

Secondhand Exposure to E-cigarettes

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A variety of e-cigarettes are available in the market

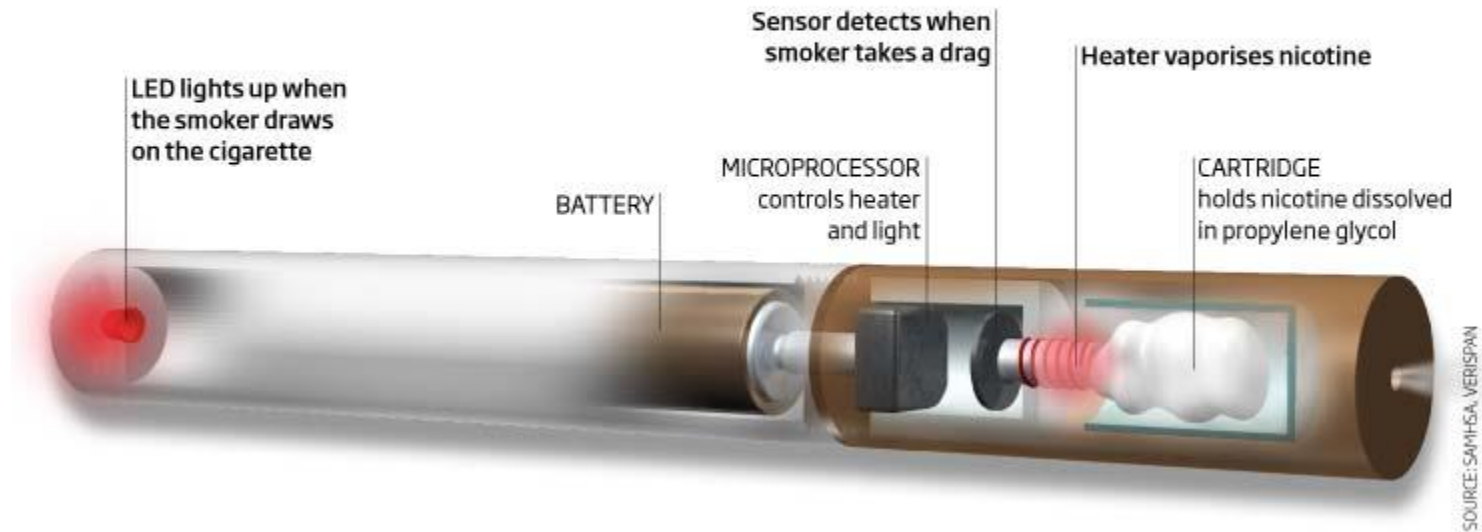


“Cigalikes” “Tankomizers” “Mods” “E-hookahs” “Vape-pens”



Electronic Cigarettes

E-cigarettes are electronic nicotine delivery systems (ENDS), they produce “*a cloud of nicotine carrying vapor with none of the toxic by products of burning tobacco*”



Patented in China by Ruyan Technology in 2003. International Patent 2007



What do e-cigarettes contain?

E-cigarettes contain nicotine derived from tobacco in propylene glycol and/or glycerol

Nicotine is heated and vaporized, but not burned

Levels of most chemicals with significant cancer and non-cancer risk are much lower in e-cigarettes than conventional cigarettes

However, their yields vary with puff duration and voltage

Aerosol contains low levels of aldehydes and particulate matter





Nicotine and related alkaloids

E-cigarettes contain very low levels of carcinogenic alkaloid NNK

Trace levels of nornicotine, anatabine, and anabasine (1-2 % of nicotine)

Variable doses of nicotine

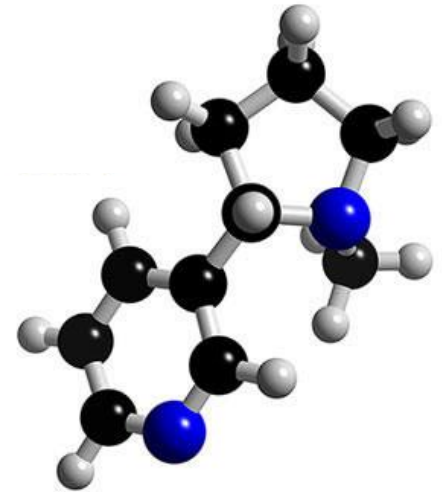
Nicotine is a psychoactive and vasoactive drug

Increases heart rate and blood pressure

Enhances cognition and suppresses appetite

Affects release and metabolism of neurotransmitters such as dopamine, norepinephrine and epinephrine

Relatively non-toxic, but long-term effects remain unknown





Propylene Glycol

Generally considered non-toxic

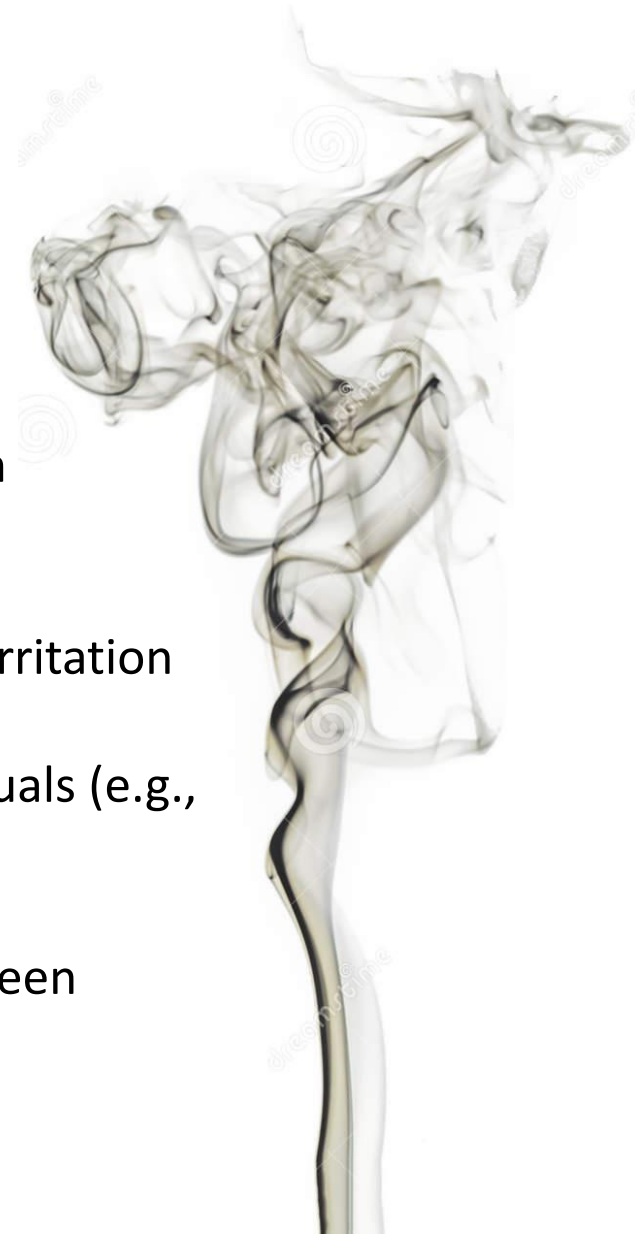
Approved by the FDA as a solubilizing agent for different types of medication

It is used to generate theatre fog and in the aviation industry

Prolonged exposure can cause eye and respiratory irritation

Exposure could be of concern in susceptible individuals (e.g., asthmatics)

Trace levels of the antifreeze ethylene glycol have been detected.

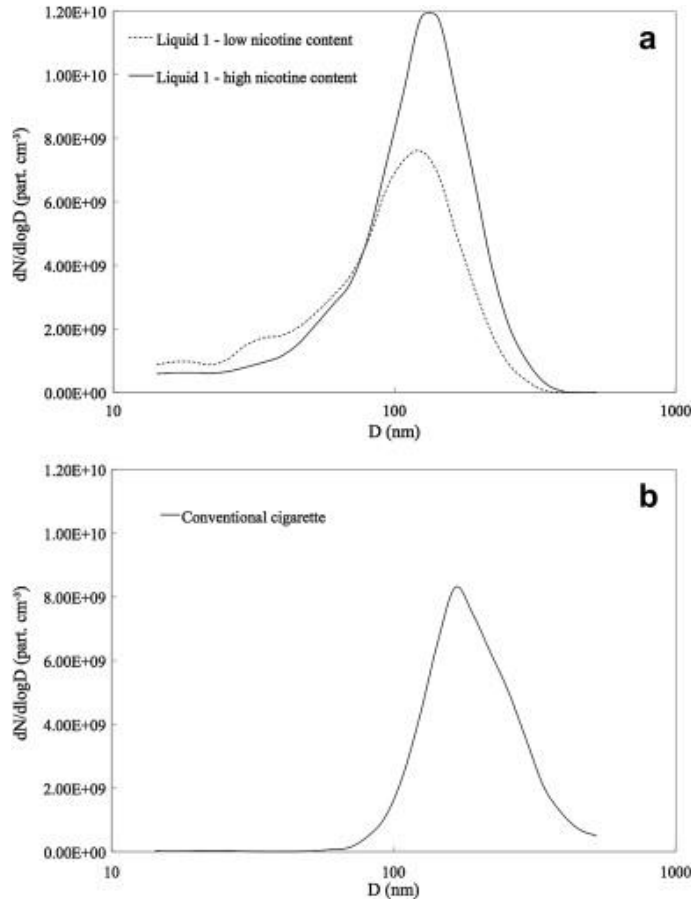


E-cigarette constituents

Toxicant	Range in Content in Aerosol From 12 E-Cigarette Samples per 15 Puffs*	Range in Content in Conventional Cigarette Micrograms in Mainstream Smoke From 1 Cigarette	Content in Nicotine Inhaler Mist per 15 Puffs*
Formaldehyde, µg	0.2–5.61	1.6–52	0.2
Acetaldehyde, µg	0.11–1.36	52–140	0.11
Acrolein, µg	0.07–4.19	2.4–62	ND
o-Methylbenzaldehyde, µg	0.13–0.71	...	0.07
Toluene, µg	ND–0.63	8.3–70	ND
p,m-xylene, µg	ND–0.2	...	ND
NNN, ng	ND–0.00043	0.0005–0.19	ND
NNK, ng	ND–0.00283	0.012–0.11	ND
Cadmium, ng	ND–0.022	...	0.003
Nickel, ng	0.011–0.029	...	0.019
Lead, ng	0.003–0.057	...	0.004



Particulate Matter (PM)



E-cigarettes

Main mode around 150 nm, smaller mode at 10 nm

20-27% particles are estimated to be deposited in the circulatory system and organs

Higher e-liquid nicotine content associated with higher number of particles

Longer puffing time results in more particles

Conventional cigarettes

Mainstream aerosol has a particle size distribution of 165 nm

25-35% particles are likely to be deposited in tissues

No difference in particle number: 4.4×10^9 versus 3.1×10^9 part. cm^{-3}

Direct Acute Health Effects

Acute exposure increases dynamic air resistance (18%) and decreased NO (16%) after puffing on e-cigarettes for 5 min

No significant decrease in expired lung volume

No change in white cell count or coronary reserve

Elevated levels of NO – attributed to pulmonary inflammation

E-cigarette constituents - PM, aldehydes and nicotine have been linked to a variety of health effects

No long-term studies are available yet

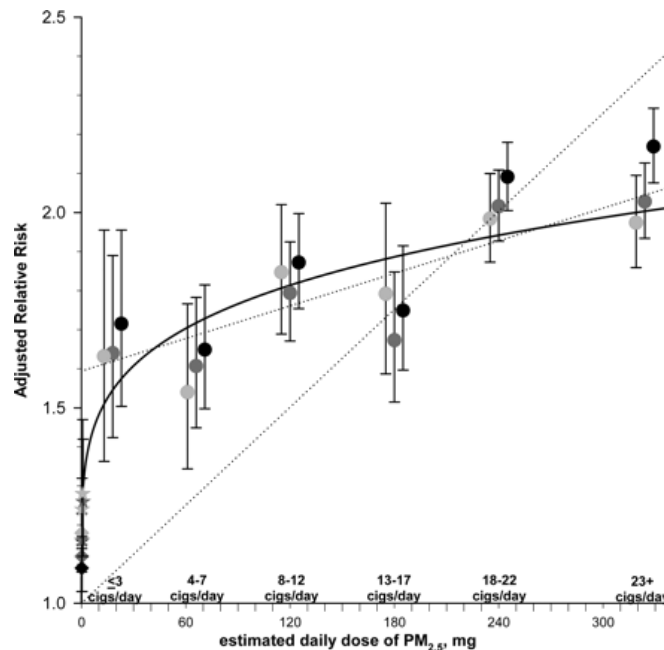




Relative toxicity of e-cigarettes

Harm depends on the level of exposure, which might increase with persistent e-cigarette use

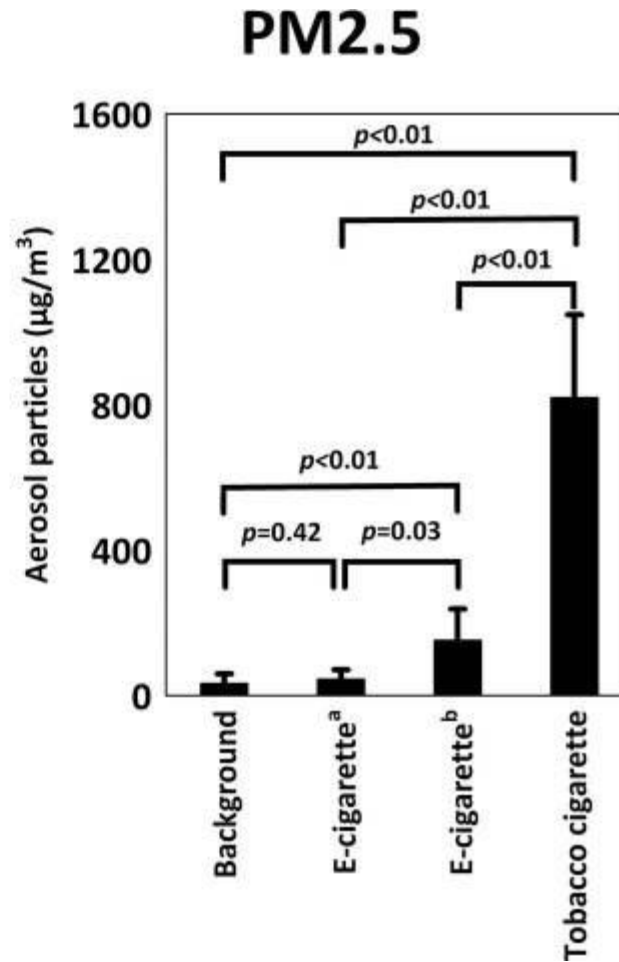
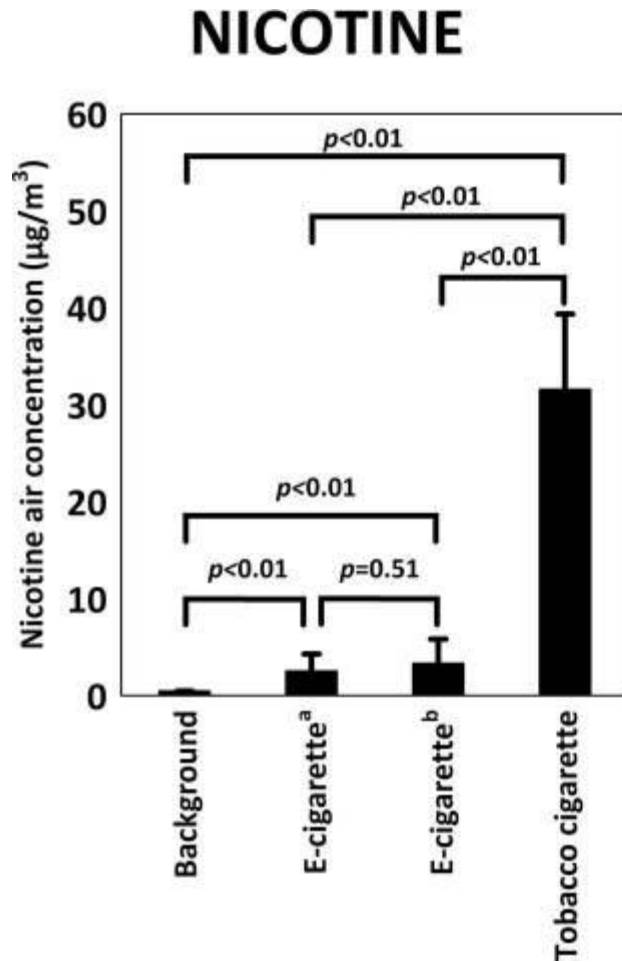
For conventional cigarettes, the dose response for cardiovascular mortality is non-linear



Most of the risk of smoking is at low doses: 80 % of the harm at <3 cigarettes/day

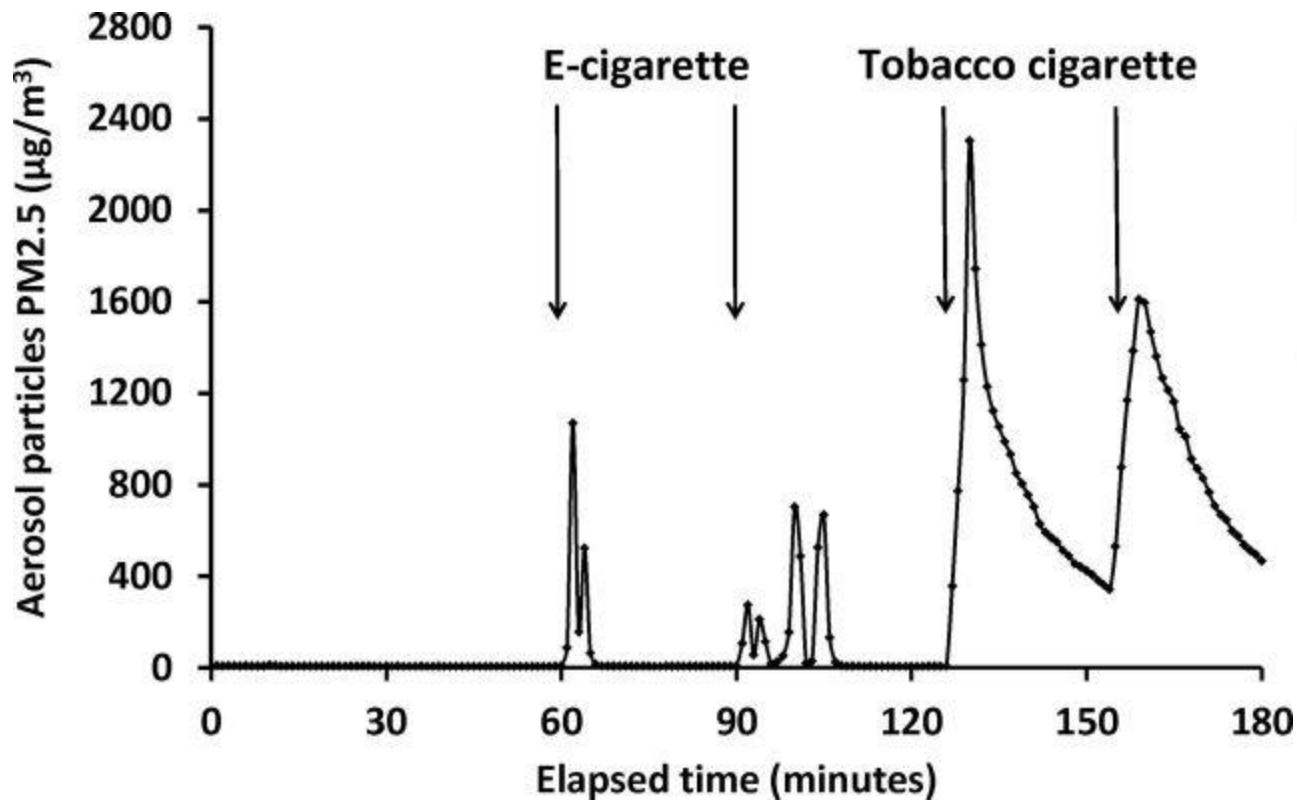


Chamber studies





Emission of PM_{2.5} from e-cigarettes



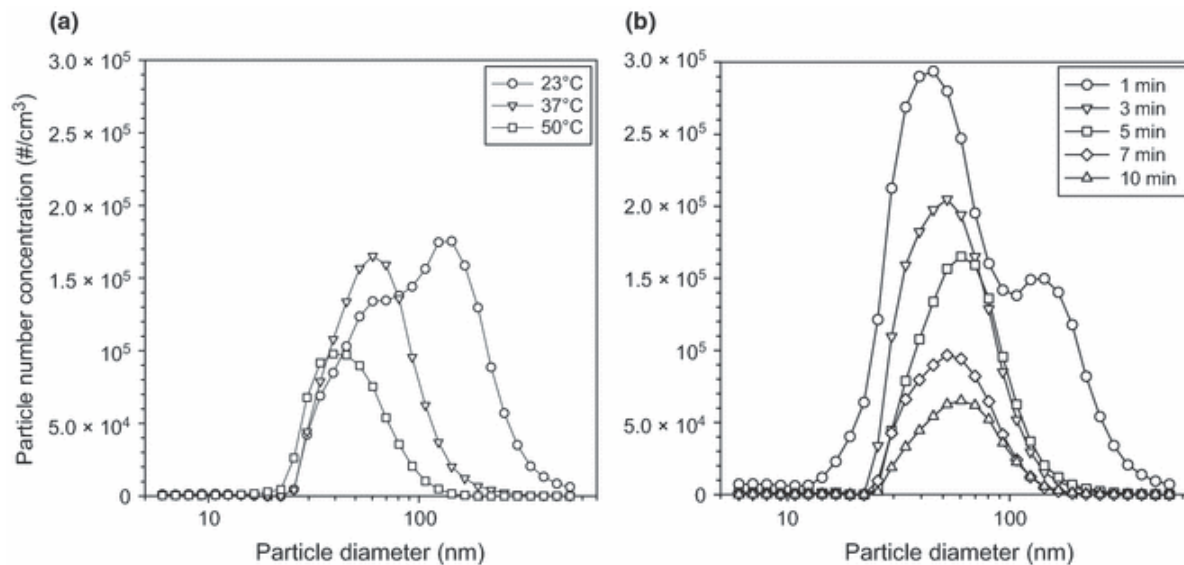


In near-to-real-use conditions

Room (48 m³): Volunteer e-cigarette user exhaling one e-cigarette puff

An increase in fine particles, ultrafine particles, volatile organic compounds

High amounts of 1,2 propanediol and nicotine in the exhaled air



Aerosol size distribution of aged e-cigarette aged at different temperatures and different times



Emissions in different setting

Café like setting

Substantial amounts of 1,2 propanediol, glycerine and nicotine were detected

Rooms

Organic and inorganic elements and metals in the aerosol, including Ni, Zn, Ag

Home like setting

E-cigarette aerosol exposure for a week in a home with 5 non-smokers with an e-cigarette user

The median airborne nicotine concentration was 10-fold higher (0.11 mg/m^3) than in smoke-free, e-cigarette free homes (0.01 mg/m^3)



Ventilated chamber study

15 nonsmokers exposed in 60 m³ ventilated chamber to 1 h of secondhand cigarette (at a concentration simulating a smoky bar) to e-cigarette aerosol generated by a smoking machine

Serum cotinine was similar in nonsmoker after secondhand tobacco smoke (2.6) versus e-cigarette aerosol exposure (2.4 ng/mL)

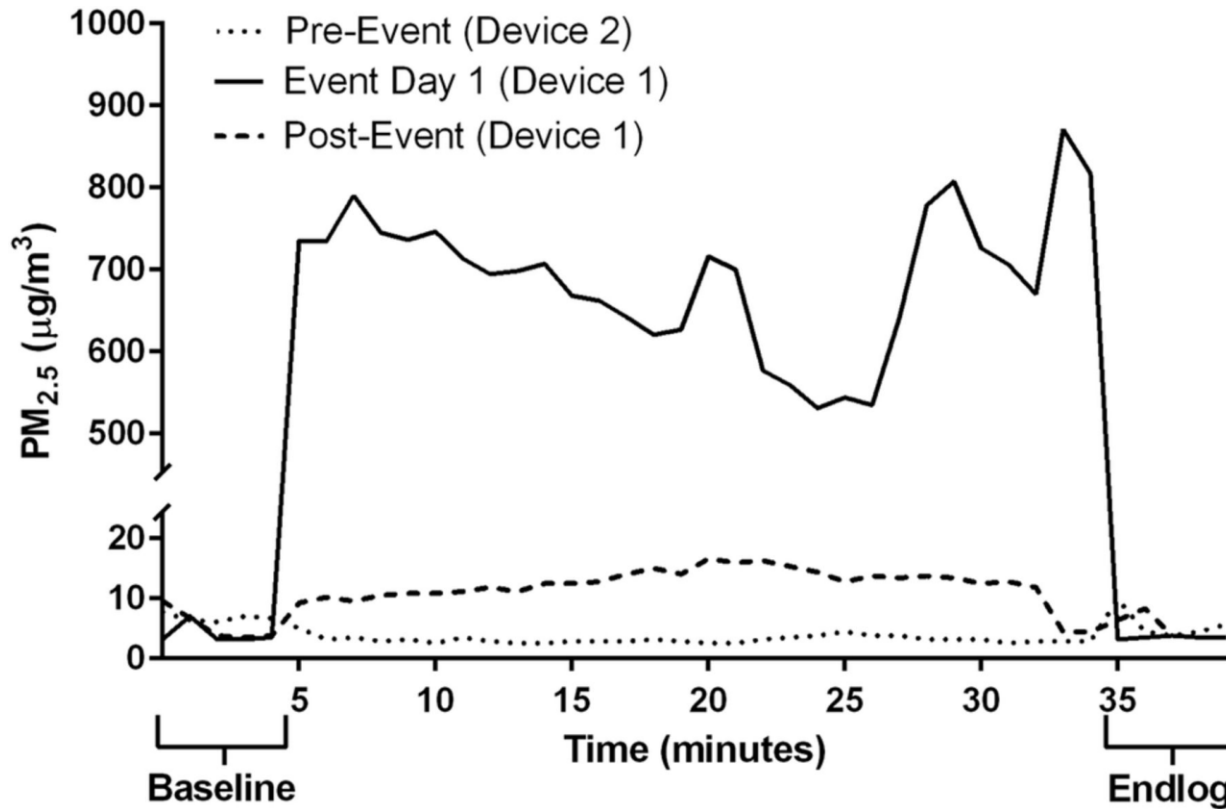
E-cigarettes generate smaller changes in lung function but similar nicotinic impact to tobacco cigarettes.

E-cig events





E-cigarette use and indoor air quality



Normalization of smoking





Normalization of smoking

Overall 8.1 % of US adolescents report ever use of e-cigarettes

Secondhand exposure to smoke at home is positively associated with ever use of e-cigarettes

Promotion of smoke free home rules may help prevent the uptake of e-cigarettes among teenagers



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