Highlighting Research and Advocacy Efforts on Electronic Nicotine Delivery Systems at the ATS International Conference in 2025

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THIS YEAR at the American Thoracic Society (ATS) International Conference, held in San Francisco, California, USA, several abstracts were presented on electronic nicotine delivery systems (ENDS). The popularity of ENDS and the exponential evolution of nicotine products beyond combustible tobacco make researching the effects of e-cigarettes imperative. Emerging clinical data raises concerns regarding the effects of vaping on health. The wide and ever-increasing variety of products available makes basic and translational studies challenging.

EXPLORING THE COMPLEX TOXICOLOGY OF ENDS COMPONENTS

Effah et al.[1] exemplified this in their study on the impact of ENDS coil composition, coil resistance, and e-liquid formulation. Their findings showed that both coil composition and e-liquid formulation influenced the reactive oxygen species present in aerosols, and that high coil resistance increased the presence of aluminum, iron, and lead. These findings demonstrate that ENDS components can yield higher toxic exposures; thus, greater adverse effects are anticipated downstream. Nicotine product manufacturers continue to seek ways to bypass regulatory controls. One novel approach involves using synthetic nicotine analogs, for which there are limited data on toxicity and addictive effects. Using *in vitro* and *in vivo* studies, Jordt et al.[2] demonstrated that 6-methyl nicotine, for example, is several times more potent than nicotine in rats, and is more cytotoxic to airway epithelial cells. Additionally, they found that product labels were highly inaccurate regarding nicotine analog content.

TRANSLATIONAL STUDIES REVEAL IMMUNOLOGIC CHANGES

Studies in both mice and non-human primates showed evidence of immunomodulation with vaping. Masso-Silva et al.[3] demonstrated that

e-cigarette aerosol exposure modulated the activation of neutrophils and macrophages in mice and decreased the presence of lymphocytes in lung-draining lymph nodes. Park et al.[4] showed systemic immune system alterations in rhesus macaques after six months of vaping, with decreased expression of TNF superfamily members and increased myeloperoxidase, CXCL2, and brain-derived neurotrophic factor in plasma. They also showed increased inflammation in airways and lung parenchyma, as well as increased collagen deposition in the airways, raising concerns that vaping may increase the risk of pulmonary fibrosis. Noel et al.[5] revealed that prenatal exposure to e-cigarette aerosols altered gene expression in the lungs and increased house dust mite-induced inflammation in male mice. Miller et al.[6] found that prior exposure to conventional cigarettes led to increased neutrophilic inflammation in mice subsequently exposed to e-cigarette aerosols. Thus, emerging data in animal models foreshadow the magnitude of the effects that vaping will have on human health.

CLINICAL CASES IN E-CIGARETTE OR VAPING-ASSOCIATED LUNG INJURY, ACUTE RESPIRATORY DISTRESS SYNDROME, AND LUNG DISEASE

The Centers for Disease Control and Prevention (CDC) has not collected data on e-cigarette or vaping-associated lung injury (EVALI) since early 2020 due to the COVID-19 pandemic. Nevertheless, EVALI remains a clinical concern, as demonstrated by multiple cases presented at ATS 2025. Case reports showed EVALI presenting concomitantly with infection, as demonstrated by Tangutoori et al.,[7] who described a case of EVALI with concurrent *Klebsiella pneumonia*. A novel presentation described by Othman et al.[8] involved EVALI masquerading as an obstructive, necrotic lung mass. Beyond EVALI, concerns persist regarding the link between vaping and both acute lung injury and acute respiratory distress syndrome (ARDS). Jiang et al.[9] conducted a retrospective study and reported a fourfold increase in the likelihood of being diagnosed with ARDS among patients who vaped, suggesting that vaping is a risk factor for ARDS and highlighting the need for screening for e-cigarette use in hospitalized patients.

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Clinical researchers are also exploring the deleterious effects of vaping on patients with pre-existing lung diseases. For example, Ramirez et al.[10] found that vaping was strongly associated with severe asthma exacerbations, even more so than smoking, and an increased need for mechanical ventilation. Vaping-associated lung disease can manifest in unexpected ways, as illustrated by a case presented by Bhattarai et al.,[11] which involved vaping-associated sarcoidosis, with radiologic findings resolving after vaping cessation.

ADVOCACY AND REGULATION: TOWARD A NICOTINE-FREE FUTURE

While the increasing evidence demonstrating the adverse effects of vaping e-cigarettes on pulmonary health is alarming, the advocacy efforts driven by dedicated members of multiple national respiratory societies for a nicotine-free future are encouraging. Bonnie Halpern-Felsher, Stanford Medicine, Stanford University, California, USA, emphasized the insidious effects of promoting flavored nicotine products and the need for a comprehensive ban. There is no evidence that flavored nicotine products help adults with smoking cessation; if e-cigarettes are intended as a means to quit cigarette smoking, there is no reason to produce flavored products at all. She discussed local efforts to broadly ban nicotine-containing products in America, particularly for adolescents. Some of these efforts, such as the generational tobacco ban passed in Brookline, Massachusetts, in 2020, have been successful. Limited data are available in many countries; however, what is available reveals how critical it is to protect adolescents and young adults. Richard van Zyl-Smit, University of Cape Town, South Africa, described the push to market ENDS in Africa, highlighting the situation in South Africa where no regulation for vaping exists. Data show that between 11–46% of adolescents who are in their final year of public education in South Africa vape. Nurdan Köktürk, Gazi University, Ankara, Türkiye, revealed that in Türkiye, which has a high smoking prevalence in the adult population, the sale of e-cigarettes is banned but the law is poorly enforced, with products remaining widely available. Laura Gochicoa-Rangel, Instituto Nacional de Enfermedades Respiratorias, Mexico City, Mexico, discussed the sweeping ban on e-cigarettes in Mexico, and highlighted the fact that flavored capsule cigarettes, popular with youth, remain unregulated. She also described the merits of a school-based anti-tobacco curriculum. Many of the speakers provided links to free resources for the audience, intended to help listeners build momentum locally as they advocate for change.

CLOSING REMARKS

The above summary highlights a series of snapshots of the variety of cases and basic, translational, and clinical research on the topic of e-cigarettes, as well as the advocacy efforts to combat ENDS presented at ATS 2025. Nicotine products are a resilient, multi-headed hydra; it is important to commit to both research and advocacy, which are the weapons needed to vanquish this beast. For instance, to determine whether vaping does predispose to ARDS, conducting studies using animal models and a variety of clinical insults that lead to ARDS would be enlightening. Alternatively, a prospective trial assessing ARDS in people who vape e-cigarettes may be more informative than the current retrospective data.

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