

# The Regulatory Challenge of Electronic Cigarettes

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**Electronic cigarettes (e-cigarettes or electronic nicotine delivery systems)** heat a nicotine solution to generate vapor that is inhaled, without the combustion of tobacco and its toxic constituents. Use of e-cigarettes is increasing in the United States and around the world. Current smokers in the United States report an 11.4% prevalence of ever use of e-cigarettes and 4.1% use in past 30 days.<sup>1</sup> They likely pose less direct hazard to the individual smoker than tobacco cigarettes and might help smokers quit smoking or reduce harm by smoking fewer tobacco cigarettes. On the other hand, there are potential harms, including promoting continued smoking of cigarettes and renormalizing cigarette smoking behaviors. The Food and Drug Administration (FDA) is authorized to regulate tobacco products, and in 2011 the agency announced plans to regulate e-cigarettes as tobacco products.<sup>2</sup> The FDA will need to make a number of regulatory decisions about product safety that could have major effects on public health and will face many challenges.

## The e-Cigarette as a Nicotine Delivery System

The delivery of nicotine to the lungs via inhalation, with rapid absorption into the circulation, is critical to the addictiveness of cigarette smoking.<sup>3</sup> The adverse

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health consequences of cigarette smoking are caused primarily by inhalation of toxic tobacco constituents and organic combustion products. Nicotine per se contributes to some smoking-related diseases, but its contribution is considered to be much smaller than that of combustion products.<sup>3</sup> The provision of clean nicotine (without combustion products or other tobacco plant toxins) in the form of nicotine replacement therapies (NRTs) has been in use for nearly 30 years and has proven to be a safe way to facilitate smoking cessation. Currently available NRT products are not as satisfying and are less acceptable to smokers compared with inhaling and absorbing nicotine from cigarette smoke. The possibility of an inhaled clean nicotine device has been discussed by health researchers for many years as a potentially more effective way to promote smoking cessation. Although not yet proven safe or effective for smoking cessation, the e-cigarette has been positioned as such an inhaled nicotine delivery device and has gained popularity through this perception.<sup>4</sup>

## Product Evolution

More than 250 e-cigarette brands are on the market currently, and products have evolved rapidly in recent years. Different e-cigarette brands are engineered differently, affecting the character and potential toxicity of the vapor. Thus, it is difficult to generalize about e-cigarettes as a single device. The FDA will need to consider the engineering of e-cigarettes with respect to different types of nicotine solutions, the capacity of the cartridges containing the solution, the nature of the heating element and battery, the types of additives and flavorings, and the potential toxicants released in the vapor.

## Assessing Potential Toxicity and Health Effects

Liquids used in e-cigarettes vary with respect to concentrations of toxicants, and the quality control in e-cigarette manufacturing is questionable.<sup>5</sup> Although a number of toxicants have been identified in e-cigarette vapors, the levels of these toxicants are orders of magnitude lower than those found in cigarette smoke, although higher than those found in NRT.<sup>6</sup> Although it cannot be said that currently marketed e-cigarettes are safe, e-cigarette vapor is likely to be much less toxic than cigarette smoke. Among the questions that should be considered by the FDA are (1) Do low levels of contaminants in e-cigarette vapor pose a health risk? (2) What are the thresholds for toxicity of contaminants in vapor? (3) What should be the basis for product standards for e-cigarettes? (4) Could the risks be ameliorated by changes in engineering?

## Potential Health Benefits for Individual Smokers

Testimonials, surveys, and one uncontrolled clinical trial report that e-cigarettes facilitate the quitting of cigarette smoking and allow smokers to smoke fewer cigarettes per day if they continue to smoke.<sup>7,8</sup> However, longitudinal analysis using population-level data found no difference in quit rates between e-cigarette users and nonusers.<sup>9</sup> Controlled clinical trials and population-level observational cohort studies are needed to establish the utility of these cigarettes to facilitate smoking cessation. Research is also needed regarding the role of e-cigarettes in harm reduction, including reduced cigarette smoking and associated reduction of tobacco toxicant exposure. The FDA will need to determine the magnitude of potential health benefits from e-cigarettes for individual smokers.

## Potential Population Harm

Several potential sources of population harm require research and subsequent weighing of individual benefit vs population risk. These include uptake of e-cigarette use

by nonsmokers, who may later become cigarette smokers or long-term nicotine addicts; promotion of dual use of e-cigarettes and regular cigarettes, such that use of e-cigarettes undermines quitting cigarette smoking; undermining the denormalization of cigarette smoking, because e-cigarettes look like regular cigarettes and their use in public would give the appearance that cigarette smoking behavior is more acceptable; and exposure to a new source of air pollution in places covered by smoke-free policies.

### Advertising and Marketing

Advertising and marketing can be considered in the context of both manufacturer and consumer. Industry has been aggressively marketing e-cigarettes with claims of health benefit compared with smoking tobacco cigarettes, for reducing and quitting smoking, for smoking without generating irritating and harmful secondhand smoke, and for using when a person cannot smoke cigarettes.<sup>10</sup> Marketing also uses young models and celebrities to convey images of the product as glamorous and modern. The net result of industry marketing and consumer advocacy has been a substantial increase in the use of the product. Effective promotion of e-cigarettes could be advantageous if it was determined there was individual health benefit and a low level of total population harm—for example, if e-cigarette use was found to facilitate smoking cessation and not encourage dual use or appeal to youth as a novel nicotine product.

The FDA needs to decide how marketing should be regulated in the context of potential benefits and population risks. This includes deciding the legal age at which minors can purchase the products and other possible access restrictions, as well as evaluating the

appeal of the marketing to youth. Determining the effect of e-cigarettes on the entire population will be challenging.

### Broader Regulatory Issues

Assuming that e-cigarettes of high quality could be safe and could offer net public health benefit (including high consumer acceptability, more effective nicotine delivery, low levels of contaminants, not undermining existing tobacco control efforts), and that product improvement is occurring in an environment of marketplace competition, a critical question is when the FDA should begin to require product licensing. A disadvantage of requiring licensing is that regulatory requirements are likely to slow product innovation. The advantage of licensing would be to ensure the quality and consistency of products.

Medications to promote smoking cessation are regulated by the FDA Center for Drug Evaluation and Research (CDER). Tobacco products are regulated by the FDA Center for Tobacco Products (CTP). According to current FDA regulations, in the event that e-cigarettes are found to be helpful in facilitating smoking cessation, the same product could be regulated simultaneously, both by CDER as a medication and by CTP as a tobacco product. This makes little practical sense. A comprehensive regulatory approach to nicotine-containing products is needed. Regulation needs to include the full spectrum of products, from the most hazardous to the least hazardous, with consideration of the potential of less harmful products to reduce exposure to the most harmful combustion products from smoked tobacco, while simultaneously evaluating the total public health effects of the policies.

#### ARTICLE INFORMATION

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