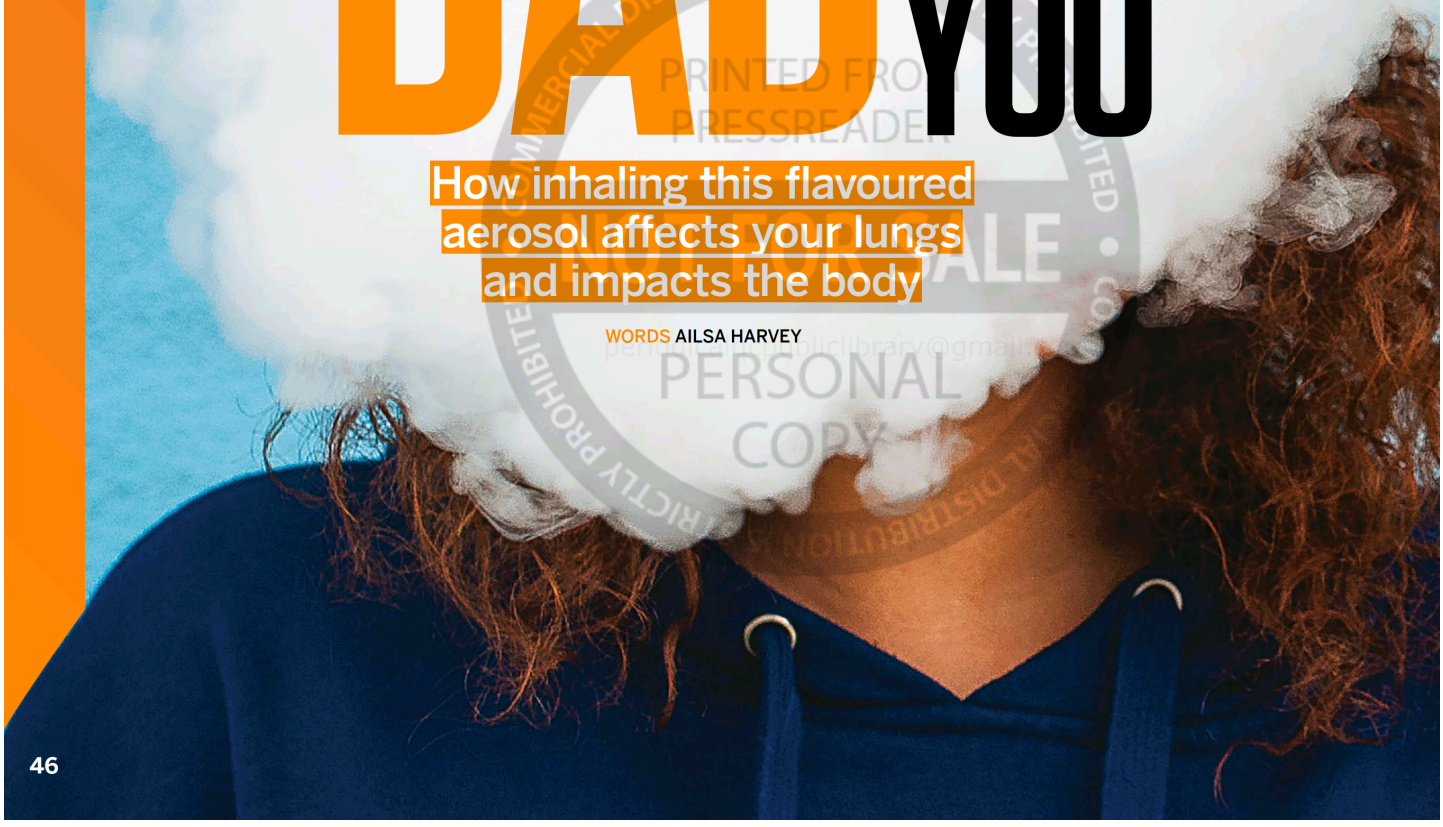
- Vaping / Smoking / Aerosols

SCIENCE

WHY VAPING IS BAD FOR YOU

How inhaling this flavoured aerosol affects your lungs and impacts the body

WORDS AILSA HARVEY



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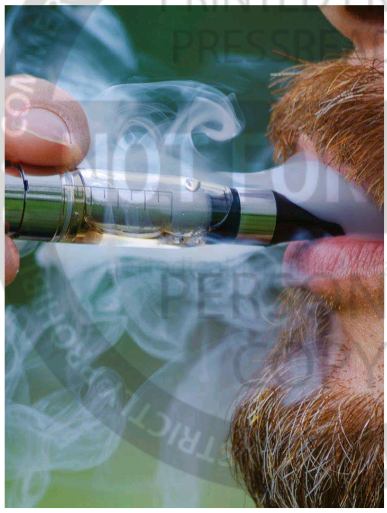
DID YOU KNOW? In the UK, 20.5 per cent of children between 11 and 17 years old had tried vaping as of 2023

Billows of fruity-flavoured mist are a common scent on today's city high streets. They plume from devices called electronic cigarettes, also known as vapes or e-cigarettes, and are exhaled from the mouths of young and old alike. But the liquid in vapes contains many harmful ingredients and a total of around 2,000 different chemicals. Despite the device's name, the mist that escapes vapes is inaccurately described as vapour. A vapour is a substance in gas form, while an aerosol contains small particles of liquid – called e-liquid in vapes – that are suspended in the air.

Although e-cigarettes were invented as a cigarette substitute, feeding nicotine cravings caused by smoking without exposing the body to many deadly toxins, vapes are a new craze that come with their own set of health hazards for a new generation of vaping addicts. Health agencies, such as those in the UK government, have previously misinformed people that vaping is a healthy alternative to smoking. Based on limited information about modern vaping devices and known ingredients, these groups promoted e-cigarettes as being 95 per cent safer than standard cigarettes. This information, which was intended to steer smokers away from tobacco products, has also steered younger non-smokers to these nicotine products.

Did you know?
About 4.5 million adults in the UK use a vape

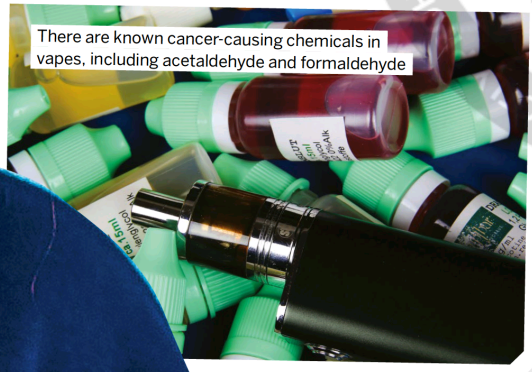
The sweet-tasting vape flavours are marketed like candy, appealing to younger generations, while their hidden and potentially deadly chemicals can damage developing bodies. This includes your brain, which isn't fully developed until you reach your mid-20s – vaping can hinder this process. Some of the main psychological risks include severe



CONTENT CHECK

Unlike cigarettes, which burn tobacco, vapes only contain the nicotine that has been extracted from tobacco. This is a very addictive, toxic substance that raises your blood pressure, heart rate and adrenaline, and can hinder proper brain development in young people. Propylene glycol is a chemical added to vapes to help create mist when heated, but is known to cause respiratory irritation. It is commonly found in paint solvent and artificial smoke machines.

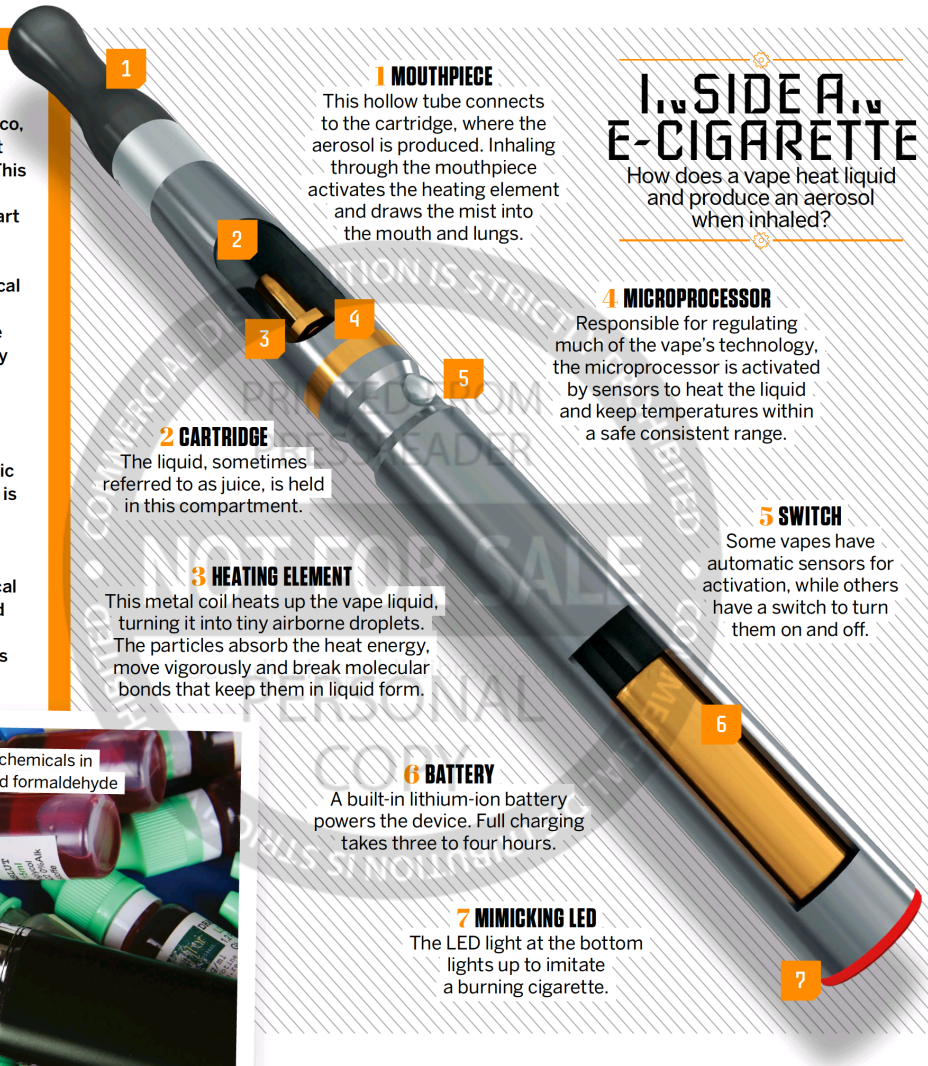
Not all chemicals found in the aerosol are present in the raw vape liquid. Those such as acrolein, a toxic chemical often used as a herbicide, is produced inside vapes when the device is heated and the flavouring chemicals begin to thermally decompose. Meanwhile, the chemical compound diacetyl is a yellow liquid that adds a buttery flavour to many vapes. Inhaling this chemical causes scarring to the lungs' air sacs.



There are known cancer-causing chemicals in vapes, including acetaldehyde and formaldehyde

INSIDE AN E-CIGARETTE

How does a vape heat liquid and produce an aerosol when inhaled?



1 MOUTHPIECE
This hollow tube connects to the cartridge, where the aerosol is produced. Inhaling through the mouthpiece activates the heating element and draws the mist into the mouth and lungs.

2 CARTRIDGE
The liquid, sometimes referred to as juice, is held in this compartment.

3 HEATING ELEMENT
This metal coil heats up the vape liquid, turning it into tiny airborne droplets. The particles absorb the heat energy, move vigorously and break molecular bonds that keep them in liquid form.

4 MICROPROCESSOR
Responsible for regulating much of the vape's technology, the microprocessor is activated by sensors to heat the liquid and keep temperatures within a safe consistent range.

5 SWITCH
Some vapes have automatic sensors for activation, while others have a switch to turn them on and off.

6 BATTERY
A built-in lithium-ion battery powers the device. Full charging takes three to four hours.

7 MIMICKING LED
The LED light at the bottom lights up to imitate a burning cigarette.

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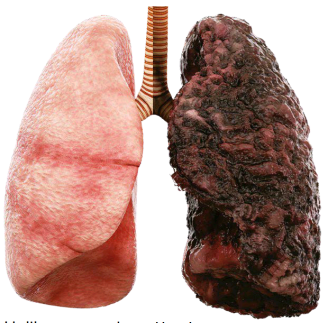
nicotine addiction, mood disorders and lowered impulse control. Those who start vaping when they're younger are more likely to pick up smoking habits later in life.

Many vapes are sold in disposable packaging that can leach hazardous chemicals into the environment when discarded carelessly. These include the plastics of the container and toxic compounds from the e-liquid remnants. The disposal of empty vapes into household bins can be just as problematic. The highly flammable lithium batteries inside the devices can easily start fires when crushed in refuse lorries. Through this process, they aren't recycled and their toxic metals enter landfills, contaminating surrounding ecosystems and water supplies. More than a million disposable vapes are thrown away every week – an indication of the scale of this increasing health and climate emergency.

CAN VAPING BE BENEFICIAL?

Vaping is considered the lesser of two evils when compared with tobacco. Cigarettes release thousands of chemicals into the body, and 70 of these are known to cause cancer. In the short term, it's better to take up vaping as a replacement to smoking rather than continuing smoking. Vapes are one of the most useful tools for stopping smoking. When an adult switches from smoking to vaping, it's also normal for them to vape more frequently than they smoked. This isn't always as harmful, as toxins in their body can still be reduced. Nicotine levels in vapes vary and don't contain the same chemicals, like tar and carbon monoxide, so the only benefit of vaping is to wean someone off their nicotine addiction by reducing the strength until they quit.



Unlike vapes, cigarettes turn healthy lungs (left) into tar-covered black tissue (right)

VAPING VS SMOKING

Discover the known and potential health impacts of inhaling vape aerosol compared with inhaling cigarette smoke

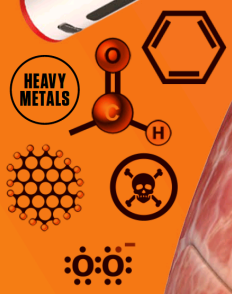
1 INFLAMMATION
Flavouring agent diacetyl causes inflammation in the branches of the lung's airways. A 2023 study suggests vapers suffer from more inflammation than smokers.



3 ACCELERATING CELL DEATH
Cell death occurs five times as often when vaping without nicotine, and ten times as much with nicotine.



11 MUCUS THICKENING
Vaping dehydrates the airways and causes thick mucus.



15 SIGNS OF EMPHYSEMA
Some studies have linked vaping with emphysema. Emphysema is damage to the lungs' air sacs, reducing gas exchange in and out of the organ.

9 IMMEDIATE INFECTIONS
Long-term infections caused by vaping are yet to be fully understood. More immediately, vaping decreases the production of antiviral protein SPLUNC1, increasing the risk of respiratory infections like the common cold.

13 SMALL AIRWAY OBSTRUCTION
The lungs' small airways are impeded by vaping, resulting in asthma-like symptoms. The extent of further damage isn't well studied.

19 FATTY IMMUNE CELLS
E-liquid contains oily substances that cigarettes lack. The fats are engulfed by immune cells called macrophages. The presence of these lipid-filled cells causes inflammation.

17 TUMOUR STUDIES
Vapes don't contain cancer-causing tobacco, and there's no significant evidence that vaping causes tumour growth.

7 DNA DAMAGE
E-liquid may stop DNA repair mechanisms, leading to DNA damage.

5 GENE EXPRESSION
E-cigarette aerosol changes the expression of non-coding RNA molecules without altering the DNA sequence. Non-coding RNA controls cell function without directly making proteins.

DID YOU KNOW? People in Australia need a prescription in order to legally buy vapes

2 CHRONIC INFLAMMATION
Smoking is known to cause severe inflammation due to containing more lung-irritating compounds like tar and carbon monoxide.



"Their hidden and potentially deadly chemicals can damage developing bodies"



4 IRREVERSIBLE CELL DEATH
Smoking causes more extensive cellular damage. When cells of the lungs' air sacs die, they can't regain function.

Did you know?
Nicotine itself doesn't cause cancer or heart disease

12 MUCUS BUILD UP
Smoke increases the permeability of lung tissue, which leads to too much mucus being released.

10 SEVERE INFECTIONS
Cigarette smoking is known to cause bronchitis, pneumonia and chronic obstructive pulmonary disease (COPD), and increases the risk of contracting tuberculosis.

14 AIRWAY OBSTRUCTION
COPD is a disease that restricts airflow. 80 per cent of COPD deaths are due to smoking.

16 CAUSE OF EMPHYSEMA
Smoking is the main cause of emphysema – smokers are six times more likely to develop it than non-smokers.

18 CANCER-CAUSING
Tobacco in cigarettes can damage DNA. This causes cells to begin to grow out of control and produce tumours in the lungs.

6 GENE SUPPRESSION
Smoking may weaken the genes that control tumour growth.

8 DNA MUTATIONS
One packet of cigarettes holds enough harmful compounds to cause two mutations in the DNA of lung cells.

5 FACTS HIDDEN DANGERS

1 MISLEADING LEVELS
E-cigarette packaging can be misleading. Research shows that around half of the labels on e-cigarette containers display levels that don't actually match the contents.

2 SECOND-HAND EXPOSURE
Inhaling second-hand aerosol from others vaping in the home is linked to shortness of breath in young adults.

3 CARDIOVASCULAR CHAOS
Using vapes more than five times a week and for at least three months is enough to cause blood vessels to stop working properly and lead to cardiovascular disease. Nicotine increases your chances of suffering a heart attack.

4 MENTAL HEALTH
In a study by the American Heart Association, anxiety was 20 per cent more prevalent in vapers. 50 per cent of those who vaped experienced symptoms of depression as opposed to 25 per cent of non-vapers.

5 ALTERING IRRITANTS
Not all of the toxins are labelled on a vape's packaging. Those that are produced during the heating of the ingredients are often missed off the list.

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Workers at a factory in Shenzhen, China, make e-cigarette pods for vaping manufacturer KangerTech

WHERE E-CIGARETTES ARE MADE

Around 90 per cent of vape pens are manufactured in China by companies owned by entrepreneur Zhang Shengwei. Every year, hundreds of millions of vapes are shipped from China to the UK and US, but many of these factories lack quality control. This results in thousands of harmful chemicals entering the products and the lungs of those that use them. For example, studies have discovered that some vape aerosols have four times more of the hazardous metals nickel and chromium in them than standard cigarette smoke. As vapes don't contain tobacco in its full form, the Chinese tobacco authority that regulates cigarette manufacturing and other similar products in China doesn't monitor these factories. When vapes became popular, many countries struggled to categorise the devices. They weren't classed as drugs, food or tobacco. Today the Medicines and Healthcare products Regulatory Agency (MHRA) in the UK and the Food and Drug Administration (FDA) in the US regulate vapes.

Did you know?

In 2021, thousands of unidentified chemicals were found in vapes

WHAT IS EVALI?

Recognised as hazy spots on the lungs in a chest X-ray and with symptoms that include shortness of breath, fever and chest pain, EVALI is a severe lung disease caused by vaping. The full name of the illness is e-cigarette or vaping use-associated lung injury, and vitamin E acetate is thought to be the main substance in e-cigarette liquid that causes this lung damage.

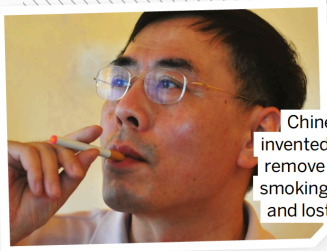
The disease can crop up quickly, affecting people soon after they start vaping, or it can build up over a longer period of vaping. 90 per cent of those who develop EVALI need to go to hospital, and it can be deadly in the most severe cases. Young people under the age of 35 are believed to be most at risk of EVALI. The condition has only been reported in the last few years, so scientists are researching the disease to discover how to reverse the damage it causes.



Healthy parts of the lungs usually appear dark on X-ray scans

HOW VAPES EVOLVED

Controversy has surrounded vaping since it was invented



2003

Chinese pharmacist Hon Lik invented the modern e-cigarette to remove the smoke from the act of smoking. He was a smoker himself, and lost his father to lung cancer.



2007

Vapes entered the global market and the World Health Organization expressed health concerns.



2010

2010 is considered the year in which vaping increased greatly in popularity around the world.

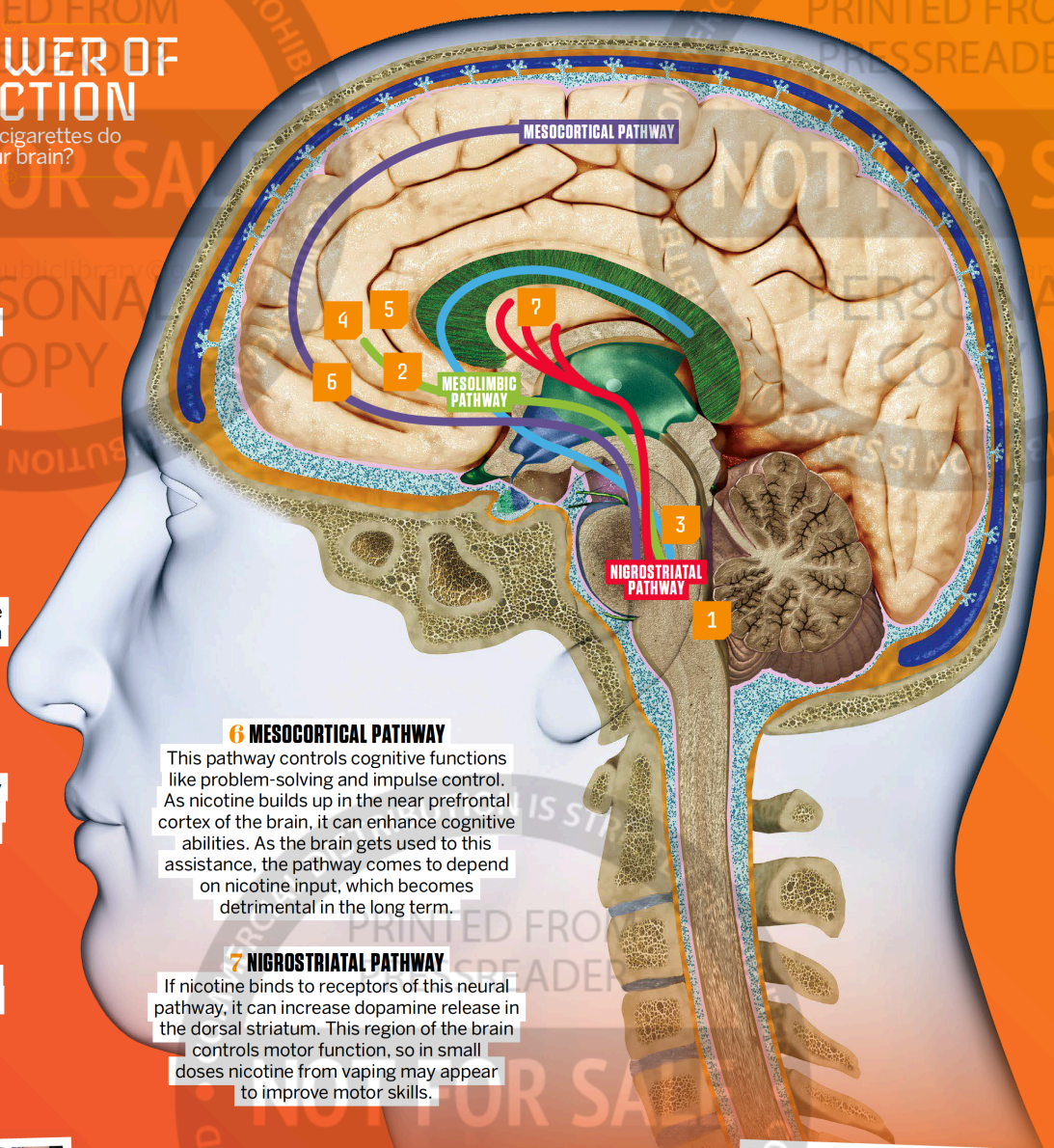
2014

Advertising and packaging became targeted at adolescents' tastes, sparking safety concerns. The term 'vaping' became popular in this year.

DID YOU KNOW? Vapes are intended for the 70 per cent of smokers who want to quit

THE POWER OF ADDICTION

What do e-cigarettes do to your brain?



1 BLOOD-BRAIN BARRIER
10 to 20 seconds after inhaling nicotine, it crosses the blood-brain barrier into the brain.

2 MESOLIMBIC PATHWAY
This neural circuit releases the feel-good chemical dopamine into the body.

3 VENTRAL TEGMENTAL AREA (VTA)
Neurons in this area have nicotine receptors. When the molecules bind to them, the mesolimbic pathway is activated.

4 NUCLEUS ACCUMBENS
The mesolimbic pathway connects the VTA to this area of the brain, where dopamine is released.

5 REWARD AND REINFORCEMENT
Dopamine, released here, creates feelings of pleasure in the brain. As the brain learns this feeling, it seeks further reward from more nicotine hits.

6 MESOCORTICAL PATHWAY
This pathway controls cognitive functions like problem-solving and impulse control. As nicotine builds up in the near prefrontal cortex of the brain, it can enhance cognitive abilities. As the brain gets used to this assistance, the pathway comes to depend on nicotine input, which becomes detrimental in the long term.

7 NIGROSTRIATAL PATHWAY
If nicotine binds to receptors of this neural pathway, it can increase dopamine release in the dorsal striatum. This region of the brain controls motor function, so in small doses nicotine from vaping may appear to improve motor skills.



2016
In the US, the FDA gained authority to regulate tobacco and vape products on 8 August.

2019
EVALI was officially identified. In the US alone, there were 2,051 cases and 39 deaths reported in four months.



2019
In the US, the legal age for purchasing vaping products was raised from 18 to 21.



2020
Amid the COVID pandemic, respiratory health entered the spotlight, re-igniting the debate around the dangers of vaping.



2024
Following a 2023 proposal to ban cigarettes for those born in 2009 or later, the UK announced plans to ban all disposable vapes.

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