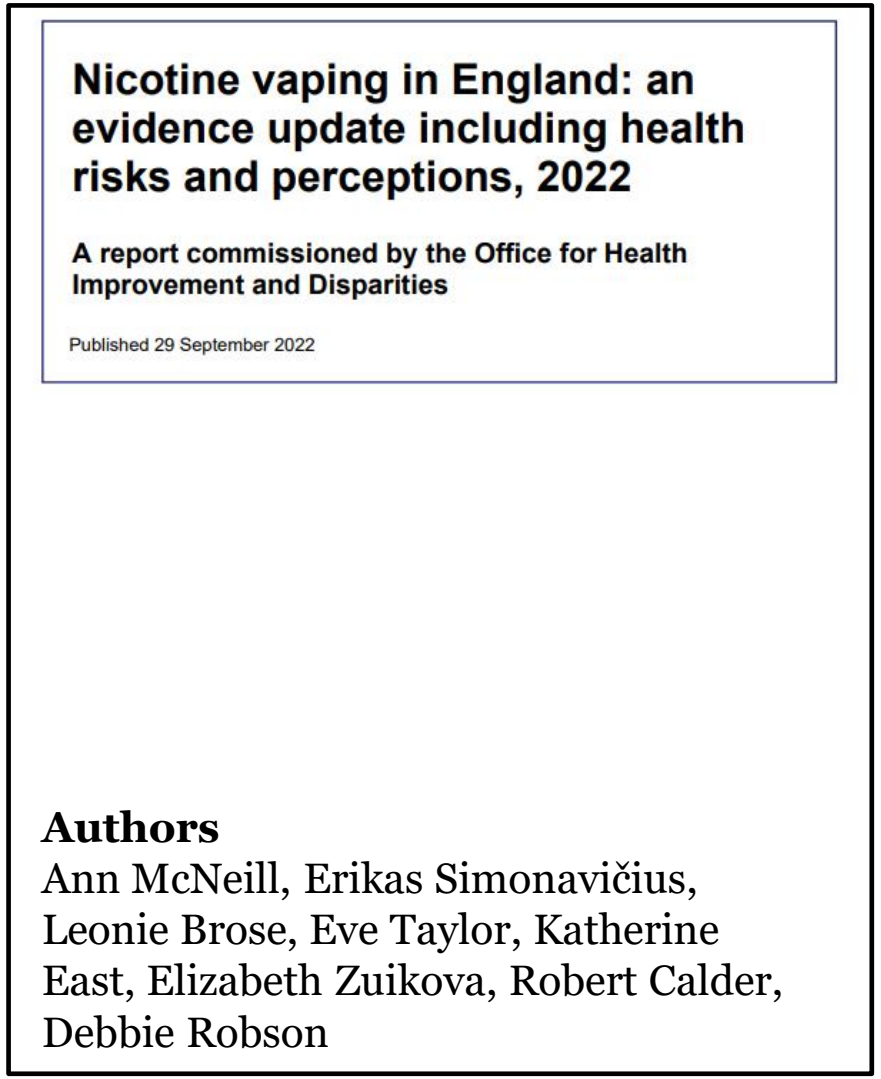
# Nicotine vaping in England: an evidence update including health risks and perceptions, September 2022


KING'S College LONDON

# Final report of the evidence review series

| 2015 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|
| E-cigarettes: an evidence review | Evidence review of EC & HTP<br>Focus on cessation and health risks | Vaping in England<br>Focus on SE indicators | Vaping in England<br>Focus on mental health & pregnancy | Vaping in England<br>Focus on smoking cessation |

2022

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## Full report

www.gov.uk/government/publications/nicotine-vaping-in-england-2022-evidence-update

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## We would also like to thank our independent reviewers

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- This work was funded by Public Health England, now Office for Health Improvement and Disparities, part of the Government's Department of Health & Social Care
- The authors have no links with any tobacco or vaping product manufacturers or distributors

- See our full statements:

www.gov.uk/government/publications/nicotine-vaping-in-england-2022-evidence-update

# Chapters

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6. Flavours in vaping products
7. Biomarkers of exposure to nicotine and potential toxicants
8. Biomarkers of potential harm cutting across several diseases
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1468 pages

# Topline message

*Vaping poses only a small fraction of the risks of smoking in short-to-medium term*

*This does not mean vaping is risk-free, particularly for people who have never smoked*

# Methods

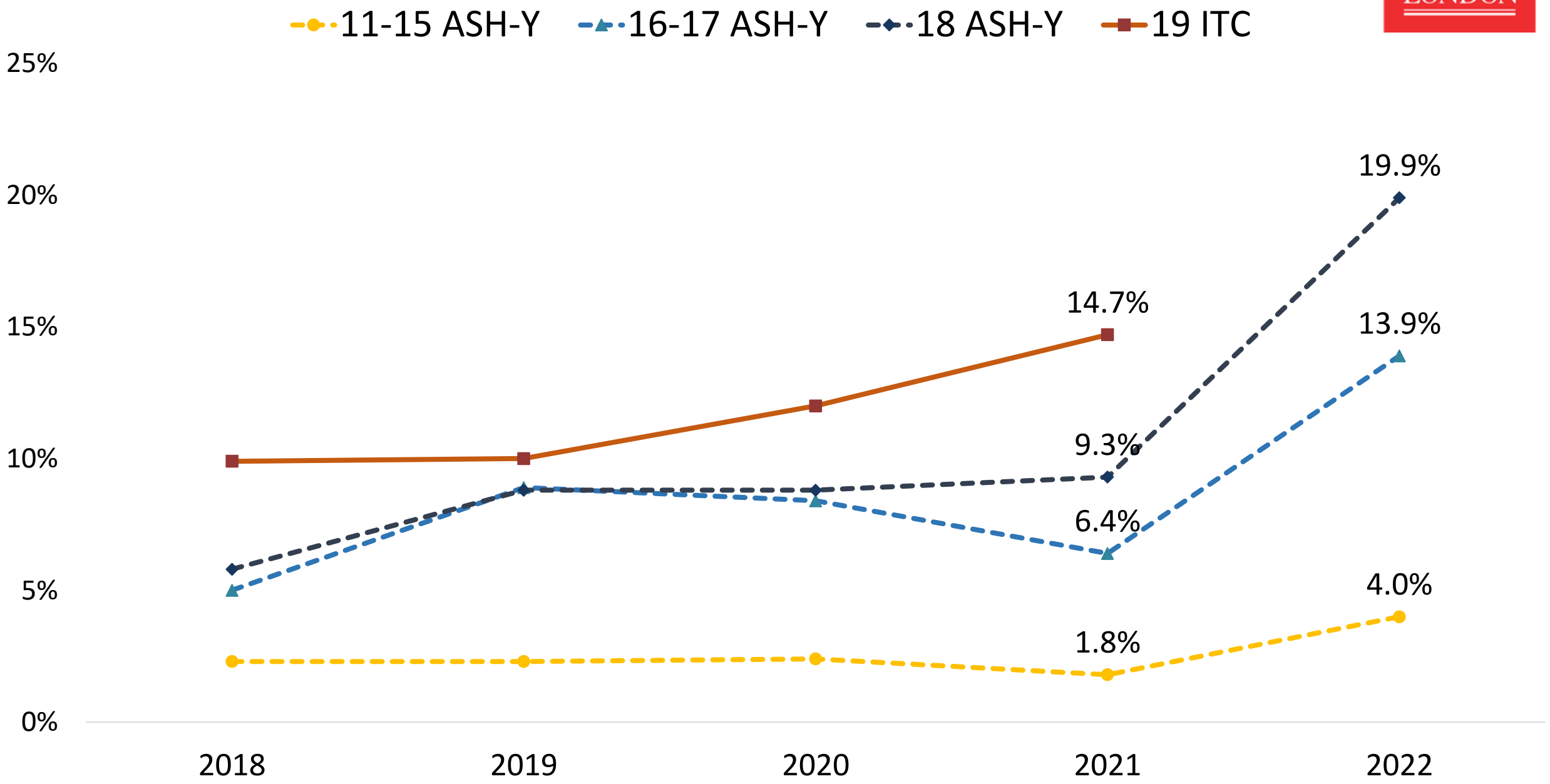
- We used **routine survey data** from England for assessing youth & adult vaping & smoking behaviours
- We carried out 2 new **systematic reviews**:
  - Health risks of vaping
  - Vaping risk perceptions & communications

# Youth

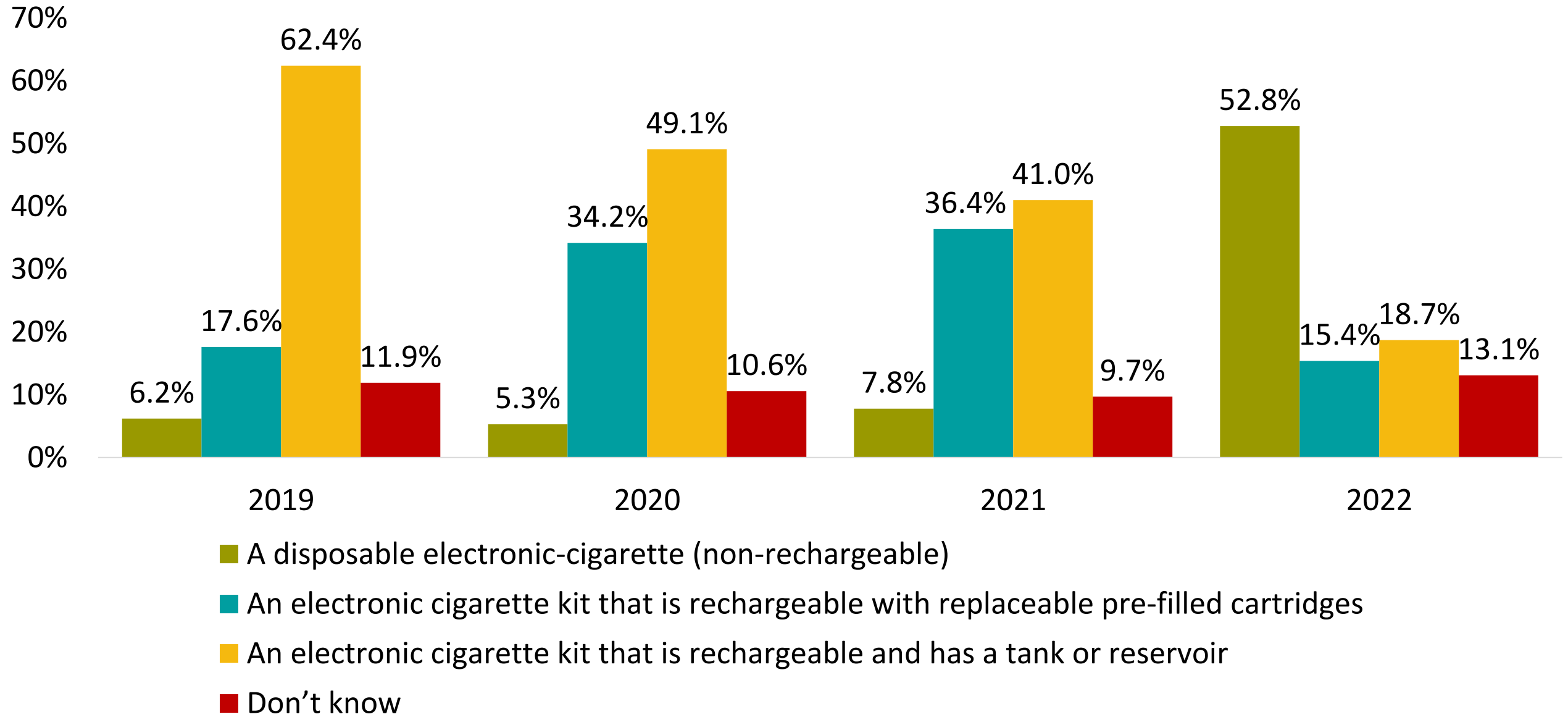
# Smoking & vaping among young people, ASH England

| ASH Surveys | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| **Smoking status %** | | | | |
| Never tried | 79.7 | 80.9 | 83.5 | 80.2 |
| Tried only | 9.0 | 8.3 | 8.6 | 8.1 |
| Former | 3.4 | 3.0 | 3.0 | 3.7 |
| **Current** | **6.3** | **6.7** | **4.1** | **6.0** |
| **Vaping status %** | | | | |
| Never tried | 83.6 | 82.8 | 86.3 | 80.9 |
| Tried only | 9.4 | 10.0 | 8.6 | 9.1 |
| Former | 0.9 | 1.8 | 1.2 | 1.4 |
| **Current** | **4.8** | **4.8** | **4.0** | **8.6** |

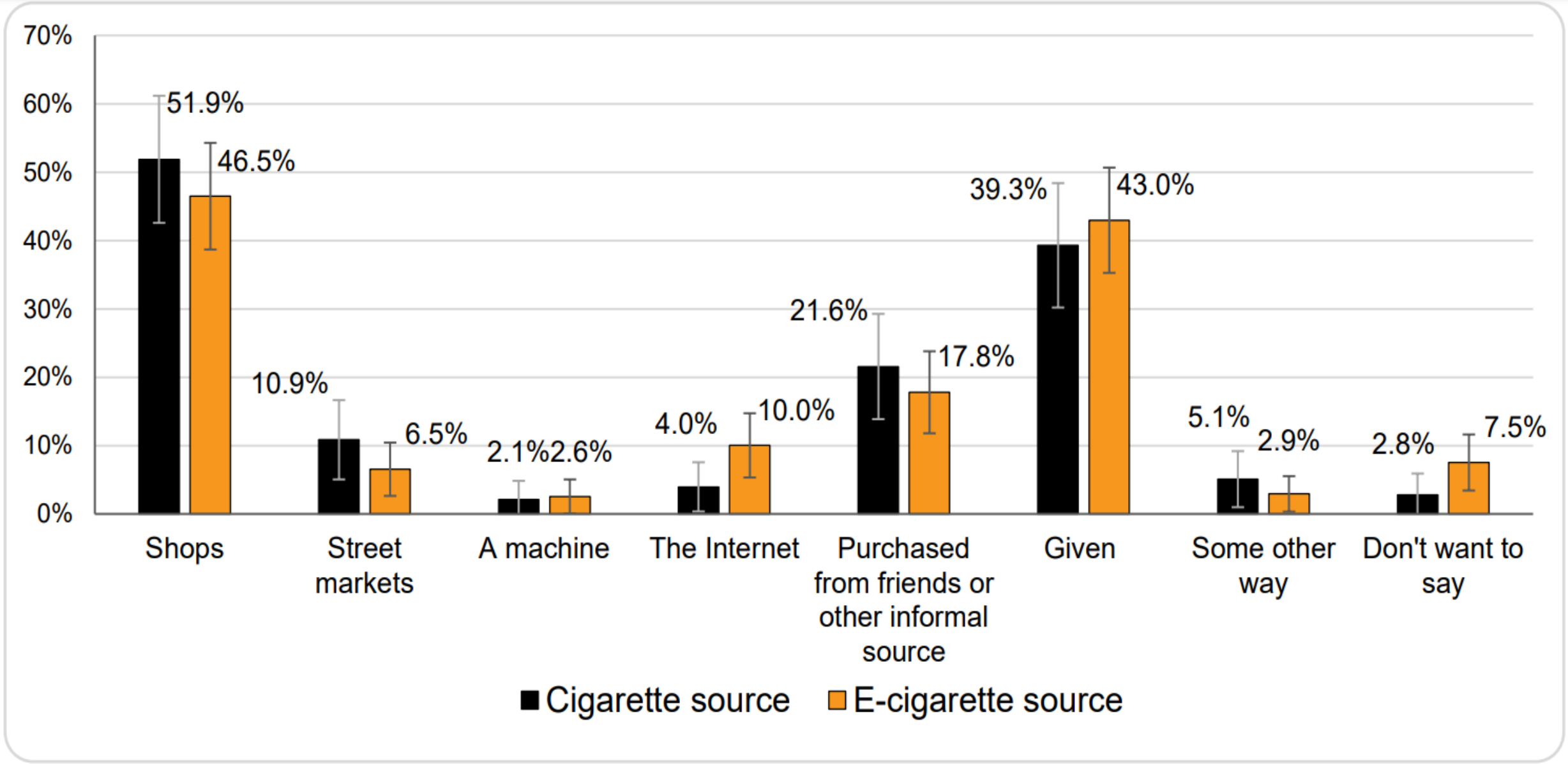
# Vaping among young people, ASH England



# Type of vaping product used by people aged 11 to 18 who currently vape, ASH England 2019-2022

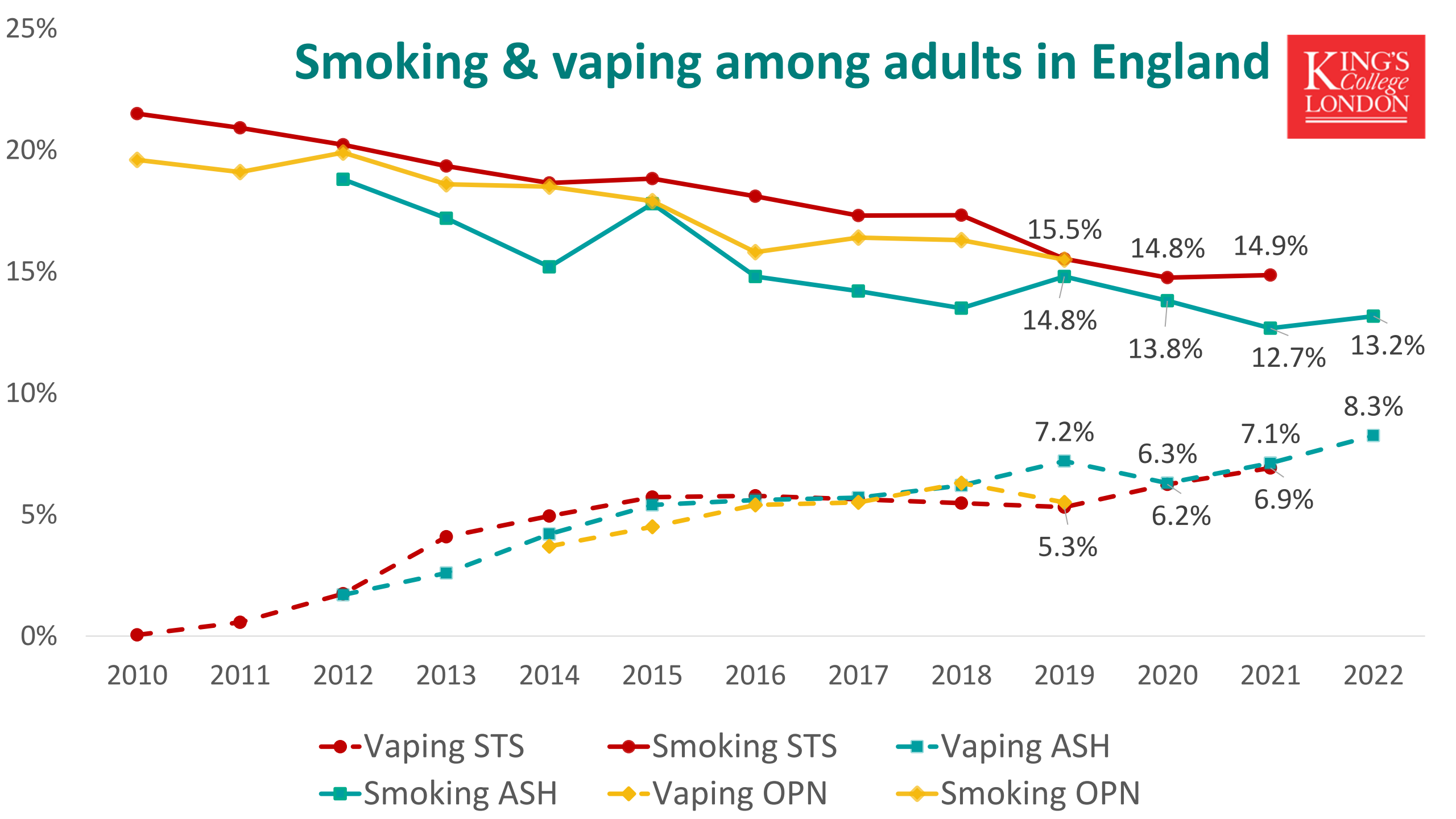


# Source of vaping products by people aged 11 to 17 who currently vape, ASH GB 2022



# Adults

# Smoking & vaping among adults in England



# Systematic review on health risks of vaping

Searched & reviewed literature published from ***August 2017 to July 2021***

Start date follows on from NASEM and PHE 2018 reports end dates

Records identified
**(n = 10,305)**

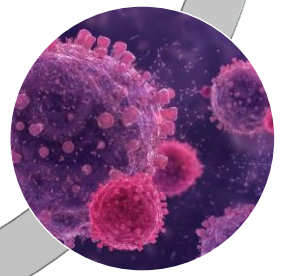
Records screened
**(n = 8,092)**

Full-text articles assessed
**(n = 772)**

413 studies

Humans
(n=275)

Animals
(n=81)

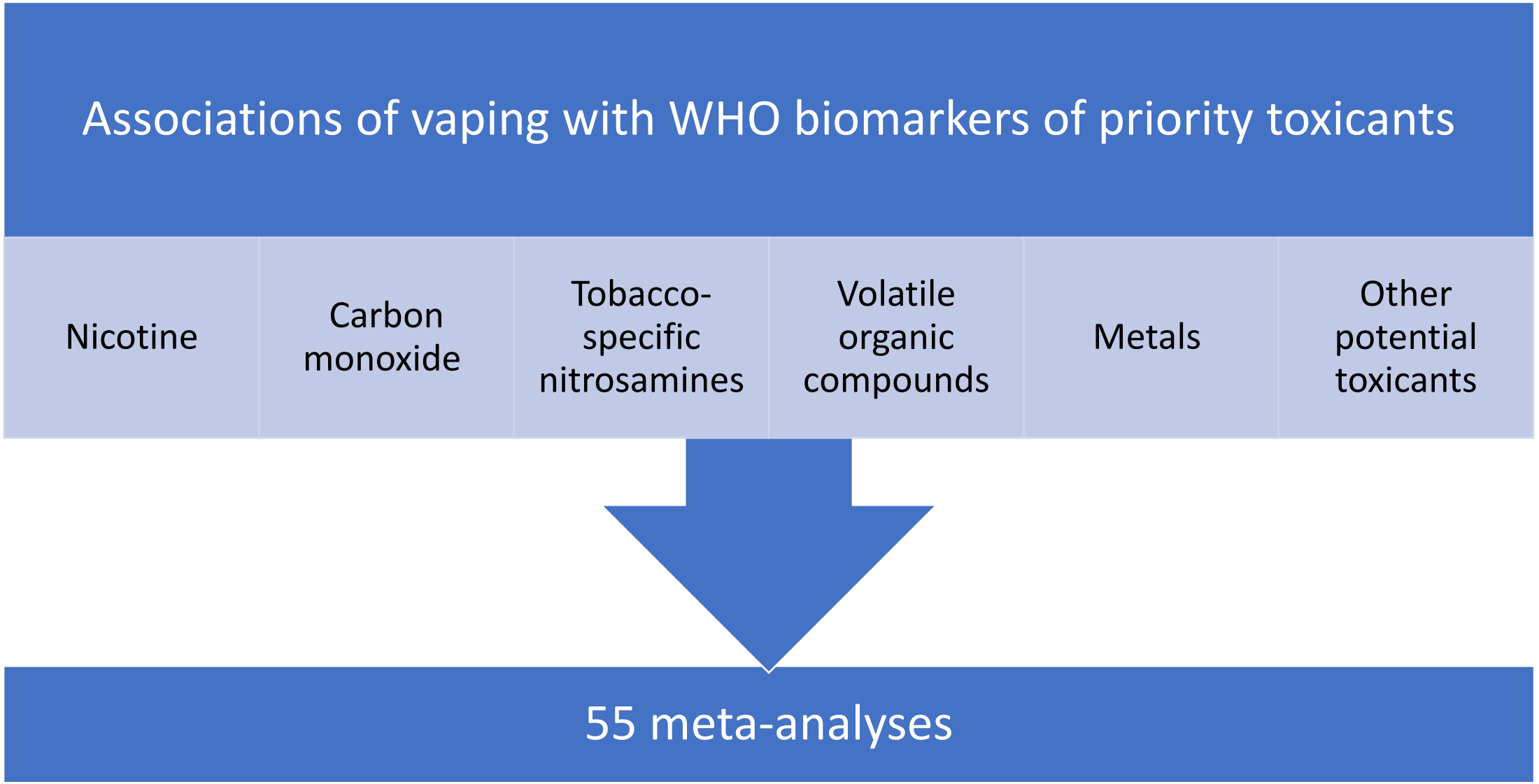


Cells
(n=58)

# Biomarkers of **exposure** to nicotine & potential toxicants

| Biomarkers of exposure (BoE) | Length of exposure |
| --- | --- |
| *Measurements of changes in toxicant or their metabolite levels in the body (in urine, saliva, blood, etc.) after exposure to tobacco or nicotine products* | **Acute:** *single use to 7 days*<br>**Short to medium:** *8 days to 12 months*<br>**Long term:** *more than 12 months* |

# Biomarkers of **exposure** to nicotine & potential toxicants



| Metabolites (toxicants) | Vaping vs Smoking (relative risk) | Vaping vs Non-use (absolute risk) |
|---|---|---|
| **Tobacco-specific nitrosamines** | | |
| NNAL (NNK) | ↓ | ↑ |
| NNN | ↓ | – |
| NAB | ↓ | ↑ |
| NAT | ↓ | ↑ |
| **Volatile organic compounds** | | |
| AAMA (Acrylamide) | = | = |
| GAMA (Acrylamide) | ↓ | = |
| CEMA (Acrolein) | = | = |
| 3-HPMA (Acrolein) | ↓ | = |
| CNEMA (Acrylonitrile) | ↓ | ↑ |
| S-PMA (Benzene) | = | = |
| MU (Benzene) | = | – |
| MHBMA (1,3-Butadiene) | ↓ | = |
| DHBMA (1,3-Butadiene) | = | = |
| HMPMA (Crotonaldehyde) | ↓ | = |
| S-BMA (Toluene) | = | = |
| **Carbon monoxide** | ↓ | – |

↓ significantly lower

↑ significantly higher

= no significant difference

– not enough data to meta-analyse

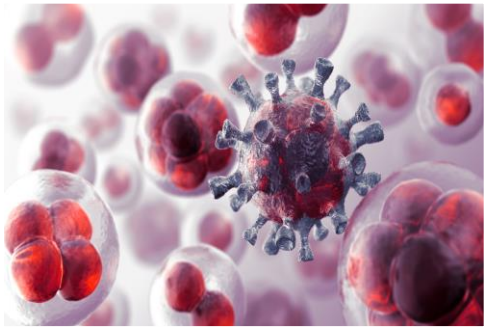
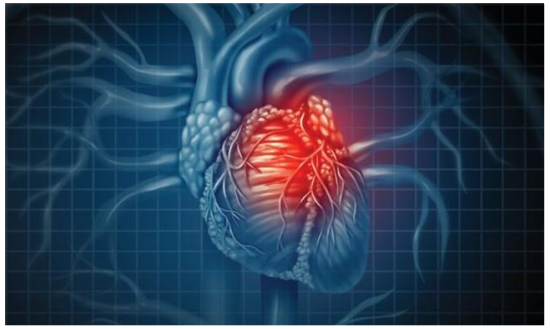
Note: these results are from meta-analyses that included only a small number of studies

# Biomarkers of exposure to nicotine & potential toxicants summary

**Significantly lower** among vapers than smokers

**Similar or higher** among vapers than non-users

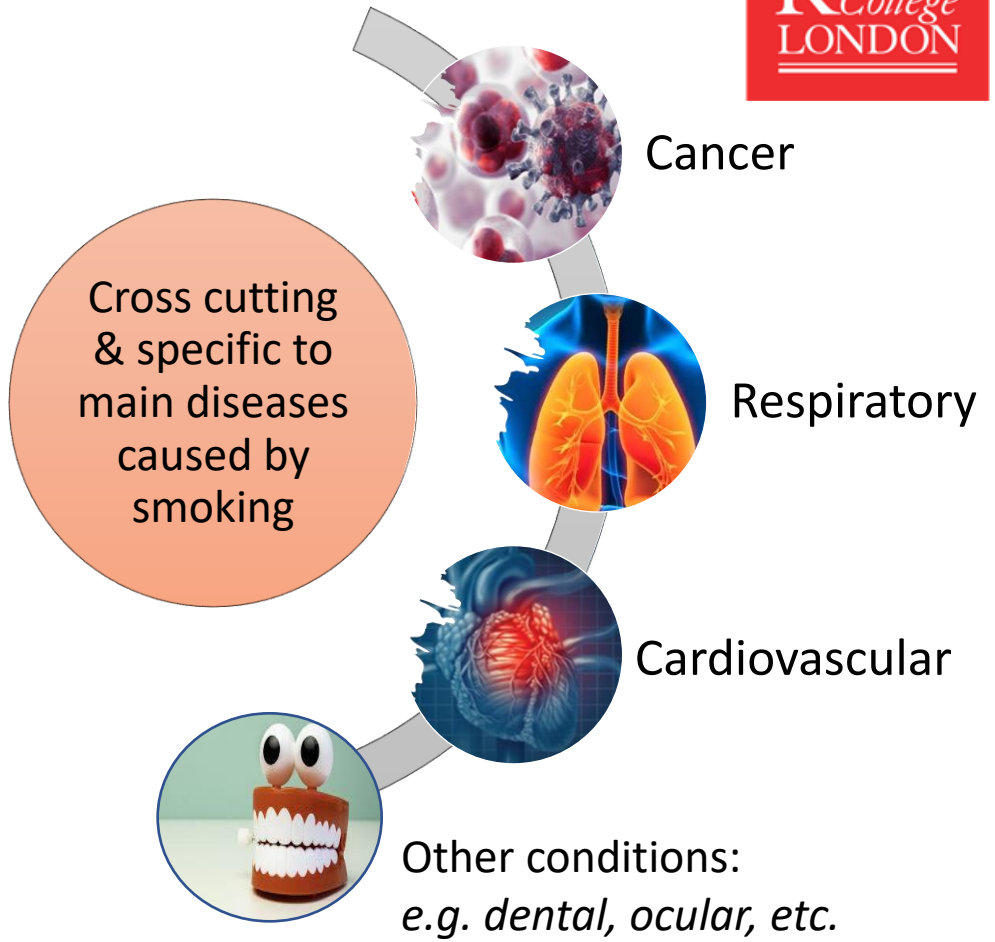
# Biomarkers of **exposure** related to specific diseases

| |  **Cancer** Exposure to carcinogens |  **Respiratory disease** Exposure to related toxicants |  **Cardiovascular disease** Exposure to related toxicants |
|---|---|---|---|
| **Vaping vs smoking** | Significantly lower | Significantly lower | Significantly lower |
| **Vaping vs non use** | Similar<br>Higher for some | Similar for most | Similar |

# Biomarker of potential harm to health (effect)

**Objective*** medical sign used to measure the effect of a substance on the body, or the presence or progress of disease

- Simple to measure: *e.g. blood pressure, white blood cell count, lung function*
- Complex to measure: *e.g. changes in the way genes are expressed*




*We did not include self reported symptoms

# Disease-specific biomarkers of **potential harm & outcomes**

## Cancers

- Research on methylation & demethylation of specific genes potentially useful
- No studies in people with existing or previous cancer

## Respiratory

**Acute exposure**

- Largely no statistically significant differences in lung function measures between nicotine vaping, non-nicotine vaping, or tobacco smoking

**Longer-term exposures**

- Switched from smoking to vaping: 3 months – no change,
  2 years, some declines (no control group, no decline in complete switchers)
- 3.5 years follow-up, similar in vapers & non-users
- A few studies on COPD & asthma outcomes

## Cardiovascular

- Heart rate & blood pressure: lower than smoking, similar to non-use after longer-term vaping
- No studies in people with existing condition, no studies on clinical outcomes

# Biomarkers of potential harm to health summary

**Mixed evidence** about negative vaping effects on biomarkers of potential harm

**No major causes of concern** regarding vaping harm to health in acute and short-to-medium term

# Secondhand exposure

# Second-hand exposure

## 6 studies overall

- 2 studies exposed people to atypically high levels of vaping emissions
- Lack of second-hand smoking exposure for comparison

## Biomarkers of exposure

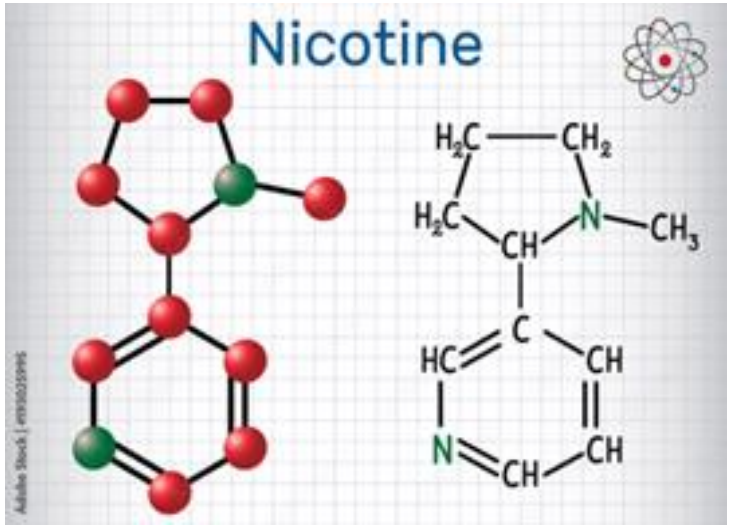
- Acute second-hand exposure to vaping aerosol resulted in non-significant changes
- Longer exposure associated with increases

## Biomarkers of potential harm

- Only 2 studies, both at serious risk of bias
- No conclusions can be drawn

# Nicotine and flavours

# Nicotine exposure to vaping compared to smoking




**Increased exposure** to nicotine using……

- e-liquids with **higher** nicotine concentration
- e-liquids based on **nicotine salts** rather than freebase nicotine
- tank or modular type vaping devices vs cartridges or disposables (cig-a-likes)

• Acute vaping vs smoking (single use – 7 days) = lower exposure to nicotine

• Short-to -longer-term vaping vs smoking (>7 days) = similar levels of exposure

•Users compensate puffing behaviour to achieve preferred nicotine levels when using lower nicotine strength liquids (end up consuming more liquid with lower than higher nic strengths)

# Flavours


## Humans

- Most common flavours used by adults and young people are fruit and menthol
- Non-tobacco flavours appeal to smokers to start and continue vaping and quit smoking
- Only a few studies
  - Levels of TSNAs and VOCs were significantly reduced in people who switched to vaping products with different flavours

## Cell and animal studies

- Relative to tobacco smoke, flavours had significantly less effect on cells (e.g. tissue viability, inflammation, oxidative stress)
- Absolute harm (from 3 cell & 1 animal study) – cinnamaldehyde flavouring had an effect on cells. Findings re exposure to PG/VG showed little effect
- Recommended further research (cinnamaldehyde) and standardized assessment

# Poisonings, fires and explosions

## Poisoning

incidents of poisonings can be serious but are rare

**National Poisons Info Service 2021:**

187 out of ~40,000 enquiries about vaping products; just under half involved children aged ≤5

2 case reports from UK of intentional poisoning (1 person died 2017)

Non-UK 16 deaths were reported, exposure intentional or unknown

## Fires

Fires from vaping are rare

**London Fire Brigade 2017-2021:**

5606 fires from smoking

15 fires from vaping

**No injuries or fatalities** from vaping related fires

**676 injuries & 46 fatalities** from **smoking** related fires

## Explosions

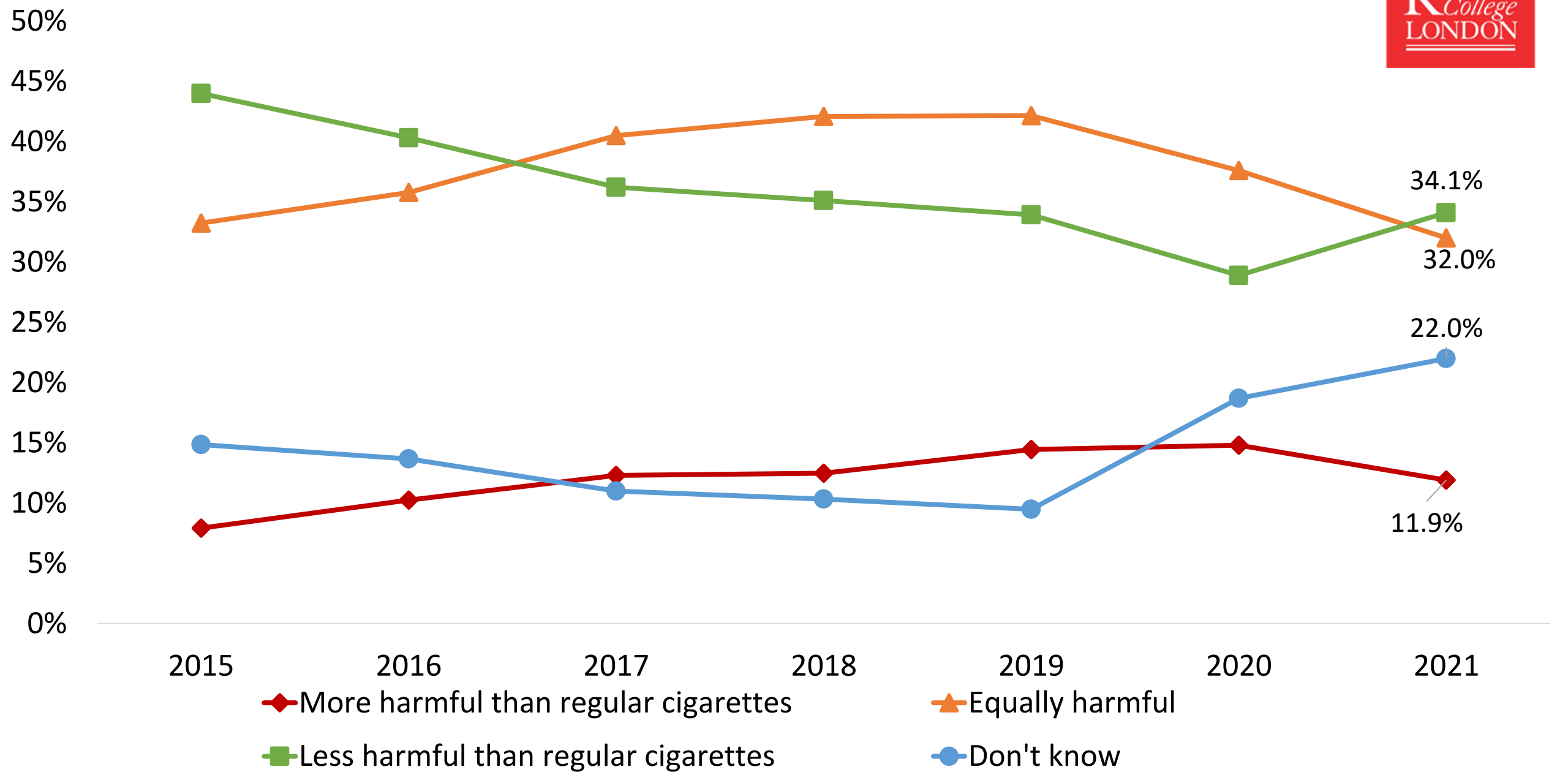
Incidents of exploding batteries can be serious but are very rare

2 case reports of non-fatal accidents involving 4 people in the UK

23 reports outside the UK, 1 fatality

# Risk perceptions

# Vaping risk perceptions among adult smokers in England



# Systematic literature review: Vaping risk perceptions & communications

NIHR | National Institute for Health Research

PROSPERO
International prospective register of systematic reviews

Print | PDF

**E-cigarette risk perceptions and communications: a systematic review**

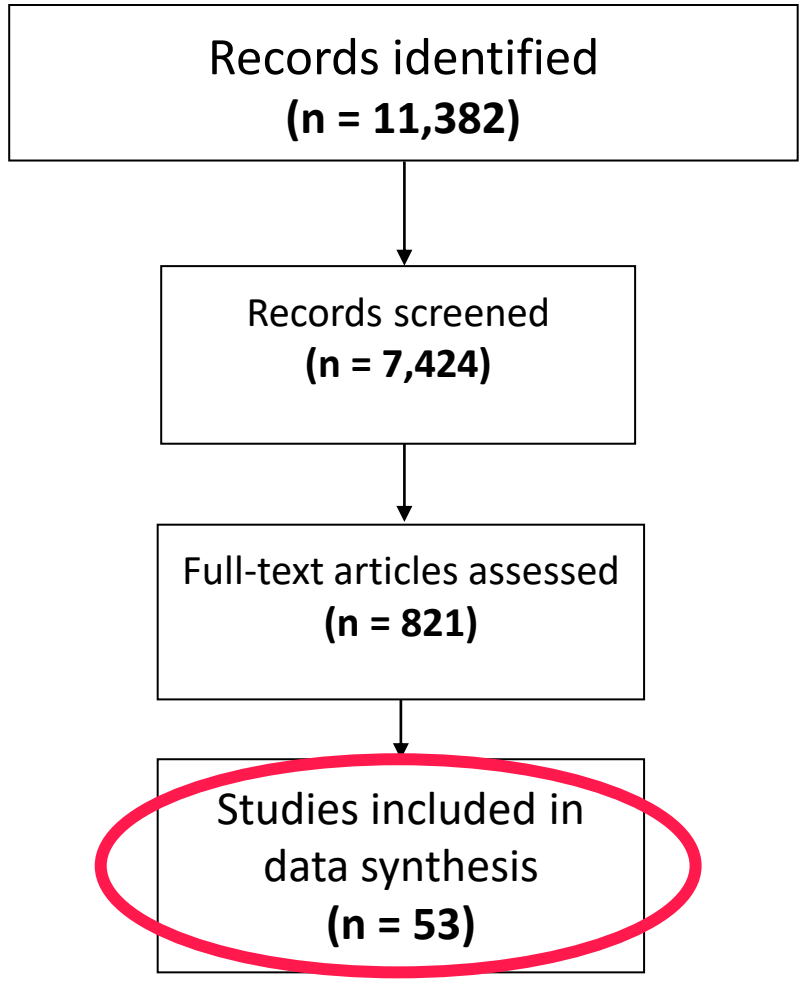
*Katherine East, Erikas Simonavicius, Debbie Robson, Leonie Brose, Eve Taylor, Lynn Kozlowski, Ann McNeill*

**Citation**

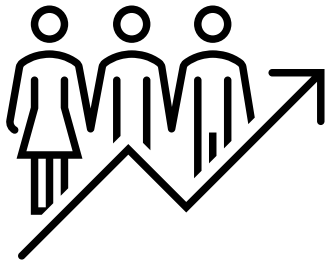
Katherine East, Erikas Simonavicius, Debbie Robson, Leonie Brose, Eve Taylor, Lynn Kozlowski, Ann McNeill. E-cigarette risk perceptions and communications: a systematic review. PROSPERO 2021 CRD42021247890
Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021247890

**To what extent are vaping risk perceptions predictive of any changes in vaping & smoking behaviours?**

**What interventions have been effective in changing vaping risk perceptions?**



# Systematic literature review:
# Vaping risk perceptions & communication



## Vaping harm perceptions can influence subsequent vaping (& smoking) behaviours (21 articles)

Vaping: Lower vaping risk perceptions (including less harmful than smoking) predicted vaping initiation/increases

Smoking: Less evidence, but 1 study found that perceiving vaping as less harmful than smoking predicted quitting smoking among adults

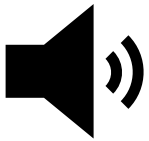
## Communicating vaping risks can change vaping harm perceptions (32 articles)

Correcting misperceptions of relative risks of vaping & nicotine harms: most research was from adults

Increasing absolute perceptions of vaping harms: most research was among youth

# Vaping risk perceptions & communication
# Systematic review take-home messages

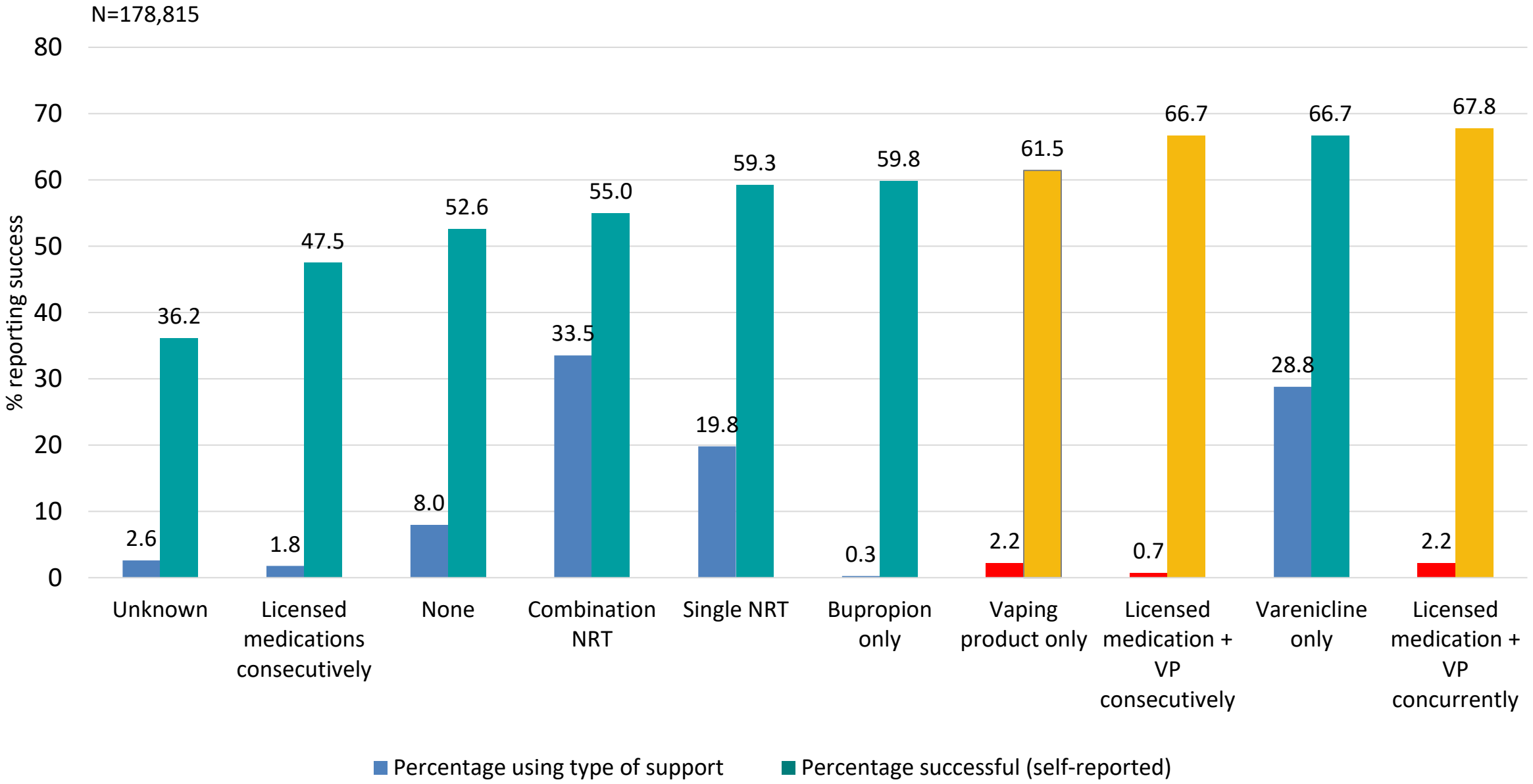
1. Communicating accurate information about the relative harms of vaping can help to correct misperceptions of vaping particularly among adults
2. This is important because vaping harm perceptions can change vaping (& smoking) behaviours
3. Interventions on absolute harms of vaping need to be carefully designed so as not to misinform people (particularly smokers) about the relative harms of smoking & vaping



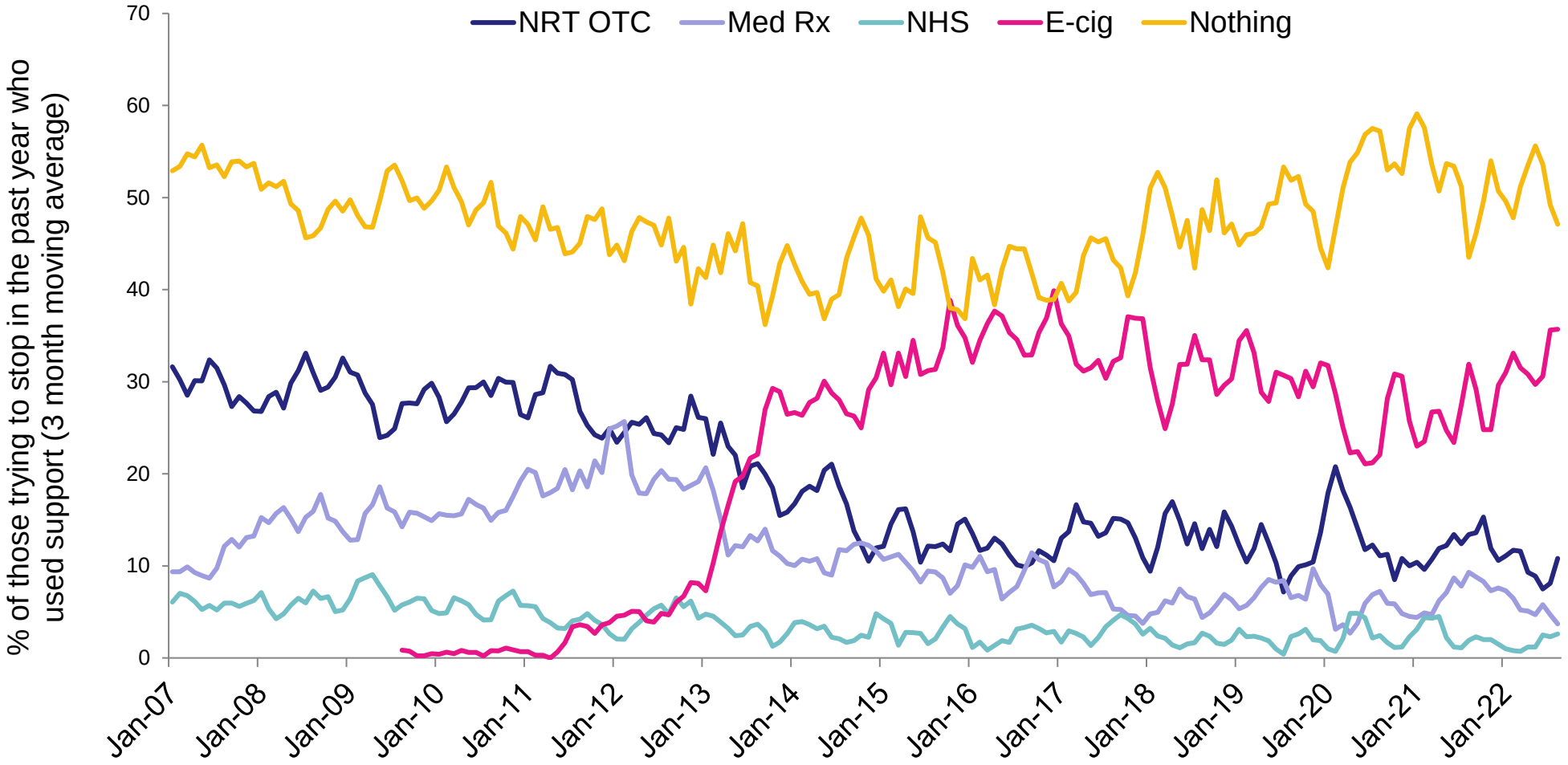
# Vaping for smoking cessation

# E-cigarettes within smoking cessation services 2020/21

(NHS Digital, 2022)



# Support used in quit attempts




NRT OTC: Nicotine replacement therapy bought over the counter; Med Rx: Prescription medication; NHS: NHS Stop Smoking Service; E-cig: E-cigarette. Method is coded hierarchically with smokers using more than one method classified into most intensive by the following scheme: 1. Nothing, 2. NRT OTC, 3. E-cigarette, 4. Med Rx, 5. NHS. In updates until June 2015, NRT OTC was coded above e-cigarette - earlier figures have now been revised. See e-cigarette tracking slides for any use of different treatments.

STS Smoking Toolkit Study

# Effectiveness of e-cigarettes for smoking cessation (Cochrane review, November 2022)


*"There is high-certainty evidence that e-cigarettes with nicotine increase quit rates compared to NRT & moderate-certainty evidence that they increase quit rates compared to e-cigarettes without nicotine"*

Hartmann-Boyce et al (2022) https://doi.org/10.1002/14651858.CD010216.pub7

# Overall findings of our evidence review & implications

# Overall findings

- Vaping poses only a small fraction of the risks of smoking in the short to medium term
- Vaping is not risk-free, particularly for people who have never smoked
- Two-thirds adult smokers don't know that vaping is less harmful than smoking; need accurate information
- Vapes are the 2nd most popular aid (1st: no support); Cochrane review vaping effective for smoking cessation
- We recommend a living systematic review to account for an increasing number of studies that explore vaping associated harm to health

# Implications

*Vaping can be used as an alternative to smoking to reduce the health harms of smoking*

*Never or long-term former smokers should be discouraged from taking up vaping (unless they would smoke instead)*

# Thank you for listening!

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