

# E-cigarette consumption and puffing topography data



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## Outline

- Nicoventures Introduction
- Topography and use patterns to inform product stewardship
- Developing an e-cigarette specific topography device
- Mapping vapers' topography for our Vype products
- Understanding use patterns through consumption surveys
- Summary and next steps

# Nicoventures

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- Our aim is to provide adult smokers who want to reduce, replace or stop smoking with a range of high quality alternative products, delivering much of the experience they expect from a cigarette, but without the serious health risk of smoking.
- Our focus is the development and production of innovative, high quality inhaled nicotine products that meet relevant regulatory requirements.
- Nicoventures is part of the BAT Group but is separate from the tobacco business.



# Data gaps in informing responsible product stewardship

- Estimating exposure for product stewardship assessments:

**(# of puffs/session) X (# of sessions/day) X (constituent concentration /puff) = daily exposure**

- Need to understand how e-cigarettes are used by consumers and estimate exposure to e-cigarette aerosol to inform responsible product stewardship
- Existing topography equipment produced variable and often inaccurate puff volumes with e-cigarettes
- Published data on users' puffing topography shows considerable variation
- Also, there is limited data on the consumption patterns of various e-cigarette products in the marketplace

# E-cigarette specific topography device development and validation



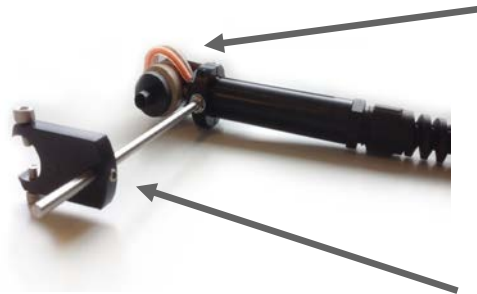
The original SA-7 device

<sup>1</sup> A Device to Measure a Smoker's Puffing Topography and Real-Time Puff-by-Puff "Tar" Delivery, Slayford S.J., Frost B.E., *Beitrage zur Tabakforschung*, 2014, 26 (2), 74 – 84.



# Adaptations made to the original SA-7 for testing e-cigarettes

Spigot adapter to attach e-cigarettes to modified topography holder. Spigot removes jetting through orifice, which results in inaccurate puff volumes



Pressure ports on top to reduce excipients from blocking tubes

Bracket to support larger e-cigarette modular devices

Removable cap allows access to orifice plate for cleaning



Device validated for accuracy of:

- Puff volumes
  - Puff duration
- Puff volumes:  $\pm 1.0$  mL across a 20 – 120 mL range
  - Puff durations:  $\pm 0.1$  s across a 1.5 – 3.0 s range

Using disposable, rechargeable cartridge and modular devices

# Puffing topography study on Vype Reload and the Vype ePen

## Study Objective

- To determine the puffing topography of regular users of e-cigarettes using either Vype Reload or ePen, to provide data to support product stewardship assessments

## Subject recruitment

- Age ranging between 21 – 64 years
- Male / female equal gender split
- Use e-cigarettes at least 2 or more days per week – ideally daily e-cigarette usage
- Could be dual users of e-cigarettes and tobacco products

## 32 users of rechargeable, cartomiser e-cigarette products

- 16 males:16 females

## 28 users of rechargeable, modular e-cigarette products

- 16 males:12 females

# Puffing topography study products

## Product

- Users of cartomiser products provided with Vype Reload
- Users of modular products provided with Vype ePen (a closed-modular device)

## Number of replicates

- Volunteers vaped the assigned product through the topography head on two separate occasions on different days
- Volunteers who used the closed-modular product used the product at high and low power settings (randomised and blinded to volunteer)



Vype Reload  
Rechargeable,  
cartomiser product



Vype e-Pen  
Rechargeable,  
closed modular  
product



# Users' puffing topography data

 Vype Reload (rechargeable, cartomiser)

Puffing Behaviour	Length of Session (Min:Sec)	Number of Puffs (#)	Mean Puff Volume (mL)	Mean Puff Duration (s)	Mean Puff Interval (s)	Mean Peak Flow Rate (mL/s)
Rep. 1 (n=32)	7:10 (4:12)	22.0 (16.3)	50.4 (21.0)	2.0 (0.6)	22.8 (10.8)	38.0 (10.2)
Rep. 2 (n=32)	6:38 (3:13)	20.3 (13.6)	54.0 (22.4)	2.1 (0.7)	23.6 (10.7)	39.9 (10.4)
<b>Total Replicates (n=64)</b>	6:54 (3:43)	21.1 (14.9)	52.2 (21.6)	2.0 (0.7)	23.2 (10.6)	39.0 (10.3)

<sup>a</sup> Presented as Mean values (Standard Deviation)

Paired Comparison (n=32) <sup>b</sup>	Length of Session	Number of Puffs	Mean Puff Volume	Mean Puff Duration	Mean Puff Interval	Mean Peak Flow Rate
<b>p value</b>	0.372	0.588	0.079	0.393	0.717	0.144

<sup>b</sup> Paired t-test,  $\alpha$  0.05

**No statistical difference in replicate data**

# Users' puffing topography data

 Vype ePen (rechargeable, closed-modular)

Puffing Behaviour	Length of Session (Min:Sec)	Number of Puffs (#)	Mean Puff Volume (mL)	Mean Puff Duration (s)	Mean Puff Interval (s)	Mean Peak Flow Rate (mL/s)
High Power (n=28)	7:05 (5:33)	14.3 (6.0)	83.8 (42.5)	2.2 (0.9)	30.1 (19.6)	60.5 (21.1)
Low Power (n=27)	8:19 (7:00)	18.1 (9.3)	82.1 (46.9)	2.1 (0.9)	28.5 (19.0)	60.7 (18.8)
<b>Total Replicates (n=55)</b>	7:41 (6:17)	16.1 (8.0)	83.0 (44.3)	2.2 (0.9)	29.3 (19.2)	60.6 (19.8)

<sup>a</sup> Presented as Mean values (Standard Deviation)

Paired Comparison (n=27) <sup>b</sup>	Length of Session	Number of Puffs	Mean Puff Volume	Mean Puff Duration	Mean Puff Interval	Mean Peak Flow Rate
<b>p value</b>	0.409	0.067	0.908	0.364	0.596	0.757

<sup>b</sup> Paired t-test,  $\alpha$  0.05

**No statistical difference between power settings**

# Users' puffing topography data

Comparison between user groups (devices)

User Group Comparison	Length of Session (Min:Sec)	Number of Puffs (#)	Mean Puff Volume (mL)	Mean Puff Duration (s)	Mean Puff Interval (s)	Mean Peak Flow Rate (mL/s)
Reload (n=64)	6:54	21.1	52.2	2.0	23.2	39.0
ePen (n=55)	7:41	16.1	83.0	2.2	29.3	60.6
<i>p</i> value	0.417	0.022	0.000	0.382	0.039	0.000

<sup>a</sup> 2 sample t-test,  $\alpha$  0.05

Statistical differences observed between users of two study products

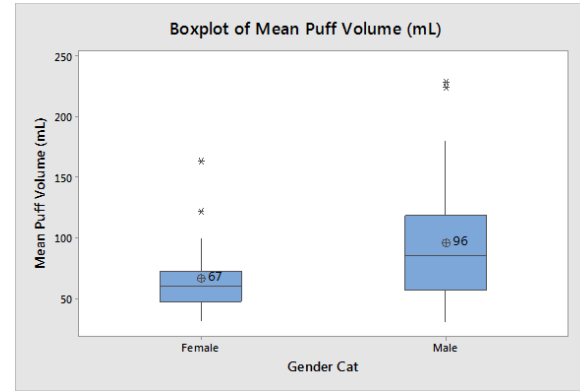
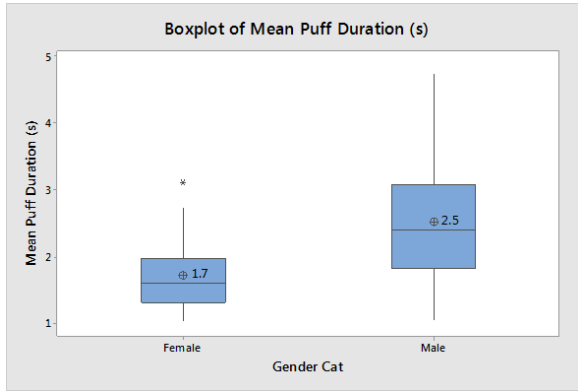
- Closed-modular users took fewer but larger puff volumes, with longer inter-puff interval
- Data show that users' topography varies according to product used
- Implication for laboratory product testing and stewardship

# Demographic and use behaviour effects

- For each user group we consider the effect of the following variables on the topography measures
  - Gender
  - Age category (18-24, 25-34, 35-44, 45+)
  - Length of use of e-cigarettes (1-2 months, 3-6 months, 6 months+)
  - Frequency of e-cigarette use per day (once, 2-3 times, 4 or more times)
  
- Data were analysed using a General Linear Mixed model ANOVA
- Where a factor was statistically significant, Tukey's comparison was used to identify differences
- Data with statistical differences shown as boxplots, highlighting differences

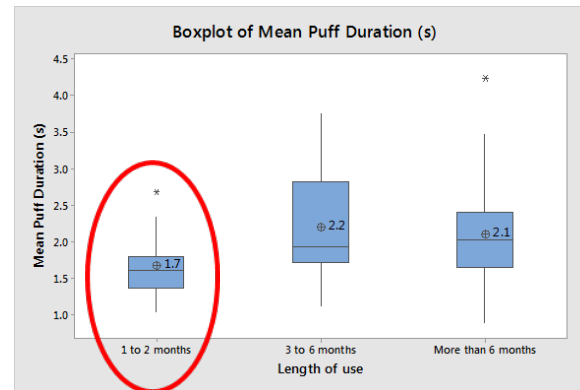
# Demographic and use behaviour effects

## Closed-modular



## Rechargeable, cartomiser

Puff duration is statistically lower for those users who have been using e-cigarettes for 1-2 months compared with more experienced users



# Consumption Survey- understanding use patterns

## Objective

- To determine the consumption of e-cigarettes across a broad range of e-cigarette users, to provide data to support product stewardship assessments

## 1200 e-cigarette users in U.K.

- 400 users each of disposable, rechargeable (cartomiser) and rechargeable modular devices
- On-line survey

## Data collected include

- Session length
- Number of puffs per session
- Number of sessions per day
- Units or e-liquid volume consumed per week

# Consumption Survey Data

	Disposable	Cartomiser	Modular
Session length (min:s)	10:24	8:54	9:36
Puffs/session (#)	11-20*	11-20*	1-10*
Sessions/day (#)	4.2	6.0	7.2
Units/week (#)	4.2	2.1	10.1**

When combined with aerosol constituent concentration data, allows calculation of daily exposure

\* Mode

\*\* mL consumed per week

# Summary

- Validated topography device for use with e-cigarettes
  - Important to ensure accurate puff volumes
  - To inform chemical and biological testing regimes representative of users' behaviour
- Statistical differences observed between users of cartomiser and closed-modular devices for:

- Puff number
- Mean puff volume
- Mean puff interval
- Mean peak flow rate

User Group Comparison	Number of Puffs/session (#)	Mean Puff Volume (mL)	Mean Puff Interval (s)	Mean Peak Flow Rate (mL/s)
Reload (n=64)	21.1	52.2	23.2	39.0
ePen (n=55)	16.1	83.0	29.3	60.6

- Age, gender and usage patterns affect some topography measures, no clear trends identified across user groups
- Combining topography and frequency of use data provide a means to estimate daily exposure to e-cigarette aerosol constituents
  - Combined data informs our approach to responsible product stewardship



The logo for nicoverventures features the word "nicoverventures" in a blue, lowercase, sans-serif font. The "i" in "nicover" is stylized with a green leaf-like shape on top. The background is white with a blue horizontal bar at the top and a green horizontal bar at the bottom.

*nicoverventures*

Thank you!