# Smoking and Vaping

# Health Needs Assessment

**Appendix 2: Nicotine vaping biomarkers evidence update**

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Biomarkers are molecular makers (also referred to as 'signature molecules') that doctors measure in your blood, body fluids, and tissues. Biomarkers of toxicant exposure are measurements of potentially harmful substance levels in the body. Biomarkers of potential harm are measurements of biological changes in the body. Biomarkers are used to gain accurate and reliable measurements of exposure to smokeless and non-tobacco nicotine products. These are essential for identifying and confirming patterns of use and for assessing their potential biological effects in both human populations and experimental systems. Table 1 provides evidence on specific biomarkers investigated.

**Table 1: Nicotine vaping biomarkers evidence update, 2022**

| Biomarkers | Evidence |
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| **Volatile organic compounds (VOCs)**<br>*Potentially harmful gases released into the air, while vaping* | • In general, most research showed statistically significantly lower levels of VOCs among vapers when compared to smokers.<br>• Vapes showed a substantial reductions in some VOCs compared to smoking including:<br>  ○ acrolein metabolite 3-HPMA (71%),<br>  ○ acrylonitrile metabolite CNEMA (94%)<br>  ○ 1,3 Butadiene metabolite MHBMA (83%)<br>• For a few VOCs, such as formaldehyde and toluene, available evidence was inconclusive on the significant differences between vapers and smokers[16]. |
| **Tobacco specific nitrosamines**<br>*Group of chemicals found in tobacco and tobacco smoke, some of which are harmful and cause cancer* | • 28 studies found significantly lower levels of TSNAs among vapers than smokers[16]. |
| Other potential toxicants | • Nine studies assessing a range of other potential toxicants. Generally, the very limited findings suggested the levels of these other potential toxicants were lower among vapers than smokers, and higher among vapers than non-users[16]. |
| Carbon monoxide | • 33 studies assessing carbon monoxide (CO) exposure, with 3 studies from the UK.<br>• Research found significantly lower blood carboxyhaemoglobin levels among vapers than smokers.<br>• Exposure to CO in smokers who completely switch to vaping product use might be reduced to levels similar to non-users[16]. |
| Metals | • 10 cross-sectional studies examining a range of metals (arsenic, cadmium, lead, mercury.<br>• In general, the studies had mixed findings about relative exposure.<br>• Absolute exposure assessments were also mixed although most studies showed higher levels of exposure to the metals assessed among vapers compared to non-users[16]. |
| Vaping flavourings | • In general, e-cigarettes often contain ingredients such as propylene glycol (PG) and glycerol, mixed with |

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| | concentrated flavours and, optionally, a variable percentage of nicotine.<br>• Biomarker levels slightly differed between flavoured vaping products.<br>  ○ Users of fruit-only flavoured vaping products had significantly higher concentrations of a biomarker for acrylonitrile (CNEMA) compared to users of a single other flavour<br>• Findings from 13 cell and 9 animal studies suggest:<br>  ○ There is evidence that some flavourings in vaping products, particularly cinnamaldehyde, or buttery or creamy flavours have the potential to alter cellular responses but less than exposure to tobacco smoke.<br>  ○ Exposure to propylene glycol or vegetable glycerine (PG/VG) base liquids without added flavourings appeared to have little or no effect.<br>• It was not always possible to differentiate the effect of nicotine or solvents from flavourings due to lack of appropriate controls.<br>• There was also variability of e-liquid composition, cell types, dose exposure and duration.<br>• There was not a great deal of consistency about whether cells or animals were exposed to e-liquids, aerosol extracts or aerosols[16] |

Source: OHID