Electronic cigarettes (e-cigarettes) are battery-powered devices that deliver aerosolised nicotine, propylene glycol and/or glycerol and flavourings to users from an e-liquid. As they do not contain tobacco or require combustion, they are gaining acceptance with smokers as alternatives to traditional tobacco products [1].

Regulators and the public health community are keen to understand whether the aerosol exhaled following use of e-cigarette products has implications for the quality of air breathed by bystanders. An indoor air quality model was recently published which evaluated potential bystander exposures to exhaled e-cigarette constituents, particularly to nicotine [2]. The authors identified ‘quantity of chemical constituent exhaled’ as potentially the most important factor influencing indoor air quality and bystander exposures.

To understand the potential impact of exhaled nicotine on indoor air quality and bystander exposures, it is essential that measurements are made regarding the quantity of nicotine retained by e-cigarette users (i.e. the fraction not exhaled). Here an experimental method is presented that allows the concentration of nicotine exhaled following e-cigarette use to be measured and the retention rate by the user estimated [3]. The influence that vaping topography (i.e. mouth-hold versus inhalation) has upon the retention of nicotine following e-cigarette use was studied in experienced volunteers.

In one study, three experienced e-cigarette users followed a series of specified vaping topographies (Table 2) for each e-cigarette. Test e-cigarettes were evaluated by GC-FID above were vaporised through a smoking machine attached to a smoking machine mobile device (DA-M; SOOM, France) equipped with a specific e-cigarette adapter. As the device records time, puff duration, volume inhaled and pressure drop, it was used in this study to record the vaping topography of the e-cigarette users. From the participant’s recorded smoking topography, the concentration of nicotine inhaled per puff was determined using the calibration curve obtained with the smoking machine for the corresponding e-cigarette device (Figure 2).

### 3. Summary of findings

The mean values for the concentration of nicotine delivered and exhaled and therefore the concentration retained by the three e-cigarette participants across each e-cigarette for the mouth-hold and inhalation topographies is summarized in Table 3.

### 4. Conclusions & future work

The retention rate of nicotine following use of the commercially available ‘closed’ system e-cigarette was >99% on average following inhalation of e-cigarette aerosols and 86% on average following holding aerosols in the mouth-hold only (i.e. no inhalation), regardless of the nicotine concentration of the device.

In a recent assessment of indoor air quality during e-cigarette use there was no measurable increase in the airborne concentrations of nicotine when compared with no vaping control sessions or background measurements [6]. The authors suggested this may be attributable to the high retention rate of nicotine following e-cigarette use. However, this recent study support the suggestion that extremely low concentrations of nicotine are exhaled following inhalation of e-cigarette aerosols as a result of the high nicotine retention rate i.e. >99%.

The 2015 review of the scientific literature by Public Health England also noted that use of e-cigarettes “release negligible levels of nicotine into ambient air with no identified health risks to bystanders” [1], which can be attributed to the high retention rate of nicotine by e-cigarette users as reported in this study.

The results from this present study support the suggestion that extremely low concentrations of nicotine are exhaled following inhalation of e-cigarette aerosols as a result of the high nicotine retention rate in the user.