Electronic Cigarettes
The Resistance Value of the Heating Filament Could Be the Key to Lung Toxicity

To the Editor:
In the recently published article by Hurt et al in CHEST (December 2014), the minimal scientific evidence for long-term safety of electronic cigarettes (e-cigarettes) was stated. We believe that e-cigarette product design features may have a considerable impact on health. In particular, the relations behind the heating power of an e-cigarette urgently requires research. The use of e-cigarettes with a higher voltage than 3.3 V and especially 5 V is reported to effectively disseminate formaldehyde. Both voltages are common. This dissemination is potentially dangerous for the health of the user and may lead to lung cancer through reactions among the various components contained in the liquid, such as propylene glycol and glycerol. It is important to clarify whether the voltage triggers formaldehyde emission or the heating power. Indeed, the heating power of an e-cigarette depends on a combination of the resistance value of the heating filament used and the voltage applied to it through the Joule effect as follows:

\[ Power = \frac{Voltage^2}{Resistance} = \frac{[V]^2}{[\Omega]} \]

However, e-cigarette users can easily obtain filaments called "coil" with different ohmic values. Subsequently, it is possible for a 3.3-V e-cigarette to obtain the same power of a 5-V e-cigarette. Commonly used filament values are between 0.4 and 2 Ω. Figure 1 compares the possible power of a 3.3- and 5-V e-cigarette, depending on the filament value. When evaporation settings are not optimal (eg, when the heating power is too high), it creates a bad feeling called “dry hit” in users. This bad feeling may be related to the formation of formaldehyde. Therefore, further studies should investigate these parameters when studying the composition of the smoke released by e-cigarettes.

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![Figure 1 – Power of 3.3- and 5-V electronic cigarettes, depending on the filament used.](image-url)
Pathological Conditions EA3533 (Mr Chausse and Dr Dutheil), Blaise Pascal University, Clermont Auvergne University; School of Exercise Science (Drs Naughton and Dutheil), Faculty of Health Science, Australian Catholic University; and Preventive and Occupational Medicine (Dr Dutheil), University Hospital of Clermont-Ferrand (CHU).

FINANCIAL/NONFINANCIAL DISCLOSURES: The authors have reported to CHEST that no potential conflicts of interest exist with any companies/organizations whose products or services may be discussed in this article.

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DOI: 10.1378/chest.15-0497

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1. Hurt RD, Murphy JG, Dunn WF. Did we finally slay the evil dragon of cigarette smoking in the late 20th century? Unfortunately, the answer is no—the dragon is still alive and well in the 21st century and living in the third world. Shame on us! Chest. 2014;146(6):1438-1443.

Response
To the Editor:

Although the focus of our article in CHEST was on the history of the current cigarette epidemic, we also included a brief section on electronic nicotine-delivery devices (electronic cigarettes [e-cigarettes]) because of their place in the continuum of the epidemic. We very much appreciate the concern expressed by Mr Chausse and colleagues about the safety of e-cigarettes because we, too, are concerned about the long-term safety of these products, which were not subject to adequate long-term scientific safety studies before public availability.

From a medical perspective, the only possible rationale for advocating use of e-cigarettes is as an adjunct to helping smokers to stop smoking. Even this argument is now flawed, because, since our earlier article was accepted for publication, numerous articles and a meta-analysis have shown that e-cigarettes do not help smokers to stop smoking.

We support the clarion calls for the regulation of e-cigarette products to protect our children and fully inform smokers of both their risks and potential benefits, if any. Long-term studies are needed to validate the safety and efficacy, if any, of e-cigarettes in the treatment of tobacco dependence. The current over-the-counter availability of e-cigarettes in the absence of long-term safety and efficacy studies should be strongly condemned by learned medical societies, and we should advocate for reversal of this flawed public policy of widespread availability of a new nicotine-delivery product known to be potentially addictive and likely to be biologically harmful in the long term.

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FINANCIAL/NONFINANCIAL DISCLOSURES: The authors have reported to CHEST the following conflicts of interest: Dr Hurt has received a medical education grant from Pfizer Medical Education Group 2010-2014. Drs Murphy and Dunn have reported that no potential conflicts of interest exist with any companies/organizations whose products or services may be discussed in this article.

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DOI: 10.1378/chest.15-0830

Acknowledgments
Other contributions: Editing, proofreading, and reference verification were provided by the Section of Scientific Publications, Mayo Clinic.

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