



## Commentary

## Electronic Cigarette Terminology: Where Does One Generation End and the Next Begin?

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### Abstract

**Implications:** The electronic cigarette (ECIG) research community faces several challenges when it comes to regulatory science; not only is the ECIG market changing at a rapid pace, but the terms used by researchers, health organizations, ECIG users, and ECIG manufacturers/distributors to describe devices are inconsistent. These discrepancies make it difficult to advance science and develop regulations. Although researchers have used “generations” to categorize ECIG device types based on various characteristics, with the constantly evolving ECIG market, it is unclear where one “generation” of devices ends and the next begins.

Electronic cigarettes (ECIGs) were released into the US marketplace in 2006. By the end of 2014, there existed over 460 ECIG brands<sup>1</sup> and researchers began documenting the variation in ECIG design.<sup>2,3</sup> ECIG products can differ on several characteristics related to the device (eg, battery size, number of coils/atomizer design) and the liquid (eg, nicotine concentration, solvent ratio); such an inexhaustible list of product configurations presents challenges for advancing science and developing regulations. Complicating matters further is that neither ECIG users nor researchers are consistent with the terms they use to describe ECIG devices. Though some attention has been paid to ECIG users’ terminology to improve survey work,<sup>4</sup> no work has addressed the terms used in the scientific community.

As a product class, ECIGs have been referred to as e-cigarettes, electronic nicotine delivery systems,<sup>5</sup> nicotine vaping products,<sup>6</sup> or electronic nicotine products,<sup>7</sup> creating obstacles for researchers searching databases to keep up with the ECIG literature. Within the class of products, [Table 1](#) demonstrates researchers’ attempts at making sense of the variation; devices have been categorized based on shared features and referred to in terms of their generation. “First generation” devices have been defined as resembling a cigarette (a.k.a. “cigalikes”<sup>3,8–15</sup>) and are small in size.<sup>15</sup> The liquid storage container has often been called a “cartridge,”<sup>9,13</sup> and

is not refillable.<sup>8,9</sup> “First generation” ECIGs also are fully disposable and not rechargeable<sup>8</sup> and have low, fixed-power batteries.<sup>3,10</sup> “Second generation” devices are larger than “first generation” devices,<sup>15</sup> allowing for a larger battery and increased power.<sup>3,10,12</sup> The battery also is rechargeable,<sup>8,12,14</sup> and the liquid container evolved into a “tank”<sup>3,10</sup> (a.k.a. “clearomizer”<sup>3,10,11</sup>) that can be refilled as needed.<sup>3,8–10,13,14</sup> “Second generation” devices have been described as having a “pen-like” appearance.<sup>3,8,15</sup> “Third generation” devices are similar to “second generation” devices in that they are relatively large,<sup>15</sup> as well as rechargeable<sup>8,12</sup> and refillable.<sup>8,9</sup> They are usually distinguished from “second generation” devices by having modifiable features (adjustable power<sup>3,8,13–15</sup>), and thus are referred to as “mods.”<sup>3,8,9,11–13,15</sup> Some “third generation” devices assumed the label of “box mod” due to their shape being akin to a small box.<sup>12,14</sup> In addition to these device features, ECIG generations differ in other ways that can have important implications for their use, such as variation in atomizer design (eg, thickness, metal type).<sup>3</sup> Importantly, the evolution of ECIG product design for these initial generations appeared to parallel their nicotine delivery capabilities; in general, delivery was shown to be lowest for “first generation” followed by “second generation” and then “third generation” devices.<sup>16</sup>

**Table 1.** Terms Used by Researchers to Describe Different ECIG Device Types and Features

	Overall device	Liquid container	Battery	Other features
First generation <sup>3,8-16</sup>	Cigalike <sup>3,8-15</sup> Vape stick <sup>11</sup> Pen-style cigalike <sup>11</sup>	Cartridge <sup>9,13</sup> Not specified <sup>8</sup> Cartomizer <sup>10</sup> Not refillable <sup>8,9</sup> Reloadable <sup>13</sup> Closed <sup>9</sup> Cartridge <sup>8</sup> Tank <sup>3,10</sup> Clearomizer <sup>3,10,11</sup> Refillable <sup>3,8-10,13,14</sup> Prefilled <sup>8</sup> Transparent cartridge <sup>11,12</sup> Open <sup>9</sup> Refillable <sup>8,9</sup> Open <sup>9</sup>	Rechargeable <sup>3,9,10</sup> Fully disposable <sup>3,8,10</sup> Fixed, low voltage <sup>3</sup> Not rechargeable <sup>8</sup> Low capacity <sup>10</sup> Pen-style <sup>3,8</sup> Larger, higher powered than first generation <sup>3,10,12</sup> Variable voltage <sup>3</sup> Thin <sup>11</sup> Rechargeable <sup>8,12,14</sup> Has a button <sup>15</sup> Modifiable <sup>3</sup> Adjustable voltage <sup>3,8,13-15</sup> Adjustable wattage <sup>3,8,13-15</sup> Adjustable power <sup>3,10</sup> Rechargeable <sup>8,12</sup> Larger capacity than second generation <sup>10,12</sup>	Lights up at the end <sup>15</sup> Same size but heavier than a cigarette <sup>15</sup> Disposable (part(s) not specified) <sup>13,14</sup>  Larger than a cigalike <sup>15</sup> Looks like a laser pointer <sup>15</sup> Tubular shaped <sup>14</sup> Reusable pens or gadgets <sup>10</sup> Reusable (part(s) not specified) <sup>8,9</sup>  Fluid reservoir similar to second generation <sup>3</sup> Has a button <sup>15</sup> Larger than first and second generation <sup>15</sup> Reusable (part(s) not specified) <sup>8,9</sup> Can modify components <sup>12</sup>
Second generation <sup>3,8-15</sup>	Tank system or tank-style <sup>1,12,14</sup> Vape pen <sup>9,12,13</sup> Personal vaporizer <sup>15</sup> Pen or pen-like <sup>15</sup>			
Third generation <sup>3,8-15</sup>	Mod <sup>3,8,9,11-13,15</sup> Box mod <sup>12,14</sup> Tank-style or tank system <sup>8,9,13</sup> Sub-ohm tank <sup>8</sup> Modifiable ECIG <sup>9</sup> Mechanical mod <sup>15</sup> Vaping product <sup>11</sup> Regulated mod <sup>15</sup> Pod <sup>3,9</sup> Pod mod <sup>8,14</sup>	Pod <sup>8,9,14</sup> Cartridge <sup>8</sup> Prefilled <sup>8</sup> Refillable <sup>8,9</sup> Disposable <sup>9</sup> Contains atomizer <sup>14</sup>	Rechargeable <sup>9</sup> Fixed voltage <sup>3</sup> Various shapes <sup>3</sup> Adjustable wattage <sup>15</sup> Adjustable voltage <sup>15</sup> Sub-ohm resistance <sup>15</sup>	Modifiable system <sup>8</sup> Does not have a button <sup>14</sup>
Fourth generation <sup>3,8,9,13-15</sup>				

Articles cited in the table were selected by conducting a search using all possible terms (eg, first generation, fourth generation, mods, pods, cigalike, tank, pen), and this process was repeated several times until searches returned few if any relevant articles (ie, articles that offered new information or different examples of ECIG-related terminology). From the final list, we selected a portion that best demonstrated the variability in terminology that was observed while keeping below the maximum number of references permitted for this commentary. ECIG = electronic cigarette.

Enter JUUL, a product released in 2015 that challenged this categorization system. JUUL has some features that mimic “first generation” devices: smaller size, fixed power, and prefilled, disposable liquid storage containers. However, JUUL’s battery is rechargeable and the storage container, called a “pod,” is a different shape from the earlier “cartridges” and “tanks.” The liquid nicotine used by JUUL is very high in concentration compared with earlier generations and includes salts rather than freebase. JUUL’s combination of device/liquid features spurred what is now known as “fourth generation” or “pod-style” ECIGs.<sup>8</sup> Although recent work suggests that JUUL may deliver more nicotine than earlier generation devices,<sup>17</sup> little is known about the capabilities of “fourth generation” products generally. Moreover, given how rapidly ECIG devices are released to the market, these newer devices may ultimately not fit neatly into the “fourth generation” category. Indeed, “pod-style” devices as a class seem to be less standardized in terms of their individual features; they can be fully disposable (eg, Puff Bar) or rechargeable<sup>9</sup> and may have liquid storage containers that are prefilled<sup>8</sup> or refillable,<sup>8,9</sup> making them capable of using liquid nicotine containing salts or freebase. Likewise, their designs take on a wider variety of shapes: teardrop (eg, Suorin Drop), duckbill (eg, Suorin Reno), diamond (eg, Smoant Karat), and comma (eg, HQD Comma). While these later generation devices continued to evolve, earlier generation devices also were being redesigned. For instance, “first generation” models, originally one-piece and fully disposable, are now available as two- and three-piece options with a rechargeable battery.<sup>3,9,10</sup> Similarly, some devices that normally would be categorized as “second generation” (based on shape/size) allow for power adjustments (eg, Vertex Variable Voltage 510 Battery). Of course, confusion in the research community is a direct result of confusion in the marketplace. In the absence of strict regulation, manufacturers continue to reinvent their products to meet consumer demands, and do so at a pace that is incompatible with the scientific process. It is therefore vital that researchers take caution when describing ECIG products.

ECIG product terminology in the scientific literature is heterogeneous and inconsistent (see Table 1). Using the liquid storage container for “second generation” devices as an example, this feature has been referred to as a cartridge,<sup>8</sup> a clearomizer,<sup>3,10,11</sup> and a tank.<sup>3,10</sup> Regardless of the term chosen, details regarding the container are not always provided, but can be important for understanding device capabilities and potential effects on behavior. For instance, the optimal quantification of ECIG consumption for disposable “cartridges” may be the number of containers used (eg, one per day), whereas for refillable “tanks” may be the volume of liquid used (eg, 3 mL per day).<sup>18</sup> Another example is use of the term “tank,” a feature initially used to distinguish “second generation” devices from others early in the literature despite the fact that many “third generation” devices also use a “tank.”<sup>8,9</sup> Specifically, “second generation” devices are typically referred to as “tank systems” or “tank-style”<sup>11,12,14</sup> whereas “third generation” devices are referred to as “mods.”<sup>3,8,9,11–13,15</sup> Still, more recent work has referred to “third generation” devices as those that are “tank-like,”<sup>8,9,13</sup> or has seemingly collapsed these two generations into a single category (ie, “tanks/mods”).<sup>19</sup> Adding to the confusion is the term “pod mod” to refer to some “fourth generation” devices like JUUL. This particular device has no modifiable features in the sense that its liquid containers are prefilled and disposable, and the power level is fixed, though newer “pod-style” devices do permit users to refill the containers and/or adjust the power level (eg, Smok Nord 4). Then there’s the Gemini Hybrid

Pod Mod that allows users to switch between a “pod” container and a “tank” container, both of which are refillable. Clearly, ECIG technology has advanced such that features of previous designs are being combined in new ways, and products can no longer be categorized in meaningful ways.

Now more than ever researchers should be mindful of the products available to consumers and the ways in which these products are advertised. For instance, blu PLUS+ and Vuse Vibe containers are marketed as “tanks” even though they are prefilled and their physical appearance closely resembles what researchers have historically called “cartridges” or “cartomizers.”<sup>20,21</sup> There also are containers that look arguably like a “tank” but are marketed as “pods” (eg, Smok Thallo S<sup>22</sup>) or even “pod tanks” (eg, VooPoo DRAG 3<sup>23</sup>). Manufacturers and sellers may be adopting terms as they become popular to attract buyers, without concern for the confusion being generated. These same terms are then perpetuated through various outlets. Take IQOS for example, a heated tobacco product that was introduced to the US market in 2019. IQOS has been described as an acronym for “I quit ordinary smoking” by users on vaping forums,<sup>24</sup> by major health organizations,<sup>25</sup> and by researchers in peer-reviewed scientific articles.<sup>26</sup> Its use implies that IQOS is a smoking cessation aid despite any evidence to support this designation.<sup>26</sup> Although the manufacturer of IQOS (Phillip Morris International) publicly rejects the acronym, some would not be surprised if they were covertly facilitating its use.<sup>26</sup> Let us not forget the myriad of tactics used by the tobacco industry to deceive the public, and the fact that some ECIG companies have modeled these tactics.<sup>27</sup>

Our use of ECIG terminology has implications for regulatory science, with inconsistencies and inaccuracies impeding our ability to make cross-study comparisons, understand device capabilities, survey specific device types to identify trends, and communicate with public health offices and consumers. As an example, the reference to “generations” to categorize ECIG device types is likely insufficient for capturing the complexity of products that are available today. Indeed, it is increasingly unclear where one device “generation” ends and the next begins. Likewise, exclusive use of terms like “tanks” (“second generation,” “third generation,” and/or newer hybrid devices) and “disposables” (early cigalikes and/or modern pod-styles) to reference a device subgroup is non-descript. We therefore recommend that researchers err on the side of providing more rather than less detail not only to avoid confusion when referring to products generally but also when those details might convey important information about device capabilities (eg, nicotine delivery, modifiable features, appeal). Such details include: refillable versus prefilled storage containers, rechargeable versus disposable batteries, fixed versus variable voltage, salt versus freebase nicotine, etc. Together, these small changes can have a big scientific impact.

## Supplementary Material

A Contributorship Form detailing each author’s specific involvement with this content, as well as any supplementary data, are available online at <https://academic.oup.com/ntr>.

## Acknowledgments

The authors thank Abigail Barton and Miranda Signorelli for their contributions.

## Funding

Financial supported provided by the National Institute on Drug Abuse of the National Institutes of Health and the Center for Tobacco Products of the U.S. Food and Drug Administration (NIDA/FDA R21DA051628). The content is solely the responsibility of the authors and does not necessarily represent the views of the NIH or FDA.

## Declaration of Interests

None declared.

## References

- Zhu SH, Sun JY, Bonnevie E, et al. Four hundred and sixty brands of e-cigarettes and counting: implications for product regulation. *Tob Control*. 2014;23(suppl 3):iii3–iii9.
- Hsu G, Sun JY, Zhu SH. Evolution of electronic cigarette brands from 2013–2014 to 2016–2017: analysis of brand websites. *J Med Internet Res*. 2018;20(3):e80.
- Williams M, Talbot P. Design features in multiple generations of electronic cigarette atomizers. *Int J Environ Res Public Health*. 2019;16(16):2904.
- Weaver SR, Kim H, Glasser AM, et al. Establishing consensus on survey measures for electronic nicotine and non-nicotine delivery system use: current challenges and considerations for researchers. *Addict Behav*. 2018;79(1):203–212.
- Case KR, Obinwa UC, Clendennen SL, Perry CL, Harrell MB. Predictors of JUUL, other electronic nicotine delivery systems, and combustible tobacco initiation among Texas youth. *Prev Med*. 2020;138(1):106097.
- O'Connor RJ, Fix BV, McNeill A, et al. Characteristics of nicotine vaping products used by participants in the 2016 ITC Four Country Smoking and Vaping Survey. *Addiction*. 2019;114(suppl 1):15–23.
- Atuegwu NC, Perez MF, Oncken C, Thacker S, Mead EL, Mortensen EM. Association between regular electronic nicotine product use and self-report periodontal disease status: Population Assessment of Tobacco and Health Survey. *Int J Environ Res Public Health*. 2019;16(7):1263.
- Centers for Disease Control and Prevention. *E-Cigarette, or Vaping, Products Visual Dictionary*. 2020. [https://www.cdc.gov/tobacco/basic\\_information/e-cigarettes/pdfs/ecigarette-or-vaping-products-visual-dictionary-508.pdf](https://www.cdc.gov/tobacco/basic_information/e-cigarettes/pdfs/ecigarette-or-vaping-products-visual-dictionary-508.pdf). Accessed April 15, 2021.
- Aherrerera A, Aravindakshan A, Jarmul S, et al. E-cigarette use behaviors and device characteristics of daily exclusive e-cigarette users in Maryland: implications for product toxicity. *Tob Induc Dis*. 2020;18(1):93.
- Dawkins L, Kimber C, Puwanesarasa Y, Soar K. First- versus second-generation electronic cigarettes: predictors of choice and effects on urge to smoke and withdrawal symptoms. *Addiction*. 2015;110(4):669–677.
- National Academies of Sciences Engineering and Medicine. *Public Health Consequences of E-Cigarettes*. Washington, DC: The National Academies Press; 2018.
- Cwalina SN, Braymiller JL, Leventhal AM, Unger JB, McConnell R, Barrington-Trimis JL. Prevalence of young adult vaping, substance vaped, and purchase location across five categories of vaping devices. *Nicotine Tob Res*. 2020;23(5):1–7.
- Walley SC, Wilson KM, Winickoff JP, Groner J. A public health crisis: electronic cigarettes, vape, and JUUL. *Pediatrics*. 2019;143(6):e20182741.
- Galstyan E, Galimov A, Sussman S. Commentary: The emergence of pod mods at Vape Shops. *Eval Health Prof*. 2019;42(1):118–124.
- Protano C, Avino P, Manigrasso M, et al. Environmental electronic vape exposure from four different generations of electronic cigarettes: airborne particulate matter levels. *Int J Environ Res Public Health*. 2018;15(10):2172.
- DeVito EE, Krishnan-Sarin S. E-cigarettes: impact of e-liquid components and device characteristics on nicotine exposure. *Curr Neuropharmacol*. 2018;16(4):438–459.
- Phillips-Waller A, Przulj D, Smith KM, Pesola F, Hajek P. Nicotine delivery and user reactions to Juul EU (20 mg/ml) compared with Juul US (59 mg/ml), cigarettes and other e-cigarette products. *Psychopharmacology (Berl)*. 2021;238(3):825–831.
- Cassidy RN, Tidey JW, Colby SM, Long V, Higgins ST. Initial development of an e-cigarette purchase task: a mixed methods study. *Tob Regul Sci*. 2017;3(2):139–150.
- Wang TW, Neff LJ, Park-Lee E, Ren C, Cullen KA, King BA. E-cigarette use among middle and high school students—United States, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(37):1310–1312.
- Blu. *Flavor for Every Taste*. <https://www.blu.com/en/US/flavors/blu-plus-tanks>. Accessed July 27, 2021.
- Vuse. *Vuse Vibe Flavors*. <https://vusevapor.com/devices/vibe/flavors>. Accessed July 27, 2021.
- Smok. *Thallo S*. <https://www.smoktech.com/kit/thallo-s>. Accessed July 27, 2021.
- VooPoo. *Drag 3*. <https://www.voopoo.com/drag-series/drag-3-kit.html>. Accessed July 27, 2021.
- Asean Now. *E Cigarettes*. <https://aseannow.com/topic/1003935-e-cigarettes/>. Accessed July 27, 2021.
- American Academy of Pediatrics. *IQOS Heat-Not-Burn Tobacco Products*. <https://www.healthychildren.org/English/health-issues/conditions/tobacco/Pages/IQOS-Heat-Not-Burn-Tobacco-Products-Not-Safe.aspx>. Accessed May 13, 2021.
- Seidenberg A, Freeman B. IQOS is not an acronym: a call to researchers and journals. *Tob Control*. 2021;30(3):356–358.
- Moran MB, Heley K, Baldwin K, Xiao C, Lin V, Pierce JP. Selling tobacco: a comprehensive analysis of the U.S. tobacco advertising landscape. *Addict Behav*. 2019;96(1):100–109.