

At-a-glance

Injuries and poisonings associated with e-cigarettes and vaping substances, electronic Canadian Hospitals Injury Reporting and Prevention Program, 2011–2019

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Abstract

Electronic cigarettes are devices that deliver nicotine to the user by heating an e-liquid. In Canada, the *Tobacco and Vaping Products Act* became law on May 23, 2018. The purpose of this study was to describe the cases of injuries and poisonings associated with e-cigarette and vaping substances that presented to Canadian emergency departments within the electronic Canadian Hospitals Injury Reporting and Prevention Program network between 2011 and 2019. A total of 68 cases were retrieved (54.4% males). Of the 68 cases, 8 occurred between 2011 and 2014, while 35 (51.5%) occurred in 2018 or 2019. Ingestions, inhalations and burns were observed.

Keywords: *electronic cigarette, vaping, injury, surveillance, eCHIRPP*

Introduction

Electronic cigarettes (e-cigarettes) are devices that deliver nicotine, via an aerosol, to the user by heating an e-liquid that contains propylene glycol, nicotine and flavouring agents.^{1,2} These devices were invented in the early 2000s in China and began to gain prominence in the North American marketplace in 2013, when the large tobacco companies entered the market.¹

The prevalence of e-cigarette use among youth in Canada has increased between 2013 and 2018.^{3,4} Reid et al.³ indicated that in 2013, 8.5% of Canadians aged 15 years and older reported ever having tried an e-cigarette (1.8% reported use in the last 30 days). Prevalence was highest among youth aged 15 to 19 years (19.8% ever; 2.6% past 30 days). Hammond et al.⁴ reported on vaping from a more recent survey of adolescents aged 16 to 19 years; in 2018, ever-prevalence was 37.0% and past-30-day use was 14.6%.

In Canada, the *Tobacco and Vaping Products Act*⁵ (TVPA) became law on May 23, 2018.

The TVPA replaced the *Tobacco Act*, which governed how tobacco products were sold, labelled, produced and promoted. Adults can now legally get vaping products with nicotine. In addition to the TVPA, vaping products are also subject to the *Canada Consumer Product Safety Act*,⁶ the *Food and Drugs Act*⁷ and the *Non-smokers' Health Act*.^{8,9} Despite the TVPA becoming law only recently, there is evidence that vaping products containing nicotine were available at least three to four years prior to 2018.^{10,11}

A recent outbreak in the United States of pulmonary illness associated with vaping has heightened awareness of the potential hazards associated with e-cigarette use.¹² While these cases would not necessarily be captured in an emergency department injury and poisoning surveillance system due to their differing presentation, there are reports of other injuries and poisonings that have been associated with vaping devices, including ingestions resulting in nicotine exposure by young children.¹³⁻¹⁵ These reports included a fatality,¹⁶ intentional ingestions,¹⁷ inhalation effects¹⁵ and burns due to explosions.^{18,19}

Highlights

- Of 68 cases of injury or poisoning due to e-cigarette use or vaping between 2011 and 2019, 54.4% involved males.
- Of the 68 cases, 8 occurred between 2011 and 2014 while 35 (51.5%) occurred in 2018 or 2019.
- The annual percent change (APC) was 50.7% (95% CI: 15.9–96.1).
- Children under 5 years of age who either ingested the e-juice or vaping liquid or inhaled from the device accounted for 52.9% of incidents.
- In two cases, the device's battery exploded in the pocket of an adult male, causing a burn to the thigh.
- There were 3 traumatic brain injuries as a result of a fall subsequent to vaping.

The purpose of this study was to describe the circumstances of injuries and poisonings associated with e-cigarette and vaping substances that presented to Canadian emergency departments within the electronic Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP) network between 2011 and 2019.

Methods

Data source

The electronic Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP) is an injury and poisoning sentinel surveillance system operating in 11 pediatric and 8 general hospitals across

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Canada. The eCHIRPP is managed by the Public Health Agency of Canada (Centre for Surveillance and Applied Research).²⁰

Extraction of cases

We searched the eCHIRPP database for cases (all ages) of injuries and poisonings related to e-cigarette and vaping substance use entered into the system between 1 April, 2011, and 4 October, 2019. Cases were identified using eCHIRPP factor codes “858F:e-cigarette” or “859F:e-cigarette fluid” and a bilingual text-based search of the eCHIRPP narrative fields (Narrative, Product, Substance ID) using a list of slang and brand-name terms such as: “Ecig”, “e-cig”, “nicotine”, “Vapouriz”, “e-juice”, “JUUL”, “lene glycol” and “myblu”. The full list of search terms is available upon request. We cleaned the data by mining the narrative fields using practical extraction and report language (Perl) regular expressions²¹ in SAS 9.4 (SAS Institute Inc., Cary, NC, USA). The clean dataset was manually reviewed and coded with further circumstantial detail. The temporal trend was assessed using Joinpoint software.²²

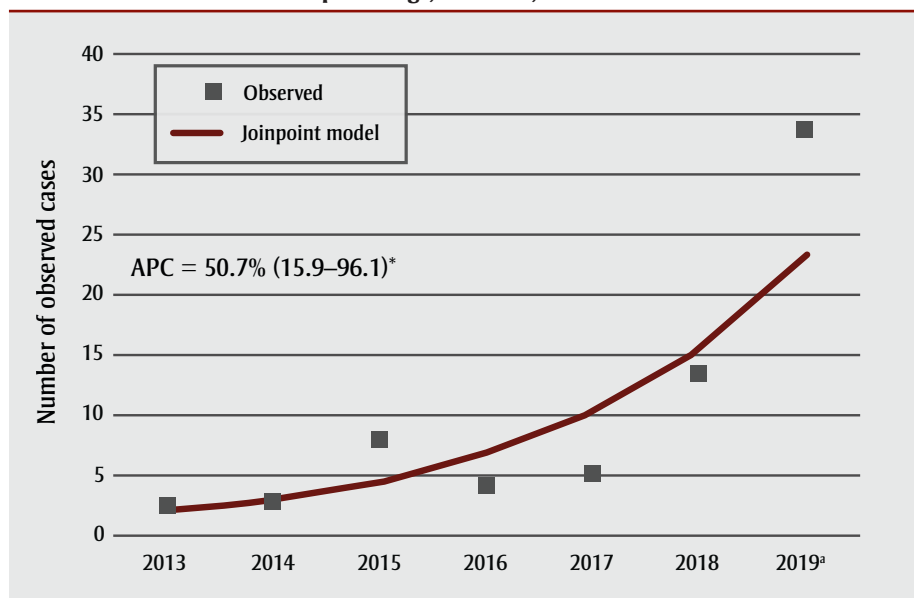
Results

We retrieved a total of 68 cases, of which 37 (54.4%) involved males. In the emergency department 26 patients (38.2%) were held for prolonged observation and 2 were admitted to hospital.

Of the 68 cases, 8 occurred between 2011 and 2014, while 35 (51.5%) occurred in 2018 or 2019. Figure 1 shows the trend over time and the results of the Joinpoint analysis. Since there was one case in 2011 and there were none in 2012, the analysis was limited to 2013 to 2019. The annual percent change (APC) was 50.7% (95% CI: 15.9–96.1). The number of cases were normalized to the proportion of eCHIRPP cases (per 100 000) in the same year.

Table 1 describes the circumstances and the injuries and poisonings associated with electronic cigarettes and vaping devices. Children under 5 years of age who either ingested the e-juice or vaping liquid or inhaled from the device accounted for 52.9% of incidents. A smaller number of children and youth aged between 5 and 19 years also ingested the vaping fluid; however, youth at this age vape (either with or without cannabis) and therefore

FIGURE 1
Emergency department presentations for e-cigarette/vaping-related injuries and poisonings, eCHIRPP, 2013–2019



Abbreviations: APC, annual percent change; eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program.

Note: Normalized proportion: number of cases/total number of cases in eCHIRPP in the given year (x 100 000).

^a 2019 is incomplete.

* Significant at $\alpha = .05$.

may experience inhalation effects (as did 18 of the cases in our study).

In two cases, the device’s battery exploded in the pocket of an adult male, causing a burn to the thigh. The 68 patients suffered 71 injuries (3 had a second injury). There were 3 traumatic brain injuries as a result of a fall subsequent to vaping.

Discussion

In addition to the usual potential health effects of vaping, it is clear that injuries and poisonings related to vaping are a real concern. The large annual percent change depicted in Figure 1 likely reflects the increased marketing exposure of these devices in recent years, although increased awareness may also have contributed to the inflection. However, given the proximity of the May 2018 law to the cut-off date of the current study, changes may not be detectable and would require a longer post-law surveillance period.

Nicotine poisoning in children became an issue in the early 1990s, when transdermal nicotine patches became available in the US.²³ With the increasing prominence of e-cigarettes, the issue has re-emerged.⁹⁻¹¹ Because of their increased exposure to e-liquids and vaping devices, children under 5 years of age are at risk for unintentional

ingestion or inhalation, resulting in a poisoning diagnosis. While these cases are overrepresented in this study due to the predominance of pediatric hospitals in the eCHIRPP system, it is still an important issue that requires continued surveillance. The study by Chang et al.¹³ in the United States showed an increase in such cases between 2013 and 2015, and then a decrease to 2017. These researchers indicated that the *Child Nicotine Poisoning Prevention Act of 2015*,²⁴ which became effective in 2016 and which required child-resistant packaging for liquid nicotine, may have in part contributed to the awareness of state and federal legislation. While packaging/labelling requirements were being enforced since May 23, 2018, Health Canada published new regulations for the labelling and packaging of vaping products in December 2019.²⁵ Continued surveillance will be essential if we are to assess the effects of legislative measures.

A Canadian survey of pediatricians¹⁵ reported 85 ingestion cases among children aged from 1 to 4 years and 135 cases of inhalation among youth aged 15 to 19 years. The difference between the results of this survey and the current study may be due to the fact that they each cover different points of care (ED vs. physician’s office), although there will have been some overlap. Also, eCHIRPP underrepresents

TABLE 1
Characteristics of injuries and poisonings associated with e-cigarettes and vaping

Characteristics	Counts	Example narrative ^a
Circumstances		
0–4 years	37	
Unintentional ingestion of vaping solution	31	“Found with open bottle of e-cigarette solution. Drank entire bottle of solution and has been crying since.”
Sucked/inhaled on vaping device	5	“Playing at home and mom found sucking on an e-cigarette.”
Injured by piece of disassembled device	1	“Playing with e-cigarette. Dad was cleaning e-cigarette and had it apart. Child put ring on finger.”
5–14 years	14	
Vaping nicotine—felt ill	5	“Nicotine poisoning from vaping all day with friends.”
Vaping cannabis/marijuana—felt ill	4	“Smoking friend’s e-cigarette. Took puff of vaporizer cigarette. It was laced with marijuana.”
Unintentional ingestion of vaping solution	3	“Accidentally had a couple drops of e-cigarette oil into mouth. Was playing with mom’s e-cigarette, and some oil leaked into mouthpiece.”
Other or unknown circumstances	2	“Attending house party. Drinking. Vaping. Highly intoxicated.”
15–19 years	15	
Vaping cannabis/marijuana—felt ill	6	“She was hanging out with a friend and took 2 ‘hits’ of THC oil from a vape pen. Says she has never taken THC or cannabis before. Brought in by EHS.”
Vaping nicotine—felt ill	3	“He was vaping, using nicotine. Felt nauseated and dizzy.”
Unintentional ingestion of vaping solution	2	“Ingested ‘purple glide’ vape juice.”
Vaping and using other substances	2	“Vaping with cannabis, and using LSD.”
Intentional self-harm	1	“Vaping marijuana, threatening suicide.”
Swallowed piece of vaping device	1	“Vaping; piece of device broke off and he swallowed it.”
30–49 years	2	
Battery exploded in pocket	2	“Walking, battery of his vaping device exploded in his front pocket.”
Injuries and poisonings	71^b	
Poisonings	55	“Swallowed nicotine e-juice.”
Traumatic brain injury	3	“Was vaping with THC; stood up and fainted; fell to the floor and struck head.”
Thigh burn	2	“Walking, battery of his vaping device exploded in his front pocket.”
FB in alimentary tract	1	“Vaping; piece of device broke off and he swallowed it.”
Crushing injury to finger	1	“Playing with e-cigarette. Dad was cleaning e-cigarette and had it apart. Child put ring on finger.”
No injury or poisoning detected	5	“In store, had been vaping marijuana; fainted and hit head on counter.”
Unknown	4	“Playing. Took a sip of liquid for e cigarette. She was shaking, parents called poison control. Called paramedics. No shaking when they arrived.”

Abbreviation: FB, foreign body.

Note: There were no cases among people aged 20–29 years.

^a Identifying information has been removed.

^b 3 patients had a second injury.

older teenagers who may go to a general hospital.

In this study, two cases of burns due to explosion or overheating of the device were identified. Both incidents resulted in a burn to the thigh. There have been other reported cases of significant burns to the face, mouth, thigh and genitalia.^{18,19} Given the array of newer products appearing on the market, some with the ability to

change the power capacity and voltage,² this aspect of injury due to e-cigarette use warrants serious attention.

Injuries and poisoning associated with e-cigarettes can be very serious, especially among children and adolescents. Ongoing surveillance is necessary to profile the Canadian experience and identify emerging trends. Since new brands with unique names are regularly introduced into the

market, a continued evolution of the search strategy is necessary to accurately monitor these cases.

Strengths and limitations

The eCHIRPP narrative provides contextual information not available in administrative data sources. This additional information allows deeper analysis and can highlight opportunities for prevention.

However, eCHIRPP does not capture all incidents in Canada, only those presenting to the participating emergency departments. Because most of the eCHIRPP hospitals are pediatric (usually located in major cities), certain groups are under-represented in the data, including rural inhabitants (including some Indigenous peoples), older teens and adults. Also, while eCHIRPP captures people who are dead-on-arrival at the hospital, those who died at the scene or later in hospital are not included (although there have not been any deaths associated with vaping in Canada). In addition, patients who bypass the ED registration desk for immediate treatment may not be captured, as well as those who do not complete an injury/poisoning reporting form.

Conclusion

Injuries and poisonings related to e-cigarettes range from ingestions in young children to inhalation effects in adolescents and burns related to device explosion. Continued monitoring of the eCHIRPP text fields can help to focus mitigation efforts.

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Conflicts of interest

The authors declare no conflicts of interest.

References

- Grana R, Benowitz N, Glantz SA. E-cigarettes: a scientific review. *Circulation*. 2014;129:1972-86.
- Walley SC, Wilson KM, Winickoff JP, Gorner J. A public health crisis: electronic cigarettes, vape, and JUUL. *Pediatrics* [Internet]. 2019 [cited 2019 Aug];143(6):e20182741. doi:10.1542/peds.2018-2741.
- Reid JL, Rynard VL, Czoli CD, Hammond D. Who is using e-cigarettes in Canada? Nationally representative data on the prevalence of e-cigarette use among Canadians. *Prev Med*. 2015; 81:180-83.
- Hammond D, Reid JL, Rynard VL, et al. Prevalence of vaping and smoking among adolescents in Canada, England and the United States: repeat national cross sectional surveys. *BMJ* 2019 [cited 2020 Jan];365:l2219. doi:10.1136/bmj.l2219.
- Tobacco and Vaping Products Act* (S.C. 1997, c. 13; 2018, c.0, s.2) [Internet]. Ottawa (ON): Government of Canada. Available from: <https://laws-lois.justice.gc.ca/eng/acts/T-11.5/page-1.html>
- Canada Consumer Product Safety Act* (S.C. 2010, c. 21) [Internet]. Ottawa (ON): Government of Canada. Available from: <https://laws-lois.justice.gc.ca/eng/acts/c-1.68/>
- Food and Drugs Act* (R.S.C., 1985, c. F-27) [Internet]. Ottawa (ON): Government of Canada. Available from: <https://laws-lois.justice.gc.ca/eng/acts/f-27/>
- Non-smokers' Health Act* (R.S.C., 1985, c. 15 (4th Supp.)) [Internet]. Ottawa (ON): Government of Canada. Available from: <https://laws-lois.justice.gc.ca/eng/acts/n-23.6/>
- Government of Canada. Vaping product regulation [Internet]. Ottawa (ON): Government of Canada; 2019 [modified 2020 Jan 23; cited 2020 Apr]. Available from: <https://www.canada.ca/en/health-canada/services/smoking-tobacco/vaping/product-safety-regulation.html>
- Hammond D, White CM, Czoli CD, Martin CL, Magennis P, Shipio S. Retail availability and marketing of electronic cigarettes in Canada. *Can J Public Health*. 2015;106(6):e408-e412.
- Volesky KD, Maki A, Scherf C, Watson LM, Cassol E, Villeneuve PJ. Characteristics of e-cigarette users and their perceptions of the benefits, harms, and risks of e-cigarette use: survey results from a convenience sample in Ottawa, Canada. *Health Promot Chronic Dis Prev Can*. 2016;36(7):130-8.
- Perrine CG, Pickens CM, Boehmer TK, et al. Characteristics of a multi-state outbreak of lung injury associated with e-cigarette use, or vaping—United States, 2019. *MMWR*. 2019; 68(39):860-4.
- Chang JT, Wang B, Chang CM, Ambrose BK. National estimates of poisoning events related to liquid nicotine in young children treated in US hospital emergency departments, 2013–2017. *Inj Epidemiol* [Internet]. 2019 [cited 2019 Aug];6:10. doi:10.1186/s40621-019-0188-9.
- Govindarajan P, Spiller HA, Casavant MJ, Chounthirath T, Smith GA. E-cigarette and liquid nicotine exposures among young children. *Pediatrics* [Internet]. 2018 [cited 2019 Aug];141(5):e20173361. doi:10.1542/peds.2017-3361.
- Richmond SA, Pike I, Maguire JL, Macpherson A. E-cigarettes: a new hazard for children and adolescents. *Paediatr Child Health*. 2018;23(4): 255-9.
- Seo AD, Kim DC, Yu HJ, Kang MJ. Accidental ingestion of e-cigarette liquid nicotine in a 15-month-old child: an infant mortality cases of nicotine intoxication. *Korean J Pediatr*. 2016; 59(12):490-3.
- Chen BC, Bright SB, Trivedi AR, Valento M. Death following intentional ingestion of e-liquid. *Clin Toxicol* 2015;53(9):914-6.
- Harrison R, Hicklin D. Electronic cigarette explosions involving the oral cavity. *J Am Dent Assoc*. 2016; 147(11):891-6.
- Maraqta T, Mohamed MAT, Salib M, Morris S, Mercer L, Sachwani-Daswani GR. Too hot for your pocket! Burns from e-cigarette lithium battery explosions: a case series. *J Burn Care Res*. 2018;39(6):1043-7.
- Crain J, McFaull S, Thompson W, Skinner R, Do MT, Fréchette M, et al. Status report. The Canadian Hospitals Injury Reporting and Prevention Program: a dynamic and innovative injury surveillance system. *Health Promot Chronic Dis Prev Can*. 2016; 36(6):112-7.
- Zhang Y. Perl regular expression in SAS macro programming. Paper 159–2011 presented at: SAS Global Forum 2011; 2011 Apr 4-7; Las Vegas, United States.

-
22. Statistical Methodology and Applications Branch, Surveillance Research Program, National Cancer Institute. Joinpoint Regression Program, version 4.6.0.0 – April 2018. Bethesda (MD): National Cancer Institute.
 23. Woolf A, Burkhart K, Caraccio T, Litovitz T. Childhood poisoning involving transdermal nicotine patches. *Pediatrics* [Internet]. 1997 [cited 2019 Sep];99(5):e4. doi:10.1542/peds.99.5.e4.
 24. *Child Nicotine Poisoning Prevention Act of 2015* (P.L. No: 114-116 [01/28/2016]). Washington (DC): US Congress; 2016 [cited 2020 Jan]. Available from: <https://www.congress.gov/bill/114th-congress/senate-bill/142>
 25. Government of Canada. Vaping Products Labelling and Packaging Regulations: SOR/2019-353 [Internet]. Ottawa (ON): Government of Canada; 2019. Available from: <http://www.gazette.gc.ca/rp-pr/p2/2019/2019-12-25/html/sor-dors353-eng.html>