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

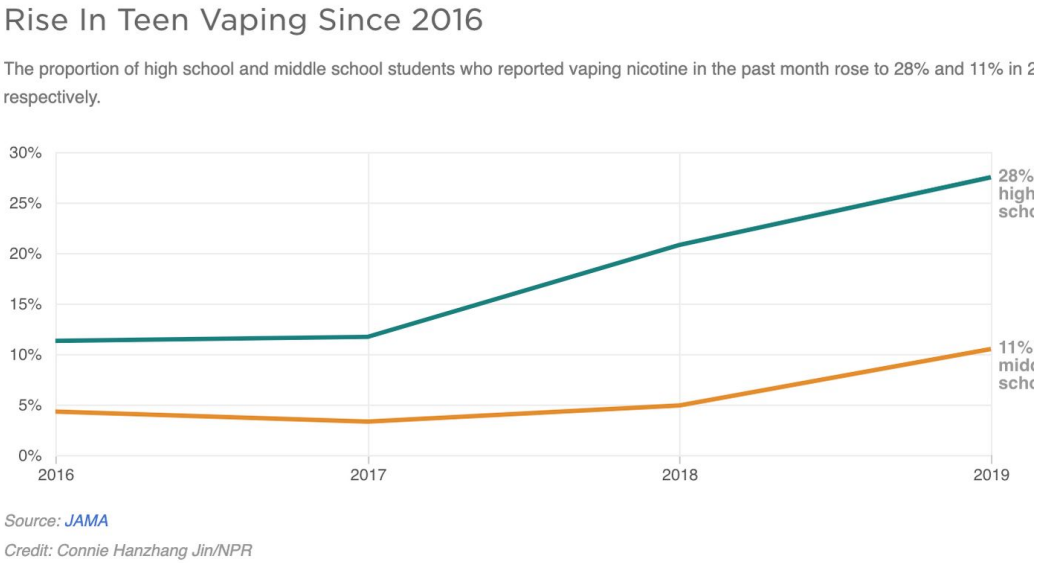
Kevin Schichlein

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



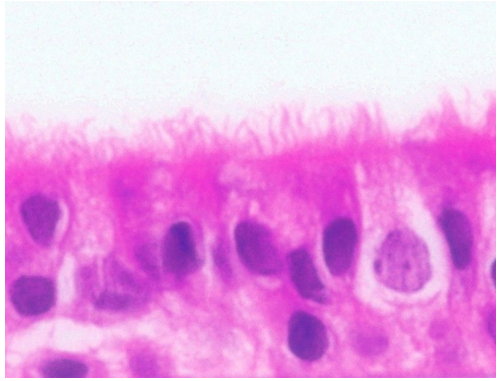
Common Ingredients in E-cigarettes

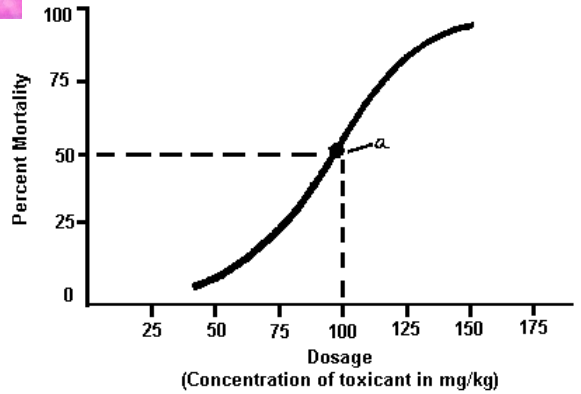
- Propylene Glycol/Vegetable Glycerin (PG/VG)
- Flavoring
- Nicotine

Source: vaporboss.com

Testing Toxicity of NETPS

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



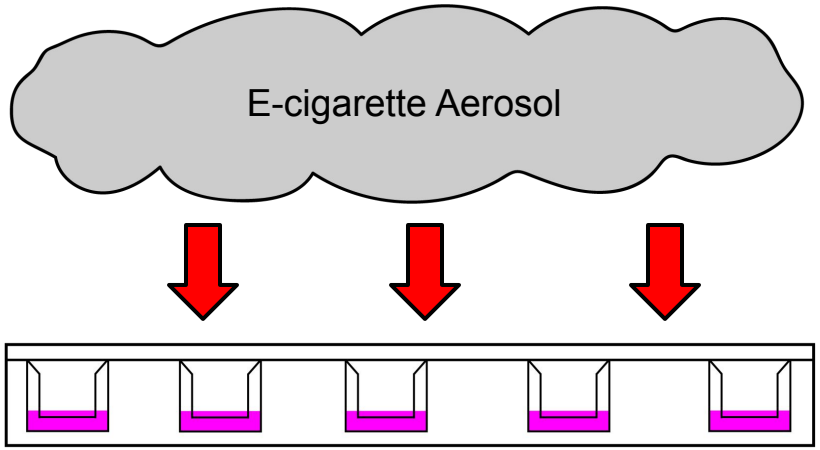


In Vitro Toxicity Testing of NETPs

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

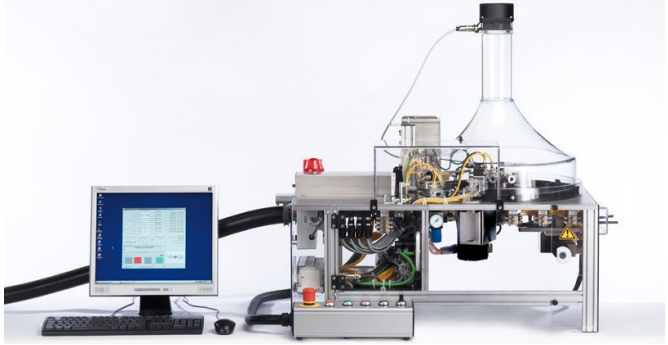
Aerosol Exposure

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

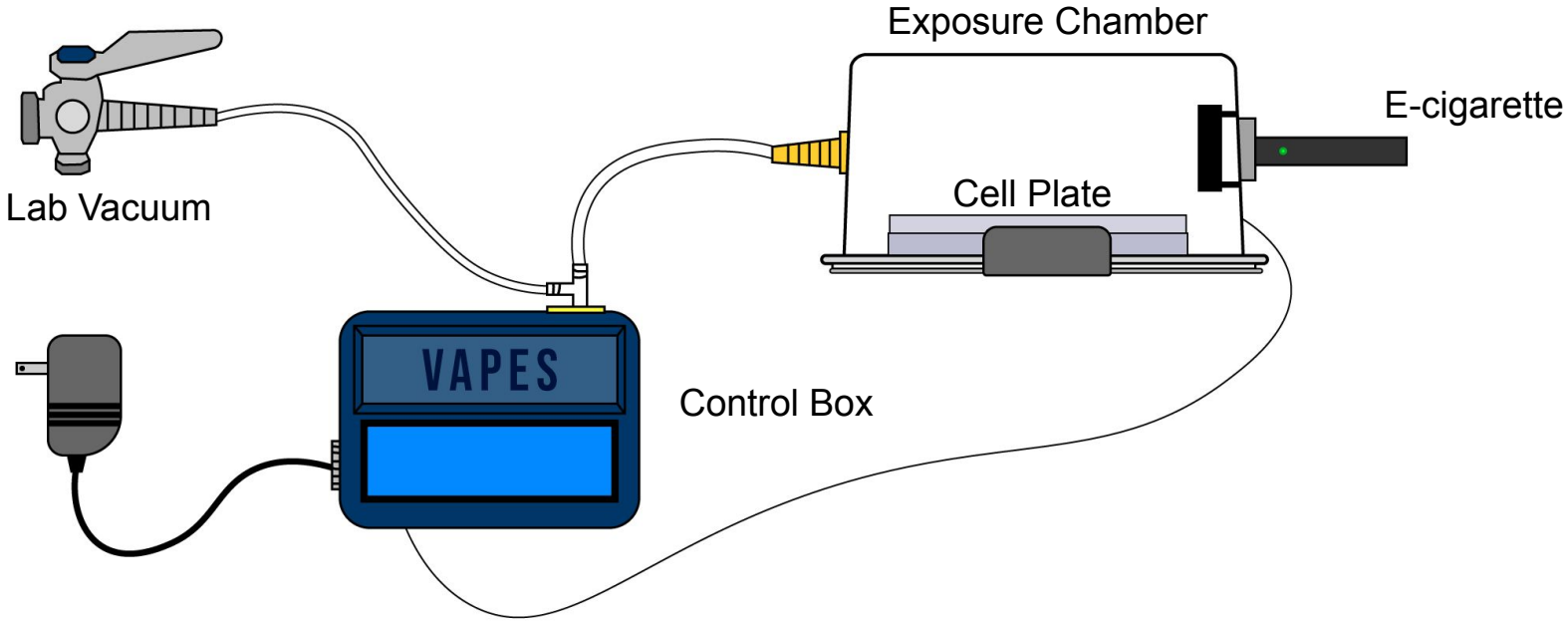


Exposure Systems Currently Available

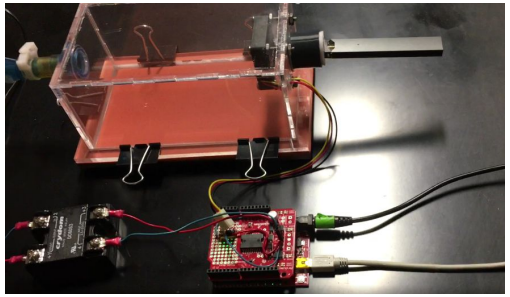
- Expensive
- Difficult to use
- Designed for use with traditional cigarettes
- Do not produce adequate deposition for toxicity testing

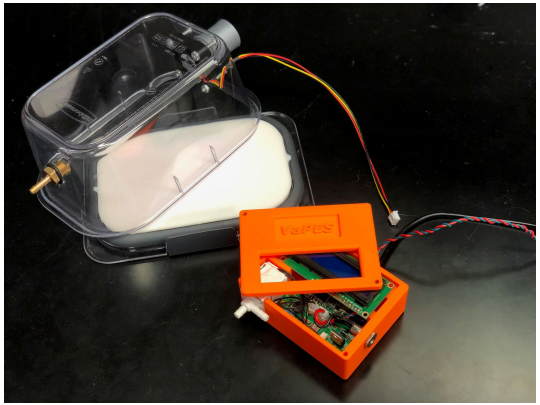


Vaping **P**roduct **E**xposure **S**ystem (VaPES)



Design of VaPES

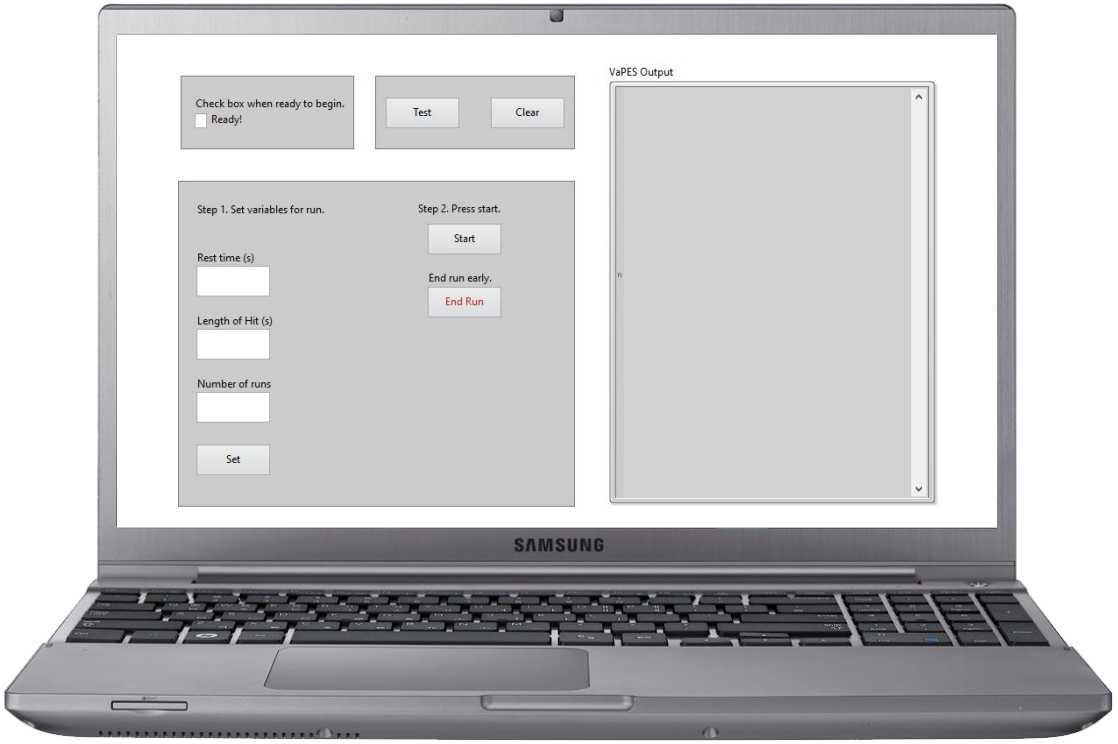




- Redesigned electrical components
- Created box to house circuit
- Updated code and created standalone software
- Added LCD to show exposure information

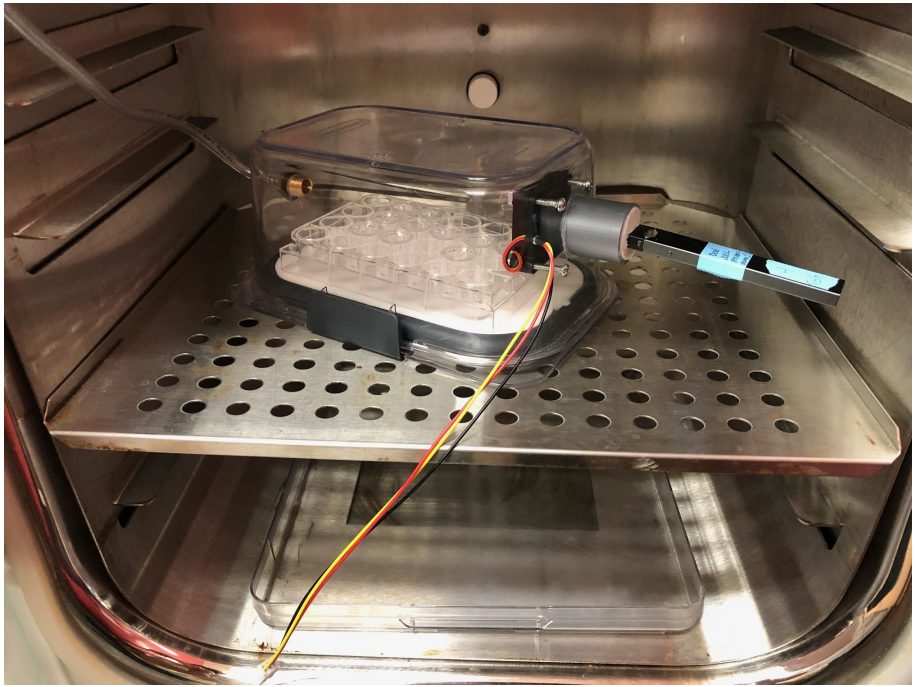
Controlling VaPES

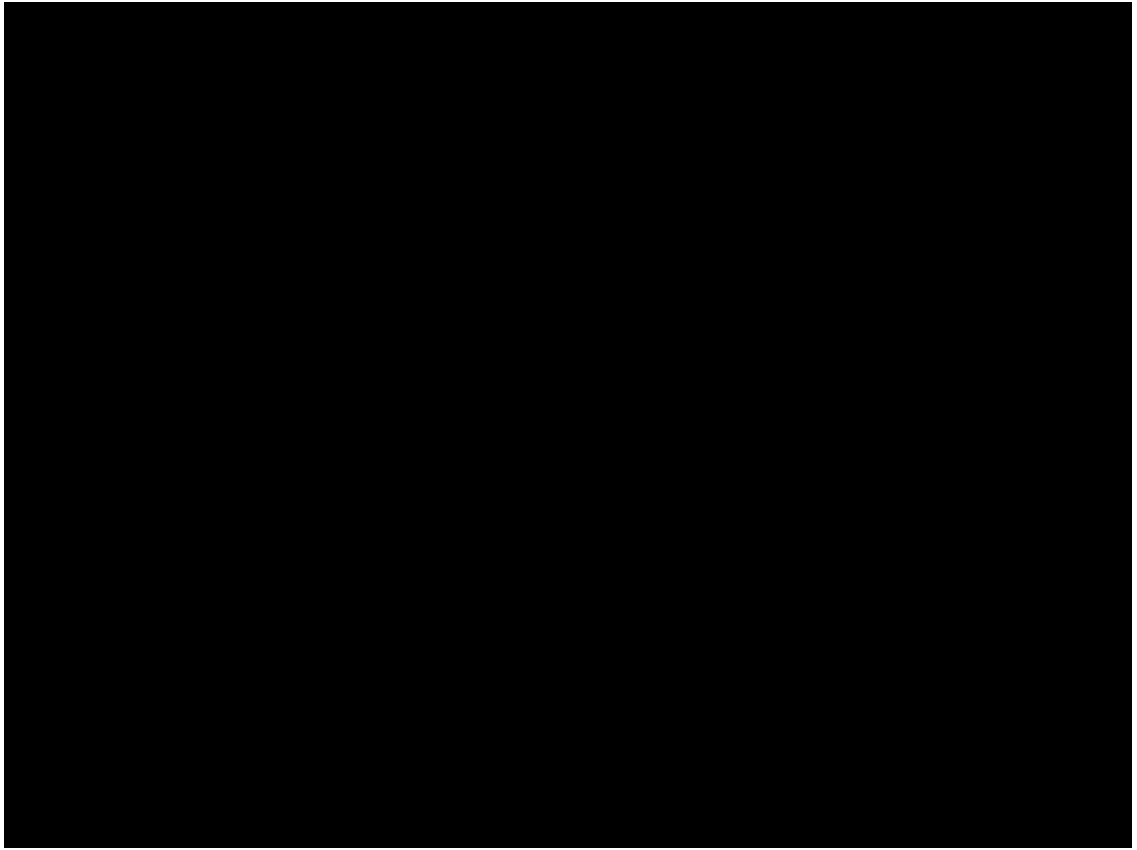
- Can control time between puffs, puff length, and number of puffs
- Full control over deposition

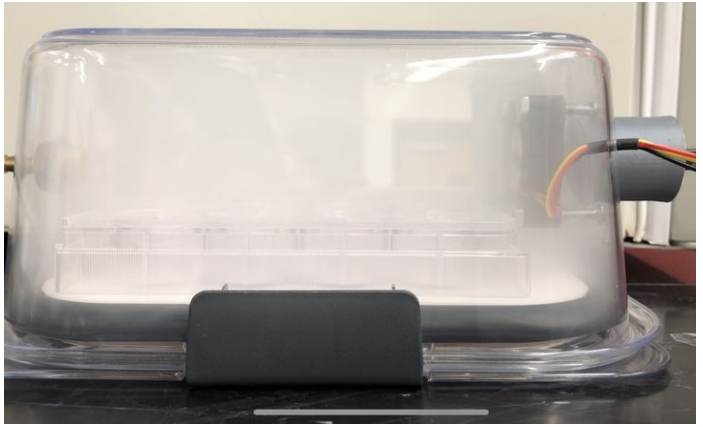


Adapting for Different Devices

Use of VaPES





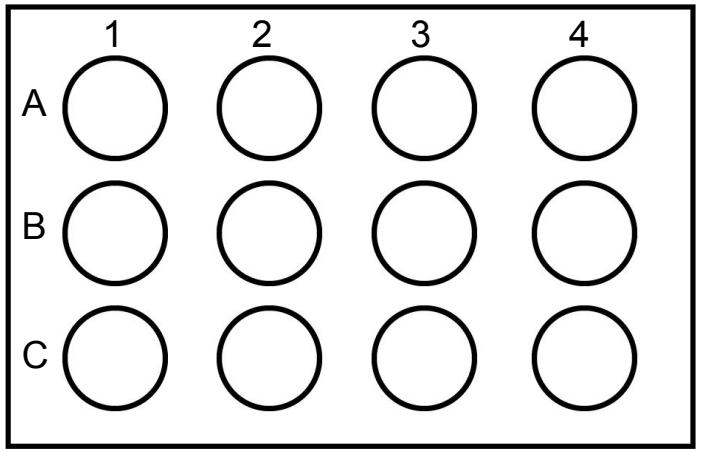


Validation of VaPES

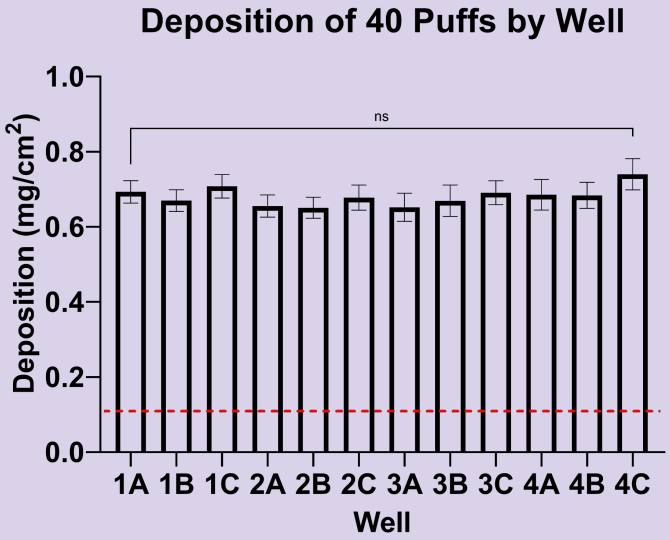
- Transwell Plate

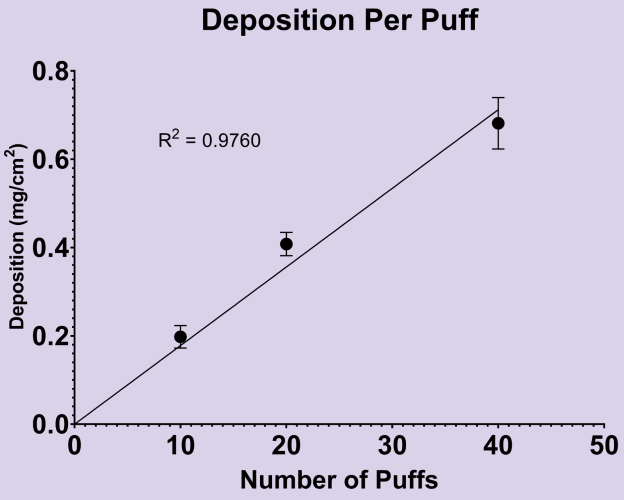
- Paper filters were placed into each well

- Filters were weighed before and after exposure



Aerosol Deposition of VaPES



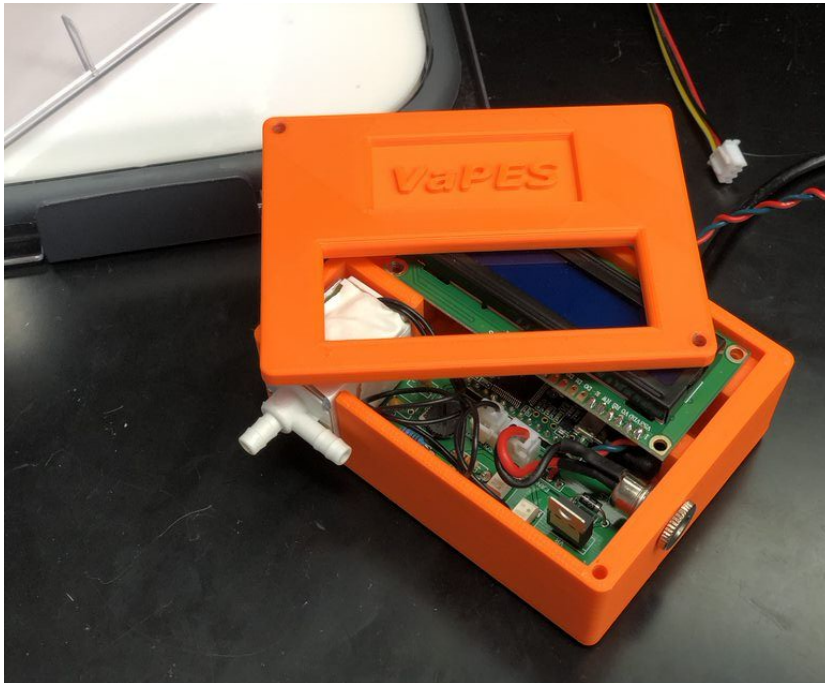


-Produced even deposition across cell plate for a range of puff numbers

-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.

Acknowledgments

Clapp Lab
Phillip Clapp, PhD
Charlotte Love
Maxwell Conolly

Bennett Lab
William Bennett, PhD
Jihong Wu, MD
Chris Jadelis

Jaspers Lab
Ilona Jaspers, PhD
Elise Hickman

Brian Button, PhD

Devin Hubbard, PhD

Joint Department of BIOMEDICAL ENGINEERING
UNC CHAPEL HILL
NC STATE UNIVERSITY

UNC CENTER FOR ENVIRONMENTAL MEDICINE ASTHMA & LUNG BIOLOGY