Should Clinicians Recommend E-cigarettes to Their Patients Who Smoke? No.

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Clinicians should not *routinely* recommend electronic nicotine delivery devices (ENDS), such as e-cigarettes, to their patients who smoke. The wisdom of this evidenced-based recommendation stems from 4 key issues: inadequate safety, poor effectiveness, little regulation, and an ethical framework to do no harm.

First, we lack strong evidence in regard to the safety of ENDS, and evidence exists about potential and real harms. While many studies report lower levels of toxicants in ENDS compared with conventional cigarettes,[1] the belief that ENDS are thus safe is false. ENDS appear to deliver a similar number of particulate matter as cigarettes,[2] and exposure to particles increases risks for cardiovascular and respiratory disease,[3,4] raising concern that particulate matter in ENDS may have similar adverse effects. Potentially cytotoxic or nephrotoxic effects of ENDS are also emerging.[5,6] Finally, virtually all ENDS products utilize flavorings, and the inhalation of flavor additives, such as diacetyl, is a recognized health hazard associated with respiratory disease, including bronchiolitis obliterans, commonly known as "Popcorn Lung".[7,8] Long-term inhalation of flavorings and other chemicals found in ENDS, even at low concentrations, is a safety concern.[9]

Second, the effectiveness of ENDS as a smoking cessation aid is questionable at best, potentially ineffective at worst, and significantly poorer than existing FDA-approved optimal therapies, such as combined nicotine replacement therapy (NRT) or varenicline, with intensive behavioral treatment. Results from 2 randomized controlled trials suggest that ENDS may help some smokers stop smoking, but the quality of evidence was rated as low.[10] On the contrary, a meta-analysis of 4 population-based longitudinal studies and 1 cross-sectional study indicated ENDS use is associated with significantly lower odds of quitting smoking cigarettes.[9] Whether ENDS help or hurt a patient's chances of quitting, as of today, they are significantly *less* effective than existing best practices.[11]

Third, until regulations are approved by authorities, clinicians should pause for thought before recommending ENDS. Lack of regulation has resulted in battery and other safety concerns, resulting in overheating, fire, and explosions, with damaging, disfiguring, and life-threatening consequences to users and non-users.[12] Poisonings from ENDS exposure, particularly for young children, has increased exponentially in the last 5 years.[13] From a regulatory approach, nicotine concentrations found in ENDS can be markedly different than the labeled content, and some supposedly nicotine-free products contain varying concentrations of nicotine.[1] Finalizing pending FDA regulations of ENDS in the United States would be a significant step forward.

Finally, the ethical duty of medicine is to do no harm. Jumping from the 10th floor of a burning building rather than the 15th floor offers no real benefit. If a clinician recommends penicillin for a resistant infection in the face of more effective therapy, they would face an uncertain defense in front of their colleagues or courts. For clinicians that do recommend ENDS, do they document such in the medical record? Given the rise in medical lawsuits related to ENDS side effects or injuries,[14,15] until such time that medical evidence supports ENDS safety and effectiveness, and robust regulatory frameworks exist, clinicians who recommend ENDS to patients in favor of more effective and safe products[16] may face medico-legal risks.

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Some clinicians may be tempted to recommend ENDS for certain subgroups of smokers, but this approach is problematic. Pregnant women may think ENDS use in pregnancy is safe and avoid quitting tobacco entirely in pregnancy in favor of switching to ENDS.[17] No trials, however, have evaluated the safety of ENDS use during pregnancy[18] and cells from embryos and newborns have shown greater cytoxicity to ENDS fluid than adult cells.[19] It is problematic to recommend ENDS for asthmatic tobacco users, as immediate reduction in lung function is observed when using ENDS.[20,21] Perhaps most importantly, the impact of increased ENDS use among youth has generated national and international concern.[22,23] In adolescents, ENDS use is associated with increased odds of being diagnosed with asthma and increased asthma severity[24] and is also associated with lower cigarette smoking abstinence.[25]

One thing perhaps all clinicians can agree on is that patients need more help from providers in quitting tobacco use. The good news is that clinicians already have adequate tools at their disposal. Best practices (ie, combined behavioral support and FDA-approved pharmacotherapy) provide safe and effective treatment for smoking cessation, increasing quit rates by two- to threefold.[11] Encouraging clinicians to utilize such best practices should be a priority. Until more independent data on ENDS safety and effectiveness emerges, clinicians should be advised against routinely recommending ENDS to their patients who smoke.

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References

1. Pisinger C, Døssing M. A systematic review of health effects of electronic cigarettes. *Prev Med*. 2014;69:248-260.
2. Fuoco FC, Buonanno G, Stabile L, Vigo P. Influential parameters on particle concentration and size distribution in the mainstream of e-cigarettes. *Environ Pollut*. 2014;184:523-529.
3. Pope CA III, Burnett RT, Krewski D, et al. Cardiovascular mortality and exposure to airborne fine particulate matter and cigarette smoke: shape of the exposure-response relationship. *Circulation*. 2009;120(11):941-948.
4. Mehta S, Shin H, Burnett R, North T, Cohen AJ. Ambient particulate air pollution and acute lower respiratory infections: a systematic review and implications for estimating the global burden of disease. *Air Qual Atmos Health*. 2013;6(1):69-83.
5. Jensen RP, Luo W, Pankow JF, Strongin RM, Peyton DH. Hidden formaldehyde in e-cigarette aerosols. *N Engl J Med*. 2015;372(4):392-394.
6. Golli NE, Jrad-Lamine A, Neffati H, et al. Impact of e-cigarette refill liquid exposure on rat kidney. *Regul Toxicol Pharmacol*. 2016;77:109-116.
7. Allen JG, Flanigan SS, LeBlanc M, et al. Flavoring chemicals in e-cigarettes: diacetyl, 2,3-pentanedione, and acetoin in a sample of 51 products, including fruit-, candy-, and cocktail-flavored e-cigarettes. *Environ Health Perspect*. 2015;124(6):733-739.
8. National Institute for Occupational Safety and Health. *Occupational Exposures to Diacetyl and 2, 3-pentanediione*. Cincinnati, OH: National Institute for Occupational Safety and Health; 2013.
9. Grana R, Benowitz N, Glantz SA. E-cigarettes: a scientific review. *Circulation*. 2014;129(19):1972-1986.
10. McRobbie H, Bullen C, Hartmann-Boyce J, Hajek P. Electronic cigarettes for smoking cessation and reduction. *Cochrane Database Syst Rev*. 2014;12(12):CD010216. 10.1002/14651858.CD010216.pub2.
11. Fiore MCJC, Baker TB. *Clinical Practice Guideline: Treating Tobacco Use and Dependence: 2008 Update*. Washington, DC: US Department of Health and Human Services Public Health Service; 2008.
12. Rudy SF, Durmowicz EL. Electronic nicotine delivery systems: overheating, fires and explosions [published online ahead of print March 9, 2016]. *Tob Control*. doi: 10.1136/tobaccocontrol-2015-052626.
13. Chatham-Stephens K, Law R, Taylor E, et al. Notes from the field: calls to poison centers for exposures to electronic cigarettes—United States, September 2010-February 2014. *MMWR Morb Mortal Weekly Rep*. 2014;63(13):292-293.
14. Branson-Potts H. E-cigarette explosions promot three lawsuits in California. *Los Angeles Time*s. November 19, 2015. http://www.latimes.com/local/lanow/la-me-e-cigarette-lawsuits-20151119-story.html. Accessed Mar 23, 2016.
15. Ovalle D. E-cigarette exploded in Florida man's mouth, lawsuit contends. *Miami Herald*. January 28, 2016. http://www.miamiherald.com/news/local/community/miami-dade/article57037303.html. Accessed Mar 23, 2016.
16. Kandra KL, Ranney LM, Lee JG, Goldstein AO. Physicians' attitudes and use of e-cigarettes as cessation devices, North Carolina, 2013. *PLoS One*. 2014;9(7):e103462.
17. Meernik C, Goldstein AO. A critical review of smoking, cessation, relapse and emerging research in pregnancy and post-partum. *Br Med Bull*. 2015;114(1):135-146.
18. Coleman T, Chamberlain C, Davey MA, Cooper SE, Leonardi-Bee J. Pharmacological interventions for promoting smoking cessation during pregnancy. *Cochrane Database Syst Rev*. 2015;12(12):CD010078.
19. Bahl V, Lin S, Xu N, Davis B, Wang YH, Talbot P. Comparison of electronic cigarette refill fluid cytotoxicity using embryonic and adult models. *Reprod Toxicol*. 2012;34(4):529-537.
20. Vardavas CI, Anagnostopoulos N, Kougias M, Evangelopoulou V, Connolly GN, Behrakis PK. Short-term pulmonary effects of using an electronic cigarette: impact on respiratory flow resistance, impedance, and exhaled nitric oxide. *Chest*. 2012;141(6):1400-1406.
21. Marini S, Buonanno G, Stabile L, Ficco G. Short-term effects of electronic and tobacco cigarettes on exhaled nitric oxide. *Toxicol Appl Pharmacol*. 2014;278(1):9-15.
22. Arrazola RA, Singh T, Corey CG, et al.; Centers for Disease Control and Prevention (CDC). Tobacco use among middle and high school students - United States, 2011-2014. *MMWR Morb Mortal Wkly Rep*. 2015;64(14):381-385.
23. Dutra LM, Glantz SA. High international electronic cigarette use among never smoker adolescents. *J Adolesc Health*. 2014;55(5):595-597.
24. Cho JH, Paik SY. Association between electronic cigarette use and asthma among high school students in South Korea. *PLoS One*. 2016;11(3):e0151022. 10.1371/journal.pone.0151022.
25. Dutra LM, Glantz SA. Electronic cigarettes and conventional cigarette use among U.S. adolescents: a cross-sectional study. *JAMA Pediatr*. 2014;168(7):610-617.