

# Nicotine content of electronic cigarettes, its release in vapour and its consistency across batches: regulatory implications

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## Abstract

### Background and aims

Electronic cigarettes (EC) may have a potential for public health benefit as a safer alternative to smoking, but questions have been raised about whether EC should be licensed as a medicine, with accurate labelling of nicotine content. This study determined the nicotine content of the cartridges of the most popular EC brands in the United Kingdom and the nicotine levels they deliver in the vapour, and estimated the safety and consistency of nicotine delivery across batches of the same product as a proxy for quality control for individual brands and within the industry.

### Methods

We studied five UK brands (six products) with high internet popularity.

### Measurements

Two samples of each brand were purchased 4 weeks apart, and analysed for nicotine content in the cartridges and nicotine delivery in vapour.

### Results

The nicotine content of cartridges within the same batch varied by up to 12% relative standard deviation (RSD) and the mean difference between different batches of the same brand ranged from 1% [95% confidence interval (CI) = -5 to 7%] to 20% (95% CI = 14–25%) for five brands and 31% (95% CI = 21–39%) for the sixth. The puffing schedule used in this study vaporized 10–81% of the nicotine present in the cartridges. The nicotine delivery from 300 puffs ranged from ~2 mg to ~15 mg and was not related significantly to the variation of nicotine content in e-liquid ( $r = 0.06$ ,  $P = 0.92$ ). None of the tested products allowed access to e-liquid or produced vapour nicotine concentrations as high as conventional cigarettes.

## Conclusions

There is very little risk of nicotine toxicity from major electronic cigarette (EC) brands in the United Kingdom. Variation in nicotine concentration in the vapour from a given brand is low. Nicotine concentration in e-liquid is not well related to nicotine in vapour. Other EC brands may be of lower quality and consumer protection regulation needs to be implemented, but in terms of accuracy of labelling of nicotine content and risks of nicotine overdose, regulation over and above such safeguards seems unnecessary.

## Citing Literature



### We recommend

[Comparison of e-cigarette use characteristics between exclusive e-cigarette users and dual e-cigarette and conventional cigarette users: an on-line survey in France](#)

Ivan Berlin et al., *Addiction*, 2019

[E-cigarette regulation: a delicate balance for public health](#)

Alayna P. Tackett et al., *Addiction*, 2020

[Nicotine delivery and users' reactions to Juul compared with cigarettes and other e-cigarette products](#)

Peter Hajek et al., *Addiction*, 2020

[The need to more effectively regulate END markets: A primary public health lesson of the U.S. vaping associated lung injury outbreak](#)

Rosalie Liccardo Pacula et al., *Addiction*, 2020

[Differences in nicotine intake and effects from electronic and combustible cigarettes among dual users](#)

Gideon St.Helen et al., *Addiction*, 2019

[Pod Mod Electronic Cigarettes—An Emerging Threat to Public Health](#)

Tory R. Spindle et al., *JAMA Network Open*, 2018

[Electrical features, liquid composition and toxicant emissions from 'pod-mod'-like disposable electronic cigarettes](#)

Soha Talih et al., *Tobacco Control*, 2021

[Electronic cigarette use intensity measurement challenges and regulatory implications](#)

Eric Soule et al., *Tobacco Control*, 2021

[Young adult perceptions of JUUL and other pod electronic cigarette devices in California: a qualitative study](#)

Emily Keamy-Minor et al., *BMJ Open*, 2019

[One-third of e-cigarette users report symptoms of lung irritation, injury](#)

By Erin T. Welsh et al., *Healio*, 2020