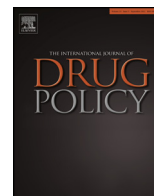




Contents lists available at ScienceDirect

## International Journal of Drug Policy

journal homepage: [www.elsevier.com/locate/drugpo](http://www.elsevier.com/locate/drugpo)



### Editorial

## Disruptive innovations: The rise of the electronic cigarette

### Disruptive innovations and psychoactive substances

The history of psychoactive substances is replete with examples of technologies that change the production and consumption of drugs, alcohol and tobacco. Business analysts use the term 'disruptive innovation' to describe innovations that lead to relatively rapid and dramatic transformations in manufacture, marketing, and consumer behaviour (Christensen, 2003). A classic instance is the 'Kodak moment' when, with the rise of digital processes, photographic film manufacturers were left with an obsolete technology. But as we will suggest, disruption is far broader than the technical impact of the innovation, for it has social ramifications affecting a wide range of social groups. This is especially the case with psychoactive substances where innovations can challenge the position of powerful groups and established wisdoms.

The invention and spread of alcohol distillation is one such example of a disruptive innovation. Although distillation was invented around the 1st century AD by Alexandrian chemists in ancient Egypt, it is claimed that the distillation of spirit alcohol dates to 13th century Bologna (Forbes, 1948). The use of this new technology to produce 'aqua vitae' was opposed by the Church, which warned Dominican priors to destroy or sell the equipment (Wilson, 2006). However, the production of spirits spread slowly to other parts of Europe. In the late 17th century the use of revolutionary new technology to produce gin in the Netherlands, and the political and economic climate which led to its introduction into England, resulted in a rapid rise in gin consumption. Gin was not the first spirit to appear in England but it was the first to gain widespread popularity and the first to be produced using native raw materials. Within the 30 years from 1700 to 1729, consumption of gin rose from under half a gallon per person annually to around 1.3 gallons (Nicholls, 2009). The moral indignation regarding gin drinking is well illustrated by the eighteenth century engraver William Hogarth's depiction of *Gin Lane* – as contrasted with the robust good health of the drinkers in *Beer Street*.

A major disruptive innovation for tobacco was the invention of the cigarette rolling machine by James Bonsack in 1880. Prior to this most tobacco was consumed by smoking in pipes, as snuff, as chewing tobacco or as hand rolled cigarettes. A skilled hand roller could make four cigarettes a minute. Bonsack's machine could make 200 a minute. The efficiency of the cigarette rolling machine resulted in a surplus product and the development of the new arts of product branding and marketing. The tobacco cigarette was an efficient and convenient way of ingesting nicotine, and was viewed as

modern and glamorous in comparison with oral tobacco. By the 1920s cigarettes had overtaken all other ways of consuming tobacco in the United States.

### The rise of the electronic cigarette

The electronic cigarette is a new disruption for tobacco. Following the Chinese patent by Hon Lik in 2003, the Chinese company Ruyan started manufacture and sale in 2004. The marketing of e-cigarettes was introduced into Europe and North America around 2007–2008. There has been rapid uptake. US sales were valued at \$20m US in 2009, and doubled each year to over \$1b in 2013 (Robehmed, 2013). It is estimated that there were seven million users in Europe by 2012 (European Commission, 2012). The number of electronic cigarette users in Britain has tripled since 2012, with 2.1 million users, of whom around 700,000 are now ex-smokers (Action on Smoking and Health, 2014). Electronic cigarettes are now the most common aid for smoking cessation in England, having replaced nicotine replacement therapy and smoking cessation clinics (West, 2013). There is high awareness of electronic cigarettes among cigarette smokers, and high levels of experimentation and use (Polosa, Rodu, Caponnetto, Maglia, & Raciti, 2013). US stock market analysts predict that given the right regulatory environment, electronic cigarette sales could well overtake conventional cigarette tobacco sales within the next ten years (Wells Fargo, 2013). The last twelve months have seen declines in cigarette sales volumes in the UK, North America and Europe, in part attributed to secular decline, in part due to electronic cigarettes (Adelman & Grainger, 2013).

Most electronic cigarettes comprise a nicotine cartridge, a battery and an atomiser. The nicotine cartridge contains nicotine solution and a diluent such as propylene glycol or vegetable glycol, and flavourings. Smoked tobacco contains approximately 4000 chemical products, many of which are toxic. Most electronic cigarettes are not free from trace substances (nor are medically licensed nicotine replacement therapy products) but chemical analysis of liquids and aerosols finds that trace constituents are manifold times less present than in regular cigarettes and smoked tobacco. There is no evidence that vaping (inhalation) produces exposures to contaminants that would warrant health concerns by the standards that are used to ensure safety of workplaces (Burstyn, 2014). In terms of a gradient of risk, electronic cigarettes are at the low end close to NRT products, with smoked tobacco products at the top end (Nutt et al., 2014).

## Electronic cigarettes as a disruptive innovation

Electronic cigarettes are a major disruption for the tobacco and pharmaceutical industries, governments and regulators, public health and tobacco control organisations, consumers, and for the public view of nicotine.

The rapid growth in sales of electronic cigarettes was spurred initially by products sold by small and medium sized electronic cigarette companies and distributors (though originating from large manufacturers in China). Declining cigarette sales, and competition from these cleaner products, present the possibility that tobacco companies making cigarettes will be left not only with a demonised product, but an increasingly unpopular one – their ‘Kodak moment’. Many tobacco companies have now purchased electronic cigarette companies or are developing their own brands. This includes establishing pharmaceutical or healthcare type subsidiaries to manufacture and market non-combustible nicotine delivery devices. There are considerable uncertainties about how this might develop, but one scenario is a potential transformation of tobacco companies (in developed countries) into nicotine companies in the next two decades. Particularly problematic – and ironic – for tobacco control organisations and public health experts is that the tobacco industry now potentially has a solution to the problems it has caused by selling tobacco cigarettes. An end to the tobacco industry may be in sight, but not in the way hoped for by tobacco control, which has sought an end to the industry.

Electronic cigarettes are a disruptive innovation for nation states. The contest for ‘ownership’ of the ‘problem’ at international, regional and national level revolves around the issue of how these new products are to be defined and regulated. Are they tobacco products, hence to be included within the international Framework Convention on Tobacco Control (FCTC) (WHO, 2003) and subject to tobacco regulations? Are they a consumer product? Is nicotine a drug that can be classed as a medicine (see Farsalinos & Stimson, 2013).

WHO wants them brought under the FCTC as tobacco products. The USA Food and Drug Administration was barred from classifying them as medicinal products but has recently proposed regulations under which they will be ‘deemed’ to be tobacco products. Some countries insist on pharmacy only sale, some require medicines approval, some have banned them, and some allow sales of the devices but not the nicotine solution. The draft EU Tobacco Products Directive classed them as medicines, but this was rejected by the European Parliament, and in the agreed Directive they are classed as consumer products. The Department for Health for England and the MHRA proposed to control them as medicines (MHRA, 2013) though this position has been revised in light of the EU position. Courts in six European countries have rejected government claims that they are medicines (Farsalinos & Stimson, 2013).

Electronic cigarettes are disruptive for public health and tobacco control organisations. The rapid uptake of electronic cigarettes has been a consumer-led self-help public health movement (Stimson & Costall, 2014) with no expenditure of healthcare resources, and has been met with neglect and sometimes antipathy from many public health experts and tobacco control organisations who clearly do not have ‘ownership’ of the innovation. The public health response to regain ownership has coalesced around the precautionary principle. Hence the public health discourse has mainly focused on potential use of e-cigarettes by young people, their potential as a gateway to smoking, and fear that they might undermine the ‘de-normalisation’ of smoking by ‘re-normalising it’. Few public health experts have been engaged in supporting and promoting this grass roots movement, despite the fact that it accords with one of the basic principles of public health as outlined in the WHO Ottawa Charter for Health – that ‘Health promotion is the process of enabling people to increase control over, and to improve, their

health...’ (WHO, 1986). As has been noted ‘This seems to be exactly what electronic cigarette consumers are doing – taking control of things that determine their health’ (Stimson, 2014).

In most countries electronic cigarettes are not covered by smoke-free legislation since there is no combustion and there is no smoke. There is minimal risk to bystanders from second-hand exhalate (Burstyn, 2014; Polosa et al., 2013). Confusion reigns about whether they ‘should’ or can be used in public places. In the United Kingdom the British Medical Association (2013) and Public Health Wales (Public Health Wales, 2013) want them to be included in the ban on smoking in public places. The British Medical Journal applauds former mayor Bloomberg’s ban on electronic cigarettes in public places in New York (Godlee, 2014). Some public venues – including transport companies, entertainment venues and public houses – allow them and sell them. Others ban them on the grounds that they are unhealthy and that they cannot be distinguished from cigarettes, hence making smoking bans difficult to enforce.

Electronic cigarettes are disruptive for consumers. Most cigarette smokers want to stop smoking cigarettes, and most have tried. Many smokers are dissatisfied with nicotine replacement therapy products, and studies suggest problems with their effectiveness and acceptability for consumers (Kotz, Brown, & West, 2013; Moore et al., 2009). Electronic cigarette users like their product because it simulates the action of smoking, allows control of dose (Polosa et al., 2013), and enables people who like nicotine or are unable or unwilling to discontinue using it to still use nicotine without the hazards associated with smoking. The products succeed because they are not perceived to be medical treatments for smoking.

There is a new language – ‘vapers’ and ‘vaping’ rather than ‘smokers’ and ‘smoking’; ‘switching’ to a better nicotine product rather than ‘quitting’. There is a growing vocal group of people who self-identify as ‘vapers’. The attempt by governments and the European Union to gain control of this new product through regulation resulted in strong opposition and advocacy by e-cigarette consumers and vaping organisations across Europe (see e.g. Mabe, 2013). This had major impact on the debate within the European legislative process. A new social movement has emerged around vaping activism. This is a challenge for tobacco control organisations, who feared consumer engagement in the past, when the main consumer groups were pro-smoking activists. Tobacco control organisations do not have a tradition of engaging with nicotine users and they may have to accept that their long-standing suspicions of consumer groups need to be revised.

Finally, the adoption of electronic cigarettes disrupts popular conceptions of nicotine as a drug. Nicotine was demonised along with tobacco – indeed the two were seen as indistinguishable in terms of harm (many medical practitioners falsely believe that nicotine causes cancer (Patwardhan & Murphy, 2013). Separating nicotine from tobacco brings to the fore questions of what kind of drug this is, why people use it, and why people like it. It raises issues about nicotine addiction as opposed to tobacco addiction: is addiction to nicotine per se a ‘problem’ if it is not accompanied by impairment, intoxication, harmful health consequences or harms to others? If nicotine is a relatively benign drug on a par perhaps with caffeine, if people find it functionally useful and pleasurable, what then would be the reasons – if any – to discourage its use?

## Disruptive innovations challenge power and established wisdom

Disruptive innovations lead to more than changes in industries and consumer behaviour: they challenge existing power relationships and established wisdom, and are associated with changes in attitudes as different groups vie for ownership of the issue in

the public mind, from enthusiasm for new pleasures, to negative fears for the health of the population and social condition (Berridge, 2013). There is interplay to position, and re-position, the new way of using the substance, and whether its use is a 'problem'. Claims are made and contested by manufacturers, distributors, retailers, consumers, social movements, the state, and professional organisations. How this will play out with respect to electronic cigarettes is uncertain, but in terms of the historical use of tobacco and the disease burden from smoking, the rise of the electronic cigarette seems to be a game changer with potentially huge implications for consumers, public health and industry.

## Acknowledgements

Ideas in this editorial were first discussed at a workshop in Vienna hosted by Sigmund Freud University and held at the Beethoven Hotel, Vienna in December 2013, and we are grateful for comments from participants including Alfred Uhl, Wim van den Brink, Franca Beccaria, Geoffrey Hunt, Sébastien Tutenges, Virginia Berridge, Julian Strizek, Laura Williamson and Ulrike Kobra. Thanks also for comments from Clive Bates and Sudhanshu Patwardhan.

**Conflict of interest statement:** GVS – Member of the National Institute for Health and Care Excellence guidelines development group on tobacco harm reduction; GVS and PC are directors of K●A●C, a company that has received a smoking research feasibility grant from a company developing a nicotine product. BT – no interests declared.

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6 February 2014