



DO NEXT GENERATION NICOTINE PRODUCTS REDUCE CARDIOVASCULAR RISK?

Cigarettes remain one of the biggest preventable causes of heart disease globally. At the centre of this harm is a single key factor: *Smoking Cigarettes*

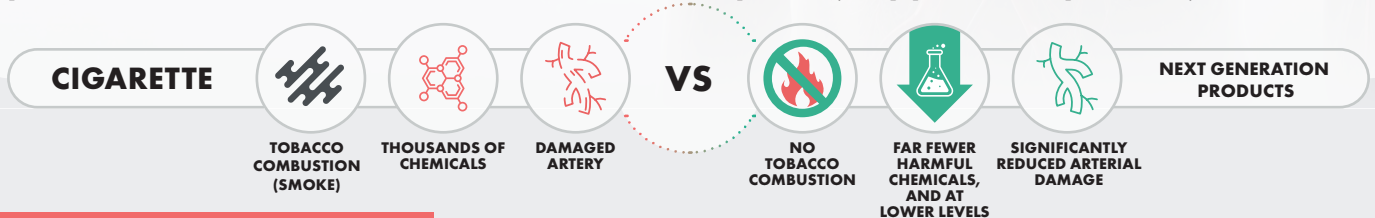
Smoking is a cause of serious disease in smokers, including heart disease. Science demonstrates the smoke created by burning tobacco damages the lining of blood vessels, triggers inflammation, and contributes to the gradual build-up of fatty plaques in arteries, increasing the risks of illnesses like heart attacks and strokes.

The emergence of next generation products (NGP) like vapes, nicotine pouches, and heated tobacco means nicotine can now be consumed

without combustion, raising a crucial public health question:

If you remove the smoke, can you reduce the harm?

Our new narrative review of the literature to-date focuses on the potential cardiovascular health impacts of NGP. It contains over **200 references** drawn from diverse fields, including laboratory science, clinical trials, epidemiology and population studies, plus regulatory documents.



HERE'S WHAT WE DISCOVERED

Different types of scientific research all point towards the same promising conclusions for NGP.



LABORATORY¹

When scientists test NGP on cardiovascular cells *in-vitro* they find:

- NGP cause significantly less damage, and trigger less inflammation and oxidative stress in blood vessels, compared to cigarette smoke.
- Using NGP instead of smoking helps lower the risk of early changes linked to plaque build-up, including reduced endothelial dysfunction, inflammatory signalling and oxidative stress, all of which contribute to the development of atherosclerosis.

Animal studies broadly back these findings up, demonstrating less arterial damage by NGP aerosol compared to cigarette smoke.



CLINIC²

When adults who smoke switch to NGP, two important events often occur:

1. Exposure to harmful chemicals drops sharply

Levels of harmful chemicals linked to heart disease – inc. carbon monoxide and certain aldehydes – drop significantly, often close to levels observed when people stop smoking entirely.

2. Cardiovascular health-related biomarkers improve

The weight-of-evidence shows:

- Lower levels of inflammation.
- Reduced biomarkers linked to potentially harmful blood clotting.
- Improvements in some cholesterol measures.

These early indicators align with how heart disease develops, and are positive signs of the cardiovascular harm reduction potential of NGP compared to smoking.



POPULATION³

Focusing on large, real-world studies:

- People who fully switch from cigarettes to NGP tend to have a lower cardiovascular risk than smokers.
- There's no clear evidence of increased heart risk in those people who have never smoked, but who still use NGP.*
- Dual users (i.e. individuals who smoke *and* use NGP) don't experience the same health gains as those who fully switch – but it's important to note that for many adults who smoke switching is a process that can help reduce cigarette consumption while supporting a gradual transition to NGP. This increases the likelihood of eventually stopping smoking altogether.

*Our NGP are designed for, and marketed towards, adult smokers and existing nicotine users only.

ARE THERE ANY DATA GAPS?



The overall picture painted by our narrative review is encouraging, but many stakeholders – including regulators and public health bodies – will likely require more data before a complete picture can be established.

For instance:

- Most of the research published in the academic literature to-date focuses on short to medium-term studies, not longer term outcomes.
- This is especially true for newer NGP categories like oral nicotine pouches – though the epidemiological outcomes of widespread tobacco snus use in Sweden in place of smoking suggests this similar category has significant public health potential.
- People's previous smoking habits can undoubtedly influence results.
- There needs to be more – and more robust – monitoring and reporting of real-world NGP usage patterns.

As with all narrative reviews, the evidence base continues to evolve, so ongoing research remains vitally important. Imperial remains committed to contributing to this through our multidisciplinary scientific assessment framework.

CONCLUSION

Across laboratory studies, clinical trials and population data, the message is broadly consistent and extremely encouraging for NGP:

- The biggest driver of cardiovascular harm is exposure to the many harmful chemicals in the smoke created from burning tobacco.
- NGP have the potential to significantly reduce exposure to these harmful chemicals.
- People who move away from cigarettes – especially those who fully switch (i.e. exclusively use NGP) – show clear signs of reduced cardiovascular risk.

It's important to note that NGP should be designed for, and marketed towards, existing adult smokers and nicotine consumers only; they're not risk-free, and the best option remains quitting nicotine use entirely.

But for those adults who continue to smoke or use tobacco or nicotine, NGP offer something vitally important:

1. Chapman F, de Haan L, Gijzen L, et al.: Optimisation of an in vitro human cardiovascular model on-a-chip for toxicological assessment of nicotine delivery products. *Front Toxicol.* 2024, 6:1395670. 10.3389/ftox.2024.1395670; Ohashi K, Hayashida A, Nozawa A, Matsumura K, Ito S: Human vasculature-on-a-chip with macrophage-mediated endothelial activation: the biological effect of aerosol from heated tobacco products on monocyte adhesion. *Toxicol In Vitro.* 2023, 89:105582. 10.1016/j.tiv.2023.105582
2. D'Ruiz CD, Graff DW, Robinson E: Reductions in biomarkers of exposure, impacts on smoking urge and assessment of product use and tolerability in adult smokers following partial or complete substitution of cigarettes with electronic cigarettes. *BMC Public Health.* 2016, 16:543. 10.1186/s12889-016-3236-1; Gale N, McEwan M, Hardie G, Proctor CJ, Murphy J: Changes in biomarkers of exposure and biomarkers of potential harm after 360 days in smokers who either continue to smoke, switch to a tobacco heating product or quit smoking. *Intern Emerg Med.* 2022, 17:2017-30. 10.1007/s11739-022-03062-1 Roethig HJ, Feng S, Liang Q, Liu J, Rees WA, Zedler BK: A 12-month, randomized, controlled study to evaluate exposure and cardiovascular risk factors in adult smokers switching from conventional cigarettes to a second-generation electrically heated cigarette smoking system. *J Clin Pharmacol.* 2008, 48:580-91. 10.1177/0091270008315316
3. Stokes AC, Xie W, Wilson AE, et al.: Association of cigarette and electronic cigarette use patterns with levels of inflammatory and oxidative stress biomarkers among US adults: Population Assessment of Tobacco and Health study. *Circulation.* 2021, 143:869-71. 10.1161/CIRCULATIONAHA.120.051551



A potentially less harmful smoking alternative, and a clear path away from cigarettes.

Read the full paper here

