



Short Report

E-cigarette nicotine content and labelling practices in a restricted market: Findings from Ontario, Canada



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ABSTRACT

Background: Although several countries, including Canada, have prohibited the sale of nicotine-containing e-cigarettes, there is little evidence examining the impact of such regulatory measures on nicotine content and labelling.

Methods: E-cigarettes were systematically purchased at 80 retail outlets across 4 cities in Ontario, Canada in January–February 2015. Products' nicotine content and labelling accuracy were assessed using gas chromatography.

Results: A total of 166 e-cigarette products were purchased, including disposable products (33%), refillable products (14%), and e-liquids (53%). Similar proportions of products were labelled as 'without nicotine' (41%), and 'with nicotine' (44%), while 15% of products were unlabelled. Analyses revealed that almost half the products (48%) contained nicotine. With respect to the presence of nicotine, 10 products (6%) were mislabelled. Just over one-quarter (27%) of products labelled as 'with nicotine' (n = 73) fell outside their labelled concentration. All of the mislabelled products were e-liquids (100%) and the vast majority were sold in vape shops (90%).

Conclusion: Despite a prohibition, nicotine-containing e-cigarettes are commonly sold in Canada. While many e-cigarettes were correctly labelled, inaccuracies were common, particularly among nicotine-containing products sold in vape shops. The findings reflect limitations regarding the design and enforcement of the current e-cigarette regulatory framework.

Introduction

Electronic cigarettes (e-cigarettes) are devices that deliver nicotine via an aerosol. The aerosol is produced by heating an enclosed solution which typically contains nicotine and flavouring chemicals dissolved in propylene glycol and/or glycerin (Breland et al., 2017). Although e-cigarettes are likely to pose fewer health risks than combustible tobacco cigarettes – given that they do not contain tobacco and do not combust to produce tobacco smoke (NASEM, 2018) – their overall potential impact on public health remains unclear (Breland et al., 2017).

According to the Institute for Global Tobacco Control (Kennedy, Awopegba, De Leon, & Cohen, 2017), 79 countries have national laws regulating e-cigarettes. In several countries, regulations restrict the amount of nicotine in e-liquids and/or the quality of nicotine or other ingredients used to manufacture e-liquids. The sale of e-cigarettes containing nicotine is prohibited or requires pre-market approval in

several countries, including Australia, Canada, Costa Rica, Jamaica, Japan, Malaysia, Mexico, New Zealand and Switzerland (Institute for Global Tobacco Control, 2017).

In Canada, nicotine-containing e-cigarettes require market approval, whereas non-nicotine containing e-cigarettes can be sold without this requirement (Health Canada, 2009). To date, no nicotine-containing e-cigarettes have received approval. While many conventional retail outlets, such as grocery and convenience store chains, typically sell e-cigarettes without nicotine in compliance with federal regulations, e-cigarettes with nicotine are widely available at vape shops (Hammond et al., 2015) and many Canadians report using nicotine-containing e-cigarettes (Hamilton et al., 2015; Reid et al., 2017), similar to consumers in jurisdictions in which e-cigarettes are permitted for sale (Gravelly et al., 2014). To date, there is little empirical evidence examining the presence of nicotine or the accuracy of nicotine labelling in markets that restrict or prohibit sales of e-cigarette products.

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Table 1
Characteristics of tested products, overall and by product label (n = 166).

	Overall (n = 166)		'Without nicotine' (n = 68)		'With nicotine' (n = 73)		Unlabelled (n = 25)	
	% (n)							
City ¹								
Toronto	40.0	(66)	29.4	(20)	43.8	(32)	56.0	(14)
Ottawa	18.8	(31)	22.1	(15)	21.9	(16)	0.0	(0)
Kitchener-Waterloo	21.8	(36)	23.5	(16)	16.4	(12)	32.0	(8)
Thunder Bay	19.4	(32)	25.0	(17)	17.8	(13)	8.0	(2)
Retail outlet type ¹								
Vape shop	53.3	(88)	23.5	(16)	93.2	(68)	16.0	(4)
Supermarket	13.3	(22)	22.1	(15)	2.7	(2)	20.0	(5)
Convenience store	27.3	(45)	42.6	(29)	4.1	(3)	52.0	(13)
Gas station convenience store	6.1	(10)	11.8	(8)	0.0	(0)	8.0	(2)
Product type								
Cartridge/cartomizer refill	13.9	(23)	17.6	(12)	2.7	(2)	36.0	(9)
Disposable	33.1	(55)	60.3	(41)	0.0	(0)	56.0	(14)
E-liquid	53.0	(88)	22.1	(15)	97.3	(71)	8.0	(2)
Nicotine detected								
No	52.4	(87)	92.6	(63)	2.7	(2)	88.0	(22)
Yes	47.6	(79)	7.4	(5)	97.3	(71)	12.0	(3)

Note: ¹One product had missing information for city and retail outlet type of purchase. This product was 'unlabelled'.

Unpublished data from testing conducted on behalf of Health Canada in spring 2014 indicated that almost half of the 91 e-cigarettes tested contained nicotine (Standing Committee on Health, 2015). However, it is unclear whether the purchasing and testing of these products was conducted systematically, with respect to the range of retail outlets from which the e-cigarettes were sourced and the types of products included.

Given that labelled concentrations of nicotine in e-cigarette products often suffer from inaccuracies (Buettner-Schmidt, Miller, & Balasubramanina, 2016; Goniewicz, Kuma, Gawron, Knysak, & Kosmider, 2013; Kim, Goniewicz, Yu, Kim, & Gupta, 2015), product testing methods can help determine whether, and the extent to which, nicotine is present in Canadian e-cigarette products, as well as provide contextual understanding of the presence of such products in a restricted market. Thus, the current study aimed to examine the nicotine content of e-cigarette products on the Canadian market, with a focus on the province of Ontario.

Materials and methods

Products

E-cigarette products were purchased by a trained research assistant using a systematic protocol at retail outlets across four Ontario cities (Toronto, Ottawa, Kitchener-Waterloo, Thunder Bay) in January and February 2015. A total of 80 retail outlets were visited, including five of each of the following types: vape shops, supermarkets, convenience stores, and gas station convenience stores. At each retail outlet, a research assistant was asked to purchase: two flavours of the most popular three brands of disposable products without nicotine; two flavours for any brands of disposable products with nicotine; two flavours for the most popular three brands of e-liquid with nicotine; and two flavours for the most popular three brands of cartomizers/cartridges. 'Popular' brands were established by prior inquiries to retail outlets. Whenever possible, the research assistant selected tobacco- and menthol-flavoured products. Finally, when purchasing e-liquids with nicotine, the research assistant was instructed to purchase e-liquids with a 'medium' concentration of nicotine, based on the available concentration levels.

Product testing

The purchased products were sent to the Tobacco Product Laboratory in Roswell Park Cancer Institute, Buffalo, USA for testing.

After arrival to the laboratory, each product was catalogued and assigned a unique sample number. All samples were stored in their original containers in a dark space at room temperature prior to analysis, in order to minimize the risk of nicotine degradation. Laboratory technicians were blinded to the labelled nicotine levels and to the product names, until the determined levels were obtained. Aliquotes of 100 µL of each product were collected from each original container using the reverse pipetting technique. The samples were diluted with 10 mL methanol, and an internal standard (100 µL quinoline solution 50 mg/mL in methanol) was added. The samples were then vigorously shaken for 10 min and subsequently analysed as described below. Each sample was prepared in triplicates in order to validate the results, and the calibration/control solutions were prepared in multiplicity as well. Nicotine concentrations were measured using gas chromatography with a nitrogen-phosphorous detector (GC-NPD, Agilent, USA) as described previously (Goniewicz et al., 2013). The method was validated as per the International Conference on Harmonization guideline Q2 (International Conference on Harmonization, 2005). A calibration curve was generated to cover the range of nicotine concentration from 0 to 100 mg/mL. To ensure accurate results for the samples each calibration curves had linear coefficients of 0.99 ($R^2 \geq 0.99$) or above. The average nicotine recovery was 102% and the lower quantitation limit was 0.05 mg/mL.

Statistical analysis

Product characteristics and the accuracy of nicotine labelling were examined using descriptive statistics. The accuracy of nicotine labelling was examined in two ways: first, with respect to the presence/absence of nicotine; and second, with respect to a 10% threshold of the labelled nicotine content. Analyses were conducted using SPSS v.24.

Results

A total of 166 e-cigarette products were purchased, including disposable products (33.1%), refillable products (13.9%), and e-liquids (53.0%) (see Table 1). Overall, approximately equal proportions of products were labelled as 'without nicotine' (41.0%), and 'with nicotine' (44.0%), while 15.1% of products were unlabelled.

Gas chromatography revealed that almost half of the products (47.6%) contained nicotine (see Table 1). Nicotine-containing products had an average nicotine concentration of 10.9 (SD = 4.2) mg/mL.

When examining the accuracy of nicotine labelling with respect to

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