



Australian Government
National Health and Medical Research Council



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Department of the Senate
PO Box 6100
Parliament House
Canberra ACT 2600

Dear Select Committee on Tobacco Harm Reduction,

The National Health and Medical Research Council (NHMRC) welcomes the opportunity to provide a submission to the Select Committee on Tobacco Harm Reduction.

I am writing to advise the Select Committee of the work that is currently underway at NHMRC on the safety and efficacy of electronic cigarettes (e-cigarettes).

As Australia's lead agency for health and medical research, NHMRC works actively and collaboratively to promote the highest research standards and develop evidence-based health advice. The *National Health and Medical Research Council Act 1992* charges NHMRC with promoting the development of individual and public health standards, fostering national consistency in health standards, supporting research and training, and fostering consideration of relevant ethical issues. This work includes developing evidence-based guidelines, health advice and companion resources that aim to improve the health and wellbeing of the Australian population.

In 2017, I released an updated¹ [CEO Statement: Electronic Cigarettes](#) (the Statement) which summarises evidence on the safety and efficacy of e-cigarettes. The Statement (*Attachment 1*) aims to assist consumers, policy makers, health professionals and those advising people considering the uptake of e-cigarettes. It concluded that:

- there was insufficient evidence to support claims that e-cigarettes are safe;
- further research was needed to enable the long-term safety, quality and efficacy of e-cigarettes to be assessed; and
- until such evidence was produced, health authorities and policy-makers should act to minimise harm to users and other vulnerable groups.

Recent deaths in the United States (US) linked to e-cigarette use, as well as emerging evidence, have prompted both the US and Australian Governments to review e-cigarette evidence, policy and regulation. In April 2020, the Commonwealth Department of Health contracted NHMRC, as part of a suite of projects on e-cigarettes, to update the 2017 Statement.

NHMRC has established an expert committee, the Electronic Cigarette Working Committee (the Committee) to advise on the update of the Statement. The Committee is comprised of members with expertise in public health, toxicology, respiratory medicine, marketing, epidemiology and smoking cessation. NHMRC is now seeking reviewers to evaluate current evidence relevant to the marketing and use of e-cigarettes and their impacts on individual

¹ The 2017 Statement was an update of the 2015 Statement and was developed in consultation with, and supported by, the Chief Health Officers from all Australian states and territories.



and population health. The Committee will use the findings of these evidence evaluations to inform the updated Statement.

In addition to updating the Statement, NHMRC is funding research on e-cigarettes. Since 2011, NHMRC has funded 13 grants, committing over \$12.4 million for research into e-cigarettes to investigate the:

- efficacy of e-cigarettes for smoking cessation, including amongst disadvantaged and vulnerable populations
- health effects of e-cigarettes
- uptake of e-cigarettes in children and adolescents
- potential impact of e-cigarettes on smoking uptake, and
- effect of new media platforms on e-cigarette promotion and consumer behaviour.

Further information about these research grants is provided in *Attachment 2*.

NHMRC's submission is drawn from the 2017 CEO Statement (*Attachment 1*) and from the evidence identified as part of its development. The submission addresses the following aspects of the Select Committee's Terms of Reference:

b. the impact nicotine vaping products have had on smoking rates in developed countries similar to Australia, and the aggregate population health impacts of these changes in nicotine consumption.

Stakeholders hold a range of views about the safety of e-cigarettes and whether they can minimise harm to smokers or help them to quit smoking all together. Concerns have been raised about the potential for e-cigarettes to undermine existing tobacco-control measures, by renormalising smoking, or providing young people with an alternative entryway into nicotine addiction and tobacco cigarette smoking.²

Many proponents contend that e-cigarettes are likely to be less harmful than tobacco cigarettes, because they expose users to fewer toxic chemicals. However, there is insufficient evidence to quantify the reduction in risk when e-cigarettes are used instead of tobacco cigarettes. The World Health Organisation has stated that "no specific figure about how much 'safer' the use of these products is compared to smoking can be given any scientific credibility at this time." The CEO Statement found that there was insufficient evidence to quantify the reduction in risk when e-cigarettes are used instead of tobacco cigarettes.²

c. the established evidence on the effectiveness of e-cigarettes as a smoking cessation treatment.

Experts disagree about whether e-cigarettes may help smokers to quit, or whether they will become 'dual users' of both e-cigarettes and tobacco cigarettes. The 2017 Statement found that there is insufficient evidence to demonstrate that e-cigarettes are effective in assisting people to quit smoking and no brand of e-cigarette has been approved by the Therapeutic Goods Administration (TGA) for this purpose.²

² National Health and Medical Research Council. CEO Statement: Electronic Cigarettes. [Internet]. Canberra: National Health and Medical Research Council; April 2017 [cited 2020 October 20]. Available at <https://www.nhmrc.gov.au/about-us/resources/ceo-statement-electronic-cigarettes>



A 2016 systematic review conducted by the Cochrane Collaboration found some evidence that e-cigarettes with nicotine may assist smokers to quit, but there was a low level of confidence in this finding due to the small volume of evidence.² The Cochrane Collaboration has recently updated their systematic review.

NHMRC will review new evidence in this area in the update of the Statement.

NHMRC is also funding a range of research projects (**Attachment 2**) that will assist in informing the evidence base on the role of e-cigarettes in smoking cessation.

d. the established evidence on the uptake of e-cigarettes amongst non-smokers and the potential gateway effect onto traditional tobacco products.

The 2017 Statement found that there was some evidence that e-cigarettes could act as a gateway into nicotine addiction or cigarette smoking, with some studies showing the effect of e-cigarettes on future smoking behaviour was greatest among those who were otherwise at low risk of taking up smoking. Similarly, some studies indicated an association between e-cigarette use in non-users and future use of marijuana or other tobacco products such as hookahs, cigars or pipes.²

g) tobacco industry involvement in the selling and marketing of e-cigarettes.

As part of updating the 2017 Statement, NHMRC will engage an evidence reviewer to evaluate the evidence on the impact of marketing and advertising on the uptake and consumption of electronic cigarettes.

In scoping this work, NHMRC staff have found the following on the marketing of e-cigarettes:

- Although research is still emerging, there is evidence indicating that there may be a link between the marketing of e-cigarettes and e-cigarette use.³
- International evidence regarding e-cigarette use is increasing; however Australian research and data remains limited.⁴
- E-cigarette marketing in Australia is found online, in print media and in retail outlets.⁵
- Currently, the portrayal of e-cigarettes online is strongly influenced by e-cigarette companies and advertisers, and an analysis in the US of online and social media platforms suggests that e-cigarettes are discussed in a neutral or positive context. **Error! Bookmark not defined.** Public health concerns do not appear to be reflected in ongoing social media dialogue.⁶

³ Camenga D, Gutierrez KM, Kong G, Cavallo D, Simon P, Krishnan-Sarin S. E-cigarette advertising exposure in e-cigarette naïve adolescents and subsequent e-cigarette use: A longitudinal cohort study. *Addictive Behaviour*. [Internet] 2018 [cited 2020 Aug 19]; 81, 78-83. Available from: <https://pubmed.ncbi.nlm.nih.gov/29432916/>

⁴ Dunlop S, Lyons C, Dessainx A, Currow D. *How are tobacco smokers using e-cigarettes? Patterns of use, reasons for use and places of purchase in New South Wales*, *Medical Journal of Australia*, [Internet] 2016 [cited 20 Aug 2020]; 204 (09), 355. Available from: <https://www.mja.com.au/journal/2016/204/9/how-are-tobacco-smokers-using-e-cigarettes-patterns-use-reasons-use-and-places>

⁵ Commonwealth of Australia, *Report on the Inquiry into the Use and Marketing of Electronic Cigarettes and Personal Vaporisers in Australia*, House of Representatives Standing Committee on Health, Aged Care and Sport, [Internet] March 2018 [cited 2020 Aug 17]. Available from: https://www.aph.gov.au/Parliamentary_Business/Committees/House/Health_Aged_Care_and_Sport/ElectronicCigarettes/Report

⁶ Centers for Disease Control and Prevention, *Outbreak of lung injury associated with the use of E-Cigarettes, or Vaping, Products*, US Department of Health and Human Services, [Internet] February 25 2020 [cited 2020 Aug 19]. Available from: https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease.html



- A market traditionally dominated by small companies, the e-cigarette market has grown rapidly with large tobacco companies and manufacturers now buying into or developing e-cigarette products.⁷

NHMRC will evaluate the evidence on this topic in updating the 2017 Statement.

Updating the Statement will ensure that Australians are provided with the most up-to-date information on the safety and potential health implications of e-cigarettes and the impact of marketing and advertising on the uptake of e-cigarettes.

It is anticipated that the updated CEO Statement will be released in late 2021. Once released, the Statement will be publicly available on the NHMRC [website](#).

We look forward to following the outcomes of the Select Committee on Tobacco Harm Reduction.

Yours sincerely,

Professor Anne Kelso AO
Chief Executive Officer

⁷ McCausland K, Maycock B, Leaver T, Jancey J, The Messages Presented in Electronic Cigarette-Related Social Media Promotions and Discussion: Scope Review, Journal of Medical Internet Research, [Internet] 2019, [cited 2020 Aug 20], 21(2). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6379814/>



NHMRC CEO Statement: Electronic Cigarettes (E-Cigarettes)

Summary

Electronic cigarettes (e-cigarettes, also known as electronic nicotine delivery systems (ENDS) or electronic non-nicotine delivery systems (ENNDS)) are often marketed as a method to assist smokers to quit, or as a 'safe alternative' to conventional tobacco cigarettes. However, there is currently insufficient evidence to support claims that e-cigarettes are safe and further research is needed to enable the long-term safety, quality and efficacy of e-cigarettes to be assessed.

Key messages

- E-cigarettes may expose users to fewer toxic chemicals than conventional tobacco cigarettes; however the extent to which this reduces harm to the user has not been determined.
- E-cigarettes may expose users to chemicals and toxins such as formaldehyde, heavy metals, particulate matter and flavouring chemicals, at levels that have the potential to cause adverse health effects.
- There is currently insufficient evidence to conclude whether e-cigarettes can assist smokers to quit. Smokers wishing to quit should consult the [Quitline](#) or their general practitioner.
- There is some evidence from longitudinal studies to suggest that e-cigarette use in non-smokers is associated with future uptake of tobacco cigarette smoking.
- Health authorities and policy-makers should act to minimise harm to users and bystanders, and to protect vulnerable groups such as young people, until evidence of safety, quality and efficacy can be produced.
- NHMRC is currently funding a number of studies into the safety and efficacy of e-cigarettes.
- Consumers should seek further information about e-cigarettes from reliable sources, such as the relevant [State or Territory Health Department](#) or [quit smoking services](#).

E-cigarettes are battery operated devices that heat a liquid (called 'e-liquid') to produce a vapour that users inhale. Although the composition of this liquid varies, it typically contains a range of chemicals, including solvents and flavouring agents, and may or may not contain nicotine. E-cigarettes have evolved as a product group since first entering the market, with products now ranging from early 'first generation' devices that resemble cigarettes, to second and third generation devices that enable users to modify characteristics of the device, such as adjusting the voltage.¹

This wide variation in products, and the ability of users to customise their vaping experience, makes it difficult to assess the safety and efficacy of e-cigarettes as a group, because the results from research involving one particular product may not be applicable to all e-cigarettes or all users. However, by examining the evidence to identify common findings across a range of different products, or results that are replicated in a number of studies, it is possible to gain some insight into the efficacy of e-cigarettes, their potential harms, and areas where further research is required.

NHMRC recognises the need for high-quality research in this area and is currently funding a number of studies investigating the effects of e-cigarettes.

The following information is provided to assist consumers and policy-makers in understanding the current evidence about the safety and efficacy of e-cigarettes. This information is current at the time of writing but is subject to change as more research becomes available.

Health and safety

Potential health risks

It is widely believed that e-cigarettes are likely to be less harmful than tobacco cigarettes, because they expose users to fewer toxic chemicals.^{2,3,4} However, there is insufficient evidence to quantify the reduction in risk when e-cigarettes are used instead of tobacco cigarettes.^{1,5} Although a 2014 study reported that e-cigarettes are 95% less harmful than tobacco cigarettes,⁶ this finding was based on opinion rather than empirical evidence, and concerns have been raised about potential conflicts of interest.^{7,8} The World Health Organisation has stated that “no specific figure about how much ‘safer’ the use of these products is compared to smoking can be given any scientific credibility at this time.”¹

E-cigarettes are not likely to be risk free, and may expose users to chemicals and toxins at levels that have the potential to cause health effects. These include solvents such as propylene glycol, glycerol or ethylene glycol, which may form toxic or cancer-causing compounds when vaporised.^{9, 10, 11, 12, 13, 14, 15, 16, 17} Although these chemicals are typically found in lower concentrations than in tobacco cigarettes,^{3, 4, 10, 15} in some studies e-cigarettes and tobacco cigarettes were found to produce similar levels of formaldehyde,^{11, 14} which is classified as a cancer-causing agent.¹⁸ E-cigarette liquids or vapour may also contain potentially harmful chemicals which are not present in smoke from tobacco cigarettes.^{1, 11, 19}

While some of the chemicals in e-liquid are also used in food production and are generally considered safe when eaten, this does not mean that these chemicals are safe when inhaled as a vapour directly into the lungs. A number of studies have reported harmful effects when certain flavourings that are approved for use in food production, including cherry, cinnamon and popcorn flavours, are inhaled.^{20, 21, 22, 23} There is growing evidence to suggest that the long-term inhalation of flavourings used in most e-liquids is likely to pose a risk to health.¹

Studies also show that e-cigarettes expose both users and bystanders to particulate matter (very small particles)^{16, 24, 25, 26, 27} that may worsen existing illnesses or increase the risk of developing diseases such as cardiovascular or respiratory disease.²⁸ The World Health Organisation has warned that exposure to any level of particulate matter may be harmful and that levels of exposure should be minimised.²⁹

E-cigarettes may also expose users to metals such as aluminium, arsenic, chromium, copper, lead, nickel and tin,^{3, 15, 30, 31, 32} with these elements having been detected in e-liquid and in the vapour produced during use. In some cases these metals have been detected at levels greater than, or similar to, those found in tobacco cigarettes.^{1, 30}

Adverse events

Studies that have tested e-cigarettes for use as a smoking cessation tool found that users of e-cigarettes typically experience a low rate of adverse events in the short term,^{33, 34} with mouth and throat irritation the most commonly reported symptoms. However, more serious adverse events have also been reported, with over 200 incidents of e-cigarettes overheating, catching fire or exploding reported to date in the US and UK alone.³⁵ In some cases, these events have resulted in life-threatening injury, permanent disfigurement or disability, and major property damage.

The rising popularity of e-cigarette use internationally has also corresponded with an increasing number of reported nicotine poisonings due to exposure to or ingestion of e-liquids.^{36, 37, 38, 39, 40, 41, 42} The effects of exposure range from relatively mild, including irritation of the eyes and skin, nausea and vomiting,^{36, 37, 40} to severe life-threatening illness,³⁹ and in some cases, death.^{36, 38, 42}

Passive exposure

A recent systematic review of 16 studies concluded that e-cigarette vapour has the potential to pose a health risk to bystanders, although the risk is likely to be lower than that posed by conventional cigarette smoke.⁴³ However, exposure to certain metals such as nickel and silver may be greater for e-cigarettes than tobacco cigarettes.⁴³ A 2016 study found that the most common symptoms reported by those passively exposed to e-cigarettes included respiratory difficulties, eye irritation, headache, nausea and sore throat or throat irritation.⁴⁴

Smoking cessation

Experts disagree about whether e-cigarettes may help smokers to quit, or whether they will become 'dual users' of both e-cigarettes and tobacco cigarettes. There is currently insufficient evidence to demonstrate that e-cigarettes are effective in assisting people to quit smoking¹ and no brand of e-cigarette has been approved by the Therapeutic Goods Administration (TGA) for this purpose. Although a 2016 systematic review conducted by the Cochrane Collaboration³³ found some evidence that e-cigarettes with nicotine may assist smokers to quit, the review authors had a low level of confidence in this finding, due to the small volume of evidence. The review also reported results from one study comparing e-cigarettes with nicotine replacement therapy, which found that both methods resulted in similar rates of smoking cessation at 6 months follow-up. However, the reviewers noted that more research is required to enable confidence in these estimates and that further research is likely to change the estimate of effect.³³

Smokers wishing to quit are advised to consult their general practitioner. First-line treatments include a range of TGA-approved nicotine replacement therapies and prescription medications that have been tested for safety and efficacy. Support and information are also available from the Quitline (13 78 48) or via the Quit Now website (www.quitnow.gov.au).

E-cigarettes and tobacco control policies

Concerns have been raised that the potential benefits of e-cigarettes in reducing harm to smokers may be outweighed by the risks that they may undermine tobacco control efforts. This includes the potential for e-cigarettes to provide a gateway to nicotine addiction or tobacco product use, or that they may renormalise smoking. The appeal of flavoured e-cigarettes to children and adolescents is also of concern, with studies reporting rapid uptake of e-cigarettes among adolescents in many countries, where trend data are available.^{45, 46, 47, 48, 49} This provides some cause for concern given uncertainties about the long-term safety of e-cigarettes.

There is some evidence that e-cigarettes could act as a gateway into nicotine addiction or tobacco cigarette smoking. A number of longitudinal studies have reported an association between e-cigarette use in non-smokers and the uptake of tobacco cigarette smoking in the future.^{50, 51, 52, 53} This association remained even when the studies controlled for other risk factors that might make people more likely to take up smoking. In some studies, the effect of e-cigarettes on future smoking behaviour was greatest among those who were otherwise at low risk of taking up smoking.^{51, 54} A number of studies have also reported an association between e-cigarette use in non-users and future use of marijuana⁵² or tobacco products such as hookahs, cigars or pipes.^{51, 55, 56}

In view of the above concerns, the World Health Organisation has recommended that policy-makers act to prevent the initiation of e-cigarette use by non-smokers and youth, with special attention given to protecting vulnerable groups.¹

Manufacturing quality

The manufacturing quality of e-cigarettes is highly variable, with a number of issues relating to quality control reported in the literature. Labelling of e-cigarettes and e-liquids has been found to be incomplete or inaccurate.^{57, 58} Products have been found to contain chemicals that were not listed on the label,^{57, 58, 59} or to state incorrectly that they did not contain potentially toxic chemicals, despite analyses confirming their presence.^{60, 61}

There may also be wide variation between the levels of nicotine declared on packaging and the amount contained in e-liquid.^{9, 58, 62, 63, 64, 65} One study that compared identical models of e-cigarettes found that nicotine content varied by up to 20% when the products came from different manufacturing batches, with variation of up to 12% reported for products manufactured in the same batch.⁶⁶ Furthermore, some products that are labelled as nicotine free have been found to contain nicotine.^{11, 15, 57, 59, 62, 65, 67, 68}

Where can I get more information?

When seeking information about e-cigarettes online, it is important to look at websites that provide a reliable source of information, such as government websites or [quit smoking services](#). Information on websites sponsored by retailers or manufacturers may reflect a commercial interest in promoting the sale of certain products.

Similarly, when reading published research on e-cigarettes it is important to consider whether the authors of the research held any conflicts of interest that could potentially bias their findings, or whether the research was funded by an organisation with a financial interest in the outcomes, such as e-cigarette manufacturers.⁶⁹

The following websites may provide further information of use to consumers:

Evidence-based reports

World Health Organisation – *Electronic Nicotine Delivery Systems and Electronic Non-Nicotine Delivery Systems (ENDS/ENNDS)*

http://www.who.int/fctc/cop/cop7/FCTC_COP_7_11_EN.pdf

Information, fact sheets and FAQs from government departments

ACT Health – *Electronic Cigarettes*

<http://www.health.act.gov.au/public-information/public-health/tobacco-and-smoke-free/electronic-cigarettes>

New South Wales Department of Health – *Electronic Cigarettes*

<http://www.health.nsw.gov.au/tobacco/Pages/electronic-cigarettes.aspx>

Product Safety Australia – *Electronic Cigarette Safety*

<http://www.productsafety.gov.au/news/electronic-cigarette-safety>

Therapeutic Goods Administration – *Electronic Cigarettes*

<https://www.tga.gov.au/community-qa/electronic-cigarettes>

Western Australia Department of Health – *Electronic cigarettes (e-cigarettes)*

http://healthywa.wa.gov.au/Articles/A_E/Electronic-cigarettes-e-cigarettes

State and Territory Health Departments – *Contact Details*

<http://www.health.gov.au/internet/main/publishing.nsf/Content/health-related.htm#state>

Position statements

Australian Medical Association – *Tobacco Smoking and E-cigarettes (2015) – The AMA Position*

<https://ama.com.au/position-statement/tobacco-smoking-and-e-cigarettes-2015>

Cancer Council Australia and The Heart Foundation – *Joint Position Statement on Electronic Cigarettes*

http://wiki.cancer.org.au/policy/Position_statement_-_Electronic_cigarettes

Public Health Association of Australia – *Statement by the Public Health Associations of Australia on Electronic Cigarettes*

<https://www.phaa.net.au/documents/item/704>

References

- 1 World Health Organisation, "Electronic Nicotine Delivery Systems and Electronic Non-Nicotine Delivery Systems (ENDS/ENNDS)" WHO Framework Convention on Tobacco Control, Geneva, 2016.
- 2 World Health Organisation, "Electronic Nicotine Delivery Systems" WHO Framework Convention on Tobacco Control, Geneva, 2014.
- 3 M. L. Goniewicz, J. Knysak, M. Gawron, L. Kosmider, A. Sobczak and J. Kurek, "Levels of Selected Carcinogens and Rotoxicants in Vapour from Electronic Cigarettes" *Tobacco Control*, vol. 23, no. 2, pp. 133-139, 2014.
- 4 S. S. Hecht, S. G. Carmella, D. Kotandeniya, M. E. Pillsbury, M. Chen, B. W. Ransom, R. Isaksson Vogel, E. Thompson, S. E. Murphy and D. K. Hatsukami, "Evaluation of Toxicant and Carcinogen Metabolites in the Urine of e-Cigarette Users Versus Cigarette Smokers" *Nicotine & Tobacco Research*, pp. 1-6, 2014.
- 5 N. Lindson-Hawley, J. Hartmann-Boyce, T. R. Fanshawe, R. Begh, A. Farley and T. Lancaster, "Interventions to Reduce Harm from Continued Tobacco Use" *Cochrane Database of Systematic Reviews*, no. 10, 2016.
- 6 D. J. Nutt, L. D. Phillips, D. Balfour, H. V. Curran, M. Dockrell, J. Foulds, K. Fagerstrom, K. Letlape, A. Milton, R. Polosa, J. Ramsey and D. Sweanor, "Estimating the Harms of Nicotine-Containing Products Using the MCDA Approach" *European Addiction Research*, vol. 20, no. 5, pp. 218-225, 2014.
- 7 The Lancet, "Public Health England's Evidence-Based Confusion" *The Lancet*, vol. 386, p. 829, 2015.
- 8 M. Mckee and S. Capewell, "Evidence about Electronic Cigarettes: Foundation Built on Rock or Sand?" *BMJ*, vol. 351, 2015.
- 9 T. Cheng, "Chemical Evaluation of Electronic Cigarettes" *Tobacco Control*, vol. 23, no. Suppl 2, pp. ii11-7, 2014.
- 10 O. Geiss, I. Bianchi and J. Barrero-Moreno, "Correlation of Volatile Carbonyl Yields Emitted by E-cigarettes with the Temperature of the Heating Coil and the Perceived Sensorial Quality of the Generated Vapours" *International Journal of Hygiene and Environmental Health*, vol. 219, no. 3, pp. 268-277, 2016.
- 11 C. Hutzler, M. Paschke, S. Kruschinski, F. Henkler, J. Hahn and A. Luch, "Chemical Hazards Present in Liquids and Vapors of Electronic Cigarettes" *Archives of Toxicology*, vol. 88, pp. 1295-1308, 2014.
- 12 R. P. Jensen, W. Luo, J. F. Pankow, R. M. Strongin and D. H. Peyton, "Hidden Formaldehyde in E-cigarette Aerosols" *The New England Journal of Medicine*, vol. 372, no. 4, pp. 392-394, 2015.
- 13 M. Sleiman, J. M. Logue, V. N. Montesinos, M. L. Russell, M. I. Litter, L. A. Gundel and H. Destailats, "Emissions from Electronic Cigarettes: Key Parameters Affecting the Release of Harmful Chemicals" *Environmental Science & Technology*, vol. 50, no. 17, pp. 9644-9651, 2016.
- 14 L. Kosmider, A. Sobczak, M. Fik, J. Knysak, M. Zaciera, J. Kurek and M. L. Goniewicz, "Carbonyl Compounds in Electronic Cigarette Vapors – Effects of Nicotine Solvent and Battery Output Voltage" *Nicotine & Tobacco Research*, vol. 16, no. 10, pp. 1319-1326, 2014.
- 15 W. Visser, L. Geraets, W. Klerx, L. Hernandez, E. Stephens, E. Croes, P. Schwillens, H. Cremers, P. Bos and R. Talhout, "The Health Risks of Using E-cigarettes" National Institute for Public Health and the Environment, Bilthoven, 2015.
- 16 A. El-Hellani, R. Salman, R. El-Hage, S. Talih, N. Malek, R. Baalbaki, N. Karaoghlanian, R. Nakkash, A. Shihadeh and N. A. Saliba, "Nicotine and Carbonyl Emissions From Popular Electronic Cigarette Products: Correlation to Liquid Composition and Design Characteristics" *Nicotine & Tobacco Research*, vol. Oct, 2016.
- 17 A. Khlystov and V. Samburova, "Flavoring Compounds Dominate Toxic Aldehyde Production during E-Cigarette Vaping" *Environmental Science & Technology*, vol. 50, no. 23, pp. 13080-13085, 2016.
- 18 International Agency for Research on Cancer (IARC), "IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol 100F (29)" WHO, 2012.

- 19 S. Uchiyama, K. Ohta, Y. Inaba and N. Kunungita, "Determination of Carbonyl Compounds Generated from the E-cigarette using Coupled Silica Cartridges Impregnated with Hydroquinone and 2,4-Dinitrophenylhydrazine, Followed by High-Performance Liquid Chromatography" *Analytical Sciences*, vol. 29, pp. 1219-1222, 2013.
- 20 K. Kreiss, A. Gomaa, G. Kullman, K. Fedan, E. Simoes and P. Enright, "Clinical Bronchiolitis Obliterans in Workers at a Microwave-Popcorn Plant" *New England Journal of Medicine*, vol. 347, no. 5, pp. 330-338, 2002.
- 21 P. Harber, K. Saechao and C. Boomus, "Diacetyl-Induced Lung Disease" *Toxicological Reviews*, vol. 25, no. 4, pp. 261-272, 2006.
- 22 R. Behar, B. Davis, Y. Wang, V. Bahl, S. Lin and P. Talbot, "Identification of Toxicants in Cinnamon-Flavored Electronic Cigarette Refill Liquids" *Toxicology in Vitro*, vol. 28, no. 2, pp. 198-208, 2014.
- 23 L. Kosmider, A. Sobczak, A. Prokopowicz, J. Kurek, M. Zacierka, J. Knysak, D. Smith and M. L. Goniewicz, "Cherry-flavoured Electronic Cigarettes Expose Users to the Inhalation Irritant, Benzaldehyde" *Thorax*, vol. 71, no. 4, pp. 376-377, 2016.
- 24 R. M. Pellegrino, B. Tinghino, G. Mangiaracina, A. Marani, M. Vitali, C. Protano, J. F. Osborn and M. S. Cattaruzza, "Electronic Cigarettes: an Evaluation of Exposure to Chemicals and Fine Particulate Matter (PM)" *Annali di Igiene*, vol. 24, no. 4, pp. 279-288, 2012.
- 25 W. Schober, K. Szendrei, W. Matzen, H. Osiander-Fuchs, D. Heitmann, T. Schettgen, R. A. Jorres and H. Fromme, "Use of Electronic Cigarettes (E-cigarettes) Impairs Indoor Air Quality and Increases FeNO Levels of E-cigarette Consumers" *International Journal of Hygiene and Environmental Health*, vol. 217, pp. 628-637, 2014.
- 26 T. Schripp, D. Markewitz, E. Uhde and T. Salthammer, "Does E-cigarette Consumption Cause Passive Vaping?" *Indoor Air*, vol. 23, pp. 25-31, 2013.
- 27 J. Zhao, G. Pyrgiotakis and P. Demokritou, "Development and Characterization of Electronic-Cigarette Exposure Generation System (Ecig-EGS) for the Physico-Chemical and Toxicological Assessment of Electronic Cigarette Emissions" *Inhalation Toxicology*, vol. 28, no. 14, pp. 658-669, 2016.
- 28 Environmental Protection Agency, "Integrated Science Assessment for Particulate Matter (Final Report)" U.S. Environmental Protection Agency, Washington DC, 2009.
- 29 World Health Organisation, "WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide: Summary of Risk Assessment" WHO, Geneva, 2006.
- 30 M. Williams, A. Villarreal, K. Bozhilov, S. Lin and P. Talbot, "Metal and Silicate Particles Including Nanoparticles are Present in Electronic Cigarette Cartomizer Fluid and Aerosol" *PLoS One*, vol. 8, no. 3, p. e57987, 2013.
- 31 V. B. Mikheev, M. C. Brinkman, C. A. Granville, S. M. Gordon and P. I. Clark, "Real-Time Measurement of Electronic Cigarette Aerosol Size Distribution and Metals Content Analysis" *Nicotine & Tobacco Research*, vol. May, 2016.
- 32 C. A. Hess, P. Olmedo, A. Navas-Acien, W. Goessler, J. E. Cohen and A. M. Rule, "E-cigarettes as a Source of Toxic and Potentially Carcinogenic Metals" *Environmental Research*, vol. 152, pp. 221-225, 2017.
- 33 J. Hartmann-Boyce, H. McRobbie, C. Bullen, R. Begh, L. F. Stead and P. Hajek, "Electronic Cigarettes for Smoking Cessation (Review)" *Cochrane Database of Systematic Reviews*, no. 9, 2016.
- 34 M. R. Gualano, S. Passi, F. Bert, G. La Torre, G. Scaioli and R. Siliquini, "Electronic Cigarettes: Assessing the Efficacy and the Adverse Effects through a Systematic Review of Published Studies" *Journal of Public Health*, vol. 37, no. 3, pp. 488-497, 2015.
- 35 S. F. Rudy and E. L. Durmowicz, "Electronic Nicotine Delivery Systems: Overheating, Fires and Explosions" *Tobacco Control*, vol. Mar, 2016.
- 36 K. Chatham-Stephens, R. Law, E. Taylor, S. Kieszak, P. Melstrom, R. Bunnell, B. Wang, H. Day, B. Apelberg, L. Cantrell, H. Foster and J. G. Schier, "Exposure Calls to U. S. Poison Centers Involving Electronic Cigarettes and Conventional Cigarettes-September 2010-December 2014" *Journal of Medical Toxicology*, 2016.

- 37 F. Davanzo, L. Settimi, G. Milanese, F. Giordano, F. M. Sesana, A. Celentano, E. Urbani, G. Panzavolta, L. Cossa, A. Tomoiaga, A. Travaglia and V. Dimasi, "Surveillance of Hazardous Exposures to Electronic Cigarettes in Italy" *Clinical Toxicology*, vol. 52, no. Supp, pp. 336-337, 2014.
- 38 A. Kamboj, H. A. Spiller, M. J. Casavant, T. Chounthirath and G. A. Smith, "Pediatric Exposure to E-Cigarettes, Nicotine, and Tobacco Products in the United States" *Pediatrics*, vol. 137, no. 6, 2016.
- 39 S. W. Lindberg, N. Ebbelhoj, J. Bang and L. B. Christensen, "Nicotine Poisoning Related to the Use of E-cigarettes" *Clinical Toxicology*, vol. 53, no. 4, 2015.
- 40 S. Pajarre-Sorsa, M. Saukkonen and K. Hoppu, "Calls Concerning Electronic Cigarettes to the Finnish Poison Information Centre" *Clinical Toxicology*, vol. 52, no. Supp, p. 337, 2014.
- 41 E. Thomas, R. A. Spears, G. Alldridge, C. V. Krishna, J. P. Thompson, M. Eddleston, J. A. Vale and S. H. L. Thomas, "E-cigarette Liquid Refills – a Safe Beverage? Analysis of Enquiries to the UK National Poisons Information Service from 2007 to 2013" *Clinical Toxicology*, vol. 52, no. Supp, pp. 338-339, 2014.
- 42 J. P. Vakkalanka, L. S. Hardison and C. P. Holstege, "Epidemiological Trends in Electronic Cigarette Exposures Reported to U.S. Poison Centers" *Clinical Toxicology*, vol. 52, no. 5, pp. 542-548, 2014.
- 43 I. M. R. Hess, K. Lachireddy and A. Capon, "A Systematic Review of the Health Risks from Passive Exposure to Electronic Cigarette Vapour" *Public Health Research and Practice*, vol. 26, no. 2, 2016.
- 44 E. L. Durmowicz, S. F. Rudy and I. L. Chen, "Electronic Cigarettes: Analysis of FDA Adverse Experience Reports in Non users" *Tobacco Control*, vol. 25, no. 2, p. 242, 2016.
- 45 S. Lee, R. Grana and S. Glantz, "Electronic Cigarette Use Among Korean Adolescents: A Cross-Sectional Study of Market Penetration, Dual Use, and Relationship to Quit Attempts and Former Smoking" *J Adolesc Health*, vol. 54, pp. 684-690, 2014.
- 46 B. Eastwood, M. J. Dockrell, D. Arnott, J. Britton, H. Cheeseman, M. J. Jarvis and A. McNeill, "Electronic Cigarette Use in Young People in Great Britain 2013-2014" *Public Health*, vol. 129, no. 9, pp. 1150-1156, 2015.
- 47 T. Singh, R. A. Arrazola, C. G. Corey, C. G. Husten, L. J. Neff, D. M. Homa and B. A. King, "Tobacco Use Among Middle and High School Students — United States, 2011-2015" *Morbidity and Mortality Weekly Report*, vol. 65, no. 14, 2016.
- 48 J. White, J. Li, R. Newcombe and D. Walton, "Tripling Use of Electronic Cigarettes Among New Zealand Adolescents Between 2012 and 2014" *The Journal of Adolescent Health*, vol. 56, no. 5, pp. 522-528, 2015.
- 49 J. M. Kinnunen, H. Ollila, P. L. Lindfors and A. H. Rimpelä, "Changes in Electronic Cigarette Use from 2013 to 2015 and Reasons for Use Among Finnish Adolescents" *International Journal of Environmental Research and Public Health*, vol. 13, no. 11, 2016.
- 50 K. Chatterjee, B. Alzghoul, A. Innabi and N. Meena, "Is Vaping a Gateway to Smoking: a Review of the Longitudinal Studies" *Int J Adolesc Med Health*, 2016.
- 51 J. L. Barrington-Trimis, R. Urman, K. Berhane, J. B. Unger, T. B. Cruz, M. A. Pentz, J. M. Samet, A. M. Leventhal and R. McConnell, "E-Cigarettes and Future Cigarette Use" *Pediatrics*, vol. 138, no. 1, 2016.
- 52 J. B. Unger, D. W. Soto and A. Leventhal, "E-cigarette Use and Subsequent Cigarette and Marijuana Use Among Hispanic Young Adults" *Drug and Alcohol Dependence*, 2016.
- 53 T. R. Spindle, M. M. Hiler, M. E. Cooke and T. Eissenberg, "Electronic Cigarette Use and Uptake of Cigarette Smoking: A Longitudinal Examination of U.S. College Students" *Addictive Behaviors*, vol. 67, pp. 66-72, 2017.
- 54 T. A. Wills, J. D. Sargent, F. X. Gibbons, I. Pagano and R. Schweitzer, "E-cigarette Use is Differentially Related to Smoking Onset Among Lower Risk Adolescents" *Tobacco Control*, 2016.
- 55 J. Huh and A. M. Leventhal, "Progression of Poly-Tobacco Product Use Patterns in Adolescents" *American Journal of Preventive Medicine*, vol. 51, no. 4, pp. 513-517, 2016.

- 56 A. M. Leventhal, D. R. Strong, M. G. Kirkpatrick, J. B. Unger, S. Sussman, N. R. Riggs, M. D. Stone, R. Khoddam, J. M. Samet and J. Audrain-McGovern, "Association of Electronic Cigarette Use with Initiation of Combustible Tobacco Product Smoking in Early Adolescence" *JAMA*, vol. 314, no. 7, pp. 700-707, 2015.
- 57 J. Hahn, Y. B. Monakhova, J. Hengen, M. Kohl-Himmelseher, J. Schassler, H. Hahn, T. Kuballa and D. W. Lachenmeier, "Electronic Cigarettes: Overview of Chemical Composition and Exposure Estimation" *Tobacco Induced Diseases*, vol. 12, no. 1, p. 23, 2014.
- 58 S. Han, H. Chen, X. Zhang, T. Liu and Y. Fu, "Levels of Selected Groups of Compounds in Refill Solutions for Electronic Cigarettes" *Nicotine & Tobacco Research*, vol. 18, no. 5, pp. 708-714, 2016.
- 59 M. E. Hadwiger, M. L. Trehly, W. Ye, T. Moore, J. Allgire and B. Westenberger, "Identification of Amino-tadalafil and Rimonabant in Electronic Cigarette Products Using High Pressure Liquid Chromatography with Diode Array and Tandem Mass Spectrometric Detection" *Journal of Chromatography*, vol. 1217, no. 48, pp. 7547-7555, 2010.
- 60 J. G. Allen, S. S. Flanigan, M. LeBlanc, J. Vallarino, P. MacNaughton, J. H. Stewart and D. C. Christiani, "Flavoring Chemicals in E-Cigarettes: Diacetyl, 2,3-Pentanedione, and Acetoin in a Sample of 51 Products, Including Fruit-, Candy-, and Cocktail-Flavored E-Cigarettes" *Environmental Health Perspectives*, 2015.
- 61 Australian Competition and Consumer Commission, "ACCC Takes Action Against E-cigarette Suppliers for Alleged Misleading "No Toxic Chemicals" Claims" 20 June 2016. Online. Available: <https://www.accc.gov.au/media-release/accc-takes-action-against-e-cigarette-suppliers-for-alleged-misleading-%E2%80%9Cno-toxic-chemicals%E2%80%9D-claims>. Accessed 25 November 2016.
- 62 K. Buettner-Schmidt, D. R. Miller and N. Balasubramanian, "Electronic Cigarette Refill Liquids: Child-Resistant Packaging, Nicotine Content, and Sales to Minors" *Journal of Pediatric Nursing*, vol. 31, no. 4, pp. 373-379, 2016.
- 63 B. Davis, M. Dang, J. Kim and P. Talbot, "Nicotine Concentrations in Electronic Cigarette Refill and Do-it-yourself Fluids" *Nicotine & Tobacco Research*, vol. 17, no. 2, pp. 134-141, 2015.
- 64 M. Williams, A. Villareal, B. Davis and P. Talbot, "Comparison of the Performance of Cartomizer Style Electronic Cigarettes from Major Tobacco and Independent Manufacturers" *PLoS One*, vol. 11, no. 2, 2016.
- 65 M. Famele, J. Palmisani, C. Ferranti, C. Abenavoli, L. Palleschi, R. Mancinelli, R. M. Fidente, G. de Gennaro and R. Draisci, "Liquid Chromatography with Tandem Mass Spectrometry Method for the Determination of Nicotine and Minor Tobacco Alkaloids in Electronic Cigarette Refill Liquids and Second-hand Generated Aerosol" *Journal of Separation Science*, vol. Dec, 2016.
- 66 M. L. Goniewicz, P. Hajek and H. McRobbie, "Nicotine Content of Electronic Cigarettes, its Release in Vapour and its Consistency Across Batches: Regulatory Implications" *Addiction*, vol. 109, no. 3, pp. 500-507, 2014.
- 67 U.S. Food and Drug Administration, "Evaluation of E-cigarettes" U.S. Food and Drug Administration, St Louis, MO, 2009.
- 68 J. Regueiro, A. Giri and T. Wenzl, "Optimization of a Differential Ion Mobility Spectrometry-Tandem Mass Spectrometry Method for High-Throughput Analysis of Nicotine and Related Compounds: Application to Electronic Cigarette Refill Liquids" *Analytical Chemistry*, vol. 88, no. 12, pp. 6500-6508, 2016.
- 69 C. Pisinger and M. Døssing, "A Systematic Review of Health Effects of Electronic Cigarettes" *Preventive Medicine*, vol. 69, pp. 248-260, 2014.



Attachment 2 – NHMRC funded research on e-cigarettes

	Grant ID	Year	CIA Name	Title	Grant Total	Funding Type	Administering Institution
1	GNT1194713	2020	Dr Michelle Jongenelis	Minimising uptake of e-cigarettes and encouraging cessation among Australian adolescents and adults	\$645,205	Investigator Grants	University of Melbourne
2	GNT1176137	2019	Dr Chung Kai Chan	E-cigarettes and vaping: Holy grail of tobacco control or gateway to a public health disaster?	\$648,707	Investigator Grants	University of Queensland
3	GNT1158186	2018	Prof Brian Oliver	Understanding why in-utero exposure to inhaled oxidants predispose people to develop asthma and COPD.	\$1,072,727	Project Grants	University of Technology Sydney
4	GNT1160245	2018	Prof Billie Bonevski	A trial of vaporised nicotine products for smoking cessation following discharge from drug and alcohol residential withdrawal services	\$1,881,121	Project Grants	University of Newcastle
5	GNT1148497	2017	Dr Ryan Courtney	Reducing the social gradient in tobacco smoking rates: The road less travelled; Novel and innovative paths for improved cessation rates and outcomes	\$446,651	Career Development Fellowships	University of New South Wales
6	GNT1124264	2016	A/Pr Coral Gartner	A Pragmatic Randomised Clinical Trial of Nicotine Vaporisers added to Smoking Cessation Treatment for Priority Populations Living with Comorbidities	\$1,547,575	Project Grants	University of Queensland
7	GNT1127390	2016	Dr Ryan Courtney	Adding an electronic-cigarette to standard behavioural treatment for low-socioeconomic status smokers: A randomised trial.	\$1,424,823	Project Grants	University of New South Wales
8	GNT1128231	2016	A/Pr Alexander Larcombe	The health effects of electronic-cigarettes	\$587,891	Project Grants	Curtin University



9	GNT1106451	2015	Prof Ron Borland	Understanding the impacts of Vaporised Nicotine Products on smoking in Australia	\$1,666,908	Project Grants	University of Melbourne
10	GNT1089403	2014	Dr Becky Freeman	Harnessing new media to translate prevention research evidence in to practice and policy	\$321,606	Early Career Fellowships	University of Sydney
11	GNT1095880	2014	Prof Ron Borland	Enhancing pharmacological and behavioural support to reduce smoking relapse: A factorial RCT	\$717,991	International Collaborations	Cancer Council VIC
12	GNT1061978	2013	A/Pr Coral Gartner	Public health policies and interventions to reduce tobacco-related harms among socially disadvantaged populations and 'low probability quitters'	\$421,748	Career Development Fellowships	University of Queensland
13	GNT1020123	2011	A/Pr Coral Gartner	An open-label randomised pragmatic policy trial of nicotine products for short-term cessation assistance or long-term substitution in smokers.	\$1,053,910	Project Grants	University of Queensland
					\$12,436,864		