Vaping: Health Risks, Emerging Concerns, and the Comparison With Smoking

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Vaping devices heat a liquid to create an inhaled aerosol. They do not burn tobacco, but “no combustion” does not mean “no exposure.” The aerosol can carry nicotine, fine particles, solvents, flavor chemicals, thermal breakdown products, and metals. What a person receives varies with the liquid, device, power, coil age, puffing, and whether the product is authentic or authorized.

The most useful health comparison depends on the starting point. A person who has never used tobacco gains no health advantage by starting to vape. An adult who smokes cigarettes may reduce exposure to many combustion toxicants by stopping cigarettes completely and switching to a regulated nicotine e-cigarette, although vaping remains harmful and its lifetime risk is not known precisely. Using both products is not the same as switching. Complete abstinence from cigarettes and vaping is the lowest-risk endpoint, and proven cessation medicines plus counseling remain available.

This guide separates measured chemicals, short-term biological effects, observational associations, and confirmed disease. It is general education, not an individualized diagnosis or treatment plan, and it has not undergone clinician review.

Key Takeaways

• A vape makes an aerosol, not harmless water vapor. “Vapor” is common informal language, but aerosol better describes droplets and particles suspended in gas.

• Nicotine can create strong dependence. Craving and withdrawal reflect brain adaptation, not weak character or failed willpower.

• Youth, young adults, people who are pregnant, and people who have never used tobacco should not vape. Prevention messages about adolescent brain development are important, but current evidence cannot predict permanent injury in every individual.

• For an adult who smokes, complete substitution of cigarettes with a regulated nicotine vape likely reduces exposure to many toxicants compared with continued smoking. Lower exposure is not safety, and no valid fixed percentage describes the reduction in lifetime harm.

• Dual use can preserve substantial cigarette exposure. Adding a vape while continuing to smoke is not an adequate health-protection goal.

• Vaping causes acute physiological and airway changes. Evidence that vaping alone causes specific long-latency diseases is less complete because products change quickly and many adult users previously smoked.

• A 2025 study found high metal emissions from some devices in three disposable brands. Its striking lead comparison concerned one element, a small laboratory sample, and a comparison with previously published cigarette data—not an overall vaping-versus-smoking harm ratio.

• Five jointly authored Reynolds–Bikman experiments found changes in pregnant mice and existing oral cancer cells after selected vape aerosols. Some outcomes also changed with cigarette smoke, sometimes more strongly; none establishes that vaping is worse than smoking overall or that it is safe.

• The 2019 EVALI outbreak was strongly linked to THC-containing products, especially from informal sources, and vitamin E acetate. Other chemicals could not be ruled out in every case.

• Nicotine e-cigarettes can help some adults stop smoking, but no e-cigarette is FDA-approved as a cessation medicine. NRT, varenicline, bupropion, counseling, and quitlines are established alternatives.

• Swallowed e-liquid can be a poisoning emergency. Call Poison Control at 1-800-222-1222 immediately after ingestion; call 911 for collapse, seizure, trouble breathing, or inability to wake.

1. What a vape is—and why “aerosol” matters

Electronic cigarettes include disposables, refillable tanks, pods, “cigalikes,” and devices that resemble pens or flash drives. A battery powers a heating element, usually a metal coil. The coil heats liquid held in a reservoir or wick. Typical liquids contain propylene glycol (PG), vegetable glycerin (VG), nicotine, acids used to form nicotine salts, and flavoring or cooling chemicals. Products labeled nicotine-free may still create non-nicotine exposures, and a label is not a laboratory certificate.

Heating produces an aerosol: a changing mixture of gas, liquid droplets, and solid particles. Calling it “water vapor” is misleading because water is not the only constituent and may not be the major one. CDC lists potentially harmful substances found in some aerosols, including nicotine, cancer-associated chemicals, volatile organic compounds, metals such as nickel, tin, and lead, flavorants, and small particles that can reach deeply into the lungs. Not every product contains every substance at the same concentration. [1]

“Vapor” remains common everyday language, but the distinction is useful: an apparently disappearing cloud can deposit material in the mouth, lungs, room, and bystanders. A 2023 study of one refillable device found predominantly submicron aerosol mass and more mass at higher power. Its device, machine puffs, and limited size bins cannot define a universal dose for modern disposables. [2]

Emissions change across a device's life. Power, coil material, temperature, airflow, wick saturation, PG/VG ratio, nicotine concentration, acids, flavors, cooling agents, puff length, and pauses between puffs all matter. Overheating or a poorly supplied wick can increase thermal degradation. Corrosion or repeated heating can release metals. A “puff” is therefore not a standardized dose like a tablet, and claims such as “one pod equals one pack” can be badly wrong for an individual.

Secondhand aerosol is also not simply exhaled water. The National Academies found conclusive evidence, based on studies available through its 2018 review, that e-cigarette use increases indoor airborne nicotine and particulate matter above background. Bystander exposure was generally lower than exposure from combustible cigarettes, but lower is not zero or established as safe. Ventilation, device output, room size, distance, and frequency change exposure. Avoid vaping around children, pregnant people, and people with heart or lung disease, and follow smoke-free rules. [3]

2. Nicotine delivery, dependence, and withdrawal

Nicotine activates reward and learning pathways and can reinforce repeated use. Dependence may appear as strong craving, using soon after waking, difficulty stopping, tolerance, continued use despite problems, or withdrawal when nicotine falls. Withdrawal can include irritability, restlessness, anxiety, low mood, trouble concentrating or sleeping, increased appetite, and craving. These symptoms are real physiological adaptations. A nonblaming plan treats them as expected and manageable rather than as proof that someone lacks discipline. [1]

Modern nicotine salts can make concentrated nicotine easier to inhale by reducing harshness compared with free-base formulations. In a randomized crossover pharmacokinetic study of 20 adults who were not nicotine-naive, ten standardized puffs of 20 mg/mL nicotine salt produced a higher median peak serum nicotine concentration than 20 mg/mL free-base nicotine, 5.4 versus 3.0 ng/mL. The 40 mg/mL salt condition reached 12.0 ng/mL and delivered nicotine similar to cigarette smoking under that study protocol. Twenty participants using one standardized procedure do not represent every product or user; concentration, power, puffing, and experience alter delivery. [4]

Nicotine source does not remove addiction risk. “Synthetic,” “non-tobacco nicotine,” or “tobacco-free nicotine” describes where the molecule came from, not a safer pharmacology. FDA states that nicotine is addictive regardless of source and that non-tobacco nicotine products require premarket authorization. In the application-status section of its page, FDA reported that no non-tobacco nicotine product had received marketing authorization; that status section is dated October 2023 and does not by itself establish the status at this guide’s September 2026 research cutoff. A pending application is not authorization, and the current FDA authorization records should be rechecked immediately before publication. [5]

Nicotine analogs are a different issue. These are nicotine-like chemicals rather than nicotine made synthetically. A 2024 Yale-linked analysis of two marketed product lines found substantial label-content discrepancies: a product labeled 50 mg/g 6-methyl nicotine measured around 6 mg/g, while a nicotinamide-labeled liquid contained low-level unlabeled 6-methyl nicotine. This small analysis does not estimate market prevalence. More importantly, human inhalation toxicity and dependence potential for these analogs remain poorly characterized. “Nicotine-free” or an unfamiliar ingredient name should not be interpreted as proof of safety. [6]

Youth brain and mental-health evidence: a strong prevention message with limits

Brain development continues into the mid-20s, and nicotine exposure during adolescence can affect systems involved in attention, learning, mood, and impulse control. Young people can show dependence before daily use. These facts support a clear recommendation not to start and to help youth quit early. [7]

The evidence should not be overstated. It is unethical to randomize adolescents to years of nicotine exposure, so evidence combines biology, animal experiments, short-term human studies, and observational studies. Youth groups can differ before vaping in stress, mental health, social context, and other substance use. Evidence cannot predict permanent injury in every individual.

Vaping and depression or anxiety are associated in many observational studies, but association alone does not identify direction. Nicotine withdrawal can create anxiety, low mood, and concentration problems; distress can also lead someone to seek nicotine; and shared influences can produce both. The dependence cycle is clinically important without converting it into a claim that vaping caused every diagnosed mental-health condition. Asking about mood and safety while helping someone quit is better than blame.

3. How common is vaping in the United States?

The newest final adult NHIS table with standard age bands covers 2024. “Current use” means an adult had ever used an e-cigarette and now used one every day or some days. It is a household interview estimate for the civilian, noninstitutionalized adult population. [8]

2024 adult age group	Current e-cigarette use
18–24	14.8%
25–44	11.1%
45–64	4.1%
65 and older	1.0%
All adults 18+	7.0%

The 2025 NHIS Early Release gives a newer overall adult estimate: 6.7% (95% CI 6.2–7.2). NCHS labels it preliminary because final editing and weighting had not been completed, and the fixed annual table does not supply the same age breakdown. The 6.7% should therefore be reported separately rather than used as a new total above 2024 age rows. [9]

The 2025 National Youth Tobacco Survey asks a different question of students in grades 6–12. “Current” means use on at least one of the past 30 days, not “every day or some days now.” An estimated 5.2%, or 1.44 million, middle and high school students used e-cigarettes currently: 7.1% of high school students and 2.6% of middle school students. Among current youth users, 27.5% reported use on all 30 days. That 27.5% denominator is current users, not all students. [10] [11]

These surveys should not be merged into an adult-versus-youth ranking. They cover different populations, settings, and definitions; NYTS also excludes youth not enrolled in school. Their weighted estimates are each useful within scope.

4. What health evidence shows—and what it cannot yet show

Evidence sits on a ladder: chemistry identifies emissions; cells and animals identify plausible mechanisms; human experiments and biomarkers measure immediate responses; cohorts look for later illness. Cessation trials are generally too short and small to settle rare, decades-latent harms. These rungs are not interchangeable.

Lungs and airways

Vaping can irritate the throat and airways. Human and laboratory research reports inflammation, oxidative stress, altered epithelial and immune responses, and effects on ciliary function. People may report cough, wheeze, chest tightness, or shortness of breath. These findings establish exposure and plausible injury pathways, but a laboratory inflammatory marker is not itself COPD.

In a PATH cohort of 21,618 adults initially free of the studied respiratory conditions, current vaping was associated with a composite of new self-reported asthma, emphysema, chronic bronchitis, or COPD after adjustment that included smoking history and pack-years (incidence rate ratio 1.31, 95% CI 1.08–1.59). Exposure and diagnoses were self-reported, use could change, follow-up was relatively short, and former smoking can remain incompletely captured. [12]

A later PATH analysis of 15,291 adults found increased functionally important respiratory symptoms among current cigarette smokers who also vaped. Among never-cigarette-smokers, it did not detect a statistically significant association, but exclusive-vaping groups were small and estimates imprecise. “No statistically significant association” is not proof of no effect; it means the data did not estimate one precisely in that subgroup. [13]

Respiratory research is particularly vulnerable to reverse causation. A person may develop smoking-related symptoms, then switch to vaping. If a study labels that person an “ever vaper” without detailed pack-years, timing, age at smoking initiation, time since quitting, and whether disease began first, it can wrongly assign old smoking injury to vaping. A 2025 methodological critique found that COPD syntheses often handled these variables poorly. The critique does not prove vaping is harmless; it explains why confident causal estimates remain difficult. [14]

Heart and blood vessels

Nicotine-containing vaping can acutely increase heart rate and blood pressure and can affect sympathetic activity. Human studies also report endothelial dysfunction, oxidative stress, and platelet-related changes. A 2025 systematic review estimated acute increases versus non-use of about 11 beats per minute in heart rate, 12.9 mm Hg systolic pressure, and 7.7 mm Hg diastolic pressure. Acute heart-rate effects were smaller than with smoking, while blood-pressure differences versus smoking were not significant. The review found insufficient evidence to establish diagnosed cardiovascular disease or structural cardiac change from vaping. [15]

A 2026 meta-analysis reported observational associations with coronary heart disease, major adverse cardiovascular events, and stroke, with a larger pooled estimate in dual users. It also documented major heterogeneity, residual confounding, self-reported exposures and outcomes, limited adjustment for prior smoking, and no study at low risk of bias in every domain. Some pooled analyses had extreme heterogeneity. These estimates are safety signals, not proof that vaping caused a particular heart attack or stroke. [16]

The American Heart Association's scientific statement summarizes early molecular, animal, and clinical evidence of acute physiological and airway effects and emphasizes the need for long-term study. Both parts matter: acute effects are not imaginary, and lifetime event rates are not yet known. [17]

Mouth and oral tissues

The mouth directly contacts aerosol, nicotine, solvents, flavorants, and particles. Early studies link vaping with cavities and irritation of gums and oral tissues. These concerns support routine dental care and evaluation of persistent sores, bleeding, pain, or lesions, but do not establish a precise disease rate. [18]

Cancer: hazard is plausible; the human risk number is not known

Some vape aerosols contain formaldehyde and other potentially carcinogenic substances. Cell, animal, and human biomarker studies report oxidative stress, DNA damage, inflammation, and other mechanisms relevant to cancer. A 2026 qualitative assessment classified nicotine e-cigarettes as likely carcinogenic for lung and oral cancer. It did not estimate absolute risk or attributable burden and acknowledged the absence of mature long-term population studies. A published commentary disputed that classification, illustrating active scientific disagreement. [19]

Cancer often develops over decades. Widespread current-style vaping is much newer, products change rapidly, and most older adult vapers have a smoking history. There are not yet decades-long cohorts of many exclusive vapers who never smoked with repeated objective exposure measurement. Accordingly, it is reasonable to say that carcinogenic exposures and mechanisms create concern; it is not reasonable to state a known lifetime incidence or a precise percentage relative to smoking.

A 2025 cancer systematic review sometimes encountered in searches was retracted by the journal in June 2026. The notice cited serious problems involving methodology, accuracy, scientific validity, protocol deviations, study classification, an irreproducible evidence trail, and conclusions unsupported by heterogeneous limited evidence. That review and its cancer-specific conclusions are excluded from this guide. [20]

What did Reynolds and Bikman actually find?

Paul R. Reynolds and Benjamin T. Bikman are Brigham Young University researchers; their BYU faculty/CV record identifies Reynolds and the team's publications. The five original vaping papers below list both researchers among their authors. They did not follow human smokers who switched completely to vaping to measure future disease. Three examined secondhand exposures in pregnant mice, and two examined cells that already had oral cancer. These are important early warning signals, but the user's reasonable question—“could vaping be worse than smoking in many ways?”—cannot be answered with a blanket yes from these experiments. Different liquids, durations and preparations make a single head-to-head risk ranking impossible. [21] [22] [23] [24] [25]

Study and model	What changed in the experiment	What the comparison cannot establish
Kirkham 2024: pregnant mice; four or six late-gestation days of secondhand cigarette smoke, cinnamon e-cig aerosol, or room air.	At four days, placental and fetal weights fell versus air in both exposed groups: about 1.4-fold with smoke and 1.2-fold with aerosol. At six days, both groups had higher maternal blood pressure and urine protein versus air; six-day aerosol reduced weights while six-day smoke weights were not reported as significantly reduced. [21]	These are mouse pregnancy measures, not diagnosed human preeclampsia, infertility, or proof one product is worse overall. A significant result in one group but not the other does not prove a significant difference between groups.
Beck 2025: pregnant mice; four or six days of secondhand smoke or apple e-cig aerosol versus air.	Placental cell-death and growth-regulating proteins changed with exposure and duration. After six days, cytochrome c protein was lower with both exposures; FAS/FASL increased with smoke, not the tested aerosol. [22]	Protein abundance is not a test of mitochondrial respiration or a human pregnancy diagnosis. This used a different flavor from Kirkham and related animal protocols, not an independent human replication.

Kinney 2025: already cancerous gingival Ca9-22 cells; cigarette-smoke extract or Red Hot/Green Apple vapor extracts.	Smoke extract increased invasion about 2.4-fold versus untreated cells; Red Hot with nicotine also increased invasion (figure table: 2.1-fold), whereas Green Apple did not significantly increase it. Smoke generally gave stronger invasion and RAGE/NF-κB signals in this setup. [23]	Extracts were prepared differently: 0.05% smoke extract for 24 hours versus 10% vapor extract for 6 hours, not equivalent nicotine or toxin doses. Internal text/figure ratios conflict, so these figures cannot rank total human harms or demonstrate cancer initiation or metastasis.
Chiu 2026: pregnant-mouse lungs after four or six days of secondhand smoke or e-cig aerosol.	The available publisher abstract reports stronger inflammation, immune activation and mitochondria-linked cell-death signals with smoke; aerosol produced milder inflammation but oxidative imbalance and epithelial remodeling. [24]	Full numerical results and exposure matching were not verified here. This directly counters a claim that the pair found vaping always caused greater lung inflammation or mitochondrial injury.
Vu 2026: existing gingival and tongue cancer-cell lines; apple vapor extract with or without labeled nicotine.	mTOR-related growth signaling changed by cell line and nicotine condition: for example, nicotine-containing extract lowered p-p70S6K about 1.9-fold in Ca9-22 but raised p-AKT about 3.6-fold in Cal 27. Invasion did not change significantly in either line. [25]	No cigarette-smoke group was tested. The label's nicotine concentration was not verified in the resulting extract; signaling changes cannot predict human oral cancer incidence.

The pregnancy studies used small groups of mice and nose-only secondhand exposures in late gestation, not adult humans actively smoking or switching completely to vaping. “6 mg nicotine” describes a liquid label, not nicotine actually delivered equally across smoke and aerosol arms. The oral-cell studies use existing cancer lines: making those cells respond or invade in a dish is not causing cancer to begin in a healthy person, a diagnosis, or a clinical metastasis rate. A marker that changes more for one flavor or duration can coexist with a stronger cigarette-smoke result for another marker. These harms warrant caution, especially no vaping in pregnancy, but do not overturn the broader evidence that complete substitution can lower many combustion-toxicant exposures for nonpregnant adults who smoke. Avoid dual use, seek cessation support, and do not return to cigarettes after successfully switching. [3] [26] [27] [28]

5. Smoking, switching, dual use, and never use

Combustible cigarettes burn tobacco. Combustion produces a complex smoke containing carbon monoxide and many toxicants and carcinogens. Vapes heat liquid and generally expose exclusive users to fewer or lower levels of many measured toxicants. The National Academies concluded that completely substituting e-cigarettes for combustible cigarettes reduces exposure to numerous toxicants and carcinogens. It did not conclude that vaping is harmless or quantify a universal lifetime-risk reduction. [3]

Four scenarios must remain separate:

1. Never use. A person who does not smoke or vape should not start. Any vaping exposure adds risk without removing cigarette exposure.

2. Continuing to smoke. Cigarette smoking has severe, well-established risks. For an adult who cannot yet stop nicotine, completely replacing cigarettes with a regulated nicotine vape is likely less harmful than continuing to smoke.

3. Complete switching. “Switching” means stopping combustible cigarettes, not merely reducing them. It lowers many combustion-related exposures but leaves nicotine, aerosol, dependence, and uncertain long-term risk.

4. Dual use. Smoking and vaping together may sustain dependence and substantial smoke exposure. Even a few cigarettes per day are dangerous. CDC states that dual use is not an effective way to safeguard health. [26]

In a 2013–2014 PATH biomarker analysis, cigarette frequency was the main driver of toxicant exposure among dual users. The cross-sectional study used older products and measured biomarkers, not disease. It supports eliminating cigarettes but cannot calculate today's lifetime risk. [29]

Comparative risk is not binary. Vaping and smoking are different exposures, and smoking is generally more toxic. A former smoker who vapes should not relapse to smoking in pursuit of quitting nicotine; support can target vaping while protecting cigarette abstinence.

The widely repeated “95% less harmful” figure is not a measured individual disease-risk reduction. It traces to a 2014 multi-criteria decision analysis in which an expert panel scored products across criteria. The authors acknowledged a lack of hard evidence for many harms and no formal criterion for selecting experts. Product design and evidence have changed since then. The defensible statement is that complete switching generally lowers many toxicant exposures compared with continued smoking, while the size of long-term risk reduction cannot be expressed reliably as one fixed percentage. [30]

6. Can vaping help an adult stop smoking?

The August 2026 Cochrane living review found that regulated nicotine e-cigarettes increased smoking cessation at six months or longer in several comparisons. Each effect belongs with its comparator, denominator, absolute difference, and certainty rating. [31]

Comparison for smoking abstinence at least 6 months	Relative effect	Absolute difference	Certainty
Nicotine e-cigarette vs NRT; 7 studies, 2,544 participants	RR 1.59 (95% CI 1.30–1.93)	4 more quitters per 100 (2–6 more)	High
Nicotine vs non-nicotine e-cigarette; 6 studies, 1,613 participants	RR 1.46 (1.09–1.96)	3 more per 100 (1–7 more)	Moderate; imprecision
Nicotine e-cigarette vs behavioral support only/no support; 11 studies, 6,819 participants	RR 1.96 (1.66–2.32)	4 more per 100 (3–5 more)	Low; risk of bias

Cochrane's plain-language context is roughly 8–10 quitters per 100 using nicotine e-cigarettes, versus about 6 per 100 using NRT, 6 per 100 using non-nicotine e-cigarettes, or 5 per 100 receiving behavioral or no support. These are group averages, not personal guarantees. The rendered Cochrane page contains inconsistent overall study and participant totals between sections, so this guide intentionally does not quote one overall count.

Adverse events were probably similar to NRT in the review, and serious adverse events were rare. That finding is bounded by trial duration and by the regulated nicotine products studied. It does not establish lifetime safety and does not cover illicit products or THC products. Longer and larger studies remain necessary.

FDA tobacco marketing authorization and FDA drug approval answer different questions. At the research cutoff, FDA's live page listed 48 e-cigarette products authorized for U.S. marketing. FDA explicitly says authorization does not mean the product is safe or “FDA approved.” No e-cigarette is FDA-approved as a smoking-cessation medicine. The live count can change. [32] [33]

Established options for nonpregnant adults include nicotine patch, gum, lozenge, nasal spray, or inhaler; varenicline; and bupropion SR. Counseling and medication together can more than double quit chances. Combining long-acting NRT with short-acting gum or lozenge is more effective than one form alone. Choice depends on age, pregnancy, health, prior response, and preference. [27] [34]

USPSTF recommends behavioral interventions plus FDA-approved pharmacotherapy for nonpregnant adults who smoke. For pregnant people, it recommends behavioral interventions and finds evidence insufficient to assess medication or e-cigarettes for cessation. A clinician can help weigh options rather than leaving a pregnant smoker to choose alone between continued cigarettes and unmonitored vaping. [28]

7. Pregnancy and people who should not vape

Vaping is not considered safe during pregnancy. Nicotine crosses the placenta and can harm developing brain and lung systems. Observational studies associate vaping in pregnancy with preterm birth and low birth weight, but concurrent smoking, changing use, and other differences complicate exact risk estimates. Products labeled nicotine-free cannot be assumed harmless because other aerosol exposures remain and labels may be inaccurate. [1]

The response should be supportive, not punitive. Dependence is treatable, and shame can drive use underground or discourage prenatal care. A pregnant person who smokes should not be told to return to cigarettes. Contact prenatal care and 1-800-QUIT-NOW (1-800-784-8669) for an individualized plan. Behavioral support has the clearest recommendation in pregnancy; medication decisions require clinician review.

Youth and young adults should not vape. Adults who have never used tobacco should not start. People with heart or lung disease may be especially affected by nicotine or airway irritants and should discuss symptoms and quitting with a clinician. These cautions do not erase comparative harm reduction for a nonpregnant adult who already smokes; they identify populations for whom initiation offers no health benefit.

8. Emerging concerns: metals, flavors, labels, and device aging

What the 2025 metals study actually found

A 2025 laboratory study tested seven product types from Esco Bar, Flum Pebble, and ELF Bar, ordered online. The brand-level sample comprised nine ELF Bar, six Flum Pebble, and six Esco Bar units, reflecting triplicate units across the tested product types. Machines took 2-second, 56.7 mL puffs twice per minute and collected 100-puff blocks. The initial protocol extended through 500 puffs, but the Esco devices lost power after 300 puffs and became inoperable during 400–500. Only three individual devices were followed beyond 500 puffs: one ELF Bar Flavored to 1,500, one ELF Bar Clear to 1,300, and one Flum Pebble Flavored to 1,400. [35]

Chromium and nickel generally rose as devices aged, consistent with release during coil heat cycling. Some Esco Bar liquids contained up to 175 parts per million lead, 38 ppm nickel, 546 ppm copper, and 462 ppm zinc. Component analysis traced lead to leaded-bronze non-heating pieces in contact with liquid, showing that metals do not all come from the coil. Antimony reached 2,300 micrograms per kilogram aerosol in some Flum Pebble and Esco Bar measurements, but its source was unknown.

The most striking cigarette comparison was narrow: during the first 200 machine puffs, two tested Esco Bar types emitted about 4–13 times as much lead as the highest previously reported lead value for a pack of 20 cigarettes, using the authors' nominal nicotine-dose comparison. This was a cross-study comparison for lead—not a side-by-side measurement of total smoke toxicity and not evidence that a disposable vape is four to thirteen times as harmful overall. Cigarette smoke contains many other toxicants.

The paper's cancer and noncancer estimates were risk models based on measured concentration, assumed use of 100 puffs per day, and 100% absorption. They were not diagnoses observed in users. Three brands, few units, online sourcing, machine puffing, and limited batch coverage cannot establish how common high emissions are. Batch, counterfeit status, storage, flavor, redesign, device aging, and human puffing may change results. The finding is a serious product-quality signal, not a market-wide disease ratio.

Flavor chemicals and heating

PG, VG, and flavor chemicals can break down when heated to form reactive carbonyls such as formaldehyde, acetaldehyde, and acrolein. In a 2026 laboratory study, investigators tested eight individual flavor chemicals across four chemical classes, three PG/VG ratios, two concentrations, and 50- and 90-watt settings in one mod with a Kanthal dual-mesh coil. Flavored liquids tended to produce more carbonyls than unflavored controls. Limonene and linalool had the strongest effects in that matrix, reaching roughly twofold formaldehyde and eightfold acrolein under some conditions; higher flavor concentration, VG fraction, and power generally increased emissions. [36]

That design isolates mechanisms but is not a clinical trial. Real mixtures and devices may behave differently, and occupational exposure limits shown for context are not validated consumer-vaping safety thresholds.

A separate 2025 study tested 25 disposables from four brands purchased online. Most labels said 50 mg/mL nicotine. Only 12 of 25 were within the study's ±20% recovery bounds, and 10 were statistically below the label; this does not show systematic overstatement or intent. All samples contained only the naturally predominant nicotine enantiomer, so they did not demonstrate synthetic nicotine in those product lines. Carbonyl yields varied within and between brands without a simple relationship to flavor additive or nicotine concentration. The products came from one manufacturing batch, only new-device early puffs were tested, and the collection method may have underestimated some carbonyls. [37]

“Flavored,” “synthetic,” “high nicotine,” “mislabeled,” and “unauthorized” are separate questions. Flavor does not predict one carbonyl dose; a 5% label may be inaccurate; synthetic nicotine remains nicotine; and an analog is a different, less-studied molecule.

9. THC products, EVALI, and acute safety events

EVALI means e-cigarette or vaping product use-associated lung injury. The 2019 outbreak was strongly associated with THC-containing products, especially products from informal sources, and vitamin E acetate used as a diluent. In CDC's January 2020 update, among 2,022 hospitalized patients with product-use information, 82% reported any THC-containing product, 57% any nicotine-containing product, 33% exclusive THC use, and 14% exclusive nicotine use. Categories overlapped, histories were self-reported, and product information was missing for some patients. [38]

Vitamin E acetate was found in implicated products and in lung fluid from geographically diverse patients. CDC described it as strongly linked, not as a normal nicotine e-liquid ingredient or an explanation proved for every case. Evidence was insufficient to rule out other chemicals in THC or non-THC products in some cases. Exclusive-nicotine reports may reflect unknown contents, misclassification, or true injury and warranted investigation.

EVALI should not be used as a synonym for every symptom after vaping or as proof that ordinary nicotine vaping causes chronic COPD or cancer. It is an important example of how rapidly changing product ingredients and informal supply chains can create severe acute harm. New chest pain, marked shortness of breath, blue lips, confusion, or severe worsening after vaping warrants urgent evaluation.

Liquid nicotine can poison by swallowing, inhalation, skin contact, or eye exposure, especially in children. Severe effects can include vomiting, seizure, coma, respiratory arrest, and death. If anyone drinks e-liquid, call Poison Control at 1-800-222-1222 immediately; do not wait for symptoms. Wash skin promptly with soap and water after a spill. Keep products locked away from children and pets. Call 911 for collapse, seizure, trouble breathing, or inability to wake, and do not induce vomiting unless a poison specialist directs it. [39]

FDA has received voluntary reports of seizures after vaping, particularly among youth and young adults. Seizures are a known manifestation of nicotine toxicity, but reports cannot establish incidence or prove that vaping caused each event. FDA calls the pattern a potential emerging safety issue and advises ordinary evaluation for other causes. “Reported after” is more accurate than “proven caused by.” [40]

Defective lithium batteries can ignite or explode and cause burns and trauma, often during charging in reported cases. Use the manufacturer-recommended charger, do not charge an obviously damaged, wet, hot, swollen, or leaking device, and keep loose batteries away from metal objects. Any significant burn, blast injury, inhalation injury, or eye injury needs prompt medical care. [1]

10. Quitting vaping without blame

Dependence can be intense because a small device allows frequent, discreet dosing throughout the day. Start by identifying nicotine concentration, how soon use begins after waking, high-risk times, triggers, withdrawal, other nicotine or cannabis use, pregnancy, mood, and prior attempts. A slip is data for revising the plan, not failure.

Behavioral tools include a quit date or structured reduction plan, removing devices and chargers, changing routines linked to use, planning for cravings, asking household members not to offer products, counseling, text support, and follow-up. Smokefree Teen provides free planning and coping tools. U.S. quitline support is available at 1-800-QUIT-NOW. [41]

Two recent trials clarify both promise and limits. A randomized trial enrolled 1,503 adolescents ages 13–17 through social media. At seven months, self-reported 30-day abstinence was 37.8% with an interactive tailored text program versus 28.0% with assessment only. Retention was 70.8%, abstinence was not biochemically confirmed, and online recruitment affects generalizability. A 2025 correction changed wording about an adverse-childhood-experiences score, not the quit result. [42]

A 2025 trial randomized 261 treatment-seeking participants ages 16–25 who vaped daily or near-daily, did not regularly smoke, and wanted to quit. Mean age was 21.4 and 98% were in postsecondary school. All groups received referral to a text program; varenicline and placebo groups also received weekly counseling. Verified continuous abstinence was 51% with varenicline versus 14% with placebo at weeks 9–12, and 28% versus 7% across weeks 9–24. Nausea or vomiting, vivid dreams, and insomnia were more frequent with varenicline. [43]

This trial tested varenicline plus counseling and text referral, not medication alone. It excluded regular dual users and people with some unstable medical or psychiatric conditions, included relatively few younger teens, and needs replication. Varenicline is FDA-approved for adult cigarette-smoking cessation, not specifically for vaping cessation; vaping cessation and use in a minor are off-label decisions. Anyone under 18, pregnant or breastfeeding, or with complex medical or psychiatric history should discuss medication with a clinician. No cessation medicine should be described as FDA-approved specifically to quit vaping.

For a former smoker who now vapes, the plan should protect against cigarette relapse. Some people may first stabilize complete smoking abstinence, then address vaping. For a dual user, eliminating cigarettes is the urgent comparative-risk priority while working toward freedom from all tobacco and nicotine. The best plan is the one that reduces harm now and remains feasible, supported, and adjustable.

11. Common claims and evidence-based context

Aerosol composition. Vape emissions are aerosols containing droplets and particles, rather than only water vapor. Composition varies, but nicotine, carbonyls, metals, flavor chemicals, and fine particles have been measured.

Vaping compared with smoking. Available chemistry and biomarker evidence does not support equivalent harm. Cigarette combustion creates exceptionally toxic smoke, and complete switching usually lowers many exposures. That does not make vaping safe.

Lower harm does not mean no harm. Lower exposure relative to smoking can coexist with meaningful airway, cardiovascular, dependence, poisoning, injury, and uncertain long-term risks.

Cutting down compared with switching. Dual use can preserve substantial smoke exposure, and even low-intensity smoking is dangerous. The relevant harm-reduction endpoint is zero combustible cigarettes.

The “95% safer” estimate. The number came from an expert-scoring model, not decades of disease outcomes. It should not be used as a fixed personal risk estimate. The direction of comparative risk is clearer than its exact magnitude.

What the disposable-vape metal study can show. Some tested devices emitted concerning metal levels. The 4–13 comparison was lead-specific, cross-study, and limited to two types from one brand during the first 200 machine puffs. It does not compare total toxicity or all products.

FDA authorization and approval. Tobacco marketing authorization allows a specified product to be sold under a regulatory standard. It is not drug approval, a safety endorsement, or approval as a quit aid.

EVALI and nicotine vapes. Informal-source THC products and vitamin E acetate were central to the 2019 outbreak. CDC could not rule out every other chemical in every case.

Long-term evidence. Mature lifetime risk estimates are not available, but nicotine dependence, poisoning, emissions, acute physiological effects, and airway responses are established concerns. The size of specific long-term disease risks remains uncertain, especially in exclusive never-smoking users.

The balanced conclusion is practical: never-users should not start; youth and pregnant people should not vape; adult smokers should receive effective cessation support; complete switching is preferable to continued smoking when other approaches have not worked; dual use is not the goal; and people who vape should be helped to quit without shame or pressure to return to cigarettes.

12. When to get help

Call 911 for severe trouble breathing, blue lips, collapse, seizure, inability to wake, major chest pain, a battery explosion with serious injury, or another life-threatening emergency.

Call Poison Control at 1-800-222-1222 immediately if e-liquid is swallowed or a significant exposure occurs; do not wait for symptoms. Follow the specialist's instructions.

Arrange prompt medical evaluation for persistent or worsening cough, wheeze, shortness of breath, chest pain, palpitations, repeated vomiting, significant mouth lesions, burns, or symptoms after THC or informal-source product use. Symptoms have many possible causes; disclose products and ingredients honestly so clinicians can evaluate them.

For quitting in the United States, call 1-800-QUIT-NOW (1-800-784-8669). Youth can also use Smokefree Teen. Pregnancy-tailored support is available through prenatal care and the quitline. Needing repeated attempts is common and does not make treatment futile.

Frequently Asked Questions

Is vaping safer than smoking?

For an adult who currently smokes, completely replacing cigarettes with a regulated nicotine vape is likely less harmful than continuing to smoke because it removes combustion and lowers exposure to many measured toxicants. Vaping is not safe, and the long-term reduction cannot be stated as one reliable percentage. Starting to vape offers no health benefit to a never-smoker.

Does switching count if I still smoke occasionally?

No. Comparative benefit depends on stopping combustible cigarettes. Even a few cigarettes per day carry meaningful risk, and biomarkers in dual users are strongly influenced by cigarette frequency. A lapse need not become a relapse: return to the plan and seek support.

Are nicotine-free vapes safe?

No. They can still produce particles, solvents, flavor-related chemicals, carbonyls, and metals, and labels may be inaccurate. They remove nicotine only if the label is accurate; they do not remove aerosol exposure.

Do vapes cause cancer?

Vape aerosol can contain carcinogens, and mechanistic evidence raises concern. A 2026 qualitative review judged lung and oral carcinogenicity likely, while critics dispute whether evidence supports that classification. Decades-long human incidence data are not mature, so absolute risk and latency are unknown. The accurate answer is neither “proven harmless” nor a precise cancer-rate claim.

Can vaping cause popcorn lung?

“Popcorn lung” refers to bronchiolitis obliterans, historically associated with intense occupational exposure to diacetyl. Some flavor chemicals have raised airway concerns, but the phrase is often used online as if every vape user will develop this rare diagnosis. Persistent breathing symptoms require evaluation; a slogan is not a diagnosis.

Can vaping help me quit cigarettes?

Yes, regulated nicotine e-cigarettes improve six-month-or-longer quit rates compared with NRT in current Cochrane evidence, by about four additional quitters per 100. They are not FDA-approved cessation medicines. Counseling, NRT, varenicline, and bupropion are established alternatives, and complete cigarette cessation is the key endpoint.

What if I already stopped smoking by vaping?

Do not return to cigarettes. If you want to stop vaping, use a supported plan that protects your smoking abstinence. A clinician or quitline can help manage withdrawal and discuss behavioral or medication options.

How can a teenager quit?

Support works better than punishment. Ask about dependence, triggers, mood, and other substance use; build a quit plan; and use counseling or evidence-based text support. Medication decisions require a clinician. A varenicline trial is promising but mostly involved older youth and young adults and tested medication with counseling and text referral.

Is secondhand aerosol safe for children?

No safe long-term threshold has been established. Indoor vaping raises airborne nicotine and particulate matter above background. Exposure is generally lower than secondhand cigarette smoke, but avoid vaping around children and keep liquids and devices locked away.

What should I do if a child swallows vape liquid?

Call Poison Control at 1-800-222-1222 immediately, even before symptoms. Call 911 for seizure, collapse, breathing trouble, or unresponsiveness. Do not induce vomiting unless instructed.

Evidence limitations

Devices, liquids, nicotine chemistry, and behavior evolve. Many adult users have current or past cigarette exposure, making confounding and reverse causation difficult to eliminate. Exposure and diagnoses are often self-reported; exclusive never-smoking cohorts are small; use changes over time; and cancer needs long latency.

Laboratory studies identify hazards but use selected products and machine puffing. Animal and cell findings establish plausibility, not human disease rates. Biomarkers are not diagnoses, and adjusted observational associations may not be causal. Cessation trials provide stronger efficacy evidence but not lifetime safety.

Sources were checked through September 24, 2026 (individual source checks vary). Regulatory lists and living reviews can change. The retracted cancer review was excluded. This editorial guide has not undergone clinician review and does not replace individualized care.

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