and quitting efficacy are needed.

Funding and acknowledgements Ruyan Group (Holdings) Ltd Beijing funded Health NZ to carry out initial tests. Duke University, (NC, USA) and British American Tobacco, Group R&D (UK), kindly supplied further results at no cost.

Competing interests None. Neither the author, or his company, has any financial interest in Ruyan or any other manufacturer.

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Unfortunately, the tantalizing benefits stemming from e-cigs may not come to fruition if artificial barriers slow their adoption among current smokers. These threats range from the Food and Drug Administration regulating e-cigs as a pharmaceutical to states extending their cigarette tax to e-cigs. To be sure, e-cigs are still a new product and should be closely monitored for long-term health effects. However, given the long-term fiscal challenges facing Medicaid, the prospect of large e-cigs cost savings is worth a non-interventionist approach until hard evidence proves otherwise.

Prevalence of Smoking in the Medicaid Population

According to the Centers for Disease Control and Prevention, in 2011, 21.2% of Americans smoked combustible cigarettes. However, as shown in Table 1, the smoking rate varies considerably across states with the top three states being Kentucky (29%), West Virginia (28.6%), and Arkansas (27%) and the three lowest states being Utah (11.8%), California (13.7%), and New Jersey (16.8%).[3]

Table 1
Smokers Represent Significantly Larger Proportion of Medicaid Recipients than General Population
2011

State	Percent Smokers		Medicaid Enrollment	Number of Smokers on Medicaid
	Medicaid	General Population		
United States	51%	21.2% (median)	68,372,045	36,461,209
Alabama	52%	24.3%	938,313	487,923
Alaska	68%	22.9%	135,059	91,840
Arizona	49%	19.2%	1,989,470	974,840
Arkansas	54%	27.0%	777,833	420,030
California	45%	13.7%	11,500,583	5,175,262
Colorado	61%	18.3%	733,347	447,342
Connecticut	49%	17.1%	729,294	357,354
Delaware	58%	21.7%	223,225	129,471
Florida	46%	19.3%	3,829,173	1,761,420
Georgia	42%	21.2%	1,925,269	808,613
Hawaii	62%	16.8%	313,629	194,450
Idaho	62%	17.2%	409,456	253,863
Illinois	58%	20.9%	2,900,614	1,682,356
Indiana	68%	25.6%	1,208,207	821,581
Iowa	61%	20.4%	544,620	332,218
Kansas	54%	22.0%	363,755	196,428
Kentucky	65%	29.0%	1,065,840	692,796
Louisiana	43%	25.7%	1,293,869	556,364
Maine	63%	22.8%	327,524	206,340
Maryland	51%	19.1%	1,003,548	511,809
Massachusetts	53%	18.2%	1,504,611	797,444
Michigan	64%	23.3%	2,265,277	1,449,777
Minnesota	54%	19.1%	989,600	534,384
Mississippi	35%	26.0%	775,314	271,360
Missouri	66%	25.0%	1,126,505	743,493
Montana	70%	22.1%	136,442	95,509
Nebraska	64%	20.0%	284,000	181,760
Nevada	62%	22.9%	363,357	225,281
New Hampshire	80%	19.4%	152,182	121,746
New Jersey	36%	16.8%	1,304,257	469,533
New Mexico	50%	21.5%	571,621	285,811
New York	54%	18.1%	5,421,232	2,927,465
North Carolina	63%	21.8%	1,892,541	1,192,301
North Dakota	63%	21.9%	85,094	53,609
Ohio	65%	25.1%	2,526,533	1,642,246
Oklahoma	58%	26.1%	852,603	494,510
Oregon	67%	19.7%	690,364	462,544
Pennsylvania	70%	22.4%	2,443,909	1,710,736
Rhode Island	48%	20.0%	221,041	106,100
South Carolina	41%	23.1%	978,732	401,280
South Dakota	69%	23.0%	134,798	93,011
Tennessee	58%	23.0%	1,488,267	863,195
Texas	43%	19.2%	4,996,318	2,148,417
Utah	54%	11.8%	366,271	197,786
Vermont	67%	19.1%	184,088	123,339
Virginia	58%	20.9%	1,016,419	589,523
Washington	67%	17.5%	1,371,987	919,231
West Virginia	67%	28.6%	411,218	275,516
Wisconsin	63%	20.9%	1,292,799	814,463
Wyoming	62%	23.0%	76,372	47,351
District of Columbia	51%	20.8%	235,665	120,189

Source: Centers for Disease Control and Prevention, Centers for Medicare and Medicaid Services, and State Budget Solutions

Additionally, the smoking rate varies dramatically by income level. Nearly 28% of people living below the poverty line smoke while 17% of people living at or above the poverty line smoke.[4]

As a consequence, the level of smoking prevalence among Medicaid recipients is more than twice that of the general public, 51% versus 21%, respectively. However, this too varies considerably across states with the top three states being New Hampshire (80%), Montana (70%), and Pennsylvania (70%) and the three lowest states being Mississippi (35%), New Jersey (36%), and South Carolina (41%).[5]

In absolute terms, the U.S. Medicaid system includes 36 million smokers out of a total Medicaid enrollment of over 68 million. As such, this places much of the health burden and related financial cost of smoking on the Medicaid system which strains the system and takes away scarce resources from the truly needy.

Economic Benefit of Smoking Cessation and Harm Reduction

Smoking creates large negative externalities due to adverse health impacts. Table 2 shows the results of a comprehensive study that quantified the two major costs of smoking in 2009-lost productivity and healthcare costs.[6]

Lost productivity occurs when a person dies prematurely due to smoking or misses time from work due to smoking. This cost the economy $185 billion in lost output in 2009.

Smokers incur higher healthcare costs when those individuals require medical services such as ambulatory care, hospital care, prescriptions, and neonatal care for conditions caused by smoking. This cost the economy $116 billion in extra medical treatments.

Overall, in 2009 alone, the negative externalities of smoking cost the U.S. economy $301

billion in lost productivity and higher healthcare costs. Not surprisingly, these costs were centered in high population states such as California ($26.9 billion), New York ($20.6 billion), and Texas ($20.4 billion).

Literature Review On E-cig Impact On Harm Reduction Through Reduced Toxic Exposure and Smoking Cessation

E-cigs have only been around since 2006, yet their potential to dramatically reduce the damaging health impacts of traditional combustible cigarettes has garnered significant attention and credibility. Numerous scientific studies are showing that e-cigs not only reduce the harm from smoking, but is also a successful path to smoking cessation.

In perhaps the most comprehensive e-cig literature review to date, Neil Benowitz et al. (2014) identified eighty-one studies with original data and evidence from which to judge e-cig effectiveness for harm reduction.[7] They concluded:

"Allowing EC (electronic cigarettes) to compete with cigarettes in the market-place might decrease smoking-related morbidity and mortality. Regulating EC as strictly as cigarettes, or even more strictly as some regulators propose, is not warranted on current evidence. Health professionals may consider advising smokers unable or unwilling to quit through other routes to switch to EC as a safer alternative to smoking and a possible pathway to complete cessation of nicotine use."

There are two ways that e-cigs benefit current smokers. First, there is harm reduction for the smoker by removing exposure to the toxicity associated with the thousands of compounds, many carcinogenic, found in the burning of tobacco and the resulting smoke. Second, smoking cessation efforts by the smoker are enhanced by simultaneously fulfilling both the chemical need for nicotine and physical stimuli of smoking.

In the last few years the academic literature has exploded with articles on these two topics. The following is a selection of some of the most recent studies and their conclusions.

Reduced Toxic Exposure

Igor Burstyn (2014) concludes, "Current state of knowledge about chemistry of liquids and aerosols associated with electronic cigarettes indicates that there is no evidence that vaping produces inhalable exposures to contaminants of the aerosol that would warrant health concerns by the standards that are used to ensure safety of workplaces . . . Exposures of bystanders are likely to be orders of magnitude less, and thus pose no apparent concern."[8]

Table 2
Comprehensive Costs of Smoking
(Billions of Dollars)
2009

State	Lost Productivity			Healthcare Costs	Total Smoking Costs
	Premature Death	Workplace	Total		
United States	117.1	67.5	184.6	116.4	301.0
Alabama	2.7	1.2	3.9	1.7	5.6
Alaska	0.2	0.2	0.4	0.3	0.7
Arizona	1.9	1.3	3.2	1.9	5.1
Arkansas	1.7	0.7	2.4	1.1	3.4
California	9.6	5.7	15.2	11.6	26.9
Colorado	1.3	1.2	2.5	1.6	4.1
Connecticut	1.2	0.7	1.8	1.7	3.6
Delaware	0.4	0.2	0.6	0.4	1.1
District of Columbia	0.3	0.1	0.4	0.5	0.9
Florida	7.9	4.4	12.3	7.3	19.6
Georgia	3.7	2.4	6.2	2.9	9.0
Hawaii	0.4	0.2	0.7	0.4	1.1
Idaho	0.4	0.3	0.7	0.4	1.1
Illinois	5.0	2.9	7.9	4.8	12.7
Indiana	3.0	2.1	5.1	2.6	7.7
Iowa	1.2	0.7	1.9	1.1	3.0
Kansas	1.0	0.6	1.6	1.0	2.6
Kentucky	2.6	1.3	3.9	1.8	5.7
Louisiana	2.4	0.9	3.3	1.8	5.1
Maine	0.6	0.3	0.9	0.7	1.6
Maryland	2.1	1.3	3.4	2.2	5.6
Massachusetts	2.2	1.3	3.4	3.7	7.1
Michigan	4.5	2.4	7.0	4.0	11.0
Minnesota	1.5	1.5	3.0	2.3	5.4
Mississippi	1.8	0.7	2.4	1.0	3.5
Missouri	3.0	1.5	4.5	2.7	7.2
Montana	0.3	0.2	0.6	0.4	0.9
Nebraska	0.6	0.5	1.1	0.7	1.8
Nevada	1.1	0.7	1.7	0.9	2.6
New Hampshire	0.5	0.3	0.8	0.6	1.4
New Jersey	2.9	1.8	4.7	3.6	8.3
New Mexico	0.5	0.4	0.9	0.6	1.5
New York	6.9	3.9	10.8	9.8	20.6
North Carolina	4.1	2.2	6.3	3.4	9.7
North Dakota	0.2	0.2	0.4	0.3	0.7
Ohio	5.7	2.9	8.6	5.2	13.9
Oklahoma	2.1	0.9	3.0	1.3	4.3
Oregon	1.3	0.8	2.1	1.3	3.4
Pennsylvania	5.4	3.2	8.5	5.7	14.2
Rhode Island	0.4	0.2	0.7	0.6	1.3
South Carolina	2.3	1.0	3.3	1.6	4.9
South Dakota	0.3	0.2	0.5	0.3	0.8
Tennessee	3.6	1.7	5.3	2.6	7.9
Texas	7.9	4.9	12.8	7.6	20.4
Utah	0.4	0.3	0.7	0.4	1.1
Vermont	0.2	0.1	0.4	0.3	0.7
Virginia	2.9	2.0	4.8	2.7	7.5
Washington	2.1	1.3	3.4	2.4	5.7
West Virginia	1.1	0.5	1.6	0.9	2.5
Wisconsin	2.0	1.4	3.4	2.4	5.8
Wyoming	0.2	0.2	0.4	0.2	0.6

Source: See Endnote 6 and State Budget Solutions

Neal Benowitz, et al. (2013) concludes, "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."[9]

Kostantinos E Farsalinos et al. (2014) concludes, "Although acute smoking inhalation caused a delay in LV (Left Ventricular) myocardial relaxation in smokers, electronic cigarette use was found to have no such immediate effects in daily users of the device. This short-term beneficial profile of electronic cigarettes compared to smoking, although not conclusive about its overall health-effects as a tobacco harm reduction product, provides the first evidence about the cardiovascular effects of this device."[10]

Smoking Cessation

Emma Beard et al. (2014) concludes, "Among smokers who have attempted to stop without professional support, those who use e-cigarettes are more likely to report continued abstinence than those who used a licensed NRT [Nicotine Replacement Therapy] product bought over-the-counter or no aid to cessation. This difference persists after adjusting for a range of smoker characteristics such as nicotine dependence."[11]

Christopher Bullen et al. (2013) concludes, "E-cigarettes, with or without nicotine, were modestly effective at helping smokers to quit, with similar achievement of abstinence as with nicotine patches, and few adverse events . . . Furthermore, because they have far greater reach and higher acceptability among smokers than NRT [Nicotine Replacement Therapy], and seem to have no greater risk of adverse effects, e-cigarettes also have potential for improving population health."[12]

Pasquale Caponnetto et al. (2013) concludes, "The results of this study demonstrate that e-cigarettes hold promise in serving as a means for reducing the number of cigarettes smoked, and can lead to enduring tobacco abstinence as has also been shown with the use of FDA-approved smoking cessation medication. In view of the fact that subjects in this study had no immediate intention of quitting, the reported overall abstinence rate of 8.7% at 52-weeks was remarkable."[13]

Konstantinos E. Farsalinos et al. (2013) concludes, "Participants in this study used liquids with high levels of nicotine in order to achieve complete smoking abstinence. They reported few side effects, which were mostly temporary; no subject reported any sustained adverse health implications or needed medical treatment. Several of the side effects may not be attributed to nicotine. In addition, almost every vaper reported significant benefits from switching to the EC [e-cigarette]. These observations are consistent with findings of Internet surveys and are supported by studies showing that nicotine is not cytotoxic, is not classified as a carcinogen, and has minimal effects on the initiation or propagation of atherosclerosis . . . Public health authorities should consider this and other studies that ECs are used as long-term substitutes to smoking by motivated exsmokers and should adjust their regulatory decisions in a way that would not restrict the availability of nicotine-containing liquids for this population."[14]

Potential E-cig Medicaid Cost Savings

To date, the academic literature strongly suggests that e-cigs hold the promise of dramatic harm reduction for smokers simply by switching from combustible tobacco cigarettes to e-cigs. This harm reduction is due to both its positive impact on smoking cessation and

Table 3
Smoking Costs on Medicaid by State
(Millions of Dollars)
Fiscal Year 2012

State	Medicaid Spending	Smoking Costs as Percent of Medicaid Spending	Smoking Costs on Medicaid
United States	415,154	11%	45,667
Alabama	5,027	9%	452
Alaska	1,348	15%	202
Arizona	7,905	18%	1,423
Arkansas	4,160	11%	458
California	50,165	11%	5,518
Colorado	4,724	17%	803
Connecticut	6,759	7%	473
Delaware	1,485	10%	148
District of Columbia	2,111	11%	232
Florida	17,907	11%	1,970
Georgia	8,526	10%	853
Hawaii	1,493	11%	164
Idaho	1,452	14%	203
Illinois	13,393	11%	1,473
Indiana	7,486	15%	1,123
Iowa	3,495	10%	350
Kansas	2,667	12%	320
Kentucky	5,702	12%	684
Louisiana	7,358	12%	883
Maine	2,413	14%	338
Maryland	7,687	12%	922
Massachusetts	12,926	11%	1,422
Michigan	12,460	13%	1,620
Minnesota	8,894	11%	978
Mississippi	4,466	9%	402
Missouri	8,727	14%	1,222
Montana	973	15%	146
Nebraska	1,722	15%	258
Nevada	1,739	11%	191
New Hampshire	1,187	15%	178
New Jersey	10,389	6%	623
New Mexico	3,430	12%	412
New York	53,306	11%	5,864
North Carolina	12,282	11%	1,351
North Dakota	744	12%	89
Ohio	16,352	13%	2,126
Oklahoma	4,642	12%	557
Oregon	4,587	15%	688
Pennsylvania	20,393	11%	2,243
Rhode Island	1,856	8%	148
South Carolina	4,848	11%	533
South Dakota	749	16%	120
Tennessee	8,798	11%	968
Texas	28,286	11%	3,111
Utah	1,903	14%	266
Vermont	1,353	15%	203
Virginia	6,906	11%	760
Washington	7,560	18%	1,361
West Virginia	2,790	11%	307
Wisconsin	7,096	13%	923
Wyoming	528	16%	85

Note: States do not sum to Total due to rounding.
Source: See Endnote 15 and State Budget Solutions

reduced exposure to toxic compounds in cigarette smoke.

As a result, we can expect the healthcare costs of smoking to decline over time as the adoption of e-cigs by smokers continues to grow. Additionally, we can expect greater rates of adoption as e-cigs continue to evolve and improve based on market feedback-a dynamic that has never existed with other nicotine replacement therapies.

As discussed earlier, the potential savings to the economy are very large. In terms of healthcare alone, most of that cost is currently borne by the Medicaid system where the prevalence of cigarette smoking is twice that of the general public, 51% versus 21%, respectively. So what are the potential healthcare savings to Medicaid?

Brian S. Armour et al. (2009) created an impressive economic model to estimate how much smoking costs Medicaid based on data from the Medical Expenditure Panel Survey and the Behavioral Risk Factor Surveillance System.[15]

Overall, their model ". . . included 16,201 adults with weighting variables that allowed us to generate state representative estimates of the adult, noninstitutionalized Medicaid population."

The study concluded that 11% of all Medicaid expenditures can be attributed to smoking. Additionally, among the states these costs ranged from a high of 18% (Arizona and Washington) to a low of 6% (New Jersey).

This study uses their percentage of Medicaid spending due to smoking and applies it to the latest year of available state-by-state Medicaid spending. As shown in Table 3, in FY 2012, smoking cost the Medicaid system $45.7 billion. Of course, the largest states bear the brunt of these costs such as New York ($5.9 billion), California ($5.5 billion), and Texas ($3.1 billion).

To put this potential savings to Medicaid into perspective, in FY 2012, state governments and the District of Columbia combined collected $24.4 billion in cigarette excise taxes and tobacco settlement payments. As shown in Table 4, the potential Medicaid savings exceeds cigarette excise tax collections and tobacco settlement payments by 87%.

However, this varies greatly by state with high ratios in the South Carolina (435%), Missouri (409%), and New Mexico (260%), Arizona (238%), and California (238%) and low ratios in New Jersey (-39%), New Hampshire (-31%), Rhode Island (-17%), Connecticut (-13%), and Hawaii (-4%). Overall, 45 states and D.C. stand to gain more from potential Medicaid savings than through lost cigarette tax collections and tobacco settlement payments.

Note that many of the five states with negative ratios are distorted because excise tax collections are based on where the initial sale occurred and not where the cigarettes were ultimately consumed. This can vary greatly because of cigarette smuggling and cross-border shopping created by state-level differentials in cigarette excise taxes.[16]

For instance, New Hampshire has long been a source for out-of-state cigarette purchase from shoppers living in Massachusetts, Maine, and Vermont because of its lower cigarette excise tax. As such, the ratio is too high for Massachusetts, Maine, and Vermont and too low for New Hampshire. The same applies to New Jersey and Connecticut vis-à-vis New York and, more specifically, New York City, which levies its own cigarette tax on top of the state tax.

Hawaii is an exception due to its physical isolation which creates monopoly rents. Rhode Island levies a very high cigarette excise tax, but not relatively high enough compared to neighboring Connecticut and Massachusetts to drive a lot of cross-border shopping.

Other Potential E-cig Cost Savings

Another area of cost savings from greater e-cig adoption is the reduction in smoke and fire dangers in subsidized and public housing. According to a recent study, smoking imposes three major costs:

1. Increased healthcare costs from exposure to second hand smoke within and between housing units.

2. Increased renovation costs of smoking-permitted housing units.

3. Fires attributed to cigarettes.

As shown in Table 5, the study estimates that smoking imposes a nationwide cost of nearly $500 million.[17] The top three states facing the greatest expenses are New York ($125 million), California ($72 million), and Texas ($24 million) while the top three states with the lowest expenses are Wyoming ($0.6 million), Idaho ($0.8 million), and Montana ($1 million).

Table 5
Smoking Costs on Subsidized and Public Housing
(Millions of Dollars)
2012

State	Smoking Costs
United States	496.8
New York	124.7
California	72.4
Texas	28.3
Massachusetts	24.0
Florida	23.2
Ohio	21.7
Pennsylvania	17.7
New Jersey	15.8
Louisiana	14.4
North Carolina	13.9
Illinois	13.3
Tennessee	12.9
Michigan	12.8
Alabama	12.4
Georgia	11.6
Connecticut	10.7
Missouri	9.4
Indiana	8.3
Virginia	7.8
Mississippi	7.2
Kentucky	7.1
Minnesota	7.1
South Carolina	7.0
Maryland	7.0
Arkansas	6.8

Table 4
Smoking Costs on Medicaid Exceeds State Cigarette Tax Collections and Tobacco Settlement Payments
(Millions of Dollars)
Fiscal Year 2012

State	State Cigarette Tax Collections (a)	Tobacco Settlement Payments (b)	Smoking Costs on Medicaid	Smoking Costs on Medicaid as a Percent of State Cigarette Tax Collections and Tobacco Settlement Payments
United States	17,226	7,190	45,667	87%
Alabama	126	94	452	106%
Alaska	67	30	202	108%
Arizona	319	101	1,423	238%
Arkansas	247	51	458	54%
California	896	736	5,518	238%
Colorado	203	91	803	173%
Connecticut	418	124	473	-13%
Delaware	121	27	148	1%
District of Columbia	36	38	232	214%
Florida	381	365	1,970	164%
Georgia	227	141	853	132%
Hawaii	122	49	164	-4%
Idaho	48	25	203	177%
Illinois	606	274	1,473	67%
Indiana	465	130	1,123	89%
Iowa	225	66	350	20%
Kansas	104	58	320	98%
Kentucky	277	102	684	81%
Louisiana	133	141	883	222%
Maine	140	51	338	77%
Maryland	411	146	922	66%
Massachusetts	574	254	1,422	72%
Michigan	965	256	1,620	33%
Minnesota	422	167	978	66%
Mississippi	157	110	402	50%
Missouri	105	135	1,222	409%
Montana	87	30	146	24%
Nebraska	68	38	258	145%
Nevada	103	40	191	34%
New Hampshire	215	43	178	-31%
New Jersey	792	231	623	-39%
New Mexico	75	39	412	260%
New York	1,632	738	5,864	147%
North Carolina	295	141	1,351	210%
North Dakota	28	32	89	49%
Ohio	843	295	2,126	87%
Oklahoma	293	77	557	50%
Oregon	256	79	688	106%
Pennsylvania	1,119	337	2,243	54%
Rhode Island	132	47	148	-17%
South Carolina	26	73	533	435%
South Dakota	60	24	120	42%
Tennessee	279	139	968	131%
Texas	1,470	475	3,111	60%
Utah	124	36	266	66%
Vermont	80	35	203	77%
Virginia	192	117	760	145%
Washington	471	151	1,361	119%
West Virginia	110	64	307	77%
Wisconsin	653	131	923	18%
Wyoming	26	19	85	90%

(a) Includes all forms of tobacco taxes.
(b) Includes Master Settlement Agreement and individual state payments.
Source: Department of Commerce: Census Bureau, Internal Revenue Service, and State Budget Solutions

Applying Cigarette Taxes to E-cigs?

Many policymakers around the country have suggested applying the existing cigarette tax, wholly or in part, to e-cigs. This is bad public policy and is based on a fundamental misunderstanding of the cigarette tax.

The cigarette tax is what economists call a "Pigovian Tax" which is designed to mitigate negative externalities of certain actions. Cigarette smoking creates many negative externalities such as

Oklahoma	6.8
Wisconsin	6.5
Washington	5.0
Arizona	4.9
Colorado	4.5
West Virginia	4.3
Oregon	4.3
Maine	4.2
Rhode Island	4.0
Hawaii	3.8
Iowa	3.8
New Mexico	3.0
Kansas	2.9
Nebraska	2.1
Nevada	1.9
Vermont	1.9
New Hampshire	1.9
Utah	1.4
Delaware	1.3
North Dakota	1.2
South Dakota	1.1
Montana	1.0
Idaho	0.8
Wyoming	0.6
Alaska	N.A.
District of Columbia	N.A.
Source: See Endnote 17 and State Budget Solutions	

harmful health consequences to the user or to those in near proximity (second-hand smoke).

As detailed in this study, the negative externalities associated with traditional smoking are all but eliminated by e-cigs. Without evidence of actual negative externalities, applying the existing cigarette tax to e-cigs is simply bad public policy.

Conclusion

Policymakers have long sought to reduce the economic damage due to the negative health impact of smoking. They have used tactics ranging from cigarette excise taxes to subsidizing nicotine replacement therapies. To be sure, smoking prevalence has fallen over time, but there is more that can be done, especially given the fact that so much of the healthcare burden of smoking falls on the already strained Medicaid system.

As with any innovation, no one could have predicted the sudden arrival into the marketplace of the e-cig in 2006. Since e-cigs fulfill both the chemical need for nicotine and physical stimuli of smoking the demand for e-cigs has grown dramatically. The promise of a relatively safe way to smoke has the potential to yield enormous healthcare savings. The most current academic research verifies the harm reduction potential of e-cigs.

As shown in this study, the potential savings to Medicaid significantly exceeds the state revenue raised from the cigarette excise tax and tobacco settlement payments by 87%. As such, the rational policy decision is to adopt a non-interventionist stance toward the evolution and adoption of the e-cig until hard evidence proves otherwise. While cigarette tax collections will fall as a result, Medicaid spending will fall even faster. This is a win-win for policymakers and taxpayers.

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COPD & the Non-Smoker

Kathi MacNaughton Health Pro

- You've never smoked a cigarette in your life, but your doctor just told you that you have COPD, which stands for chronic obstructive pulmonary disease. Are you wondering how this can be? Isn't COPD a disease of smokers and former smokers?

While it's true that in the United States, COPD in 80% to 90% of all people diagnosed was due to smoking, there is a small percentage of people who develop this disease due to other risk factors. Some of the other risk factors for COPD can include:

- **Occupational or environmental hazards.** Long-term exposure to certain types of dusts, fibers and chemical fumes can result in the airway obstruction associated with COPD. Secondhand tobacco smoke can be another contributing factor.
- **Air pollution.** People who live in areas with poor air quality seem to have a higher risk for COPD. This can be both urban outdoor air pollution (especially in areas with high levels of motor vehicle exhaust) as well as indoor air pollution from wood fires or cooking fire smoke common in developing countries.
- **Genetics.** COPD is more common in relatives of people who have COPD. Experts are not sure why this is. In rare cases, COPD is related to an alpha 1-antitrypsin deficiency. This type of deficiency is what usually causes COPD (ordinarily a disease of middle-aged to older adults) in people younger than age 40.
- **GERD.** Gastroesophageal reflux disease, GERD for short, causes a backflow of stomach acid and other stomach contents into the esophagus. It can worsen COPD or may even cause it.
- **Other factors.** Race, gender, or even chronic lung infections during childhood may also be at work in raising risk for COPD, though more study is needed to explore these relationships further.

So, while it is not common to find COPD in a non-smoker, it IS possible, unfortunately.

How Is COPD Different for Non-Smokers?

The short answer to this question is, it isn't different. It may be harder for a doctor to diagnose COPD in a non-smoker, because it is more unexpected. But your symptoms will likely be the same, so diagnosis will come from a medical history, exam and possibly testing such as spirometry.

The course of illness is much the same as well. COPD is a chronic progressive airway disease. There is no cure and it will get worse over time, but the progress can be slowed with a healthy lifestyle and the right treatment plan. COPD in smokers does often progress more quickly than non-smokers however, because smokers find it hard to quit smoking.

So, the biggest difference in COPD in non-smokers is the treatment plan. For smokers, the most important part of the treatment plan is to quit smoking (and not to start again). But, obviously, for non-smokers, this does not need to be a part of your plan (though avoiding secondhand smoke should be). So your treatment plan will focus on a healthy lifestyle (including sleep, exercise and healthy eating) as well as a medication regime suitable to your needs.

Learning to cope with your disease is also an important part of the treatment plan. You might find you have a great deal of anger over getting COPD even though you never smoked. There could be this kind of thinking, "Why the heck was I so good if this is what I get anyway?" It's important for your ongoing health to learn how to deal with this anger (and your other feelings about your diagnosis) in a positive manner.

-

You can learn more about the physical aspects of COPD as well as tips for coping with the shock of diagnosis in previous articles on this site.

The important thing to remember is that COPD -- whether you have been a smoker or never smoked a day in your life -- is far from hopeless. You can still live a full and fairly healthy life for some time to come, with the right approach to the disease.

Published On: October 13, 2009

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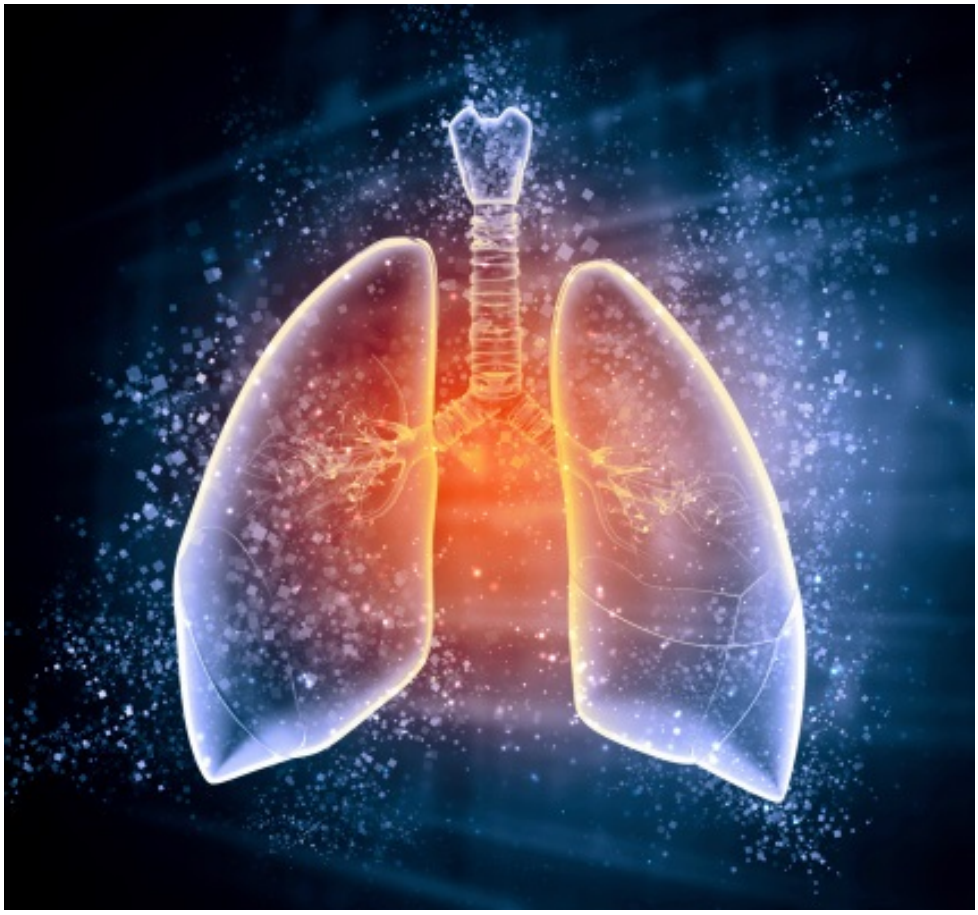

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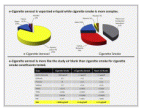

Regulatory Toxicology and Pharmacology

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Comparison of select analytes in aerosol from e-cigarettes with smoke from conventional cigarettes and with ambient air

Rana Tayyarah , Gerald A. Long

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Highlights

- The e-cigarettes contained and delivered mostly glycerin and/or PG and water.
- Aerosol nicotine content was 85% lower than the cigarette smoke nicotine.
- The levels of HPHCs in aerosol were consistent with the air blanks (<2 μg/puff).
- Mainstream cigarette smoke HPHCs (~3000 μg/puff) were 1500 times higher than e-cigarette HPHCs.
- No significant contribution of tested HPHC classes was found for the e-cigarettes.

Abstract

Leading commercial electronic cigarettes were tested to determine bulk composition. The e-cigarettes and conventional cigarettes were evaluated using machine-puffing to compare nicotine delivery and relative yields of chemical constituents. The e-liquids tested were found to contain humectants, glycerin and/or propylene glycol, (⩾75% content); water (<20%); nicotine (approximately 2%); and flavor (<10%). The aerosol collected mass (ACM) of the e-cigarette samples was similar in composition to the e-liquids. Aerosol nicotine for the e-cigarette samples was 85% lower than nicotine yield for the conventional cigarettes. Analysis of the smoke from conventional cigarettes showed that the mainstream cigarette smoke delivered approximately 1500 times more harmful and potentially harmful constituents (HPHCs) tested when compared to e-cigarette aerosol or to puffing room air. The deliveries of HPHCs tested for these e-cigarette products were similar to the study air blanks rather than to deliveries from conventional cigarettes; no significant contribution of cigarette smoke HPHCs from any of the compound classes tested was found for the e-cigarettes. Thus, the results of this study support previous researchers' discussion of e-cigarette products' potential for reduced exposure compared to cigarette smoke.

Graphical abstract

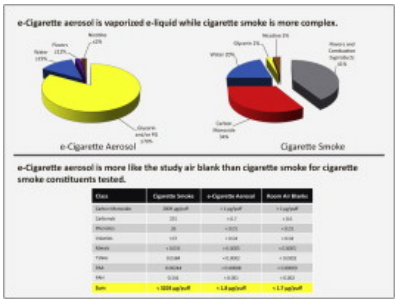

Figure options

Abbreviations

ACM, aerosol collected mass; HPHC, harmful and potentially harmful constituents; CO, carbon monoxide; TSNA, tobacco-specific nitrosamines; PAA, polyaromatic amines; PAH, polyaromatic hydrocarbons; LOQ, limit of quantitation; LOD, limit of detection; CAN, Health Canada Test Method T-115; blu CTD, Classic Tobacco Disposable; blu MMD, Magnificent Menthol Disposable; blu CCH, Cherry Crush, Premium, High Strength; SKYCIG CTB, Classic Tobacco Bold; SKYCIG CMB, Crown Menthol Bold; MGB, Marlboro Gold Box; L&B O, Lambert & Butler Original; L&B M, Lambert & Butler Menthol; TPM, total particulate matter; PG, propylene glycol

Keywords

Electronic cigarette; Smoking; Tobacco; Nicotine; Harmful and potentially harmful constituents (HPHC)

1. Introduction

Electronic cigarettes (e-cigarettes) are a relatively new consumer product. Unlike conventional cigarettes, e-cigarettes do not burn tobacco to deliver flavor. Instead, they contain a liquid-based flavorant (typically referred to as e-liquid or e-juice) that is thermally vaporized by an electric element. This liquid typically consists of a mixture of water, glycerin, and/or propylene glycol. The liquid also contains nicotine and flavor, although nicotine-free products are available.

While there are decades of characterization studies and numerous standardized analytical procedures for conventional cigarettes, relatively little published analytical data exists for commercial e-cigarette products. Furthermore, no standardized test methods or reference products exist for e-cigarettes.

Electronic cigarettes are generally purported to provide reduced exposure to conventional cigarettes' chemical constituents because they deliver flavors and nicotine through vaporization rather than by burning tobacco. Goniewicz et al. (2014) reported low levels of select chemical constituents in select e-cigarette brands commercially available in Poland. A recent review of analyses from diverse e-cigarettes shows comparatively simple chemical composition relative to conventional cigarette smoke (Burstyn, 2014). However, limited published results exist for commercial products that represent a significant presence in the marketplace (Cheng, 2014).

The purpose of this study was to evaluate e-cigarette products with a significant presence in the marketplace for bulk composition, including nicotine, and for select constituents for comparison with conventional cigarette products. Three blu eCigs products (approximately 50% of the US market) and two SKYCIG products (approximately 30% of the UK market) were chosen for evaluation. Marlboro Gold Box (US), and Lambert & Butler Original and Menthol products (UK), with significant market share in their respective geographical areas, were included in the study for conventional

cigarette comparisons.

The products used in the study were evaluated for content and delivery of major ingredients (glycerin, propylene glycol, water, and nicotine) and for select constituents (carbon monoxide (CO), carbonyls, phenolics, volatile organic compounds (volatiles), metals, tobacco-specific nitrosamines (TSNAs), polyaromatic amines (PAAs), and polyaromatic hydrocarbons (PAHs)). Many of these constituents are included in cigarette industry guidance issued by the FDA that includes reporting obligations for harmful and potentially harmful constituents (HPHCs) in cigarette filler and smoke under section 904(a)(3) of the 2009 Family Smoking Prevention and Tobacco Control Act (FDA, 2012). For delivery studies, the conventional cigarettes were smoked under an intense puffing regime published by Health Canada (1999). The e-cigarettes were tested using minimal modifications to this smoking regime. Ninety-nine puffs were used to collect approximately the same aerosol mass as obtained from conventional cigarette testing. Ambient 'air' samples, empty port collections, were included as a negative control of aerosol testing for cigarette constituents (i.e. HPHC).

2. Materials and methods

2.1. Test products

Two disposable e-cigarette products and three rechargeable e-cigarette products were obtained from the manufacturers. Three conventional cigarette products were purchased through wholesale or retail sources for testing. Information for each of the products is listed in Table 1.

Table 1.
List of cigarette and e-cigarette products tested.

Product	Manufacturer	Product type	Nicotine information provided on packaging
Classic Tobacco Disposable (blu CTD)	blu eCigs	Disposable e-cigarette	Content: 24 mg/unit
Magnificent Menthol Disposable (blu MMD)	blu eCigs	Disposable e-cigarette	Content: 24 mg/unit
Cherry Crush, Premium, High Strength (blu CCH)	blu eCigs	Rechargeable e-cigarette	Content: 16 mg/unit
Classic Tobacco Bold (SKYCIG CTB)	SKYCIG	Rechargeable e-cigarette	Content: 18 mg/unit
Crown Menthol Bold (SKYCIG CMB)	SKYCIG	Rechargeable e-cigarette	Content: 18 mg/unit
Marlboro Gold Box (MGB)	Philip Morris USA	Conventional cigarette	–
Lambert & Butler Original (L&B O)	Imperial Tobacco	Conventional cigarette	Yield: 0.9 mg/cig (ISO)
Lambert & Butler Menthol (L&B M)	Imperial Tobacco	Conventional cigarette	Yield: 0.5 mg/cig (ISO)

Table options

2.2. Methods overview

ISO 17025 accredited analytical methods were used to evaluate the cigarette samples for select HPHCs in mainstream smoke. Official methods are cited and other, internally validated, methods are briefly described for general understanding. Furthermore, because no standardized methods exist for e-cigarette analysis, the methods used to evaluate the conventional cigarettes were adapted to evaluate the e-cigarette products and the study blanks (room air). In an effort to maximize signal and lower methods' limits of quantitation, aerosol collection amounts were maximized (but maintained below breakthrough) and extraction solvent volumes were minimized. In some cases, alternative instrumentation was employed to improve detection. For example, mainstream smoke TSNAs were analyzed by GC–TEA while aerosol and air blank samples were analyzed by LC–MS/MS. Accuracy, precision, and method limits of quantitation and detection (LOQ and LOD) were verified for each method. On average,

accuracy and method variability for the analytes tested were determined to be 98% and 3%, respectively. Analyte LOD and LOQ information is listed in Supplemental Appendix A Tables 1 and 2. Method resolution for low levels of analytes was influenced by background levels of select analytes in air control samples. These background levels are attributed to instrument or smoking machine carry-over as evidenced in solvent or air blanks. In addition, the high concentration of glycerin and water in e-cigarette aerosol present challenges for volatile-based measurement systems (i.e. GC). Additional method refinements and dedicated e-cigarette puffing machines are two areas for consideration to improve e-cigarette aerosol method sensitivities. Method development and verification details for e-cigarette liquids and aerosols are the subject of a future publication.

2.3. Smoke and aerosol collection

Cigarette preparation and machine smoking for conventional cigarettes are described in Health Canada Test Method T-115 (CAN) (1999). Two to three cigarettes were smoked per replicate for conventional cigarettes and 99 puffs were taken from single e-cigarettes for no more than approximately 200 mg of particulates collected per pad. Three to five replicates were tested for each measurement. Prior to analysis, filter pads from cigarette smoke collection were visually inspected for overloading of particulates, as evidenced by brown spotting on the back of the filter pad. To ensure no overloading of particulates for aerosol collection, e-cigarette units were weighed before and after collection to verify that product weight change and filter pad weight change were comparable. Air blanks were prepared by puffing room air (99 puffs) through an empty smoking machine port to the indicated trapping media for an analysis method. These air blank samples were prepared and analyzed in the same manner and at the same time as the e-cigarette aerosol samples. Smoke and aerosol collection sections were conducted separately. Smoke and aerosol particulate was collected onto 44 mm glass fiber filter pads with >99% particulate trapping efficiency for each replicate analysis. For carbonyls, smoke/aerosol was collected directly by two impingers, in series. For smoke metals analysis, electrostatic precipitation was used. For volatiles and PAH determinations, single chilled impingers were placed in-line with the filter pads. e-Liquid glycerin and nicotine were quantitated using GC–FID and/or GC–MS using a method equivalent to ISO 10315 (ISO, 2000a). e-Liquid water was quantitated using Karl Fischer analysis. A reference e-liquid was developed and used as a testing monitor for ingredient determinations in the e-liquid samples. The reference e-liquid is composed primarily of glycerin, propylene glycol, and water with low levels of nicotine, menthol, and Tween 80. The Tween 80 is added to improve solubility of menthol in the solution. The reference is not meant to directly mimic an e-liquid used for consumption but merely used for analytical control charts. Three replicates were tested for each sample and the reference.

2.4. Analytical assays

Carbon monoxide was determined concurrently with aerosol and smoke collection for nicotine and water and analyzed by NDIR using ISO method 8454:2007 (ISO, 2007). Carbonyls were trapped using 2,4-dinitrophenylhydrazine as a derivatizing agent with subsequent analysis by UPLC–UV using CORESTA method 74 (CORESTA, 2013). For phenolics determination, filter pads were extracted with 20 mL of 1% acetic acid/2.5% methanol (MEOH) in water using 30 min of agitation. Extracts were analyzed by UPLC-fluorescence detection using a C18 column for separation. For volatiles analysis, filter pads and impinger solutions (20 mL MEOH) were combined. Extracts were analyzed by GC–MS in SIM mode using a WAX capillary column. For metals analysis, cigarette smoke was collected using an electrostatic precipitator while e-cigarette aerosol was collected on glass fiber filter pads. After smoking, the cigarette smoke condensate was rinsed from the electrostatic precipitation tube using methanol. The dried condensates were digested using hydrochloric (10% v/v), nitric acids (80% v/v), and heat and were diluted prior to analysis by ICP-MS. For aerosol samples, filter pads were extracted using 20 mL of a mixture of nitric (2% v/v) and hydrochloric acids (0.5% v/v) using wrist action shaker (20 min). Resultant extracts were analyzed by ICP-MS equipped with an octapole

reaction cell.

For TSNA analysis of smoke, samples were extracted in nonpolar solvent, treated to an SPE clean-up, concentrated and analyzed by GC–TEA following CORESTA method 63 (CORESTA, 2005). For TSNA analysis of aerosol samples, filter pads were extracted with 20 mL of 5 mM aqueous ammonium with 15 min of shaking. Extracts were analyzed by LC–MS/MS with a C18 column. For PAA determinations, filter pads were extracted using 25 mL of 5% HCl (aq) and shaking (30 min) followed by solvent exchange and derivatization with pentafluoropropionic acid anhydride and trimethylamine. After an SPE clean-up step (Florisil® SEP-PAK), samples were analyzed by GC–MS in SIM mode using negative chemical ionization. PAH analysis was conducted by extraction in MEOH followed by SPE clean-up and analysis by GC–MS in SIM mode (Tarrant et al., 2009).

The results obtained from these analyses were tabulated as mean ± one standard deviation for levels of selected compounds in Supplementary Appendix A. In cases where quantifiable amounts of analyte were present in an e-cigarette aerosol sample above that of the associated air blanks, an Analysis of Variance (ANOVA) was used to compare the means for the cigarette smoke data with respective aerosol data. Statistical analyses were performed using JMP 10.0.0 (SAS Institute, Inc. Cary, NC, USA). The significance level was established as $p < 0.05$ for all comparisons.

3. Results and discussion

3.1. Collection of aerosol

Machine smoking of cigarettes under standardized regimes is for comparative purposes and is not intended to represent the range of consumer smoking behaviors. Thus, standardized equipment, cigarette reference products, and methodology have been established to allow comparison of different products under a common set of controlled conditions. ISO 3308:2000E and Health Canada (CAN) methods are frequently used for standardized smoking of conventional cigarettes for the purposes of laboratory comparisons among products (ISO, 2000b and Health Canada, 1999). Following each of these methods, conventional cigarettes are smoked to a specified butt length using a fixed and specified puffing volume, duration, and interval.

Regarding e-cigarette experimentation, there is no generally accepted standard e-cigarette puffing regime at this time. Topography studies are limited but anecdotal information indicates e-cigarette usage depends greatly on the individual consumer and product design and capabilities. For the purposes of this study, our objective was to collect sufficient aerosol to be able to detect, if present, select HPHCs. A wide range of parameters would be adequate to accomplish this. Given the objectives of this study, use of collection parameters which are compatible with conventional and electronic cigarettes was essential for facilitating comparisons between cigarette smoke and e-cigarette aerosol. The more intense of the standard regimes used with cigarettes, CAN, which requires 55 mL puffs taken twice a minute, was adapted for this investigation. The key difference required for testing e-cigarettes with the CAN method is that a fixed puff count (rather than 'butt length') is necessary for aerosol collection. A standard of 99 puffs was adopted for all e-cigarette and air blank analyses. This puff count provides similar total particulate collection per pad between the e-cigarette samples and the conventional cigarette testing. This also represents approximately 11 times more puffs than are typically observed for a conventional cigarette. Marlboro Gold Box, L&B O, and L&B M averaged 9.1, 8.2, and 7.2 puffs per cigarette, respectively, when machine-smoked to the standard butt length. If more aggressive puffing parameters had been chosen for the study, the puff count specification would have been lowered to maintain the target level of ACM collected. Note that the range of puffs collected in-use may vary widely depending on product design, battery strength, and user puffing preferences. Thus, the 99 puffs collection in this study is not intended to represent a life time use yield for any of the analytes tested.

3.2. Aerosol and smoke characterization – reference information

Traditional cigarette testing incorporates the use of monitor or reference cigarettes that

serve as positive controls and provide quality metrics for standardized analytical methods. Key examples are Kentucky Reference cigarettes and CORESTA monitor cigarettes (CORESTA, 2009, ISO, 2003 and University of Kentucky, 2014). Each of these reference cigarettes can serve as a single positive control and an indicator of method variability within and among laboratories for all analytes of interest. The manufacture, design, and function of these reference products are similar to those of commercial cigarettes. Currently reference products are not available for e-cigarette testing. Given the range of e-cigarette designs, development of a consensus strategy to produce positive controls or monitors for e-cigarette testing is needed.

In the absence of standardized e-cigarette references, measures were taken to ensure experimental robustness. For example, aerosol collected mass (ACM) results for the e-cigarette samples were compared across methods as an indicator of puffing consistency for a given product among the machine-puffing sessions required to conduct the battery of tests. Thus, if a sample set yielded ACM outside of a specified ranged deemed typical for a given product, the sample set was repeated. This range was determined for each product based on collection of 20 or more replicates across the product lot using CAN parameters.

Also, because results from initial analyses indicated low or no measurable levels of many of the analytes, blank samples were included to verify any contribution of analyte from the laboratory environment, sample preparation, and/or analyses for each HPHC test method. The air blank results are listed with the samples' results in Table 4 and Table 5. There were instances for which solvent blank and air blank samples had measurable levels of an analyte. This is due to the ubiquitous nature of some of the analytes, such as formaldehyde, or to carry-over. Laugesen reported similar findings (2009). These observations serve as a cautionary note regarding the measurement of extremely low levels of constituents with highly sensitive instrumentation.

3.3. Main ingredients

e-Liquid expressed from the individual products was tested for reported e-cigarette ingredients to compare the percent compositions of the e-liquids and the aerosols. Percent composition calculations of the ingredients are shown in Table 2 for each sample and in Fig. 1 for blu CTD, as this product's comparative results were exemplary of the samples. The primary ingredients in the e-cigarette samples were glycerin and/or propylene glycol (⩾75%). Water (⩽18%) and nicotine (~2%) were also present. Based on a mass balance, other ingredients, presumed to be flavorants, were present at less than 7%. Note that this calculation would also include method uncertainty and any possible HPHCs, if present. The composition of the aerosol was calculated based on the ACM delivery as analyte yield (mg)/ACM (mg) × 100. The bulk composition of the delivered aerosol was similar to the bulk composition of the e-liquid.

Table 2.
Percent composition of e-liquid and aerosol.

	Glycerin (%)	Propylene glycol (%)	Water (%)	Nicotine (%)	Flavor[a] (%)
e-Liquid composition					
blu Classic Tobacco Disposable	82	–	9	2	7
blu Magnificent Menthol Disposable	75	–	18	2	5
blu Cherry Crush High Premium	77	–	14	2	7
SKYCIG Classic Tobacco Bold	24	67	6	2	1
SKYCIG Crown Menthol Bold	21	66	7	2	4
e-Cigarette aerosol composition[b]					
blu Classic Tobacco Disposable	73	–	15	1	11
blu Magnificent Menthol	80	–	18	2	–

Disposable					
blu Cherry Crush High Premium	70	–	19	1	10
SKYCIG Classic Tobacco Bold	24	61	10.4	1.4	3
SKYCIG Crown Menthol Bold	21	59	12	2	6

a Flavor content is estimated by difference.

b Aerosol % composition calculated based on the ACM delivery as analyte yield (mg)/ACM (mg) × 100.

Table options

Fig. 1.
Percent composition comparison for e-liquid, e-cigarette aerosol, and cigarette smoke: (a) Classic Tobacco Disposable e-liquid Composition. (b) Classic Tobacco Disposable Aerosol Composition (99 puffs, CAN). (c) Marlboro Gold Box Smoke Composition (9 puffs, CAN).

Figure options

By comparison, the total particulate matter (TPM) of the conventional cigarettes tested is 30% water and <5% nicotine. The essential difference between the ACM composition of the e-cigarettes tested and the TPM of the conventional cigarettes is that the remaining 65% of the TPM of the conventional cigarette is predominantly combustion byproducts. There was no detectable carbon monoxide in the emitted aerosol of the e-cigarette samples. The conventional cigarettes, on the other hand, delivered more than 20 mg/cig of CO. Smoke composition for Marlboro Gold Box, exemplary of the conventional cigarettes tested, is shown in Fig. 1 in contrast to the e-liquid and aerosol results for blu CTD.

While the percent composition of the nicotine in the ACM and TPM are relatively similar, it should be noted that the actual deliveries of nicotine are markedly lower for the e-cigarettes tested than the conventional cigarettes. The nicotine yields ranged from 8 μg/puff to 33 μg/puff for the e-cigarette samples which was 85% lower than the 194–232 μg/puff for the conventional cigarettes. These results are presented in Table 3.

Table 3.
Nicotine content and yield comparison between e-cigarettes and conventional cigarettes (mean ± standard deviation).

	Nicotine content (μg/unit)	Nicotine yield (μg/puff)
blu Classic Tobacco Disposable	20,600 ± 1500	33 ± 12
blu Magnificent Menthol Disposable	20,000 ± 300	25 ± 4
blu Cherry Crush High Premium	11,700 ± 300	8 ± 3
SKYCIG Classic Tobacco Bold	12,750 ± 295	29 ± 4
SKYCIG Crown Menthol Bold	13,027 ± 280	33 ± 6
Marlboro Gold Box	11,431 ± 80	226 ± 2
L&B Original	12,941 ± 26	232 ± 5
L&B Menthol	12,131 ± 24	194 ± 10

Number of replicates = 3–5.

Table options

3.4. Aerosol and smoke HPHC testing

For cigarette smoke analysis, the conventional cigarettes were machine smoked by established cigarette smoking procedures. Approximately 7–9 puffs per cigarette were collected. For the e-cigarette samples and air blanks, 99 puffs were collected. Results were compared on an 'as tested' basis; i.e. yields for a single cigarette of 7–9 puffs compared to yields from 99 puffs of an e-cigarette as displayed in Table 4. Additionally, in order to simplify making comparisons between the cigarette and e-cigarette samples, all values were converted to yield per puff. These results are summarized by class in Table 5. Results for individual analytes are tabulated as mean ± one standard deviation in Supplemental Appendix A Tables 1 and 2.

Table 4.
Analytical characterization of commercial e-cigarettes and conventional cigarettes collected using CAN parameters – select cigarette HPHC methodology (mg/total puffs collected) summary by analyte classes.

	CO	Carbonyls[a]	Phenolics[b]	Volatiles[c]	Metals[d]	TSNAs[e]	PAA[f]	PAH[g]
Marlboro Gold Box (mg/cig)	27	1.92	0.204	1.430	<0.00020	0.000550	0.000024	0.00222
L&B Original (mg/cig)	22	1.89	0.26	1.02	<0.0002	0.000238	0.000019	0.00219
L&B Menthol (mg/cig)	20	1.81	0.17	0.94	<0.0003	0.000185	0.000017	0.00153
blu CTD (mg/99 puffs)	<0.1	<0.07	<0.001	<0.001	<0.00004	<0.00002	<0.000004	<0.0001
blu MMD (mg/99 puffs)	<0.1	<0.08	<0.001	<0.001	<0.00004	<0.00002	<0.000004	<0.0001
blu CCHP (mg/99 puffs)	<0.1	<0.05	<0.003	<0.0004	<0.00004	<0.00002	<0.000004	<0.0001
SKYCIG CTB (mg/99 puffs)	<0.1	<0.06	<0.0010	<0.008	<0.00006	<0.000013	<0.000014	<0.0000

SKYCIG CMB (mg/99 puffs)	<0.1	<0.09	<0.0014	<0.008	<0.00006	<0.000030	<0.000014	<0.0000
Air Blank (blu Set) (mg/99 puffs)	<0.1	<0.06	<0.001	<0.0004	<0.00004	<0.00002	<0.000004	<0.0001
Air Blank (SKYCIG Set) (mg/99 puffs)	<0.1	<0.05	<0.0009	<0.008	<0.00006	<0.000013	<0.000014	<0.0000

< Indicates some or all values were below method limits of quantitation or detection, number of replicates = 3–5.

a Formaldehyde, acetaldehyde, acrolein propionaldehyde, crotonaldehyde, MEK, butyraldehyde.

b Hydroquinone, resorcinol, catechol, phenol, m-+p-cresol, o-cresol.

c 1,3-Butadiene, isoprene, acrylonitrile, benzene, toluene, styrene.

d Beryllium, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, selenium, tin.

e NNN, NAT, NAB, NNK.

f 1-Aminonaphthalene, 2-aminonaphthalene, 3-aminobiphenyl, 4-aminobiphenyl.

g Naphthalene, acenaphthylene, acenaphthene, fluorine, phenanthrene, anthracene, fluoranthene, pyrene, benzanthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, B(a)P, indeno[1,2,3-cd]pyrene, benzo(g,h,i)perylene.

Table options

Table 5.
Analytical characterization of commercial e-cigarettes and conventional cigarettes collected using CAN parameters – select cigarette HPHC methodology (µg/puff) summary by analyte classes.

	CO	Carbonyls[a]	Phenolics[b]	Volatiles[c]	Metals[d]	TSNAs[e]	PAA[f]	PAH[g]
Marlboro Gold Box	2967	211	22	157	<0.026	0.0604	0.00264	0.244
L&B Original	2683	230	32	124	<0.024	0.0290	0.00232	0.267
L&B Menthol	2778	251	24	130	<0.042	0.0257	0.00236	0.213
blu Classic Tobacco Disposable	<1.0	<0.7	<0.01	<0.01	<0.0004	<0.0002	<0.00004	<0.002
blu Magnificent Menthol Disposable	<1.0	<0.8	<0.01	<0.01	<0.0004	<0.0002	<0.00004	<0.002
blu Cherry Crush High Premium	<1.0	<0.5	<0.03	<0.004	<0.0004	<0.0002	<0.00004	<0.001
SKYCIG Classic Tobacco Bold	<1.0	<0.6	<0.01	<0.08	<0.0006	<0.0001	<0.00014	<0.0004
SKYCIG Crown Menthol Bold	<1.0	<0.9	<0.01	<0.08	<0.0006	<0.0003	<0.00014	<0.0004
Air Blank (blu Set)	<1.0	<0.6	<0.01	<0.004	<0.0004	<0.0002	<0.00004	<0.002
Air Blank	<1.0	<0.5	<0.01	<0.08	<0.0006	<0.0001	<0.00014	<0.001

(SKYCIG Set)									

< Indicates some or all values were below method limits of quantitation or detection, number of replicates = 3–5.

a Formaldehyde, acetaldehyde, acrolein propionaldehyde, crotonaldehyde, MEK, butyraldehyde.

b Hydroquinone, resorcinol, catechol, phenol, m-+p-cresol, o-cresol.

c 1,3-Butadiene, isoprene, acrylonitrile, benzene, toluene, styrene.

d Beryllium, cadmium, chromium, cobalt, lead, manganese, mercury, nickel, selenium, tin.

e NNN, NAT, NAB, NNK.

f 1-Aminonaphthalene, 2-aminonaphthalene, 3-aminobiphenyl, 4-aminobiphenyl.

g Naphthalene, acenaphthylene, acenaphthene, fluorine, phenanthrene, anthracene, fluoranthene, pyrene, benzanthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, B(a)P, indeno[1,2,3-cd]pyrene, benzo(g,h,i)perylene.

Table options

All analytes tested were present in the cigarette smoke at quantifiable levels except for select metals. These results are consistent with internal historical results for commercial cigarettes tested under the CAN smoking regime. For the cigarette samples, the total yield range was 3069–3350 µg/puff of HPHCs tested.

Of the 55 HPHCs tested in aerosol, 5 were quantifiable in an e-cigarette sample but not the associated air blank. The quantifiable results for aerosol are listed in Table 6 and Table 7 in contrast with the conventional cigarettes from the same geographical region. The five analytes which were quantifiable were statistically different ($p < 0.05$) at levels 50–900 times lower than the cigarette smoke samples. Phenol was quantified in one e-cigarette product at 900 times lower than cigarette smoke. N-Nitrosoanatabine was quantified in one product at 50 times lower than cigarette smoke. Three carbonyls (acrolein, acetaldehyde, and propionaldehyde) were quantified at 86–544 times lower than cigarette smoke.

Table 6.
Per puff comparisons of quantifiable analytes for blu eCigs products from CAN puffing – yields and ratios to conventional product yields.

	Marlboro Gold Box µg/puff	blu MMD µg/puff	MGB/blu MMD
Acrolein	16.4 ± 0.2	0.19 ± 0.06	86
Phenol	1.53 ± 0.16	0.0017[a]	900

a Fewer than three replicates were quantifiable; no standard deviation is listed.

Table options

Table 7.
Per puff comparisons of quantifiable analytes for SKYCIG products from CAN puffing – yields and ratios to conventional product yields.

	L&B average µg/puff	SKYCIG CTB µg/puff	SKYCIG CMB µg/puff	L&B average/SKYCIG CTB	L&B average/SKYCIG CMB
Acetaldehyde	174	–	0.32[a]	–	544
Acrolein	17	0.15 ± 0.02	–	113	–
Propionaldehyde	12	–	0.11 ± 0.05	–	109
N-Nitrosoanatabine	0.010	–	0.0002 ± 0.0001	–	50

a Fewer than three replicates were quantifiable; no standard deviation is listed.

Table options

All other analytes were not quantifiable above the air blanks in aerosol samples. The e-cigarettes and air blanks total yields for analytes were <2 µg/puff which is 99% less than the approximately 3000 µg/puff quantified for the cigarette smoke samples. Thus, the

results support the premise of potentially reduced exposure to HPHCs for the e-cigarette products compared to conventional cigarette smoke.

4. Conclusions

The purpose of this study was to determine content and delivery of e-cigarette ingredients and to compare e-cigarette aerosol to conventional cigarettes with respect to select HPHCs for which conventional cigarette smoke is routinely tested. Routine analytical methods were adapted and verified for e-cigarette testing. Aerosol collection was conducted using conventional smoking machines and an intense puffing regime. As machine puffing cannot, and is not intended to, mimic human puffing, results of this study are limited to the scope of the comparisons made between the e-cigarette and conventional cigarette products tested.

The main ingredients for the e-cigarettes tested were consistent with disclosed ingredients: glycerin and/or propylene glycol ($\geqslant$75%), water ($\leqslant$18%), and nicotine ($\sim$2%). Machine-puffing of these products under a standardized intense regime indicated a direct transfer of these ingredients to the aerosol while maintaining an aerosol composition similar to the e-liquid. Nicotine yields to the aerosol were approximately 30 μg/puff or less for the e-cigarette samples and were 85% lower than the approximately 200 μg/puff from the conventional cigarettes tested.

Testing of the e-cigarette aerosol indicates little or no detectable levels of the HPHC constituents tested. Overall the cigarettes yielded approximately 3000 μg/puff of the HPHCs tested while the e-cigarettes and the air blanks yielded <2 μg. Small but measurable quantities of 5 of the 55 HPHCs tested were found in three of the e-cigarette aerosol samples at 50–900 times lower levels than measurable in the cigarette smoke samples. Overall, the deliveries of HPHCs tested for the e-cigarette products tested were more like the study air blanks than the deliveries for the conventional cigarettes tested. Though products tested, collection parameters, and analytical methods are not in common between this study and others, the results are very consistent. Researchers have reported that most or all of the HPHCs tested were not detected or were at trace levels. Burstyn (2014) used data from approximately 50 studies to estimate e-cigarette exposures compared to workplace threshold limit values (TLV) based on 150 puffs taken over 8 h. The vast majority of the analytes were estimated as $\ll$1% of TLV and select carbonyls were estimated as <5% of TLV. Cheng (2014) reviewed 29 publications reporting no to very low levels of select HPHCs relative to combustible cigarettes, while noting that some of the tested products exhibited considerable variability in their composition and yield. Goniewicz et al. (2014) tested a range of commercial products and reported quantifiable levels for select HPHCs in e-cigarette aerosols at 9- to 450-fold lower levels than those in cigarette smoke that in some instances were on the order of levels determined for the study reference (a medicinal nicotine inhaler). Laugesen, 2009 and Theophilus et al., 2014 have presented results for commercial e-cigarette product liquids and aerosols having no quantifiable levels of tested HPHCs, or extremely low levels of measurable constituents relative to cigarette smoke. Additionally, findings from several recent studies indicate that short-term use of e-cigarettes by adult smokers is generally well-tolerated, with significant adverse events reported relatively rarely (Etter, 2010, Polosa et al., 2011, Polosa et al., 2014, Caponnetto et al., 2013, Dawkins and Corcoran, 2014 and Hajek et al., 2014). Thus, the results obtained in the aforementioned studies and in the present work broadly support the potential for e-cigarette products to provide markedly reduced exposures to hazardous and potentially hazardous smoke constituents in smokers who use such products as an alternative to cigarettes.

Additional research related to e-cigarette aerosol characterization is warranted. For example, continued characterization of major components and flavors is needed. Establishment of standardized puffing regimes and reference products would greatly aid sharing of knowledge between researchers. Continued methods' refinement may be necessary for improved accuracy for quantitation of analytes at the low levels determined in this study. To that end, it is critical that negative controls and steps to avoid sample

contamination be included when characterizing e-cigarette aerosol since analytes are on the order of what has been measured in the background levels of a laboratory setting. Though researchers have reported quantification of select analytes, great care must be taken when interpreting results at such trace levels.

Conflicts of interest

The company for which the study authors work and the companies that manufacture the e-cigarettes tested for this study are owned by the same parent company.

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Appendix A. Supplementary data

Supplementary data.

This document contains supplementary tables

Help with DOCX files

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Plans to ban e-cigarettes in public places defeated

Contentious legislation to ban vaping in certain public places like schools and public transport was defeated by just one vote

Staff at the Swansea branch of Vibrant Vapours, a supplier of electronic cigarettes and fluid, demonstrate the use of "vaping" devices Photo: Alamy

By Nicola Harley

9:16PM GMT 16 Mar 2016

Plans to ban e-cigarettes for the first time in the UK in public places where children are present have been defeated.

The landmark vote by the Welsh Assembly aimed to restrict the use of nicotine inhaling devices in public places such as schools,restaurants and on public transport.

But the contentious legislation was defeated by just one vote in the Senedd.

Opposition parties and even some health charities had strongly criticised the planned curb on e-cigarettess.

Shadow health minister and Conservative AM Darren Millar said a ban would have been a huge step backwards for smoking cessation and efforts to improve public health.

He said: "I'm delighted that pressure from the Welsh Conservatives and other opposition parties yielded results in the end.

"Labour ministers are totally misguided in their war on e-cigarettes and in the end their arrogant attempt to force a ban through were thwarted.

"There is no evidence supporting their plans and they should have been ditched months ago. Ultimately, we should be giving people a helping hand to quit smoking - not placing obstacles in their way"

Originally, ministers wanted to ban e-cigarettes from all enclosed public and work places.

However, its proposals were watered down to places where children were present after a committee report split Assembly Members' opinions.

Wales Health Minister Mark Drakeford Photo: Alamy

Labour is one seat shy of an overall majority in the Senedd and needed other parties' backing before it can pass legislation.

Ahead of the vote on Wednesday night, it was thought Plaid Cymru may lend its support - with the Welsh nationalists saying they would consider the plans "very carefully".

However, at the 11th hour Plaid joined forces with the Tories and Welsh Liberal Democrats - bringing the total votes against to 27, pipping the 26 votes in favour.

A Plaid spokeswoman said: "We proposed to Welsh Government that the Bill should be withdrawn before the vote and that the Assembly should be reconvened immediately after Easter to vote on a Bill with all sections on e-cigarettes removed. Plaid Cymru would have supported that legislation."

Pro smoking group Forest branded the e-cigarette ban as illogical.

A spokesman said: "Vapers are almost exclusively smokers who wish to cut down or quit or are looking for an alternative nicotine delivery system in places where smoking is banned.

"Given the a lack of evidence that the use of electronic cigarettes is harmful to users and bystanders, it would be hugely counter-productive to discourage the use of e-cigarettes in public places."

In its previous evidence to an Assembly committee, The British Heart Foundation called the legislation "heavy handed".

Health Minister and Labour AM Mark Drakeford said he was deeply disappointed the Bill would not pass onto the statute books.

He said: "It puts to waste five years of careful preparation and constructive work with a very wide range of stakeholders and supporters.

"There will be widespread anger that opposition parties, who had exerted a real influence on the Bill failed to support it into law and abandoned all the important protections for the public it would have put in place.

"They chose not to do so and they must answer for their conduct."

However, Welsh Lib Dem leader Kirsty Williams said: "Labour's illiberal plan flew in the face of medical evidence.

"When you've got a whole host of experts and charities like Cancer Research UK against you, you should realise you're on the wrong side of the argument."

Had the law been passed it would have been the first of its kind in the UK.

Other features of the Public Health (Wales) Bill included measures to license all tattooists, increase the age someone can have their tongue pierced to 16 and making local councils produce a public toilets strategy.