

the hospital was due to the outdoor smoking. In line with this finding we detected a significant decrease in PM<sub>2.5</sub> levels in the indoor and outdoor control areas.

- Our data point out the need for a prompt implementation of current policies to protect patients, visitors and employees from passive SHS promoting totally smoke-free hospital campuses.

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*Conflicts of interest:* None declared.

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## Short Report

# The impact of the 2010 Polish smoke-free legislation on the popularity and sales of electronic cigarettes

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 Electronic cigarettes, also called e-cigarettes or electronic nicotine delivery systems (ENDS), have become widely available globally, particularly via the Internet. They are considered by many users as a safe alternative to regular cigarettes, and some use them for smoking cessation. We investigated whether the implementation of new tobacco control legislation in Poland affected the popularity and sales of ENDS. This study monitored Google searches and online sales before and after the implementation of new tobacco control legislation in November 2010. The study demonstrated that the implementation of the smoke-free legislation was associated with only a temporary increase in ENDS online popularity in Poland. In longer time frames, there was decrease in ENDS online popularity and sales in Poland after implementation of the smoke-free policy.

## Introduction

Electronic cigarettes, also called e-cigarettes or electronic nicotine delivery systems (ENDS), have become widely available globally,

particularly via the Internet. Although vapors generated from ENDS contain nicotine and trace amounts of toxicants, the products are likely to be less hazardous to the individual user than regular cigarettes.<sup>1–4</sup> One study showed that popularity of ENDS was

greater in countries with stronger tobacco control policies and it was hypothesized that ENDS help smokers circumvent or quit in response to smoking restrictions.<sup>5</sup> However, no data have been published so far regarding whether the implementation of comprehensive smoke-free laws leads to increased popularity of ENDS.

Recent data showed that 30.3% (9.8 million) of the Polish population aged  $\geq 15$  years old currently smoke cigarettes.<sup>6</sup> Currently, there is no data on prevalence of ENDS in Poland, although a survey of Polish ENDS users showed that the devices are primarily used as a stop-smoking aid or as an alternative to conventional cigarettes, and a 2010–11 national survey of students showed that about one-fifth of Polish youth have tried ENDS.<sup>4,7</sup>

In 2010, two years after ENDS appeared on national market, a new tobacco control law was implemented in Poland. The new act prohibits smoking in public places and strengthened restrictions on the promotion of tobacco products. However, it allowed for marketing of ENDS, including their sale and promotion via Web sites. We investigated whether the strengthening of national-level tobacco control measures was associated with changes in the popularity and sales of ENDS in Poland.

## Methods

### Monitoring of the online popularity of ENDS

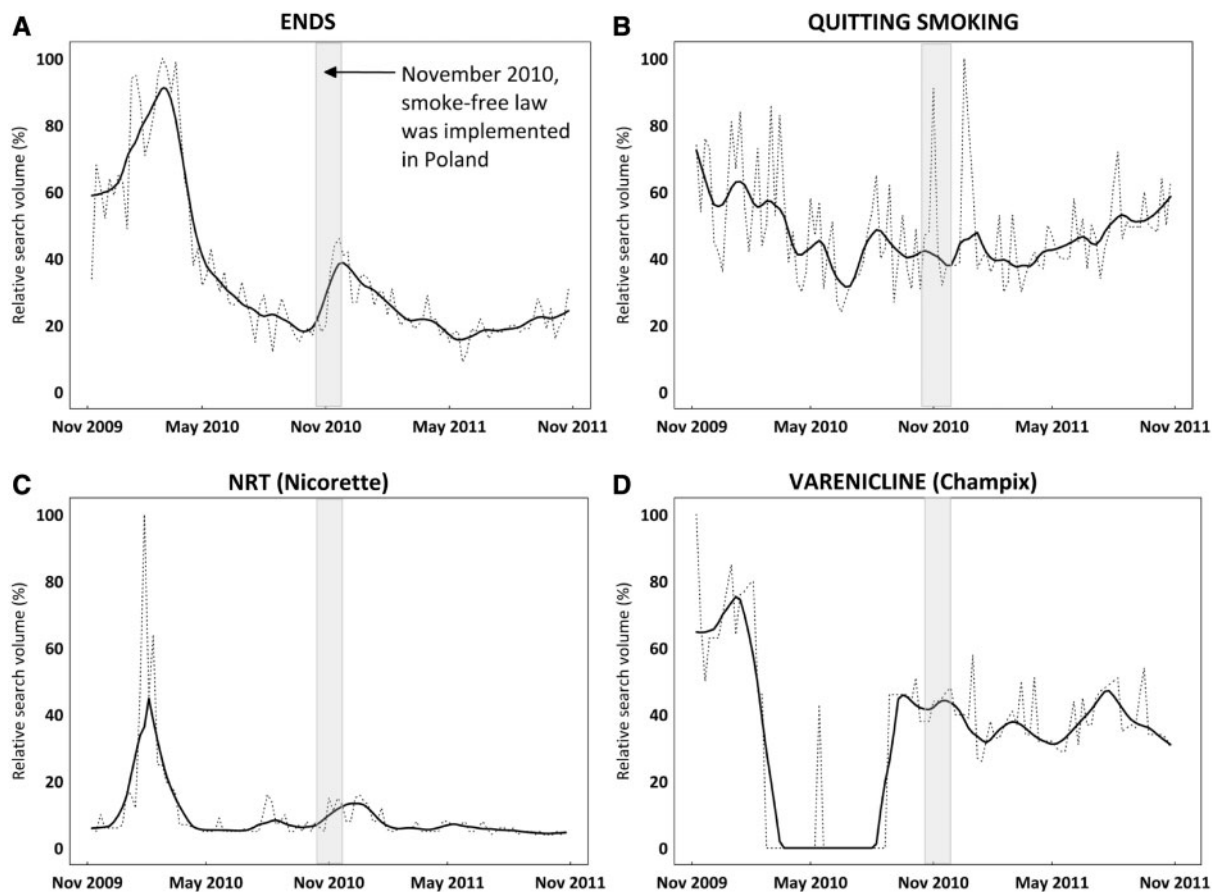
The online popularity of ENDS was assessed with the same method as previously described by Ayers et al.<sup>5</sup> We used Google Trends monitoring application (previously Google Insights; [www.google.com/trends](http://www.google.com/trends)). We searched for all categories of Web sites (online shops, discussion forums, news, personal pages and blogs) using two keywords: ‘e-cigarette’ and ‘electronic cigarette’. Analysis was

performed between 15 November 2009 and 15 November 2011 and was limited to Polish Web sites. We generated a plot showing changes in ENDS online popularity over this period of time (Fig. 1A). To better illustrate trends, it was fitted using LOWESS (locally weighted scatterplot smoother) and recalculated to show relative search volume to the maximum search traffic. We also generated plots showing changes in national search trends for ‘quitting smoking’ (Fig. 1B), and two alternatives to ENDS, namely, ‘Nicorette’ (a brand of nicotine replacement therapy products; Fig. 1C) and ‘Champix’ (varenicline, a prescription smoking cessation drug; Fig. 1D).

To assess the impact of smoke-free law on ENDS online popularity, we compared relative search volumes conducted between November 2009 and November 2010 (one year before implementation of the law) and between November 2010 and November 2011 (one year post-implementation). We compared the area under the trend curves estimated for both periods (pre- vs. post-implementation) using the trapezoidal rule and Excel software (Microsoft, 2010).

### Monitoring of ENDS sales

We monitored the number of ENDS sale offers from the biggest Polish auction service ‘Allegro.pl’. It has been estimated that >80% of Internet auction sales in Poland are offered via Allegro.pl (source: [aukcjostat.pl](http://aukcjostat.pl)). According to the same source, Allegro.pl has offered >12.5 million products on sale during the time our study was conducted, which was >50 times more than ‘ebay.pl’ at the same time. We recorded the number of ENDS sale offers every other week starting 15 March 2010 until 15 May 2011. We used the Student *t*-test to compare the average number of sales offers for six months before implementation of the smoke-free law (from 15 March 2010



**Fig. 1** National search trends for ENDS (A) and their alternatives (B–D) pre- and post-implementation of the 2010 Polish smoke-free legislation. The bold lines indicate the weekly running trends fitted using LOWESS (bandwidth=0.1); the background trends are the raw relative search volumes

until 15 November 2010) and six months post-implementation (from 15 November 2010 until 15 November 2011).

## Results

### Online popularity of ENDS

Fig. 1A shows trends in ENDS and its alternatives online popularity between 15 November 2009 and 15 November 2011. There was a sharp increase in the relative search volumes for ENDS after they entered the market, which was followed by a sudden decline. The implementation of the smoke-free policy was associated with only a temporary increase in the relative search volumes for ENDS. Statistical analysis showed that the ENDS online popularity was higher one year before implementation of the smoking-free law than one year post-implementation (~2.4 times). An online search for information on quitting smoking was decreasing before the implementation of the law, but after the law was implemented there was a reversal of this negative trend. The trends in relative search volumes for nicotine replacement therapy also suggest a small temporary increase after implementation of the smoke-free policy, in analogy with ENDS search.

### ENDS sales

An average number of ENDS offered for sale biweekly was significantly higher during six months before implementation of the smoke-free law than post-implementation ( $4424 \pm 788$  vs.  $2845 \pm 291$  mean  $\pm$  SD;  $P < 0.05$ ).

## Discussion

To our knowledge, this is the first study to look at the effect of smoke-free policy on popularity of ENDS. The introduction of a new Polish smoking-free legislation in 2010, which was two years after ENDS had been introduced on the national market, created an opportunity for us to conduct the observational study in a real-life setting. The study has demonstrated that the implementation of the smoke-free legislation in November 2010 was associated with only a temporary increase in ENDS online popularity in Poland. In longer time frames, there was a decrease in ENDS online popularity and sales in Poland after implementation of the smoke-free policy.

The strength of the study is that we used two various online resources to test our hypothesis. This approach was justified by findings of previously published studies showing that a majority of people interested in ENDS search for information about the devices on Web sites. Internet also was shown to be the main channel for distribution of ENDS.<sup>2,4,5</sup>

This study had several limitations. We did not control our analysis for factors that might have affected changes in ENDS online popularity and their sale trends. These factors might include publicity trends on ENDS in national and local media. We recorded the maximum search volume for ENDS one week before Polish parliament voted on the new law (April 2010, Fig. 1A). During that time, a proposition on banning ENDS sale was widely discussed in media, and this might have led to increased awareness of the products.

The study only shows trends in online popularity and sales one year pre- and post-smoke-free law implementation and does not reflect the present time. The other limitation of the study is that we did not monitor ENDS sales via other distribution channels. We used Allegro.pl because this Web site is very popular in Poland and it grants unlimited access to statistics on sale offers. Although many ENDS retailers use this service to sell their products, we were unable to control if the distribution pattern shifted to other channels (e.g. kiosks in shopping malls).

Although this study did not compare online popularity with ENDS sales, we observed that decrease in popularity after implementation of smoke-free legislation corresponds to decrease in the number of sale offers. This finding is consistent with results reported by Ayers et al. that showed that 50–75% of all ENDS searches in the USA and UK were shopping searches.<sup>5</sup> As this study was purely observational, we feel that more research is needed to assess whether there is any association between stronger tobacco control and the popularity of ENDS.

**Conflicts of interest:** Maciej L. Goniewicz received research funding from 'Pfizer', manufacturer of stop smoking medication, and was funded by the UK Centre for Tobacco Control Studies (UKCTCS) during the study. UKCTCS receives funding from the 'Economic and Social Research Council', 'British Heart Foundation', 'Cancer Research UK', 'National Institute for Health Research' (NIHR) and 'Medical Research Council' (MRC). Andrzej Sobczak received research funds and travel expenses from 'Chic Group Ltd', manufacturer of electronic cigarettes in Poland. Other authors declare no conflict of interest.

### Key points

- Electronic cigarettes, also called e-cigarettes or electronic nicotine delivery systems (ENDS), became widely available globally, particularly via the Internet.
- In 2010, two years after ENDS appeared on the national market, a new tobacco control law was implemented in Poland, which allows for marketing of ENDS, including their sale and promotion via Web sites. We investigated whether strengthening of tobacco control on national level was associated with changed popularity and sales of ENDS in November 2010 in Poland.
- The relative online search volumes for ENDS were changing over the time and were higher before implementation of the smoking-free law than after implementation. An average number of ENDS offered for sale biweekly was significantly higher six months before implementation of the smoke-free law vs. post-implementation.
- The study has demonstrated that the implementation of the smoke-free legislation in November 2010 was associated with only a temporary increase in ENDS online popularity in Poland. In longer time frames, there was decrease in ENDS online popularity and sales in Poland after implementation of the smoke-free policy.

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