

**2<sup>nd</sup> Edition**

# **GLOBAL ATLAS OF ASTHMA**



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RECENTLY DEVELOPING HAZARDS  
FOR LUNG HEALTH: WILD FIRES AND  
ELECTRONIC NICOTINE DELIVERY  
SYSTEMS

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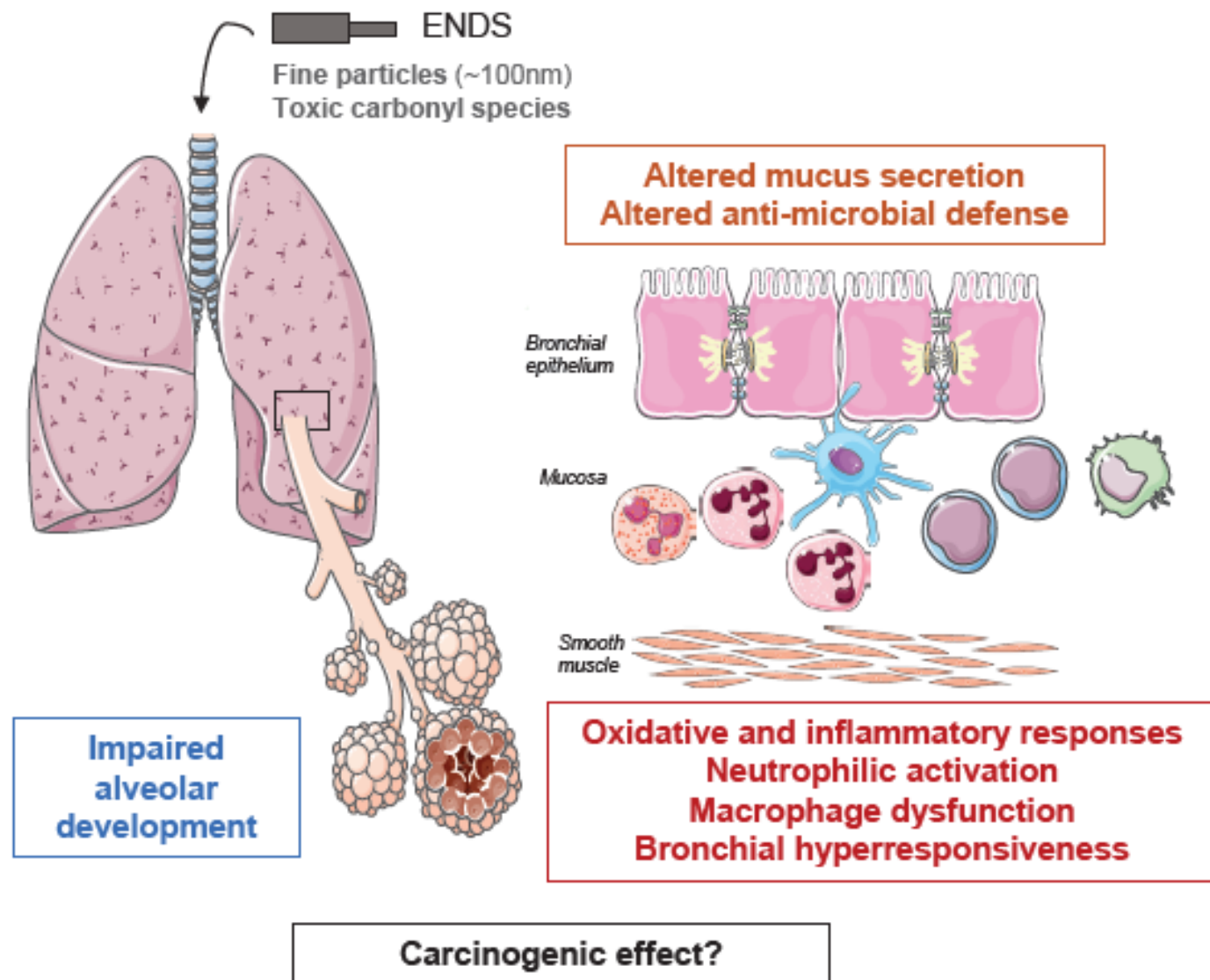


# IMPACT OF THE ELECTRONIC NICOTINE DELIVERY SYSTEMS

- ▶ **Electronic nicotine delivery systems (ENDS)**, including electronic cigarettes (EC), are non-combustible tobacco products.
- ▶ They appeared in China and were commercialized worldwide starting in 2007, providing a potential new tool for cessation of conventional cigarette (CC) consumption.
- ▶ Though difficult to estimate, 1.5% of European adults in 2014 and 1.8% in 2017 reported regular ENDS consumption.
- ▶ **Risk factors for consumption** are younger age, male sex, and past/current history of CC use.
- ▶ **Adolescents**, of whom 16% reported current consumption in 2016, are more prone to start ENDS with no history of CC use, raising *a concern for the development of nicotine addiction*.

- ▶ **ENDS** are battery-powered handled devices, generating an aerosol of highly variable fine particles (~100 nm), by heating a solution called e-liquid.
- ▶ Although **ENDS harm has been estimated at about 5% CC** based on *experts' opinions, pre-clinical and clinical data suggest higher deleterious effects*, among which include cardiovascular, brain and lung damage (Figure 1).
- ▶ **Nicotine concentration is often higher** to that observed in CC, able to saturate brain receptors and induce rapid addiction.
- ▶ **Flavoring agents**, which are a major attraction for ENDS consumption, are composed of more than 7,500 compounds.

Component	Potential effects in the lungs
<b>Components of the e-liquid</b>	
<b>Vegetable glycerin, Propylene glycol:</b> <i>While heated:</i> Generate formaldehyde, acetaldehyde and acrolein ( <i>temperature-dependent quantity</i> )	Generation of toxic carbonyl species Potent irritants Impairment of epithelial response and mucus secretion
<b>Tobacco-specific nitrosamines</b>	Potent carcinogens
<b>Metal nanoparticles</b> <i>Resulting from the heating of device components</i>	Potential carcinogenic effect, lung toxicity and autoimmune dysfunction.
<b>Nicotine</b>	
	<i>In murine models:</i> Increased susceptibility to respiratory viral infections Epigenetic alterations induced by nicotine exposure during pregnancy, alteration of signaling pathways for lung development. <i>Possible transgenerational effects with asthma-like disease observed up to 3<sup>rd</sup> generation.</i>
<b>Flavoring agents</b>	
<b>Diacetyl</b>	Acute onset bronchiolitis obliterans
<b>Menthol</b>	Bronchial hyperresponsiveness with acute decline of lung function
<b>Aldehydes (Benzaldehyde)</b>	Impaired lung function Development of asthma and exacerbations
<b>All agents</b> Including Acetone, siloxanes, volatile organic compounds, polycyclic aromatic hydrocarbons, etc	Generation of toxic carbonyl species



**Figure 1** Potential effects of ENDS components in the lungs.  
*ENDS - Electronic nicotine delivery systems.*

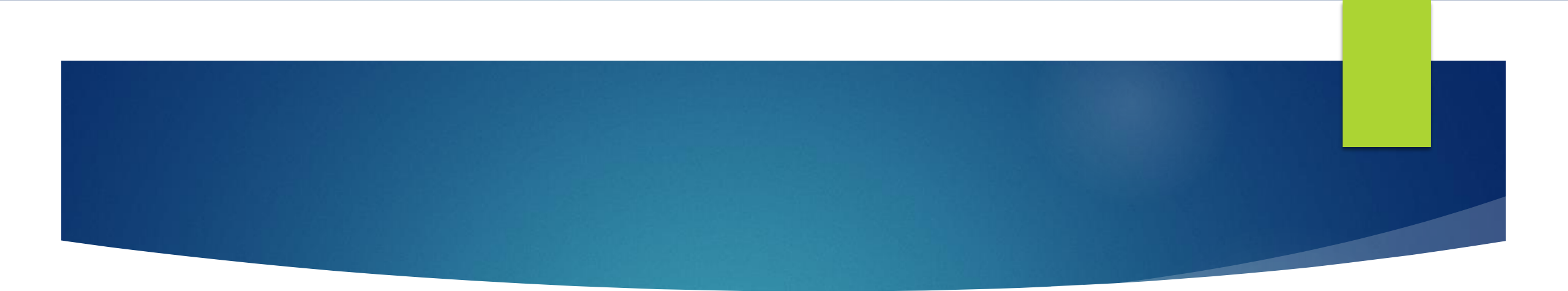
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- ▶ **ENDS consumption** has been linked with self-reported respiratory symptoms (cough), and school absenteeism in adolescents.
  - ▶ **Epidemiological studies** have described an **impact on** asthma symptoms, risk of exacerbations and impaired lung function (Table 1).
  - ▶ In 2019, **several cases of diffuse pneumonia following consumption** were described, possibly linked to lipoid inhalation, together with reports of **acute respiratory distress syndrome and deaths** (E-cigarette or vaping product use-associated lung injury: EVALI). These reports have raised serious concerns worldwide.
  - ▶ **ENDS consumption risks needs** to be further addressed and users closely monitored in the upcoming years.

TABLE 1

## Impact of ENDS consumption on asthma parameters

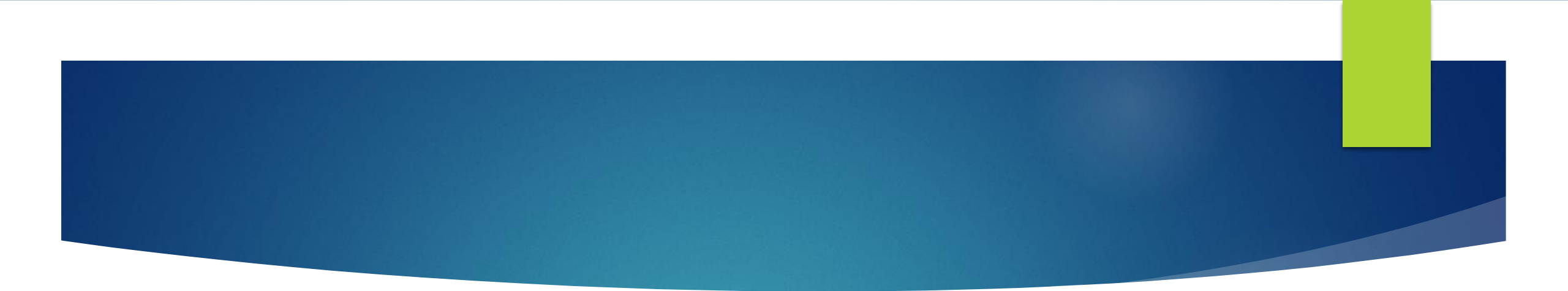
Asthma parameter	ENDS impact
<b>Prevalence (current asthma)</b>	<ul style="list-style-type: none"> <li>• ENDS consumption associated with more frequent reports of current asthma among adolescents and adults</li> <li>• Graded increased odds of having asthma with increase of ENDS use intensity</li> <li>• Increased perception of ENDS being “harmless products” in asthma patients</li> </ul>
<b>Asthma symptoms</b>	<ul style="list-style-type: none"> <li>• Coughing and symptoms of asthma are among the most-frequent reported symptoms following ENDS use in an analysis of more than 40,000 online forum posts</li> <li>• School absenteeism associated with current ENDS use in high school students</li> </ul>
<b>Asthma attacks</b>	<ul style="list-style-type: none"> <li>• Self-reported asthma attacks in the previous year more frequent among ENDS users and adolescents with second-hand exposure</li> <li>• Case reports of <i>status asthmaticus</i> in asthmatic adolescent patients consuming ENDS</li> </ul>
<b>Lung function</b>	<ul style="list-style-type: none"> <li>• <i>Mouse models:</i> Decreased functional residual capacity and increased trans-respiratory pressures in mice exposed to ENDS aerosol, hyperresponsiveness to methacholine in mice exposed to glycerin-based ENDS aerosols</li> <li>• No impact of nicotine- and flavor-free ENDS aerosols (70% Propylene glycol, 30% Vegetable glycerin) inhalation on lung function parameters in healthy and asthmatic volunteers</li> <li>• Immediately after ENDS exposure: significant increase of respiratory system resistances (impulse oscillometry system measurements) in healthy and asthmatic volunteers, more pronounced in asthma patients, and decrease of FeNO levels compared to baseline</li> </ul>

ENDS: Electronic nicotine delivery systems; FeNO: Fractional exhaled nitric oxide

# IMPACT OF CLIMATE CHANGE

- ▶ **Climate change** is impacting the quality of respiratory health.
- ▶ The Intergovernmental Panel on Climate Change predicts with varying degrees of certainty the **changes that will occur due to climate change**: higher maximum and minimum temperatures (Virtually Certain); increased frequency, intensity and length of warm spells (Very Likely); precipitation extremes (Likely); and droughts or dryness (Medium Confidence).
- ▶ **All of these changes are linked to** increased allergies, asthma exacerbations and other respiratory conditions.
- ▶ **Precipitation extremes** include more rain and thunderstorms.
- ▶ During thunderstorms the pollen ruptures and releases its allergenic contents into the air.
- ▶ **Melbourne, Australia** experienced the *worst epidemic of thunderstorm-related asthma attacks* in 2010, which resulted in 9 deaths and 8500 hospitalizations.



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- ▶ **CO2 increases** associated with climate change spurs the growth of allergenic plants.
  - ▶ **Increased dryness** is associated with windstorms and dust storms, also aggravating respiratory conditions.
  - ▶ **Climate change** is also causing an increase in size, duration and intensity of wildfires, resulting in more particulate matter of 2.5 microns or smaller to be released into the atmosphere and is associated with increased emergency room visits and hospital admissions for respiratory and cardiovascular diseases (Figure 2).
  - ▶ **All of these** alterations associated with climate change are **impacting lung health in compounding and unprecedented ways.**



## KEY MESSAGES

- Over the past few years, mankind has witnessed an outbreak of new environmental hazards, related to climate change and/or consumption habits
- Electronic nicotine delivery systems use has developed in the past decades, especially among adolescents, males, and for individuals with past/current history of conventional cigarette use. There is increasing knowledge regarding their impact on airway growth and development and on, pre-existing respiratory conditions, such as asthma
- Climate change poses increased risk to lung health. Meteorological conditions linked to asthma exacerbations include temperature extremes and heat waves, precipitation extremes (e.g. rain and thunderstorms) and droughts/dryness (e.g. more windstorms, dust storms and wildfires)