

E-cigarettes and adolescents

There is a concern that the use of e-cigs by adolescents could be a gateway to smoking, says **Graham Cope**



There is evidence that use of e-cigs by adolescents is growing, and may surpass use of conventional cigarettes

Electronic cigarettes (e-cigs) have rapidly gained popularity since their introduction in 2004 and are now used regularly by an estimated 2.6 million people in the UK,¹ with annual sales worth about £459 million.²

Since their introduction, e-cigs have been unregulated and are freely available. They have been heavily advertised,³ which significantly increased when the large tobacco companies began buying up small, independent manufacturers or producing their own brand, such as the e-Voke®.^{3,4}

E-cigs typically comprise a re-chargeable lithium ion battery to power an atomiser. This produces vapour by heating a solution of nicotine,

usually in propylene glycol or glycerine, held in a (often refillable) cartridge in the device.⁵

E-cigs contain nicotine solutions of variable concentrations from zero to 36 mg/mL. An aerosol of nicotine is generated via a heating coil; the coil heats to a temperature of up to 350°C.

The nicotine solution has various flavours, some of which appear to be attractive to younger users.⁶

The ingestion of nicotine from e-cigs is generally less efficient than from combustible cigarettes, with lower plasma nicotine levels.⁷ Consequently, many users inhale deeper, more frequently and for longer than they would if they were using a normal cigarette.⁸

E-cigs are generally considered by smokers to be a safer way of inhaling nicotine than conventional cigarettes and a more attractive alternative to nicotine replacement therapy (NRT), while others use them as a tool for harm reduction or when smoking is prohibited.⁹

Government position

Public Health England recently reviewed the available evidence and stated: ‘Smokers who have tried other methods of quitting without success could be encouraged to try e-cigarettes to stop smoking and stop smoking services should support smokers using e-cigs to quit by offering them behavioural support’.¹⁰

The report suggested that smokers who cannot or do not

want to stop smoking to switch to e-cigs, because they are around 95% safer than normal or combustible cigarettes and could help reduce smoking related disease, death and health inequalities.¹⁰

The report also addressed the allegations that e-cigs may be a gateway to the use of normal cigarettes by young people. The authors stated: ‘There is no evidence that e-cigs are undermining the long-term decline in cigarette smoking among adults and youth, and may in fact be contributing to it. Despite some experimentation with e-cigs among never smokers, e-cigs are attracting very few people who have never smoked into regular e-cigs use’.¹⁰

However, the unregulated market has witnessed a great deal of variability and unpredictability as to the nicotine dose delivered by these devices, the potential of adverse health effects of other substances in the nicotine solutions and the possibility for malfunction of the electrical coil.¹¹

Toxicology reports

E-cigs have been proposed by their manufacturers and supporters as an effective aid to quit, and while there is some evidence to support this,¹² others regard their efficacy as a cessation tool as modest, appearing to be comparable to NRT with minimal behavioural support.

While it is acknowledged that a role for e-cigs in the treatment of tobacco dependence may emerge in the future, the potential risk of e-cigs currently outweigh the known benefit as a tobacco treatment strategy.¹³

Solvent and flavours

Manufacturers and supporters of e-cigs often advocate that their products are healthier than conventional cigarettes and contain only water, nicotine, glycerin, propylene glycol, and flavouring (Box 1).¹⁴ These claims, however, may be misleading as analysis has found varying levels of heavy metals in the vapour, including chromium, cadmium and mercury (Box 2).⁹

Potential carcinogens have also been identified in the vapour, with tobacco-specific nitrosamines being emitted from some devices, and DNA-damaging free radicals have also been detected,¹⁵ along with toxic levels of formaldehyde and acetaldehyde, especially when the heating element is operated at high voltage.⁹

Some e-cigs solutions also contain harmful flavouring molecules, diacetyl and acetyl propionyl, used to add a buttery taste to the e-cig vapour and are known to cause bronchiolitis obliterans.¹⁶ It is generally acknowledged that the levels of these toxins are lower or less dangerous than in conventional cigarettes, although they may still pose a risk when inhaled over long periods.

Another advantage of e-cigs is their lack of secondhand smoke – they largely emit water vapour. However, recent evidence suggests there is some particulate matter emitted along with nicotine, carbonyls and organic volatile

compounds.¹⁷

Nicotine

Although nicotine from NRT and e-cigs is considered relatively safe,¹⁰ there is recent evidence that nicotine is deleterious to the brain and parts of the nervous system, and has harmful effects on many non-neurological cells, including those in the respiratory tract, gut, placenta, and in the different cell types of the immune system.¹⁸ While nicotine is not carcinogenic, it has been shown to be tumour promoting.¹⁹

Refill solutions for e-cigs often come in cartridges with a high nicotine content, which can pose a risk when refilling e-cigs products.

There are also increasing numbers of reports of harm following accidental ingestion of nicotine solutions by children,²⁰ and of intentional intake during suicide attempts.

Fires and explosions

The lack of regulation has resulted in many brands of e-cigs being poorly manufactured, with faulty heating elements and recharging units. This has resulted in an increasing number of explosions which have resulted in personal injury or fires which have destroyed property.²¹

Adolescents

One major concern is the use of e-cigs by adolescents and young adults as a gateway to conventional cigarettes.

Recent research has shown that the use of e-cigs in adolescents is increasing, and may surpass that of conventional cigarettes.²² Analysis showed that young adult smokers were twice as likely to have tried e-cigarettes than both former and never smokers; but it was very unlikely that e-cigs were their first exposure to nicotine, as most had tried conventional cigarettes first.²³

Nevertheless, there is strengthening evidence that use of e-cigs by adolescents is growing and it is associated among some as a progression to traditional cigarette smoking.²⁴

Many adolescents use e-cigs as a replacement for conventional cigarettes, as a means of quitting or as a harm reduction exercise.²⁵ Many cite a fear of increased weight gain as their reason for persisting with e-cigs.²⁶

Advice for adolescents

As adolescents are an important and vulnerable group special attention should be given to potential users. E-cigs use could be considered as part of a smoking cessation programme because of the potential reduced health risks,²⁷ as long as this is a short-term plan with a set quit date. The rates of dual use are high, with most e-cig users having smoked conventional cigarettes at some point.²²

Screening for e-cigs use can be problematic, because (as with normal cigarettes) there may be a significant degree of denial or under-reporting.²⁸ For accurate determination, point of care cotinine testing can be used.²⁹ This is the only simple approach as carbon monoxide is not generated by e-cigs.

If this is not possible, then integrate into the routine consultation some questions about the frequency of use of e-cigs along with enquiries about tobacco use. Other factors to be considered include parental and peer group smoking and e-cig use and experimentation with tobacco products such as shisha.³⁰

Smoking cessation advice should also rely on tried and tested methods, with NRT being the first course of action, using combination therapy of long lasting (eg, patches) and short duration (gum, lozenge

or spray). This should be combined with the usual '5 A' counselling and follow up.³¹ Adherence to NRT in adolescents is frequently poor, and this is when e-cigs may be a useful alternative.³²

Controversy and regulation

The role of e-cigs as a smoking cessation tool remains controversial, with some advocating their use as a safer alternative to conventional cigarettes,³³ while others believing the devices should not be normalised and 'should be seen as a part of the armoury of devices intended to wean smokers away from cigarettes, and nothing more'.³⁴

The reputation of e-cigs has been tainted by poor quality manufacture and variability in nicotine availability and other chemicals they contain.

New regulations come into force in the UK on 20 May 2016. E-cigs will come under the revised EU Tobacco Products Directive. This will regulate the amount of nicotine available and improve the safety of the liquid containers.

Certainly, more research is required to determine the benefits of these devices as smoking cessation tools and also the potential toxic effects of long-term nicotine and the other chemicals produced. **IN**

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Box 1. Benefits of e-cigs

Benefits of e-cigs over combustible cigarettes:

- Vastly reduced particulate matter in the vapour.
- No tar and fewer carcinogens.
- No carbon monoxide.
- Significantly lower secondhand emissions.

Box 2. Identified toxicants

Identified toxicants in e-cigarette vapour:

- Nicotine - deleterious to the nervous system and to many non-neurological cells types, including the immune system.
- Heavy metals including chromium, nickel, tin, silver, cadmium, mercury, and aluminium.
- Tobacco-specific nitrosamines are emitted from some devices.
- DNA-damaging free radicals.
- Formaldehyde and acetaldehyde, especially when the heating element is operated at high voltage.

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