A Novel In Vitro Cell Exposure System for Toxicity Testing of New and Emerging Tobacco Products

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New and Emerging Tobacco Products (E-cigarettes)

- Variable geometry
- Pre-filled or refillable pods
- Lower aerosol output than box mods
- Puff activated
- Disposable vapes
Popularity of Vaping

- Use has increased over past decade

- Safety of vaping

- Increased vulnerability to respiratory infection

Rise In Teen Vaping Since 2016
The proportion of high school and middle school students who reported vaping nicotine in the past month rose to 28% and 11% in respectively.

Source: JAMA
Credit: Connie Hanzhang Jin/NPR
Common Ingredients in E-cigarettes

- Propylene Glycol/Vegetable Glycerin (PG/VG)
- Flavoring
- Nicotine

Source: vaporboss.com
Testing Toxicity of NETPS

- In Vitro testing
- Expose human airway cells to toxicant at different doses
- Observe cellular effects
In Vitro Toxicity Testing of NETPs

- Expose cells to e-liquid or emissions?
- Chemical composition of e-liquid changes during vaporization
- Compounds produced through degradation of heating elements
Aerosol Exposure

- Control amount of aerosol delivered
- Need even deposition across cell plate
- Sufficient deposition to see cellular effects
Exposure Systems Currently Available

- Expensive
- Difficult to use
- Designed for use with traditional cigarettes
- Do not produce adequate deposition for toxicity testing
Vaping Product Exposure System (VaPES)
Design of VaPES

- Redesigned electrical components
- Created box to house circuit
- Updated code and created standalone software
- Added LCD to show exposure information
Controlling VaPES

- Can control time between puffs, puff length, and number of puffs
- Full control over deposition
Adapting for Different Devices
Use of VaPES
Validation of VaPES

- Transwell Plate

- Paper filters were placed into each well

- Filters were weighed before and after exposure
Aerosol Deposition of VaPES

-Produced even deposition across cell plate for a range of puff numbers

-Nearly 7x the deposition of other systems
Benefits of VaPES

- Cheaper and easier to use
- More accessible than other exposure systems on the market
- Will hopefully increase the amount of research on NETPs
Research Using VaPES

The effect of vaping on respiratory virus binding and propagation in influenza A virus (IAV) and SARS-CoV-2.

Use of alkynyl-tagged CBD to identify adducted proteins and its role in CBD-induced cellular effects.

Determining JUUL aerosol toxicity and functional effects on human macrophages.
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