E-cigarettes in pregnancy: Reducing or introducing harm?

Jaydene Weighall and Dr Susan Wilbraham

University of Cumbria

Abstract

Electronic cigarettes use has become increasingly prevalent with around 17.6% of population using these products. The serious harm to health caused by cigarette smoke is well publicised, and government advice has promoted the message that e-cigarettes are 95% safer; however e-cigarettes are not risk free. Given the high prevalence of e-cigarette usage, pregnant women are likely to look to midwives for guidance on whether e-cigarettes are safe, however advice to midwives is inconsistent. The current paper therefore explores whether e-cigarettes are suitable for pregnant women who want an alternative to traditional cigarettes. There is a paucity of evidence to confirm the long-term impact of e-cigarettes in pregnancy but research indicates that their expose users to a number of harmful substances. Nicotine and other chemicals including Diacetyl, Acetoin and 2,3-Pentanedione are detrimental to the health of both mother and child. Harm reduction methods aim to improve the health of individuals with an addiction where abstinence is not a feasible goal; this means that in the first instance pregnant women should be advised to quit smoking and avoid products containing nicotine. If women are unable to abstain from smoking, traditional nicotine replacement therapies (NRT) such as gums and patches are likely to be safer than e-cigarettes. E-cigarettes contain a greater number of harmful chemicals and are likely to provide a greater dose of nicotine.

Keywords: Pregnancy, e-cigarettes, smoking, review. health psychology

Weighall, J. & Wilbraham, S. (2016) E-Cigarettes in pregnancy: Reducing or introducing harm? *Journal of Applied Psychology and Social Science, 2* (2), 134-154

Electronic cigarettes (also referred to as e-cigarettes, e-cigs and vaporisers) are a relatively new product within the United Kingdom, becoming available in 2003 in China, but growing in popularity across the world since 2012. Electronic cigarettes were designed to imitate cigarettes aesthetically and provide a similar experience to smoking but without the smoke, although second and third generation e-cigarettes no longer resemble cigarettes (Marketline, 2014). Usually e-cigarettes work by using a battery to heat up a vaporiser, this in turn heats the liquid in the attached cartridge, which contains both flavouring and nicotine. Users can select flavours they enjoy and the strength of nicotine they like, and third generation devices now allow users to change the voltage linked to the atomiser in order to change the strength of vapour delivery (McRobbie, 2014).

The number of users of e-cigarettes is increasing rapidly (Brown et al., 2014a; Dockrell, Morison, Bauld & McNeill, 2014; King, Patel, Nguyen, & Dube, 2014) and a 2014 survey reported that 17.6% of respondents were users of these products (Action on Smoking and Health [ASH], 2015). The high prevalence of e-cigarette use may in part be due to advertisement of the products, along with (historic) lack of regulation. The number of brands and flavours of e-cigarette liquid available is also rising rapidly, and it was estimated in 2014 that there were 460 brands and 7700 flavours available (Zhu et al., 2014). Access to e-cigarettes is relatively easy, especially when buying online (Bauld, Angus & Andrade, 2014), and given the high prevalence of e-cigarette use it is essential that the impact of these products on public health is understood.

The serious harm to health caused by smoking cigarettes is well documented, with around half of all lifetime smokers dying prematurely (Doll, Peto, Boreham, & Sutherland, 2005). Cigarette smoke is known to be extremely toxic (Hoffmann, Hoffmann, & El-Bayoumy, 2001) and exposure to smoke in pregnancy is associated with high rates of long and short term morbidity and mortality, with the harmful effect of smoking on the child

becoming apparent at various times in their life (Mund, Louwen, Klingelhoefer, & Gerber, 2013). Harm for the unborn child from smoking includes; low birth weight, increased risk of premature birth, and damage to the placenta. Furthermore, smoking in pregnancy can lead to child abnormalities, including issues with neurological and body development (Cope, 2014).

The message of the serious harm caused by smoking is prominent in antismoking health campaigns, however in comparison, the risks associated with e-cigarette use are not well publicised. This lack of information may be leading to confusion over the safety of the devices (Brown et al., 2014a). One study asked participants about the contents of e-cigarette liquid and over half were unaware of the ingredients other than nicotine (Coleman et al., 2016). Consumers should be aware of the comparative risks so they can make an informed choice: estimates suggest that e-cigarette use is 95% safer than smoking (Public Health England, 2016) due to the removal of smoke and thus the reduction of chemicals such as tar and carbon monoxide (McKwen, 2015). However, estimates of comparative safety against a product that is extremely harmful do not demonstrate that e-cigarettes are safe.

Since May 2016, e-cigarettes have been regulated under the revised EU Tobacco Products Directive (TPD), with a transition period of a year within which manufacturers must become compliant. The regulations aim to increase e-cigarette safety across the EU and will require warnings on packets about the addictive nature of nicotine. Regulations will additionally limit the nicotine strength of liquids to 20mg/ml, restrict advertising, and will prohibit the promotion of the message that e-cigarettes are a quitting aid for smokers. The TPD will also require that manufacturers notify the government about the ingredients in e-cigarette liquid and demonstrate that these ingredients meet reasonable safety standards. It is hoped that by introducing these standards, some of the 9 million smokers in the UK will switch to e-cigarettes and thus reduce their risk of harm (ASH, 2016). Because the population of smokers would be at comparatively lower risk if they switched to e-cigarettes, the risks

associated with e-cigarettes are not promoted in health campaigns. This means that smokers and e-cigarette users may be unable to make an informed choice.

Reports highlight the lack of long-term research evidence to confirm exactly what risks e-cigarettes pose. Furthermore, there is a lack of public health information explaining the risks of e-cigarette use to expectant mothers. Pregnant women are a group who are particularly conscious of health messages, and are therefore more likely than other groups to want to try a safer alternative to smoking (McRobbie, 2014; Walton et al., 2015). The lack of empirical evidence supporting the long-term safety of e-cigarettes means that pregnant women may be putting themselves and their child at risk, although they may be unaware of these risks. For example, a participant in a recent study responded, "It's not smoke. It's not tar. It's not 4000 chemicals. Case Closed" (Coleman et al., 2016).

The impact of e-cigarettes is an emerging research area so there is insufficient evidence to conclude about long-term safety. Internationally, due to the potential for harm and lack of knowledge around e-cigarettes some countries such as Belgium and Denmark, have banned the products and removed them from the consumer market. Elsewhere countries have banned the advertising of e-cigarettes (such as the Netherlands); while in contrast others have endorsed e-cigarettes as a product for medical purposes (Cervellati et al., 2014). Under the EU TPD manufacturers can apply for their e-cigarettes to be licensed by the MHRA as a medicine. Although to date one licence has been granted in the UK (to a product called E-voke) this product is not yet on sale or available on prescription.

Given the high prevalence of e-cigarette usage, pregnant women are likely to look to midwives for guidance on whether these products are safe. In particular, it is important for midwives to know whether e-cigarettes can be considered a safe alternative to smoking tobacco products (Pisinger & Dossing, 2014). Due to the unknown impact and lack of safety

information surrounding e-cigarettes, some authors have recommended midwives not to advise or encourage the use of e-cigarettes (e.g. Chenery-Morris, Passmore & Muscat, 2015). However, this message is not consistent: the National Centre of Smoking Cessation and Training (NCSCT) have been working with Public Health England to establish a coherent approach to e-cigarettes for professionals to follow. They advise professionals to be 'open' to the use of e-cigarettes and praise pregnant women that are using e-cigarettes solely (McKwen, 2015). The NCSCT argue that pregnant women who use e-cigarettes in replacement of cigarettes should be supported and encouraged to do so, they propose that e-cigarette use reduces chemical intake and exposure to carbon monoxide thus reducing the potential harm to the baby.

The National Institute of Clinical Excellence (NICE) also endorse a harm reduction method and support the use of licenced nicotine replacement products, for example nicotine patches or gum (NICE, 2013). Pregnant women may look at this as an endorsement of nicotine replacement therapy (NRT), and therefore conclude that such products are suitable or safe for use. Other agencies such as the Centre for Disease Control and Prevention (CDC) provide a much clearer statement; that nicotine is a reproductive toxicant that is detrimental to fetal brain development. Further, they assert that pregnant women should avoid smoking, and nicotine containing products such as e-cigarettes (CDC, 2016). It is unlikely that pregnant women would see such a declaration and conclude that e-cigarettes are harmless. Women should be informed that nicotine crosses the placenta and can lead to developmental problems prenatally and harm to the foetus (Ernst, Moolchan & Robinson, 2001) and is associated with low birthweights and preterm delivery (Gaither, Huber, Thompson & Huet-Hudson, 2009). Exposure to nicotine is also associated with developmental problems in childhood including an impairment of cognitive function (Dwyer et al., 2009).

Understanding Harm Reduction

Harm reduction is a strategy aimed at improving the health of individuals with an addiction for whom abstinence is not feasible goal (Leslie, 2008). In the case of smoking, harm reduction may involve promoting the reduction of the number of cigarettes smoked during a day or using an alternative method to deliver the nicotine to which the individual is addicted, for example, by using nicotine patches (Logan & Marlatt, 2010). In order to determine whether e-cigarettes are a suitable form of harm reduction, there is a need to assess whether abstinence is a feasible goal for each woman.

Smoking statistics reveal that the number of women smoking in pregnancy is declining. Results from the Infant Feeding Survey (2010) revealed that 26% of women were smoking shortly before pregnancy or during pregnancy (a decrease of 7% since 2005); however, just over half of these women managed to quit before they gave birth with 12% continuing to smoke throughout their pregnancy. The decreasing number of women who smoke in pregnancy is likely to be a result of increased public knowledge of the harmful effects of cigarettes on the foetus, but may also be a result of women responding to social pressure to quit smoking. Overall, these figures suggest that abstinence is a reasonable goal for many of the women who smoke at the outset of pregnancy.

Pregnant women are advised to quit smoking from the beginning of their pregnancy and midwives may recommend that expectant mothers use NRTs such as gum or patches, while monitoring their carbon monoxide levels as an indicator of abstinence success (McKwen, 2015). When NRTs are effective in allowing smokers to reduce their tobacco usage, it is predictive of positive health outcomes (compared to those for smokers) including increased baby birthweight (Walton et al., 2015). However, there is limited evidence that NRTs are successful in the long term. Many mothers restart smoking after the birth of their child (Cope, 2014); this is likely to be because NRTs maintains a user's reliance on nicotine.

Therefore, NRTs should only be endorsed after a woman has tried to stop smoking using will power alone.

The harm of e-cigarettes to pregnant women

Pregnant women should be reminded that nicotine is an addictive element present in e-cigarettes, tobacco products and NRTs. The aim of e-cigarettes originally was to reduce the nicotine intake and harmful chemicals; however, the development of e-cigarettes has led to an increase in nicotine delivery in the newer generations of these devices. This means that users are able to maximize nicotine delivery by altering their voltage on them and using e-cigarettes more frequently (Vansickel & Eissenberg, 2013); the impact of this is that exposure may be greater and addiction to nicotine may become more intense.

Second hand smoking is a well-documented harm to public health; comparatively e-cigarettes produce lower levels of nicotine compared to cigarettes, producing neither tar, nor carbon monoxide. However, the vapours emitted from an e-cigarette are still potentially harmful (Britton & Bogdanovica, 2014). Carbonyls are emitted from e-cigarettes, and although levels are reduced through second hand exposure (Bekki et al., 2011) research has reported that passive exposure to e-cigarettes for one hour produced similar levels of serum cotinine compare to exposure of tobacco cigarettes (Flouris et al., 2013). Cotinine is a by-product of nicotine when absorbed and broken down, it is present in tobacco smoke; those who are exposed to smoke have raised cotinine levels (CDC, 2013). Research has revealed that e-cigarette exposure is associated with lower birthweight and high cotinine levels. Furthermore, research suggests that toxins within e-cigarettes could be transferred to infants by breastmilk, thus posing an additional risk to health (McGrath-Morrow et al., 2015).

In addition to the harm e-cigarettes cause in normal intended usage, it is also important to highlight that they constitute an unnecessary environmental hazard. Exposure to

e-cigarette fluid often occurs unintentionally; just under half of cases reported at one poison centre system in America were under 5 year olds. Moreover, e-cigarette cartridges present a risk as a choke hazard. Other environmental concerns include the risk of fire, and cases have included reports of an e-cigarette exploding and leaving a 3-year-old with significant burns (Garbutt et al., 2015). Overall, poison centres are receiving increased call volume in relation to e-cigarettes, going from one enquiry a month to 215 enquiries a month in the space of four years. Ingestion is the main form of exposure for young children, with inhalation and skin absorption closely following.

The introduction of the e-cigarette has presented an alternative to traditional NRT products; however, unlike other forms of NRTs they expose the user to a number of additional ingredients that are harmful to the health of both mother and child. It can be argued that nicotine is not the ingredient in cigarettes which causes most harm, but rather it is tar and carbon monoxide (McKwen, 2015). In a similar way the toxicity of e-cigarettes might be considered not to come from the nicotine but from the number and strength of chemicals which flavour the e-cigarette liquid (Bahl et al., 2012).

A review of the available research reported that the inhalation of e-cigarette fluid exposes users to a range of chemicals including carbonyl compounds, aldehydes, fine particulate matter, metals, propylene glycol, formaldehyde, VOCs and other additives (Allen et al., 2016). Propylene Glycol and Glycerol are the main chemicals found in e-cigarettes liquid; substances that contain glycerol have been found to produce acrolein when heated and this is known to be harmful to the lungs when inhaled (Stevens & Maier, 2008). Research has also identified the presence of a chemical called diacetyl in e-cigarette fluid (found in flavourings such as fruit, candy and cocktail). This chemical is associated with a disease commonly referred to as ‘popcorn lung’ after the serious lung condition (bronchiolitis obliterans) was found to be prevalent in microwave popcorn workers (Barrington-Trimis,

Samet & McConnell, 2014). A recent study found that Diacetyl, acetoin and 2,3-pentanedione (a structurally related replacement for diacetyl) were collectively present in 92% of the e-cigarette fluids samples tested (Allen et al., 2016).

Overall, assessing the risk posed by e-cigarettes is problematic because there are a large number of e-cigarette products on the market. Differing levels of ingredients in each product is likely to impact on the risk posed by each (Coleman et al., 2016). Therefore, while some authors consider e-cigarettes use to be a harm reduction strategy, others discuss whether e-cigarettes in fact introduce harm. E-cigarettes may be introducing exposure to new chemicals, normalising smoking, and creating new health problems for public health to consider, rather than providing harm reduction (Rennie, Bazillier-Bruneau & Rouss, 2016).

What are the benefits of e-cigarettes?

The NCSCT highlight evidence to support e-cigarettes as a smoking cessation aid, specifically the switching from using cigarettes to e-cigarette (McEwan & McRobbie, 2016). Data from NHS stop smoking services reveal that four week self-reported quit rates were 66% for those given nicotine containing products (e-cigarettes) compared to 48% of those given an NRT (NHS digital, 2016). Furthermore, a longitudinal study has reported that reduction in number of cigarettes smoked per day was significantly greater for users of e-cigarettes compared to nonusers (Grana, Benowitz, & Glantz, 2014); although this study also found that current e-cigarette use was not statistically predictive of cigarette cessation at one year follow up. Nicotine free e-cigarettes have also been introduced to the market providing a product designed to help users reduce their dependence on nicotine and ultimately stop smoking cigarettes or e-cigarettes (Ferrari et al., 2015). However, early research has shown a poor quit rate with these products (Bullen et al., 2013).

One major benefit of e-cigarettes is the cost reduction both to the user and to the NHS. The lack of regulations has meant e-cigarettes are not under the same legislation as tobacco cigarettes and therefore the untaxed price has remained low (although this may be considered problematic as a higher price might be a barrier to uptake of the habit, particularly in teenagers). Furthermore, the government spent approximately £1.8 million between 2013/2014 on prescriptions to help individuals who smoked in England to quit (Health and Information Centre, 2015). At present e-cigarettes are not available on prescription, therefore the consumer is accepting the cost of the product rather than the UK taxpayer.

Evaluating the evidence

Overall, there is a lack of long-term evidence of the impact of e-cigarettes on health compared to cigarettes. However, consumers should remember that amount of evidence is not an indicator of strength of evidence; there is comparatively little evidence relating to the long-term harm of e-cigarettes but this does not demonstrate product safety. Furthermore, true evaluation of e-cigarette safety has been hampered by the presence of biased research groups or individuals. Research evidence relating to e-cigarette safety may often be funded by manufacturers; one systematic review of e-cigarette safety reported that 34% of reviewed articles demonstrated a conflict of interest (Pisinger & Dossing, 2014). Moreover, given the damage to sales that health concerns could produce, it is likely that publication biases will be common with research being supressed where it does not demonstrate product safety. Therefore, published research may not represent the true risk of e-cigarettes.

Research testing on humans poses ethical issues, and research testing the impact of e-cigarettes on pregnant women will never take place because this would be exposing participants to unnecessary risk. Although, there is some evidence which has identified potential harmful effects of e-cigarettes, the lack of reliable and unbiased evidence means that

neither healthcare workers nor general public have a full understanding of the impact of these products (McKee & Capewell, 2015). Therefore, an informed decision for the future regarding e-cigarettes and their use for the public and pregnant women cannot be made yet by professionals.

Risks associated with e-cigarettes may take years to become apparent so despite the suggestion that e-cigarettes are potentially a positive method for reducing the prevalence of smoking (Baeza-Loya et al., 2014), this claim cannot be upheld. Just as it took years for the harm associated with tobacco to become apparent, it is likely to take many years before the safety or harm of e-cigarettes will be truly known (Walton et al., 2015). Safety cannot be assured, and therefore advice to use e-cigarettes is likely to create anxiety in both mothers and midwives over whether they are exposing unborn children to an avoidable risk (Cervellati et al., 2014). Therefore the best advice that can be given to pregnant women is that they should quit smoking and avoid e-cigarettes.

Key considerations for midwives:

For the majority of women abstinence is a reasonable goal and should therefore be recommended. If pregnant women quit smoking and avoid secondary smoke there is no risk. If pregnant women do not smoke e-cigarettes and avoid secondary exposure to vapours, then there is no risk. Women should be advised to quit without using NRTs or e-cigarettes, and only if they are unable to abstain should such products be considered. In this instance, traditional NRTs such as gums and patches are likely to be safer than e-cigarettes as e-cigarettes contain a greater number of harmful chemicals and are likely to provide a greater dose of nicotine. In conclusion, the available evidence suggests that the risks of e-cigarette

use in pregnancy are unnecessary and avoidable, and that until the long-term safety of e-cigarettes can be demonstrated, use in pregnancy must be approached with caution.

References

Action on Smoking and Health (ASH). (2015). *The economics of tobacco.* Retrieved from:: http://www.ash.org.uk/files/documents/ASH_121.pdf

Action on Smoking and Health (ASH). (2015). *Use of electronic cigarettes (vapourisers) among adults in Great Britain*. Retrieved from: http://www.ash.org.uk/files/documents/ASH_891.pdf

Action on Smoking and Health (ASH). (2016). ASH briefing: The impact of the EU Tobacco Products Directive on e-cigarette regulation in the UK. Retrieved from: http://ash.org.uk/information-and-resources/briefings/the-impact-of-the-eu-tobacco-products-directive-on-e-cigarette-regulation-in-the-uk-2/

Allen, J. G., Flanigan, S. S., LeBlanc, M., Vallarino, J., MacNaughton, P., Stewart, J. H., & Christiani, D. C. (2016). 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 (Online)*, *124*(6), 733.

Baeza-Loya, S., Viswanath, H., Carter, A., Molfese, D. L., Velasquez, K. M., Baldwin, P. R., ... & De La Garza, R. (2014). Perceptions about e-cigarette safety may lead to e-smoking during pregnancy. *Bulletin of the Menninger Clinic*, 78(3), 243. doi: 10.1521/bumc.2014.78.3.243

Bahl, V., Lin, S., Xu, N., Davis, B., Wang, Y. H., & Talbot, P. (2012). Comparison of electronic cigarette refill fluid cytotoxicity using embryonic and adult models. *Reproductive Toxicology*, 34(4), 529-537.

Barbeau, A, Burda, J & Siegal, M. (2013). Perceived efficacy of e-cigarettes versus nicotine replacement therapy among successful e-cigarette users: a qualitative approach, *Addiction Science & Clinical Practice*, 8(5), 1-7. doi: 10.1186/1940-0640-8-5.

Barrington-Trimis, J, Samet, J & McConnell, R. (2014). Flavorings in Electronic Cigarettes an Unrecognized Respiratory Health Hazard? JAMA, 312(23), 2493-2494. doi: 10.1001/jama.2014.14830.

Bauld, L, Angus, K & Andrade, M. (2014). *E-cigarette uptake and marketing, A report commissioned by Public Health England.* Retrieved from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/311491/Ecigarette_uptake_and_marketing.pdf

Bekki, K., Uchiyama, S., Ohta, K., Inaba, Y., Nakagome, H., & Kunugita, N. (2014). Carbonyl compounds generated from electronic cigarettes. *International journal of environmental research and public health*, 11(11), 11192-11200. doi: 10.3390/ijerph111111192

Bersaratinia, A & Tommasi, S. (2014) Electronic cigarettes: The road ahead, *Preventive Medicine*, 66, 65-67. doi: 10.1016/j.ypmed.2014.06.014.

British Heart Foundation. (2016) *E-Cigarettes Policy Statement*. Retrieved from: https://www.bhf.org.uk/publications/policy-documents/e-cigarettes-policy-statement

Britton, J & Bogdanovica, I. (2014). *Electronic cigarettes A report commissioned by Public Health England.* Retrieved from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/311887/Ecigarettes_report.pdf

Brown, J., West, R., Beard, E., Michie, S., Shahab, L., & McNeill, A. (2014a). Prevalence and characteristics of e-cigarette users in Great Britain: findings from a general population survey of smokers. *Addictive Behaviors*, 39(6), 1120-1125. doi: 10.1016/j.addbeh.2014.03.009.

Brown, J., Beard, E., Kotz, D., Michie, S., & West, R. (2014b). Real-world effectiveness of e-cigarettes when used to aid smoking cessation: a cross-sectional population study. *Addiction*, 109(9), 1531-1540. doi: 10.1111/add.12623

Bullen, C., Howe, C., Laugesen, M., McRobbie, H., Parag, V., Williman, J., & Walker, N. (2013). Electronic cigarettes for smoking cessation: a randomised controlled trial. *The Lancet*, 382(9905), 1629-1637. doi: 10.1016/S0140-6736(13)61842-5

Carpenter, CM, Wayne, GF and Connolly, GN. (2007). The role of sensory perception in the development and targeting of tobacco products, *Addiction*, 102(1), 136–147.

Centers for Disease Control and Prevention. (2013). *Biomonitoring Summary Cotinine.* Retrieved from: http://www.cdc.gov/biomonitoring/Cotinine_BiomonitoringSummary.html

Centers for Disease Control and Prevention. (2016). *E-Cigarettes and Pregnancy.*Retrieved from: https://www.cdc.gov/reproductivehealth/maternalinfanthealth/tobaccousepregnancy/e-cigarettes-pregnancy.htm

Cervellati, F., Muresan, X. M., Sticozzi, C., Gambari, R., Montagner, G., Forman, H. J., ... & Valacchi, G. (2014). Comparative effects between electronic and cigarette smoke in human keratinocytes and epithelial lung cells. *Toxicology In Vitro*, 28(5), 999-1005. doi: 10.1016/j.tiv.2014.04.012.

Chenery-Morris, S, Muscat, H & Passmore, H. (2015). *Contexts of Midwifery Practice*. London: Sage Publications.

Coleman, B. N., Johnson, S. E., Tessman, G. K., Tworek, C., Alexander, J., Dickinson, D. M., ... & Green, K. M. (2016). "It's not smoke. It's not tar. It's not 4000 chemicals. Case closed": Exploring attitudes, beliefs, and perceived social norms of e-cigarette use among adult users. *Drug and Alcohol Dependence,* 159, 80-85. doi: 10.1016/j.drugalcdep.2015.11.028.

Cope, G. (2014). Nicotine and e-cigarette use during pregnancy, *British Journal of Midwifery*, 22(11), 616-617.

Czogala, J., Goniewicz, M. L., Fidelus, B., Zielinska-Danch, W., Travers, M. J., & Sobczak, A. (2014). Secondhand exposure to vapors from electronic cigarettes. *Nicotine & Tobacco research*, 16(6), 655-662.

Department of Health. (2004). *National Service Framework for Children, Young People and Maternity Services, Maternity Services*. Retrieved from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/199957/National_Service_Framework_for_Children_Young_People_and_Maternity_Services_-_Maternity_Services.pdf

Dockrell, M., Morison, R., Bauld, L., & McNeill, A. (2013). E-cigarettes: prevalence and attitudes in Great Britain. *Nicotine & Tobacco Research*, ntt057. doi*: 10.1093/ntr/ntt057*

Doll, R., Peto, R., Boreham, J., & Sutherland, I. (2005). Mortality from cancer in relation to smoking: 50 years observations on British doctors. *British Journal of Cancer, 92*(3), 426–429. doi:10.1038/sj.bjc.6602359

Durmowicz, E. (2014). The impact of electronic cigarettes on the paediatric population, *Tobacco Control*, 23, 41-46. doi: 10.1136/tobaccocontrol-2013-05146

Dwyer, J. B., McQuown, S. C., & Leslie, F. M. (2009). The dynamic effects of nicotine on the developing brain. *Pharmacology & Therapeutics*, 122(2), 125-139. doi: 10.1016/j.pharmthera.2009.02.003

Ernst, M., Moolchan, E.T. & Robinson, ML. (2001). Behavioural and neural consequences of prenatal exposure to nicotine, *Journal of the American Academy of Child and Adolescent Psychiatry*, 40(6), 630-641.

Farsalinos, K. E., Spyrou, A., Tsimopoulou, K., Stefopoulos, C., Romagna, G., & Voudris, V. (2014). Nicotine absorption from electronic cigarette use: comparison between first and new-generation devices. *Scientific Reports,* 4. doi: 10.1038/srep04133.

Ferrari, M., Zanasi, A., Nardi, E., Labate, A. M. M., Ceriana, P., Balestrino, A., ... & Nava, S. (2015). Short-term effects of a nicotine-free e-cigarette compared to a traditional cigarette in smokers and non-smokers. *BMC Pulmonary Medicine*, 15 (120), 1-9. doi: 10.1186/s12890-015-0106-z.

Flouris, A. D., Chorti, M. S., Poulianiti, K. P., Jamurtas, A. Z., Kostikas, K., Tzatzarakis, M. N., ... & Koutedakis, Y. (2013). Acute impact of active and passive electronic cigarette smoking on serum cotinine and lung function. *Inhalation Toxicology*, 25(2), 91-101. doi: 10.3109/08958378.2012.758197.

Gaither, K. H., Huber, L. R. B., Thompson, M. E., & Huet-Hudson, Y. M. (2009). Does the use of nicotine replacement therapy during pregnancy affect pregnancy outcomes?. *Maternal and Child Health Journal*, 13(4), 497-504. doi: 10.1007/s10995-008-0361-1

Garbutt, J. M., Miller, W., Dodd, S., Bobenhouse, N., Sterkel, R., & Strunk, R. C. (2015). Parental use of electronic cigarettes. *Academic Pediatrics*, 15(6), 599-604.

Håberg, S. E., Stigum, H., Nystad, W., & Nafstad, P. (2007). Effects of pre-and postnatal exposure to parental smoking on early childhood respiratory health. *American Journal of Epidemiology*, 166(6), 679-686. doi: 10.1093/aje/kwm134.

Health and Social Care Information Centre. (2015) *Statistics on Smoking, England 2015.* Retrieved from: http://www.hscic.gov.uk/catalogue/PUB17526/stat-smok-eng-2015-rep.pdf

Hoffmann, D., Hoffmann, I., & El-Bayoumy, K. (2001). The less harmful cigarette: a controversial issue. A tribute to Ernst L. Wynder. *Chemical research in toxicology*, 14(7), 767-790.

Kahr, M. K., Padgett, S., Shope, C. D., Griffin, E. N., Xie, S. S., Gonzalez, P. J., ... & Stotts, A. L. (2015). A qualitative assessment of the perceived risks of electronic cigarette and hookah use in pregnancy. *BMC public health*, 15(1), 1. doi: 10.1186/s12889-015-2586-4.

King, B. A., Patel, R., Nguyen, K., & Dube, S. R. (2014). Trends in awareness and use of electronic cigarettes among US adults, 2010-2013. *Nicotine & Tobacco Research*, ntu191. doi: 10.1093/ntr/ntu191

Leslie, K. M. (2008). Harm reduction: An approach to reducing risky health behaviours in adolescents. *Paediatric Child Health*, 13(1), 53-56.

Logan, D. E., & Marlatt, G. A. (2010). Harm reduction therapy: A practice-friendly review of research. *Journal of Clinical Psychology*, 66(2), 201-214.

Marketline. (2014) *e-cigarettes Big Tobacco moves in for the kill, but could profits disappear in a puff of smoke.* Reference Code: ML00017-029.

McAndrew, F., Thompson, J., Fellows, L., Large, A., Speed, M., & Renfrew, M. J. (2012). Infant feeding survey 2010. *Leeds: Health and Social Care Information Centre*. Retrieved from: http://www.hscic.gov.uk/catalogue/PUB08694/Infant-Feeding-Survey-2010-Consolidated-Report.pdf

McEwen, A & McRobbie, H. (2016) Electronic cigarettes: A briefing for stop smoking services. *National Centre for Smoking Cessation and Training*. Retrieved from: http://www.ncsct.co.uk/usr/pub/Electronic_cigarettes._A_briefing_for_stop_smoking_services.pdf

McGrath-Morrow, S. A., Hayashi, M., Aherrera, A., Lopez, A., Malinina, A., Collaco, J. M., ... & Lazarus, P. (2015). The effects of electronic cigarette emissions on systemic cotinine levels, weight and postnatal lung growth in neonatal mice. PloS one, 10(2) pp. 1-10. e0118344. DOI: 10.1371/journal.pone.011834

McKee, M & Capewell, S. (2015). Evidence about electronic cigarettes: a foundation built on rock or sand?, *BMJ*, 15, 1-3. doi:10.1136/bmj.h4863.

McEwen, A. (2015). Smoking Cessation: A briefing for midwifery staff. *A. National Centre for Smoking Cessation and Training* Retrieved from: http://www.ncsct.co.uk/usr/pub/NCSCT_midwifery_briefing.pdf

McEwan, A., & McRobbie, H. (2016). Electronic cigarettes: a briefing for stop smoking services. *National Centre for Smoking Cessation and Training*.

McRobbie, H. National Centre for Smoking Cessation and Training (NCSCT). (2014) *Electronic Cigarettes.* Retrieved from: http://www.ncsct.co.uk/usr/pub/e-cigarette_briefing.pdf

Mund, M., Louwen, F., Klingelhoefer, D., & Gerber, A. (2013). Smoking and pregnancy—a review on the first major environmental risk factor of the unborn. *International journal of environmental research and public health*, *10*(12), 6485-6499.

Narkowicz, S., Płotka, J., Polkowska, Ż., Biziuk, M., & Namieśnik, J. (2013). Prenatal exposure to substance of abuse: a worldwide problem. *Environment international*, 54, 141-163. doi:10.1016/j.envint.2013.01.011

National Institute of Clinical Excellence (NICE). (2013) *Smoking: harm reduction, Recommendation 5 Advising on licensed nicotine-containing products.* Retrieved from: https://www.nice.org.uk/guidance/PH45/chapter/1-Recommendations#recommendation-5-advising-on-licensed-nicotine-containing-products

NHS Digital (2016). *Statistics on NHS Stop Smoking Services in England - April 2015 to December 2015*. Retrieved from: http://content.digital.nhs.uk/article/2021/Website-Search?productid=20689&q=Statistics+on+NHS+Stop+Smoking+Services+in+England&sort=Relevance&size=10&page=1&area=both#top

Ordenez, J, Forrester MB & Kleinschmidt, K. (2013) Electornic Cigarette exposures reported to poison centers, *Clin Toxicol*, 51,685.

Pisinger, C & Dossing, M. (2014). A systematic review of health effects of electronic cigarettes, *Preventive Medicine*, 69, 248-260. doi: 10.1016/j.ypmed.2014.10.009.

Polosa, R., Caponnetto, P., Morjaria, J. B., Papale, G., Campagna, D., & Russo, C. (2011). Effect of an electronic nicotine delivery device (e-Cigarette) on smoking reduction and cessation: a prospective 6-month pilot study. *BMC public health*, 11(1), 1.

Public Health England. (2015). *Health matters: smoking and quitting in England.* Available at: https://www.gov.uk/government/publications/health-matters-smoking-and-quitting-in-england/smoking-and-quitting-in-england

Public Health England. (2016). E-cigarettes: a developing public health consensus. Retrieved from: https://www.gov.uk/government/publications/e-cigarettes-a-developing-public-health-consensus

Rennie, L, Bazillier-Bruneau, C, & Rouss, J. (2016). Harm Reduction or Harm Introduction? Prevalence and Correlates of E-Cigarette Use Among French Adolescents, *Journal Of Adolescent Health*, 58(4), 440–445. doi: 10.1016/j.jadohealth.2015.12.013

Smoking and Health Action Foundation. (2013) *E-cigarettes: Understanding the Potential Risks & Benefits.* Retrieved from:

https://www.quitnow.ca/files/QN/files/library/131101_E_Cig_Fact_Sheet_NSRA_17Oct13_final.pdf

Stevens, JF & Maier, CS. (2008). Acrolein: sources, metabolism, and biomolecular interactions relevant to human health and disease, *Mol Nutr Food*, 52(1), 7–25. doi: 10.1002/mnfr.200700412.

Vansickel, AR and Eissenberg, T. (2013). Electronic cigarettes: effective nicotine delivery after acute administration, *Nicotine Tob Res*, 15(1), 267–270. doi: 10.1093/ntr/ntr316.

Valacchi, G., Davis, P. A., Khan, E. M., Lanir, R., Maioli, E., Pecorelli, A., ... & Goldkorn, T. (2011). Cigarette smoke exposure causes changes in Scavenger Receptor B1 level and distribution in lung cells. *The international journal of biochemistry & cell biology*, 43(7), 1065-1070. doi: 10.1016/j.biocel.2009.05.014

Walton, K. M., Abrams, D. B., Bailey, W. C., Clark, D., Connolly, G. N., Djordjevic, M. V., ... & Hecht, S. S. (2015). NIH electronic cigarette workshop: developing a research agenda. *Nicotine & Tobacco Research*, 17(2), 259-269. doi: 10.1093/ntr/ntu214.

Witschi, H. (2001). A Short History of Lung Cancer, *Toxicological Sciences*, 64(1), 4-6. doi: 10.1093/toxsci/64.1.4.

Zhu, S. H., Sun, J. Y., Bonnevie, E., Cummins, S. E., Gamst, A., Yin, L., & Lee, M. (2014). Four hundred and sixty brands of e-cigarettes and counting: implications for product regulation. *Tobacco control*, 23(3), iii3-iii9. doi:10.1136/tobaccocontrol-2014-051670.