Electronic Cigarette Research Briefing – September-October 2018

This research briefing is part of a series of monthly updates aiming to provide an overview of new studies on electronic cigarettes. The briefings are intended for researchers, policy makers, health professionals and others who may not have time to keep up to date with new findings and would like to access a summary that goes beyond the study abstract. The text below provides a critical overview of each of the selected studies then puts the study findings in the context of the wider literature and research gaps.

The studies selected and further reading list do not cover every e-cigarette-related study published each month. Instead, they include high profile studies most relevant to key themes identified by the UK Electronic Cigarette Research Forum; including efficacy and safety, smoking cessation, population level impact and marketing. For an explanation of the search strategy used, please see the end of this briefing.

Some of you have been in touch to report that you haven't received some recent UKECRF briefings. You can find our previous research briefings at www.cruk.org/UKECRF.

If you would prefer not to receive this briefing in future, just let us know.

1. E-cigarette use in England 2014-17 as a function of socio-economic profile.

- **Study aims**

  This English study used the annual results of the Smoking Toolkit survey between 2014-2017. It aimed to analyse the associations between socio-economic status (SES) and e-cigarette use among all adults, past-year smokers, long term ex-smokers and use during the most recent quit attempt. Changes over time were also assessed.

- **Key findings**

  Among all adults, 5.5% were current e-cigarette users. 34.6% of people who had made a quit attempt in the last year had used e-cigarettes in their most recent attempt. 5.9% of long-term ex-smokers and 21.3% of those who had smoked in the last year were current e-cigarette users.

  Across all years of the survey, there was a social gradient in e-cigarette use among adults, with those from lower social grades being more likely to report using e-cigarettes. Compared to

social grade AB, the odds of current e-cig use were: C1 OR=1.36 (95%CI 1.11-1.68, p<0.01), C2 OR=1.66 (95%CI 1.34-2.07, p<0.0001), D OR=1.45 (95%CI 1.14-1.85 p<0.01) and E OR= 2.23 (95%CI 1.75-2.84, p<0.0001)

When limiting to past-year smokers (those who had smoked in the last year), the opposite was found. Those from lower social grades were less likely to report e-cigarette use than those from the highest social grade. Odds ratios ranged from 0.53 (95%CI 0.40-0.71) for those from grade D to 0.83 (95%CI 0.64-1.07) for those from C1, compared to the AB reference group.

There were no significant associations between social grade and e-cigarette use in the most recent quit attempt and this did not change over time.

Among long-term ex-smokers, those from lower social grades were more likely to currently use e-cigarettes compared to those from the highest social grade, but this was not significant for those from group E. Across all social grades, prevalence of e-cigarette use among long-term ex-smokers increased over time.

- **Limitations**

  This study only reported current product use at single time points. Therefore, it cannot tell us about patterns of use in individuals over time, or determine causality.

  This study did not consider dual use patterns or past e-cigarette use by socio-economic status which could have influenced the associations.

  This study adjusted for age sex and region, but didn't control for all possible confounders that could affect results, such as nicotine addiction. Therefore, this study may be vulnerable to confounding.

  This study only reported the proportion of e-cigarette users in long term ex-smokers over time, not the absolute prevalence. This could have influenced the results as the number of long term ex-smokers is increasing.

  This survey relied on self-reported data and this could be subject to bias.

Kock, L., Shahab, L., West, R., and Brown, J. (2018) E-cigarette use in England 2014–17 as a function of socio-economic profile. *Addiction*, doi.org/10.1111/add.14446.

2. Association between electronic cigarette use and myocardial infarction

- **Study aims**

  This US study surveyed 69,046 people in 2014 and 2016 to assess the association between e-cigarette use and risk of having experienced a heart attack. It also looked at the association between smoking and risk of having experienced a heart attack. Analyses were adjusted for age, gender, ethnicity, smoking, hypertension, diabetes, high cholesterol and BMI.

- **Key findings**

  Compared to those who had never used e-cigarettes, daily use of e-cigarettes was associated with an increased risk of ever having had a heart attack (OR 1.79; 95% CIs 1.20 – 2.66, p = 0.004).

Former or 'some day' use of e-cigarettes was not significantly associated with ever having had a heart attack compared to those who had never used e-cigarettes.

Compared to never smoking, daily smoking was associated with an increased risk of ever having had a heart attack (OR 2.72; 95% CIs 2.29 – 3.24), $p < 0.001$). Former and 'some days' smoking was also associated with ever having had a heart attack (OR 1.70; 95 CIs 1.51 – 1.91, $p < 0.001$ and OR 2.36; 95 CIs 1.80 – 3.09, $p < 0.001$ respectively).

Assuming an additive effect of the risk of smoking and e-cigarette use, the researchers estimated that daily dual use of e-cigarettes and cigarettes would lead to an increased risk of heart attack of OR 4.62.

- **Limitations**

The data in this study is cross-sectional and observational. Therefore, it cannot draw conclusions about causality.

It is not known when the reported heart attacks occurred relative to e-cigarette use. Therefore, this study may be vulnerable to reverse causality, as it's likely that some of the heart attacks reported occurred before e-cigarette use.

The researchers in this study estimated the odds of having a heart attack among dual users by assuming that the association between smoking and e-cigarettes would be additive. This is unlikely to reflect realistic risk profiles.

This study didn't control for all possible confounders that could affect results, such as nicotine dependence, and it would have been difficult to adequately adjust for dual use given the small number of daily e-cigarette users.

This survey did not measure length of time of e-cigarette use, so cannot differentiate between longer-term users and those experimenting with e-cigarettes.

This study relied on self-reported data, which may be subject to bias.

Alzahrani, T., Pena, I., Temesgen, N., Glantz, S.A. Association between electronic cigarette use and myocardial infarction. American Journal of Preventative Medicine, doi: 10.1016/j.amepre.2018.05.004

3. Harm perceptions of electronic cigarettes and nicotine: a nationally representative cross-sectional survey of young people in Great Britain.

- **Study aims**

This was a nationally representative cross-sectional study of 2,103 young people aged 11-18 in Great Britain. Data were drawn from the online 2016 Action on Smoking and Health (ASH) Smokefree Great Britain Youth survey. It aimed to assess how common different e-cigarette harm perceptions were and the factors associated with these beliefs. It also looked at beliefs around nicotine harm and associated predictors.

- **Key findings**

63.4% of young people thought that e-cigarettes were less harmful than tobacco cigarettes. A further 22.9% believed them to be equally as harmful and 2.6% perceived they were more harmful.

Only 8.6% recognised that nicotine only contributes none or a very small amount of the harm that comes from smoking. The biggest proportion (20.2%) believed that nearly all the harm from cigarettes comes from nicotine.

After adjustment, significant predictors of the belief that e-cigarettes are less harmful than smoking are: having tried e-cigarettes, older age, e-cigarette use by a family member, having no friends who smoke (compared to those who don't know or refuse to say), belief in public disapproval of smoking, belief in public approval or public neutrality around e-cigarettes and more accurate perceptions of nicotine harm. Smoking status was not associated with accurate e-cigarette harm perceptions.

After adjustment, significant predictors of low nicotine harm perceptions were: older age, region, having a family member who smokes, belief in public disapproval of e-cigarettes (compared to those who don't know) and more accurate perceptions of e-cigarette harm. Neither smoking status nor e-cigarette use were associated with accurate nicotine harm perceptions.

- **Limitations**

This data is cross-sectional. Therefore, it cannot draw any conclusions about a causal relationship between predictors and perceptions.

Very few young people were regular smokers (n=73) or e-cig users (n=33). This would have affected the power to detect an effect of these variables on harm perceptions.

The study was able to assess relative harm perceptions of e-cigarettes and nicotine compared to smoking, but not what the absolute perceived level of harm was.

This survey relied on self-reported data and this could be subject to bias.

This study couldn't account for all potential variables that might affect results, such as dual use, other risky behaviours, or liking or disliking the effects of smoking and/or e-cigarettes.

10% of the survey sample was excluded because of missing data or because they had not heard of e-cigarettes. This may make the results less representative of the population.

The question on nicotine harm could have been misinterpreted as harm from addiction rather than direct physical harm.

East, K., Brose, L., McNeill, A., Cheeseman, H., Arnott, D., and Hitchman, S. (2018) Harm perceptions of electronic cigarettes and nicotine: A nationally representative cross-sectional survey of young people in Great Britain. *Drug & Alcohol Dependence*. 192, 257-263 doi.org/10.1016/j.drugalcdep.2018.08.016

4. Patterns, trends and determinants of e-cigarette use in 28 European Union Member States 2014-2017

- **Study aims**

This study aimed to compare e-cigarette usage in European Union member states in 2014 and 2017.

The researchers used the Special Eurobarometer for Tobacco Survey of 27,000 people, which had nationally representative data on both ever and regular tobacco and e-cigarette use.

- **Key findings**

  Between 2014 and 2017, the percentage of current regular e-cigarette users in the EU increased slightly from 1.5% (95% CI 1.2-1.8) to 1.8% (95%CI 1.5-2.1). The percentage of ever e-cigarette users increased significantly from 11.6% (95%CI 10.9-12.3) to 14.6% (95%CI 13.9-15.3).

  The UK had the highest prevalence of current regular e-cigarette users in the EU in both 2014 and 2017. In 2017, in the UK, over a quarter of ever e-cigarette users were current regular users. This was the highest proportion in the EU, which ranged from 2.0% in Bulgaria to 25.8% in the UK.

  Across the EU, younger people were more likely to have ever tried e-cigarettes (p trend <0.001), but they were also less likely to be ever-regular users of e-cigarettes (p trend <0.001).

  Among never-smokers in the EU, 2.7% had ever tried an e-cigarette. 12.8% of never-smokers who had tried vaping became regular users.

- **Limitations**

  This data is cross-sectional. It only reports on two time-points and cannot tell us about behaviour trends between these points. Therefore, it cannot draw any conclusions about causality.

  This survey relied on self-reported data and this could be subject to bias.

  Regular use of e-cigarettes was defined as daily or weekly usage. However, this does not capture the full variation in patterns of use.

  Between baseline and follow-up, some minor changes were made to the questionnaire used. Therefore, it's unclear whether some results reflect real changes in e-cigarette use or smoking, or reflect changes in the questionnaire.

Laverty, A. A., Filippidis, F. T., & Vardavas, C. I. (2018). Patterns, trends and determinants of e-cigarette use in 28 European Union Member States 2014–2017. *Preventive Medicine*, *116*, 13–18. http://doi.org/10.1016/J.YPMED.2018.08.028

5. Pro-inflammatory effects of e-cigarette vapour condensate on human alveolar macrophages

- **Study aims**

  This study aimed to compare the cytotoxic effects of un-vaped e-cigarette liquid with e-cigarette vapour condensate on alveolar macrophages, assessing both nicotine and nicotine-free solutions.

The researchers monitored cell viability, apoptosis and necrosis. Macrophage function was assessed by measuring reactive oxygen species (ROS) and inflammatory chemical signal production. Phagocytic uptake was also assessed.

- **Key findings**

  Both e-cigarette vapour condensate (ECVC)and nicotine-free e-cigarette vapour condensate (nfECVC) produced significant reductions in cell viability compared to untreated controls, following exposure to 0.8% vapour condensate for 24 hours (18.2% viable, $p<0.001$ and 62.8% viable $P<0.0001$, respectively). The effect of ECVC on cell viability was greater than the effect of e-cigarette liquid.

  Cell ROS and inflammatory chemical signal production were increased following sub-lethal doses of ECVC/nfECVC, compared to untreated controls. There was no difference between ECVC and nfECVC in induction of ROS, but ECVC induced significantly more inflammatory chemical signals compared to nfECVC.

  Phagocytic uptake of bioparticles was reduced after exposure to both ECVC and nfECVC in comparison to untreated controls (both $p<0.0001$), with more inhibition with by nfECVC.

- **Limitations**

  Studies in cells aren't able to assess real-world exposure to e-cigarette vapour and actual harms, but provide a basis for potential mechanisms of harm.

  No comparisons to tobacco smoke were made to benchmark the harms of e-cigarette vapour.

  There was no validation of the system producing e-cigarette vapour condensate. The concentrations and volume of vapour condensate that cells were exposed to are therefore not easily comparable to real-world consumption of e-cigarette vapour, and may not represent actual use.

  The nicotine concentration of e-cigarette liquid used was higher than allowed by EU limits, so may not reflect real world conditions.

  Only one type of e-cigarette was used for vapour production and tested.

Scott, A., Lugg, S.T., Aldridge, K., et al. Pro-inflammatory effects of e-cigarette vapour condensate on human alveolar macrophages Thorax Published Online First: 13 August 2018. doi: 10.1136/thoraxjnl-2018-211663

6. E-cigarette usage is associated with increased past 12 month quit attempts and successful smoking cessation in two U.S. population-based surveys.

- **Study aims**

  This study aimed to examine trends in quit attempts and smoking cessation over time. It used the results of two US based nationally representative surveys: 26,354 respondents from the National Health Interview Survey (NIHS) and 33,627 from the Tobacco Use Supplement to the Current Population Survey (TUS-CPS). For the most recent survey years, the researchers also examined the association between e-cigarette use, quit attempts and smoking cessation.

- **Key findings**

  The proportion of quit attempts among current smokers increased over time in both datasets (NIHS 49.9% in 2006 to 58.0% in 2016, TUS-CPS 38.6% in 2006-2007 to 46.3% in 2014-2015).

  The odds of past 12 month smoking cessation among recent smokers were significantly greater in the most recent survey years compared to 2006-2007 (NIHS OR=1.89 95%CI 1.38-2.59, TUS-CPS OR=1.24 95%CI 1.15-1.34), after adjusting for sex, age, ethnicity, education, employment status, region and household income.

  In the NIHS, the number of past 12 month quit attempts was significantly higher among current e-cigarette users compared to non-users (OR=2.29 95%CI 1.87-2.81, p<0.0001). And in the TUS-CPS there was also a significant interaction between quit attempts, smoking frequency and current e-cigarette use (p<0.0001). Both some-day and every-day smokers who use e-cigarettes were more likely to make a quit attempt, with every-day smokers who use e-cigarettes the most likely to try and quit.

  In the NIHS, past 12 month smoking cessation was significantly higher among e-cigarette users compared to non-users (OR=1.64 95%CI 1.21-2.21, p<0.001). In the TUS-CPS, among every-day smokers, current e-cigarette use was associated with increased past 12 month quit attempts (67.1% vs 42.2%) and successful cessation (10.6% vs 5%), compared to non-users.

- **Limitations**

  This data is cross-sectional. Therefore, it cannot draw any conclusions about the causal relationship of e-cigarette use, quit attempts and smoking cessation.

  Data on e-cigarette use was only available for one survey year, and only looked at current product use. Therefore, the effect of patterns of e-cigarette use on quit attempts and smoking cessation over time could not be considered.

  This study did not consider dual use patterns, frequency of use or past e-cigarette use which may have influenced the associations observed. They also did not consider the reasons for e-cig use and whether individuals were using their e-cigarette to quit.

  This study didn't consider the impact of other things which could have driven significant changes in quit attempts and cessation between years, such as public health campaigns or price differences.

  This study didn't control for all possible confounders that could affect results, such as nicotine addiction. Therefore, this study may be vulnerable to confounding.

  This survey relied on self-reported data and this could be subject to bias.

Linda Johnson, Yinjiao Ma, Sherri L Fisher, Alex T Ramsey, Li-Shiun Chen, Sarah M Hartz, Robert C Culverhouse, Richard A Grucza, Nancy L Saccone, Timothy B Baker, Laura J Bierut; (2018) E-cigarette Usage Is Associated With Increased Past-12-Month Quit Attempts and Successful Smoking Cessation in Two US Population–Based Surveys, *Nicotine & Tobacco Research*, nty211, doi.org/10.1093/ntr/nty211

Overview

This bulletin covers the months of September and October 2018 so we have included six papers: three from the UK, two from the USA and one paper reporting results from a survey in 28 European countries.

The first paper uses data from the CRUK funded smoking toolkit study in England to examine socio-economic status (SES) differences in e-cigarette use. Earlier research in both the UK and the USA had suggested that vaping products are more likely to be used by more affluent smokers, which could increase tobacco-related inequalities in health if used successfully for smoking cessation. The paper examined toolkit data from 2014-2017 using social grade as a measure of SES. Examining the period a whole, lower social grade recent smokers were less likely to have used an e-cigarette than more affluent smokers. However, this changed through time and by 2017, use of an e-cigarette was similar across all social grades. Use during a quit attempt was also similar across social grades. Overall the paper suggests that differences in vaping among smokers by SES, including for smoking cessation, have narrowed in England. The study also found that among long term ex-smokers, lower social grade smokers were more likely to be vaping. The authors suggested that this may suggest a pattern of higher SES smokers using e-cigarettes for a shorter period when stopping smoking but less affluent groups continuing to use them for longer. As previous research has found that lower SES smokers may have higher levels of nicotine dependence, this longer term use may reflect continued vaping for relapse prevention, an issue that could be examined in future research.

Our second paper this month aims to examine any association between e-cigarette use and heart attacks. Data were drawn from a representative sample of the adult population in the USA (the National Health Interview Survey) in two separate years, 2014 and 2016. The researchers looked at different measures of e-cigarette use and conducted statistical modelling to examine whether there was a possible link with myocardial infarction (MI-a heart attack) after controlling for other factors that might explain an association. They found that daily vaping (and daily smoking) was associated with increased odds of having a heart attack but this relationship was not apparent for less frequent vaping, in contrast to former or occasional smoking which was linked to increased odds of a heart attack. Because the data were cross-sectional, the study couldn't confirm that e-cigarette use caused heart attacks. In addition, the question asked was about ever having a heart attack and therefore the MI could have occurred before participants were vaping or even, as the authors acknowledge, before e-cigarettes became available on the US market.

The third paper reports findings from the 2016 CRUK funded ASH Smokefree Great Britain Youth Survey of 11-18 year olds in England, Scotland and Wales. It focused on harm perceptions of e-cigarettes relative to smoking. Participants were asked if they thought e-cigarettes were more or less harmful to the person using them compared to smoking. The researchers divided responses into two main categories - less harmful (an accurate perception) or other responses (about the same, more harmful or don't know). They also asked how much of the harm from smoking comes from nicotine and divided responses into 'none or very small' (accurate perception) or otherwise. 63% of young people had accurate harm perceptions of vaping relative to smoking. In contrast, only 9% had accurate harm perceptions about nicotine. Older teens (14+) those who had tried an e-cigarette or used it sometimes, had a family member who vaped and who perceived public disapproval of smoking/approval of vaping were more likely to have accurate harm perceptions of e-cigarettes relative to smoking. Those aged 16+, who had smokers in their family and had accurate e-cigarette harm perceptions were more likely to respond that none or very small risks came from nicotine in cigarettes relative to other constituents. The findings relating to e-cigarette harms in this study are

similar to those found for adults in related research. The findings on nicotine are new, as this question has not been asked of young people before in published studies from the UK.

This month's fourth paper examines e-cigarette use among adults aged 15+ in 28 European countries, using data from the 2014 and 2017 Eurobarometer survey. The authors were interested in examining changes between those two years. The survey quantifies the number of ever or regular (defined as daily or weekly) vapers. Ever use of e-cigarettes rose from 11.6% of adults in 2014 to 11.6% in 2017, equivalent to 63 million people. Regular use rose from 1.5% in 2014 to 1.8% in 2017, equivalent to 7.6 million people. The authors examined participant characteristics related to becoming a regular user by 2017. Transition from ever to regular use was much more common in current (27%) and former (41%) smokers than never smokers (12.8%). Becoming a regular user was less likely among younger survey respondents (15-24 year olds) which is consistent with studies in some individual EU countries including the UK. Differences by country were also reported. Regular use was highest in the UK (4.7%) followed by France (3.7%) and lowest in Italy and Bulgaria (both 0.2%). These differences don't appear to be directly related to the number of smokers in different countries, as EU member states with high smoking rates did not have higher proportions of e-cigarette users. Instead, they are likely to be linked to the regulatory environment, as the authors acknowledge. While policies on some aspects of e-cigarette policy are common across Europe (via the EU Tobacco Products Directive), member states have been free to add their own additional regulations. Both France and the UK have adopted pro-harm reduction policies supportive of vaping for smoking cessation, whereas others have not, with key differences such as higher taxes on vaping in Italy, for example.

Our fifth paper examined how cells from human lungs reacted to being exposed to e-cigarette liquid and vapour in order to assess whether it might be damaging. The study, funded by the British Lung Foundation, involved a series of experiments. In particular, it involved creating e-cigarette vapour condensate in a lab setting. Cells were taken from the lung tissue of eight healthy non-smokers and divided into three groups. One group of cells remained untreated, another was exposed to e-cigarette fluid and the final group to e-cigarette vapour condensate. Both un-vaped liquid and vapour condensate were toxic to cells and showed a dose-response relationship on cell viability. Interestingly the condensate produced greater reductions in cell viability than the un-vaped liquid, suggesting that the vaping process could increase toxicity. The researchers were particularly interested in macrophages in cells, which normally act to remove bacteria and other particles. When cells were exposed to e-cigarette vapour condensate at a level that didn't kill them, these macrophages were affected by the vapour in ways that could increase inflammation and affect the ability of lung cells to fight infections. These findings may suggest that vaping could affect lung function and could result in biological changes that might lead to future diseases such as COPD. What the researchers couldn't assess was how similar the vapour they produced in their experiment was to that inhaled by e-cigarette users, particularly as the vapour they created contained nicotine at much higher levels than permitted in the EU. They also didn't compare how cells responded to cigarette smoke compared with e-cigarette vapour. The same team now plan a series of future studies to examine some of these issues.

Finally we include the latest paper examining trends in quit attempts and smoking cessation in the USA in the context of e-cigarette use. It involved analysis of two national surveys - the National Health Interview Survey from 2006-2016 and the TUS-CPS survey from 2006-2015. The sample comprised 25-44 year olds. At first glance this appears a rather arbitrary age range but the authors justify this decision in the methods section of their paper (i.e. removing younger groups who may still be experimenting with smoking, and older groups whose smoking status may be affected by health conditions). The study found that both quit attempts and rates of smoking cessation had

increased from 2014 to 2016 compared with 2006. In both surveys, current e-cigarette use was related to more quit attempts in the past year, and with higher rates of smoking cessation. These results were particularly marked among those who smoked every day. Findings are consistent with other recent research that found population-level rates of smoking cessation had increased in the USA in recent years when e-cigarettes became more popular. However, as all the data in the study were cross-sectional they couldn't account for other factors that might have contributed to increased quit attempts or smoking cessation, including the use of other aids to stop smoking or wider tobacco control policies that may have been put in place during the period covered by the analysis.

Other studies from the last months that you may find of interest:

- The influence of three e-cigarette models on indoor fine and ultrafine particulate matter concentrations under real-world conditions.
- Understanding susceptibility to e-cigarettes: A comprehensive model of risk factors that influence the transition from non-susceptible to susceptible among e-cigarette naïve adolescents.
- Rates of electronic cigarette use among adults with a chronic mental illness.
- Oxidative stress responses in human bronchial epithelial cells exposed to cigarette smoke and vapor from tobacco- and nicotine-containing products.
- Electronic nicotine delivery systems (e-cigarettes) as a smoking cessation aid: A survey among pharmacy staff in Queensland, Australia.
- "Technophilia": A new risk factor for electronic cigarette use among early adolescents?
- Influence of puffing conditions on the carbonyl composition of e-cigarette aerosols.
- Electronic cigarette explosion and burn injuries, US Emergency Departments 2015-2017.
- Clinical peri-implant parameters and inflammatory cytokine profile among smokers of cigarette, e-cigarette, and waterpipe.
- Health risk perceptions and reasons for use of tobacco products among clients in addictions treatment.
- Biomarkers of exposure among "dual users" of tobacco cigarettes and electronic cigarettes in Canada.
- Biomarkers of Tobacco Exposure Decrease After Smokers Switch to an E-Cigarette or Nicotine Gum.
- Adolescent Use of Different E-cigarette Products.
- About One in Five Novice Vapers Buying Their First E-Cigarette in a Vape Shop Are Smoking Abstinent after Six Months.
- Health effects in COPD smokers who switch to electronic cigarettes: a retrospective-prospective 3-year follow-up.
- Reactive Oxygen Species Emissions from Supra- and Sub-Ohm Electronic Cigarettes.

Cariogenic potential of sweet flavors in electronic-cigarette liquids.

Differences in use of electronic nicotine delivery systems by smoking status and demographic characteristics among Australian young adults.

Knowledge and Perceptions of E-cigarettes and the Motivations for their Use: Talking to Smokers (E-cigarettes and/or Conventional Cigarettes) and Non-smokers in Puerto Rico.

Qualitative and Sensitivity Analysis of the Effect of Electronic Cigarettes on Smoking Cessation

E-Cigarette Use in a Country With Prevalent Tobacco Smoking: A Population-Based Study in Taiwan.

Worry, anxiety sensitivity, and electronic cigarettes among adults.

The relationship between cigarettes and electronic cigarettes: Evidence from household panel data.

The social patterning of electronic nicotine delivery system use among US adults.

Prevalence and Distribution of E-Cigarette Use Among U.S. Adults: Behavioral Risk Factor Surveillance System, 2016.

Reduced-Risk Warnings versus the U.S. FDA-Mandated Addiction Warning: The Effects of E-Cigarette Warning Variations on Health Risk Perceptions.

Prospective predictors of flavored e-cigarette use: A one-year longitudinal study of young adults in the U.S.

Racial/Ethnic Disparities in Tobacco Product Use Among Middle and High School Students - United States, 2014-2017.

Electronic cigarette chemicals transfer from a vape shop to a nearby business in a multiple-tenant retail building.

Influence of Coil Power Ranges on the E-Liquid Consumption in Vaping Devices.

Electronic cigarette use in New South Wales, Australia: reasons for use, place of purchase and use in enclosed and outdoor places.

Trends in Unit Sales of Flavored and Menthol Electronic Cigarettes in the United States, 2012-2016.

Intergenerational transmission of nicotine within families: Have e-cigarettes influenced passive smoking?

Measurement and predictive value of susceptibility to cigarettes, e-cigarettes, cigars, and hookah among Texas adolescents.

Use of flavored electronic cigarette refill liquids among adults and youth in the US-Results from Wave 2 of the Population Assessment of Tobacco and Health Study (2014-2015).

Effectiveness and safety of electronic cigarettes among sole and dual user vapers in Kuantan and Pekan, Malaysia: a six-month observational study.

The need to educate future dental professionals on E-cigarette effects.

Polytobacco Use Among a Nationally Representative Sample of Adolescent and Young Adult E-Cigarette Users.

Gas/Particle Partitioning Constants of Nicotine, Selected Toxicants, and Flavor Chemicals in Solutions of 50/50 Propylene Glycol/Glycerol As Used in Electronic Cigarettes.

Understanding Users' Vaping Experiences from Social Media: Initial Study Using Sentiment Opinion Summarization Techniques.

A Stability Indicating HPLC Method to Determine Actual Content and Stability of Nicotine within Electronic Cigarette Liquids.

Testing messages about comparative risk of electronic cigarettes and combusted cigarettes.

Evaluation of E-Vapor Nicotine and Nicotyrine Concentrations under Various E-Liquid Compositions, Device Settings, and Vaping Topographies.

Polytobacco Use and Nicotine Dependence Symptoms Among US Adults, 2012–2014

Smokers' risk perceptions and misperceptions of cigarettes, e-cigarettes and nicotine replacement therapies.

Delay discounting and e-cigarette use: An investigation in current, former, and never cigarette smokers.

Electronic Cigarette Use and Risk of Harmful Alcohol Consumption in the U.S. Population.

Oxidative stress responses in human bronchial epithelial cells exposed to cigarette smoke and vapor from tobacco- and nicotine-containing products.

Association between stages of change for smoking cessation and electronic cigarette use among adult smokers: A nationwide cross-sectional study in Korea

Use of social networking sites, electronic cigarettes, and waterpipes among adolescents.

Intersection of e-cigarette use and gender on transitions in cigarette smoking status: Findings across waves 1 and 2 of the Population Assessment of Tobacco and Health (PATH) study.

E-cigarette product preferences among Australian young adult e-cigarette users.

Latent Class Analysis to Examine Patterns of Smoking and Other Tobacco Products in Young Adult Bar Patrons.

The decline of cigarette smoking among adolescents and young adults in Germany and the rising relevance of waterpipes, e‐cigarettes and e‐hookahs

Physical characterization of the aerosol of an electronic cigarette: impact of refill liquids.

Patterns of awareness and use of electronic cigarettes in Mexico, a middle-income country that bans them: Results from a 2016 national survey.

Psychosocial and Behavioral Risk Profiles of Cigarette Smokers and E-Cigarette Users Among Adolescents in Minnesota: The 2016 Minnesota Student Survey.

Biomarkers of exposure specific to e-vapor products based on stable-isotope labeled ingredients.

Disentangling Within- and Between-Person Effects of Shared Risk Factors on E-cigarette and Cigarette Use Trajectories From Late Adolescence to Young Adulthood.

Environmental tobacco smoke exposure among electronic cigarette users.

E-cigarettes versus nicotine patches for perioperative smoking cessation: a pilot randomized trial

Environmental Electronic Vape Exposure from Four Different Generations of Electronic Cigarettes: Airborne Particulate Matter Levels

E-cigarettes: Perceived harmfulness and use for smoking cessation

E-cigarettes and heat-not-burn products: representative data on consumer behaviour and associated factors in the German population (the DEBRA study).

Electronic Cigarette Sales in the United States, 2013-2017

Electronic Nicotine Delivery System (ENDS) Use in Relation to Mental Health Conditions, Past-Month Serious Psychological Distress, and Cigarette Smoking Status, 2017.

Electronic Cigarette Use and Attempts to Quit Smoking Cigarettes Among Adolescents in Taiwan.

E-Cigarette Use Without a History of Combustible Cigarette Smoking Among U.S. Adults: Behavioral Risk Factor Surveillance System, 2016

An epidemiologic and clinical description of e-cigarette toxicity.

Proinflammatory cytokine levels and peri-implant parameters among cigarette smokers, individuals vaping electronic cigarettes and non-smokers.

The association between perceived e-cigarette and nicotine addictiveness, information-seeking, and e-cigarette trial among U.S. adults.

Association of pleasant sensations at cigarette smoking initiation with subsequent tobacco product use among U.S. adolescents

Search strategy

The Pubmed database is searched in the middle of each month, for the previous month using the following search terms: e-cigarette*[title/abstract] OR electronic cigarette*[title/abstract] OR e-cig[title/abstract] OR (nicotine AND (vaporizer OR vaping OR vapourizer OR vaporiser OR vapouriser))

Based on the titles and abstracts new studies on e-cigarettes that may be relevant to health, the UK and the UKECRF key questions are identified. Only peer-reviewed primary studies and systematic reviews are included – commentaries will not be included. Please note studies funded by the tobacco industry will be excluded.

This briefing is produced by Sophia Lowes from Cancer Research UK with assistance from Professor Linda Bauld at the University of Stirling and the UK Centre for Tobacco and Alcohol Studies, primarily for the benefit of attendees of the CRUK & PHE UK E-Cigarette Research Forum. If you wish to circulate to external parties, do not make any alterations to the contents and provide a full acknowledgement. Kindly note Cancer Research UK cannot be responsible for the contents once externally circulated.