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Addictive Behaviors

journal homepage: www.elsevier.com/locate/addictbeh

Establishing consensus on survey measures for electronic nicotine and non-nicotine delivery system use: Current challenges and considerations for researchers

Scott R. Weaver^{a,*}, Hyoshin Kim^b, Allison M. Glasser^c, Erin L. Sutfin^d, Jessica Barrington-Trimis^e, Thomas J. Payne^f, Megan Saddleson^g, Alexandra Loukas^h

^a School of Public Health, Georgia State University, PO Box 3995, Atlanta, GA 30302-3995, USA

^b Battelle Public Health Center for Tobacco Research, 1100 Dexter Avenue North, Suite 400, Seattle, WA 98109, USA

^c The Schroeder Institute for Tobacco Research and Policy Studies at Truth Initiative, 900 G St. NW, Floor Four, Washington, DC, 20001, USA

^d Department of Social Sciences and Health Policy, Wake Forest School of Medicine, Medical Center Blvd., Winston-Salem, NC, USA

^e Department of Preventive Medicine, Keck School of Medicine, University of Southern California, 2001 N. Soto Street, Los Angeles, CA, USA

^f Department of Otolaryngology and Communicative Sciences, ACT Center for Tobacco Treatment, Education and Research, 350 West Woodrow Wilson Drive, JMM Suite 611, University of Mississippi Medical Center, Jackson, MS, 39213, USA

^g Center for Interdisciplinary Research on Nicotine Addiction, Perelman School of Medicine, University of Pennsylvania, 3535 Market St., Philadelphia, PA 19104, USA

^h Department of Kinesiology & Health Education, University of Texas at Austin, 2109 San Jacinto Blvd Mail Stop D3700, Austin, TX 78712, USA

HIGHLIGHTS

- Few standards and data on the psychometric properties of ENDS use measures exist.
- This paper reviews and discusses measurement of ENDS use measures.
- There is large variability and relatively little consensus in ENDS use measures.
- This paper provides some considerations for measuring the use of ENDS.
- Areas in need of measurement development and validation are identified.

ARTICLE INFO

Keywords:

Electronic nicotine device systems
Electronic cigarette
E-cigarette
Measurement
Consensus measures

ABSTRACT

The development and validation of survey measures for electronic nicotine and non-nicotine delivery system (ENDS) use has not kept pace with the burgeoning research on them. This, along with the diverse and evolving nature of ENDS, presents several unique measurement challenges and hampers surveillance and tobacco regulatory research efforts. In this commentary, we identify four important areas related to ENDS use (describing ENDS products; defining current use; evaluating frequency and quantity of use; and characterizing devices and e-liquids) and summarize a selective review of the measurement and definitions of these constructs across prominent national tobacco use surveys and 30 projects within the 14 federally-funded Tobacco Centers of Regulatory Science. Across these national, regional, and local studies, there was considerable variability and relatively little consensus in ENDS use measures – thus highlighting the need for caution when comparing findings across studies or over time until more research is available to evaluate the sensitivity of findings to differing measures. Drawing from the nascent ENDS use measurement research literature and our experiences, we conclude with general considerations for measuring ENDS use for tobacco researchers as an initial step towards the development of consensus measures.

* Corresponding author at: School of Public Health, Georgia State University, PO Box 3995, Atlanta, GA 30302-3995, USA.

E-mail addresses: srweaver@gsu.edu (S.R. Weaver), kimh@battelle.org (H. Kim), aglasser@truthinitiative.org (A.M. Glasser), esutfin@wakehealth.edu (E.L. Sutfin), jtrimis@usc.edu (J. Barrington-Trimis), tjpayne1@umc.edu (T.J. Payne), meganlsa@upenn.edu (M. Saddleson), alexandra.loukas@austin.utexas.edu (A. Loukas).

<https://doi.org/10.1016/j.addbeh.2017.11.016>

Received 29 September 2016; Received in revised form 27 January 2017; Accepted 9 November 2017
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1. Introduction

Despite a large and growing federal investment in research on electronic nicotine and non-nicotine delivery systems (ENDS/ENNDS),¹ interpretations of findings from this research and their application to inform policy has been hampered by a lack of validated measurement tools for ENDS. The recent market entry of ENDS, along with their diversity and rapidly evolving nature, has presented unique measurement challenges. As a result, few standards and data on the psychometric properties of ENDS use measures exist to guide researchers on measurement development, selection, and interpretation. Furthermore, the validity and reliability of measures may change as the nature of ENDS products and their use continue to evolve. Thus, there is an ongoing, critical need for guidance in selecting and developing measures to assess ENDS use. This commentary article identifies four important areas related to the evaluation of ENDS use in population surveys: (a) describing ENDS products (terminology, images); (b) defining current use; (c) evaluating frequency and quantity of use; (d) characterizing devices and e-liquids (device type, flavors, and nicotine content). We provide a summary (conducted August–October 2015) of the measurement of these constructs across national tobacco use surveys and 30 projects within the 14 federally-funded Tobacco Centers of Regulatory Science (TCORS; see Tables 1 & 2), with emphasis on areas where there is greater consistency and possibly emerging consensus. Additionally, we provide considerations for selecting ENDS use measures for future studies.

2. Product description

Despite the widespread awareness of ENDS (Weaver et al., 2016), terminology varies among both consumers and researchers, and continues to evolve over time. Accordingly, many national tobacco use surveys and TCORS studies provide preamble text to describe ENDS prior to question administration, often by using multiple terms and identifying their common characteristics (e.g., flavored e-liquids, battery powered) and brand names. Consistent across preambles was the use of some variant of *electronic cigarette*, *e-cigarette* or *e-cig* when referring to ENDS. Less consistent was the inclusion of additional terminology (e.g., *vape pens*, *vaping devices*, *mod*, *personal vaporizer*), length and detail of the preamble text, and reference to specific characteristics (e.g., nicotine, flavors, disposable, refillable). Images of ENDS products were included in roughly half of the TCORS surveys, most of which were online surveys, as well as in the Population Assessment of Tobacco and Health (PATH) Study (Wave 3). Research is needed to evaluate the sensitivity of participant responses with respect to how ENDS are described (Walton et al., 2015). Findings from a recent study suggest a shift is occurring away from “e-cigarette” terminology towards “vapor” terminology, prompting the authors of that study to advise defaulting to “vapor” terminology (e.g., describing use as “vaping” and users as “vapers”), although another study found that “e-cigarette” and “vape” are widely understood among smokers participating in a web-based smoking intervention (Ayers et al., 2016; Pearson et al., 2016). Nonetheless, researchers should consider providing a preamble with sufficient detail and, when feasible, include images depicting the wide variety of ENDS device types, improving the likelihood that the target population has a clear understanding regarding the products to which the researcher is referring (Alexander et al., 2016).

¹ We acknowledge that there is neither consensus nor consistency in terminology for referring to these devices in the scientific literature. Multiple terms are used and each is arguably imperfect. In this paper, we use “electronic nicotine and non-nicotine delivery systems” as a variation of a commonly used term in acknowledgement that many youth and some adult users report using the devices without nicotine (Miech, Patrick, O'Malley, & Johnston, 2017; Weaver, Kemp, Heath, Pechacek, and Eriksen, 2017). For brevity, we abbreviate as “ENDS,” hereinafter.

3. Definitions of current use

Establishing meaningful definitions of ENDS use is key to understanding use patterns and the population health impact of ENDS. Whereas definitions and measures of lifetime use of ENDS are generally consistent across national and TCORS studies, there are important differences and scholarly debate in defining “current use.” Most commonly, particularly with youth studies, current use refers to any past month use. However, the value of this definition has been challenged for its inclusion of recent experimenters or recent former users, and for lumping infrequent users with frequent, established users (Amato, Boyle, & Levy, 2015, 2016; Kozlowski & Giovino, 2014). In studies of adults, current users are often defined by self-identification of current use through reported frequency of use (e.g., “some days”, “every day”, or “rarely”). The PATH Study survey programming (Wave 3; see Table 1) distinguishes regular *current* (some days or every day) adult users from *experimental current* users by whether they reported having ever “fairly regularly” used the product. A few studies have defined current use as ≥ 5 days of use during the past 30 days, suggesting this threshold might exclude infrequent, potentially experimental, users (Amato et al., 2015, 2016). The potential relevance of such a distinction is underscored by a recent study indicating that daily, but not non-daily, ENDS use was predictive of greater cigarette cessation attempts and reduced smoking among UK adults (Brose, Hitchman, Brown, West, & McNeill, 2015). Definitions of current ENDS use should incorporate this important distinction; however, broad consensus is lacking on the measures and the criteria for defining user groups, particularly across different study populations (e.g., youth and adults) where differential criteria for current use may be warranted.

Prevalence rates generated by different definitions can vary considerably, compromising comparisons across studies. Until there is consensus on how to define ENDS use status, researchers should consider including sufficient questions to permit application and reporting of multiple definitions to facilitate comparisons with other studies. At a minimum, this could entail assessing frequency of use (e.g., number of days used in past 30 days) and whether the individual self-identifies as a “current” user of ENDS. If distinguishing regular from experimental use, a measure of lifetime frequency or quantity of use would be necessary, although we are not aware of any validated measure or demarcation.

4. Frequency and quantity

Compared to measuring cigarettes, assessing the frequency and quantity of ENDS use has been more challenging. ENDS use is less finite, entailing anything from a puff or two at a time, a longer session, or relatively continuous use throughout the day. For this reason, ENDS use is substantially more variable and more difficult to quantify than cigarette use (Kim, Davis, Dohack, & Clark, 2016). Most TCORS studies and national surveys have focused on measuring frequency, rather than quantity, of use. Most commonly, frequency was measured by asking the number of days respondents used ENDS in the past 30 days. Many TCORS studies and the PATH study (among daily users only) included one or more follow-up questions asking the number of times or occasions used per day. Few studies assessed quantity of ENDS use, likely due to the difficulties in consistently and accurately capturing these data from respondents across the wide range of devices and use patterns (e.g., number of puffs, disposables, cartridges, or refills; size of cartridge/tank; volume of e-liquid used) (Cooper, Harrell, & Perry, 2016; Hinds et al., 2016; Kim et al., 2016). A shortcoming of questions assessing the quantity of disposables or cartridges is that they do not permit comparable responses from those using products that include a refillable e-liquid tank; similarly, questions assessing volume of e-liquid are both difficult for participants to answer and not applicable to disposable or cartridge ENDS users (Cooper et al., 2016).

Beyond general frequency estimations of the number of days used, it

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