TOBACCO-RELATED DISEASE RESEARCH PROGRAM

American Heart Association.

A TRDRP / AHA Workshop:

Exploring Research on the Health Effects of E-Cigarettes

June 13, 2018

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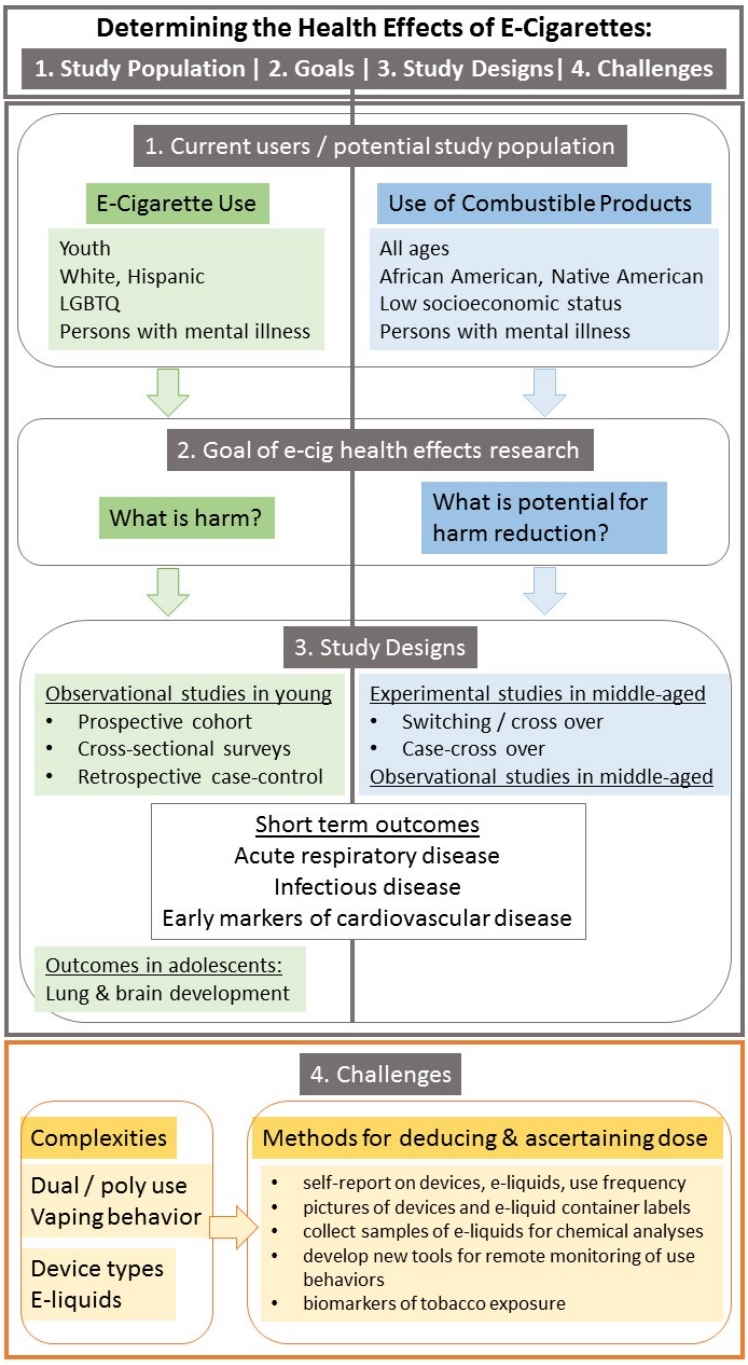

Overview: This graphic provides an overview of the discussions at a workshop of national experts to explore the challenges and best approaches for increasing our knowledge of the health effects of e-cigarettes. Based on two different tobacco use populations (1) who may be affected by e-cigarette use very differently, two general research questions (2) emerged that are best addressed by different study designs (3). Given the complexity of the vaping landscape, unique challenges (4) need to be considered when designing health effects studies, including the determination of doses of toxins delivered to the human body.

Introduction

Electronic (e)-cigarettes represent an alternative form of nicotine delivery that are promoted as safer to use than combustible cigarettes. Additional rigorous studies into their long-term health effects in humans are desired, to contribute to the overall body of knowledge needed for public health guidance.

E-cigarettes have traditionally been defined as devices with a heating element that produces an aerosol from a liquid that users can inhale (National Academies of Sciences 2018). Following introduction of the e-cigarette into the US in 2006, use has increased over time, and while surveys indicate a decline in e-cig use among youth from 2015 to 2016/17 (CDC 2018), there is evidence that newer products such as JUUL may have resulted in a recent, dramatic rise in e-cigarette use especially among youth and young adults. While it is hard to predict how e-cigarette use will evolve over time, research into their health effects is critical to enable evidence-based recommendations for the greatest possible benefit to public health. To seek input on how to best obtain this evidence, the Tobacco-Related Disease Research Program (TRDRP) and the American Heart Association (AHA) convened a workshop of national experts to hear opinions on the approaches to address some of the urgent questions about the health effects of e-cigarettes. In this report we summarize the main themes that emerged from the workshop discussions.

Current e-cigarette users

At the population level, e-cigarette use patterns are complex and change over time, and ascertaining use patterns is challenging, especially with newly emerging products potentially disrupting current user demographics and use behaviors. At the workshop, e-cigarette use patterns in the US were described based on data from the National Health Interview Survey (NHIS) and the National Youth Tobacco Survey (NYTS). NHIS data indicates that 5.2 % of young adults (18-24 year) report “every day” or “some days” use in 2015 (CDC 2017). However, prevalence estimates depend on the definition and perception of what an e-cigarette is. In fact, the data described above does not reflect the more recent introduction and adoption of novel products, such as JUUL (introduced in 2015). While NYTS data indicates that e-cigarette use among high school students dropped from 2015 to 2016/17 (CDC 2018), there is evidence that some survey respondents may not realize that JUULs are e-cigarettes and thus underreport e-cigarette use (Willett JG 2018). Workshop participants argued that introduction of JUUL, which appears to be particularly attractive to youth and young adults, may have led to an increase in the number of young e-cigarette users over the past few years, but appropriate survey instruments are needed to fully capture use of emerging e-cigarette products.

Another critical aspect of e-cigarette use is the co-use of e-cigarettes with combustible cigarettes and other tobacco products as well as other substances of abuse, such as cannabis. Such dual / poly use represents a significant proportion of actual e-cigarette use patterns, and e-cigarette-only use is relatively rare. For instance, NHIS data from 2015 show that 58.8% of all e-cigarette users are current smokers and only 11.4% are never smokers (CDC 2016). This reality of dual / poly use needs to be considered when deciding which specific research goals may have the most impact on public health, and also has implications for the feasibility of studies into e-cigarette-only use. Thus, in future studies, it may be important to distinguish sole users from polyusers, as the two groups have widely different exposures.

The demographics of e-cigarette users are not the same as those of combustible smokers. E-cigarette use is more common among high school youth and young adults (18-24 years old), among males, among

Hispanic and non-Hispanic whites, among LGBTQ and among those with mental illness. Unique opportunities may exist in California to target studies to these populations.

Goal of research into the health effects of e-cigarettes

In general terms, the goal of e-cigarette research is to create the scientific evidence base for clinical recommendations, local policies and federal regulations. Food and Drug Administration (FDA) / Center for Tobacco Products (CTP) tobacco regulatory actions are based on assessing risks and benefits to the population as a whole, and behavioral effects have important implications for the overall impact of e-cigarettes on public health. E-cigarettes have been shown to act as catalysts that might promote or facilitate transition to combustible cigarette use, i.e., vapers become dual users or smokers, and some smokers who use e-cigarettes, possibly to try to quit smoking, instead become dual users. In other smokers, however, switching to e-cigarettes may be transient and enable quitting all tobacco use (combustible and electronic) entirely. Importantly, though, understanding e-cigarettes' health effects is essential in assessing their impact on public health.

Harm versus harm reduction

When considering the health effects of e-cigarette-only use, two fundamentally different questions emerge, depending on the subjects' smoking status prior to e-cigarette use; (i) what is the harm of e-cigarette use in never smokers and (ii) does e-cigarette use lead to harm reduction in smokers of combustible cigarettes if they completely switch to continued e-cigarette-only use? Workshop participants felt that answering both questions is of critical importance, given the significant number of youth and young adult never smokers who adopt e-cigarette use, and many current smokers may benefit if complete switching to e-cigarettes is found to be less harmful. Because of the large proportion of dual / poly users among e-cigarette users, they should be included in studies of harm and harm reduction. Workshop participants pointed out, though, that studies of cardiovascular effects in dual users may not provide new actionable insights, since mild smoking (3 cigarettes a day) is known to be as detrimental to cardiovascular health as heavy smoking (2 packs a day) (Pope CA 3rd 2009), and dual users will likely display the same, if not worse, cardiovascular risks as only-smokers, even if dual use enticed them to smoke less than when they were only-smokers.

Since effects of tobacco use on chronic diseases are most efficiently studied in middle aged individuals who are beginning to show early signs of cardiovascular, respiratory, cancer and other morbidities, and quitting smoking at this age is already known to reduce harm, the ideal population for investigating whether complete switching to continued e-cigarette use reduces harm are middle-aged smokers. The vast majority (> 95%) of 45 year and older e-cigarette users are current and former smokers (CDC 2016), and comparing continued smoking only to dual use and to complete switching to e-cigarettes only may reveal harm reduction benefits of e-cigarettes.

For the same reasons, the study of harm, i.e. comparing never smokers to e-cigarette-only users, would also be best conducted in middle aged participants. However, e-cigarette-only use is rare in the 45-year and older population, and e-cigarette use is generally highest among youth and young adults. Because approximately 40% of 18-24-year-old e-cigarette users were never cigarette smokers in 2015 (CDC 2016), and the recent introduction and adoption of JUUL may further amplify this trend, workshop participants suggested that youth and young adult vapers represent the ideal population for the study of

harm. Given their overall good health, though, such studies should initially focus on acute rather than chronic health effects or the study of early biomarkers of cardiovascular or respiratory injury.

Defined e-cigarette use patterns versus population level studies

An important consideration is whether the outcomes of a study can have a direct impact on FDA regulatory activities. Representatives from the FDA underscored the need for specific and quantitative research to support the creation of unambiguous and measurable e-cigarette product standards. This could be achieved through controlled clinical trials, in which a specific device is used with specified settings and frequencies of use. This approach could point to a detrimental health effect of a specific heating coil, a specific temperature limit or a specific flavor ingredient. Other workshop participants emphasized the need for studies of human populations that reflect the reality of the complex vaping landscape. This includes a multitude of vaping devices, different e-liquids containing multiple constituents, and different use behaviors. Importantly, since most e-cigarette users also use other tobacco products as well as marijuana it is difficult to isolate the effects of e-cigarettes alone on these individuals. New methodological and statistical approaches are needed to account for dual/poly use and enable evidence-based decision making. In addition to this complexity at any given time, newly emerging products (devices and e-liquids) further complicate the task of tracking use in natural populations of e-cigarette users. Participants suggested that the range and complexity of e-cigarette use could be studied to assess which particular components and constituents of e-cigarette use may be linked to cardiorespiratory injury.

Measuring exposure and harm from e-cigarette use

Establishing the dose-response relationship is a critical step when assessing an exposure's harm potential. A major challenge in population studies is ascertaining the doses of toxicants individuals are exposed to when using e-cigarettes in their daily lives. Levels of exposure are influenced by device type, e-liquid composition and vaping behavior, and workshop participants elaborated on the complexities these factors introduce in studies of health effects and discussed approaches to measuring exposure and harm despite these challenges.

Devices and e-liquids

In the last decade, several different e-cigarette devices have been developed, and their different properties, such as heating temperatures and composition of heating coils, affect the composition of the aerosol that is generated from e-liquids. The age of a device and manipulation of a device by the user can further influence the rate of delivery of nicotine and other constituents. An important characteristic of e-cigarette devices relates to the ability of a user to access and manipulate the e-liquid. In closed systems, a single-use nicotine cartridge (pod) is used and discarded, while in open systems the user (re)fills the e-liquid tank manually, allowing use of e-liquids containing different concentrations of nicotine and other constituents, including cannabinoids. Importantly, a standardized research e-cigarette (SREC, a closed system) has been developed by the e-cigarette company NJOY LLC in response to a competitive SBIR contract solicitation by the National Institute on Drug Abuse (NIDA). The SREC tobacco product master file has been filed with the FDA, and SREC is expected to become available for purchase toward the end of 2018. Its specifications can be found at https://www.drugabuse.gov/funding/supplemental-information-nida-e-cig. This standard e-cigarette

could be particularly useful in performing uniform studies to assess the efficacy of e-cigarettes as cessation devices.

E-liquids contain numerous ingredients, including nicotine at various concentrations and in different forms that affect its bioavailability, i.e., free-base, monoprotonated and diprotonated, (El-Hellani A 2015), the solvents propylene glycol (PG) and vegetable glycerin (VG) and one or more of a very large number of different flavorings (by 2014, more than 7000 flavors had been identified (Zhu SH 2014), the actual number is much higher today). Importantly, while PG and VG are in widespread use in humans for other purposes and many flavorings used in e-liquids are designated as generally-recognized-as-safe (GRAS) by FDA for oral consumption, most have not been assessed for their toxicity when inhaled. An example of a safe food ingredient that exhibits potent respiratory toxicity when inhaled is diacetyl, the butter flavor used in popcorn (Holden VK 2016), illustrating the critical need to assess the safety of GRAS compounds when inhaled, an enormous task given the number of flavors offered in e-liquids. Furthermore, it is unknown what quality control is used during the manufacture of e-liquids and unintended contaminants (Hadwiger ME 2010) (Hutzler C 2014), such as toxic aldehydes and other volatile organic compounds and oxidizing chemicals, may be either present in the product or are introduced during use. For instance, metals may leach from metallic heating coils. Additionally, ingredient labels have been found to be inaccurate, including the listing of nicotine concentrations (El-Hellani A 2015) (Hadwiger ME 2010).

Analyses of the aerosol created by heating e-liquids indicate that it is considerably less complex than the smoke created by combustion of tobacco, and is lacking numerous carcinogens present in tobacco smoke (National Academies of Sciences 2018). However, the chemical composition of aerosols includes compounds not found in tobacco smoke and novel molecules generated through reactions with e-liquid solvents (Salamanca JC 2018).

Overall, the concentrations of nicotine, solvents, flavors, metals and other potential toxicants in aerosols vary widely, depending on device characteristics and type of e-liquid used, not only highlighting the large number of potential toxicants that need to be considered in health effects research but also the challenge of ascertaining their doses.

Vaping behavior

Beyond reliably identifying device types and composition of e-liquids used by study participants, additional factors need to be considered when estimating doses of chemicals actually delivered to the lung. In addition to variable behaviors shared with smokers, such as puff frequency, duration and volume, users of e-cigarettes engage in additional use patterns that affect dose. Device settings (voltage) determine the temperature to which the e-liquid is heated, and users may modify devices to achieve higher temperatures than set by manufacturers. Vapers use additional methods to increase nicotine delivery, and inadvertently other chemicals in e-liquids, through techniques such as dripping (i.e., inhale vapors produced by directly dripping e-liquids onto heated coils) and altering the PG/VG ratio to produce vape tricks (i.e., "cloud competitions”). Users may also switch to different devices and use a variety of e-liquids with different characteristics over time as new products appear on the market.

Similar to the impact of device types and e-liquids on the doses of potential toxicants delivered to the human lung, vaping behaviors contribute to this complexity. Careful consideration of how to ascertain dose is therefore of critical importance in studies of health effects of e-cigarettes.

Approaches to deduce and ascertain dose

The dose of a potential toxicant can be estimated and measured at many levels. As an external measure of exposure, participants in surveys or cohort studies are asked to self-report which devices and e-liquids they use and their use frequency and other behaviors. To gain more reliable information, workshop participants suggested that researchers obtain pictures of devices and e-liquid container labels, collect samples of e-liquids for chemical analyses and develop new tools for remote monitoring of use behaviors. Repositories of used e-liquids would enable future analyses in case, e.g., new toxicants are discovered in the future.

For the determination of actual human exposure, workshop participants discussed the use of various biomarkers and their limitations. Blood and urine can be analyzed to establish levels of nicotine and other harmful and potentially harmful constituents delivered to the human body. Collection and storage of biospecimens would enable future targeted analyses and even banking of exhaled breath should be considered, as exhaled breath biomarkers are currently being developed. A difficult question to consider, though, is what level of exposure is harmful, and the sensitivity and specificity of biomarker assays. A detailed account of biomarkers of tobacco exposure was recently published, summarizing the outcomes of an FDA-sponsored public workshop (Chang CM 2017), as well as a report from the TCORS Biomarkers Workgroup (Schick SF 2017). When designing cohort studies, it is important to keep in mind that many biomarkers of exposure are unstable and only report on recent tobacco use, and that biomarkers for the multitude of inhaled flavors do not yet exist. Biomarkers are also an important tool for verifying non-use in controls and lack of combustible smoking in e-cigarette-only users, but cannot be used to establish or rule out dual use since a biomarker that distinguishes between e-cigarette and combustible cigarette use has not been identified.

Measuring harm

The harm caused by smoking combustible cigarettes is well established based on many decades of research, and conclusive evidence for a causal link between smoking and a long list of diseases has been summarized in multiple editions of the Surgeon General's Report over the years. This extensive evidence base guides research into the health effects of e-cigarettes, and raises the question of how the effects of e-cigarette use compare to those of combustible tobacco. Based on the known links between tobacco smoke constituents and health effects, the emerging knowledge of e-liquid and aerosol constituents suggests plausible pathways by which exposure to e-cigarettes may influence cardiovascular and other diseases, where the short-term and long-term outcome measures to assess disease risk and harm are well understood and developed. For instance, an FDA-sponsored public workshop on biomarkers of potential harm, held in concert with the above-mentioned workshop on biomarkers of tobacco exposure, was summarized in a recent publication (Chang CM 2019).

While long-term morbidity and mortality caused by e-cigarettes will ultimately need to be understood, acute effects and biomarkers of potential harm are initially used in shorter-term studies to assess short-term harm and risk for long-term harm. Workshop participants pointed to open questions, though, including which biomarkers are most important, whether a decrease in biomarkers of potential harm translates into decreased risk when comparing e-cigarette users to smokers, and whether a lack of

increase in a biomarker of potential harm in e-cigarette users as compared to never users would be meaningful.

Human study designs to determine health effects of e-cigarettes

Workshop participants were asked to propose specific human studies for the investigation of e-cigarettes' health effects. Workshop participants reviewed the pros and cons of the main types of human study designs, including experimental studies (interventional, clinical trials) and observational studies, such as cross-sectional surveys, case-control studies (retrospective) and cohort studies (prospective) (Table 1). Recommendations made by workshop participants included investigations of e-cigarettes' potential for (i) harm in never smokers and for (ii) harm reduction in current smokers, (iii) opportunities to create and leverage resources and (iv) several general considerations.

(i) The potential for harm in never smokers

The proposed approaches for investigating the potential of e-cigarettes to cause harm in never smokers focused on observational studies. A cohort study into the long-term chronic health effects of e-cigarette use would be most compelling, as it would provide strong evidence for the harm caused by e-cigarettes. Long-term cohort studies are time-consuming and expensive. A long-term cohort study would be particularly challenging given e-cigarette-only users who never smoked are mostly youth and young adults, and would have to be followed over decades for cardiovascular, respiratory, cancer and other health effects to manifest as clinically significant events. It would also have to take into account the complexity of the vaping landscape, and changes in use behaviors over time would need to be anticipated, requiring a large cohort size. Several of these issues could be addressed using dynamic clinical studies designs, which might necessitate the development of newer methodologies not in use by most current observational cohort studies.

Given the challenges associated with long-term studies, workshop participants suggested that short-term cohort studies, focusing on acute health effects that manifest in young people, would be feasible and also still effective in providing information for evidence-based recommendations. Specific outcomes to focus on were acute respiratory diseases, infectious diseases and pre-clinical markers of cardiovascular diseases. Other suggestions included assessing the effects of e-cigarette use on lung development, as alveolar development continues to about age 20, and to investigate brain development and cognitive effects, including e-cigarettes' addictive potential and other behavioral outcomes.

Cross-sectional surveys and retrospective case-control studies can be designed to look at health effects in vapers who never smoked. Since e-cigarette use is relatively recent, and most vapers who never smoked are young, such studies would focus on acute effects.

(ii) The potential for harm reduction in smokers

The potential for harm reduction in smokers can be investigated using observational studies, such as retrospective case-control studies and prospective cohort studies**,** comparing the incidence of severe acute diseases in smokers versus smokers who have completely switched to continued e-cigarette use. One limitation in studying harm reduction using observational studies is the fact that individuals who have switched from smoking to e-cigarette-only use are relatively rare, and a large population would have to be surveyed to identify them.

An important approach for assessing the health effects of complete switching is to conduct experimental studies, or clinical trials, in which smokers either continue to smoke (controls) or entirely switch to e-cigarettes (study arm) (cross over, switching studies) and are assessed for cardiovascular, respiratory or other health effects, either short-term or longer-term. These studies would best be performed in healthy middle-aged smokers, i.e. individuals at an age when chronic diseases first appear at the population level, or smokers who have already presented with chronic disease symptoms such as hypertension, myocardial infarction (MI) or chronic obstructive pulmonary disease (COPD), and a decrease or increase in chronic disease incidence or exacerbation could be detected.

A variation of the cross over study is the case-cross over study, in which individuals are compared to themselves over time. In this scenario, health effects / biomarkers of harm are compared within individual smokers who have already presented with chronic disease symptoms such as hypertension, MI or COPD ("cases"), following periods of smoking versus periods of e-cigarette use.

In any study investigating the health effects of complete switching from smoking to continued e-cigarette use, workshop participants suggested that dual use could be included as a study arm, since dual use, or also poly use with other substances such as cannabinoids, is a likely long-term behavior in smokers who try e-cigarettes, and understanding whether dual / poly use is less or more harmful than smoking only would be important information for evidence-based medical recommendations.

(iii) Creating and leveraging resources

Ultimately, it is important to determine the long-term health effects of e-cigarettes. Since long-term cohort studies are expensive, and studying e-cigarette use long-term is challenging given the changing nature and complexity of the vaping landscape, workshop participants discussed how to create or leverage resources to overcome hurdles and enable longer-term cohort studies. One approach would be to initiate a cohort study that is focused on short-term health outcomes, biomarkers of harm or progression of subclinical disease to relatively quickly obtain data relevant for evidence-based decision making, but to design the study in such a way that it can be easily extended past the initial end date for obtaining longer-term outcome measures, should follow-on funding be secured. In another two-stage approach, a survey of a very large population would first be conducted for cross-sectional analyses and then leveraged to identify e-cigarette-only users, who are relatively rare, to recruit for cohort studies. Finally, workshop participants made the point that a clinical trial that focused on a specific device, e-liquid and a few device settings could be leveraged as a pilot for studying additional devices and e-liquids once study parameters have been worked out and first results have been obtained.

Alternative to implementing a two-stage approach, investigators could collaborate with already existing cohort studies, e.g. by identifying a relevant subset of study participants (e-cigarette users) for ancillary studies that would benefit from the data already collected by the original cohort study. Cohorts for consideration include the Population Assessment of Tobacco and Health (PATH) study, the Adolescent Brain Cognitive Development (ABCD) study, the Genetics of Asthma in Latino Americans (GALA) Study, the Children's Health Study (CHS) and others. Similarly, workshop participants pointed to opportunities in health care systems, such as Kaiser Permanente, the UC medical centers, and medical systems serving priority populations, that could use electronic health records (EHR) to study health outcomes in tobacco users and/or help identify tobacco users for recruitment into experimental studies, as long as tobacco use is reported or can be ascertained using EHRs.

(iv) General considerations

Health disparities

The existence of tobacco-related health disparities is well documented, and it is critical that particularly vulnerable populations are included in research, if not oversampled or studied exclusively, to maximize the benefits for those most affected. The demographics of e-cigarette users differ from those of smokers, so when it comes to studying the potential for harm of e-cigarettes, efforts should be made to focus on priority populations that exhibit proportionally highest use of e-cigarettes, such as Hispanics, LGBTQ individuals or individuals with mental illness. By contrast, in studies investigating the potential for harm reduction, studies could focus on populations that exhibit proportionally highest use of combustible cigarettes or other combustible products, such as certain racial ethnic groups (e.g., African Americans, American Indians and Alaska Natives, Asian Americans, Latinos, Native Hawaiians and other Pacific Islanders, individuals identifying with multiple racial groups), veterans, individuals with mental illness, people with low socioeconomic status or LGBTQ individuals.

Unique opportunities in California

E-cigarette use patterns in California differ from those nationwide, which may cause issues with extrapolating findings broadly from studies (e.g. surveys) that seek representative sampling, but this may also provide unique opportunities for efficient recruitment of youth and young adults who vape at higher rates in California than the rest of the nation. Due to California's demographics, unique opportunities may also exist to oversample priority population such as African Americans, Latinos, Native Americans, Asians, immigrants, military personnel and veterans. Silicon Valley techies were called out as a unique potential population to study.

Final remarks

The National Academies of Science, Engineering and Medicine (NASEM) released a consensus study report in January 2018, based on a comprehensive review of the literature that informs our understanding of the public health consequences of e-cigarettes. It found that progress is being made in our understanding of the exposure to nicotine and toxic substances caused by e-cigarettes, their dependence and abuse liabilities, and their short-term adverse health effects in humans (National Academies of Sciences 2018). Since the release of the report, numerous studies continued, and will continue, to advance our knowledge of the health consequences of e-cigarettes, and funders such as the National Institutes of Health (NIH)/FDA are supporting targeted research to address critical knowledge gaps. Importantly, the NASEM report concluded that long-term health outcomes of e-cigarette use in humans are not yet known. While workshop participants acknowledged that the initiation of a long-term cohort study has challenges, they did emphasize the importance of investigating both the harm and the potential for harm reduction of e-cigarettes in humans, and suggested that funders, researchers, and policy makers remain nimble to be able to adapt to the continuously changing tobacco landscape. Workshop participants communicated a sense of urgency for advancing the scientific knowledge needed for effective policies and evidence-based practice guidelines. The discussion of hurdles and solutions to overcome them and the specific suggestions for human studies made during the workshop serve as a valuable resource for framing funding and research agendas into the health effects of e-cigarettes.

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Table 1

	Study type	Pros	Cons
Experimental	Clinical trial (Interventional)	• well controlled exposures • assessment of outcomes • minimal confounding	• non-representative participants • small number of subjects • generally short duration • amenable to mechanistic but not disease outcomes
Observational	Cross Sectional (Survey, single point in time)	• large numbers • cost-effective • representative populations	• difficulty in establishing type and extent of exposure • unreliable disease ascertainment • difficulty in establishing temporality
	Case-control (Retrospective)	• less expensive than cohort studies • good case ascertainment • good control matching reduces potential confounding	• if exposure is low, requires large numbers of cases • recall bias with respect to type and time course of exposures
	Cohort (Prospective)	• can establish temporality • potentially better data on exposure and disease outcomes • strongest evidence on causation • can determine absolute and relative and attributable risk	• very expensive • unreliable for diseases with long latency

Table provided by Neal Benowitz, MD, University of California San Francisco

TRDRP AHA E-Cigarette Workshop - Participants

First Name	Last Name	Degree	Title	Organization	
Workshop Participants					
Bridget	Ambrose	PhD MPH	Epidemiologist, Division of Population Health Sciences at CTP	FDA	remote participation
Cathy	Backinger	PhD MPH	Deputy Director for Research Science, Center for Tobacco Products, Office of Science	FDA	
Neal	Benowitz	MD	Professor of Medicine and Bioengineering & Therapeutic Sciences; Chief, Division of Clinical Pharmacology	UCSF	
Paul	Billings		National Senior Vice President, Advocacy	American Lung Association	
Michael	Blaha	MD MPH	Associate Professor of Medicine	Johns Hopkins Medicine	remote participation
Esteban	Burchard	MD	Professor, Bioengineering & Therapeutic Sciences and Medicine	UCSF	
Zachary	Cahn	PhD	Director, Economic and Health Policy Research	American Cancer Society	
Ellie	Daniels	MD MPH	Program Director, Cancer Control and Prevention Research	American Cancer Society	
Steven	Dubinett	MD	Chief, Pulmonary and Critical Care Medicine; Senior Associate Dean, Translational Research, David Geffen School of Medicine; Director, Clinical and Translational Science Institute; UCLA Associate Vice Chancellor for Research	UCLA	
Maciej	Goniewicz	PhD PharmD	Associate Professor of Oncology, Department of Health Behavior	Roswell Park Comprehensive Cancer	
Jeffrey	Gotts	MD PhD	Assistant Professor, Medicine	UCSF	
Dorothy	Hatsukami	PhD	Professor, Department of Psychiatry; Associate Director, Cancer Prevention and Control, Masonic Cancer Center	University of Minnesota	
Andrew	Hyland	PhD	Chair, Department of Health Behavior, Division of Cancer Prevention & Population Sciences	Roswell Park Comprehensive Cancer Center	remote participation
Brian	King	PhD MPH	Deputy Director for Research Translation, Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion	CDC	
Suchitra	Krishnan-Sarin	PhD	Professor, Department of Psychiatry; Chair, Human Investigations Committee II and IV	Yale University	remote participation
Jeannie	Limpert	MD	Medical Officer, Division of Individual Health Science, OS/CTP/FDA.	FDA	remote participation
John	Maa	MD	President, Northern California Chapter of the American College of Surgeons Board of Directors, American Heart Association, San Francisco Division	Marin General Hospital	
Rob	McConnell	MD	Professor of Preventive Medicine	USC	
Carol	McGruder		Co-Chair	African American Tobacco Control Leadership Council	
Holly	Middlekauff	MD	Professor of Medicine (Cardiology), Professor of Physiology, Assistant Dean of Student Affairs, David Geffen School of Medicine	UCLA	
Ana	Navas-Acien	MD PhD	Professor of Environmental Health Sciences, Mailman School of Public Health	Columbia University	
Sam	Oh	MD PHD	Director of Epidemiology, Asthma Collaboratory	UCSF	
Vasan	Ramachandran	MD	Professor of Medicine and Epidemiology; Chief, Section of Preventive Medicine & Epidemiology, Dept. of Medicine	Boston University	remote participation
Chad	Reissig	PhD	Addiction Branch Chief, CTP	FDA	remote participation

Nancy	Rigotti	MD	Associate Chief, General Medicine Division; Director, Tobacco Research and Treatment Center	Harvard Medical School	
Albert	Rizzo	MD	Senior Medical Advisor to the American Lung Association Chief, Section of Pulmonary and Critical Care Medicine, Christiana Care Health System, Newark, Delaware	American Lung Association	
Lesly-Anne	Samedy	PharmD PhD	Post-doctoral Researcher, Asthma Collaboratory	UCSF	
Steve	Sidney	MD MPH	Director of Research Clinics, Northern California Division of Research	Kaiser Permanante	
Gideon	St. Helen	PhD	Assistant Professor, Division of Clinical Pharmacology, Department of Medicine	UCSF	
Jennifer	Unger	PhD	Professor of Preventive Medicine	USC	
Robert	Urman	PhD	Postdoctoral Research Associate, Department of Preventive Medicine	USC	
Kevin	Walton	PhD	Chief, Clinical Research Grants Branch, Division of Therapeutics and Medical Consequences	NIDA, NIH	
Kelly	Young-Wolff	PhD MPH	Research Scientist, Division of Research	Kaiser Permanante	
Organizers - American Heart Association					
Aruni	Bhatnagar	PhD	Professor of Medicine; Director, Diabetes and Obesity Center,	University of Louisville	
Jill	Dotts	MBA	National Vice President, Mission Advancement Grants and Operations	AHA	
Nivene	Elkoshairi	MA	Mission Advancement Executive Lead, Government Initiativ	AHA	
Lisa	Jones Barker	MS	Senior Vice President, Health Strategies	AHA	
Rose Marie	Robertson	MD FAHA	Chief Science and Medical Officer	AHA	
Organizers - Tobacco-Related Disease Research Program					
Bart	Aoki	PhD	Executive Director	Research Grants Program Office	
Raymond	Boyle	PhD	Senior Program Officer for Tobacco Policy Research	TRDRP	
Ginny	Delaney	PhD	Program Officer for Biomedical Sciences	TRDRP	
Phil	Gardiner	DrPH	UC Smoke and Tobacco Free Fellowship Awards, Program Officer	TRDRP	
Uta	Grieshammer	PhD	Program Officer for Biomedical Sciences	TRDRP	
Norval	Hickman	PhD, MPH	Program Officer for Social Behavioral Sciences and Public Health	TRDRP	
Jennifer	Jackson		Project Policy Analyst	TRDRP	
Marion	Kavanaugh-Lynch	MD MPH	Director	California Breast Cancer Research Program	
Lisa	Loeb Stanga	DrPH MPH	Program Officer for Basic and Clinical Biomedical Sciences Program	TRDRP	
Katherine	McKenzie	PhD	Program Officer for Cancer Prevention, Treatment, and Biology	TRDRP	
Laura	Packel	PhD MPH	Program Officer for Clinical Sciences and Epidemiology	TRDRP	