



## Background

- The World Health Organisation estimates that ambient outdoor air pollution leads to 4.2 million deaths every year, mostly from heart disease, stroke, chronic obstructive pulmonary disease, lung cancer and acute respiratory infections.<sup>1</sup>
- An increasing source of atmospheric particulate comes from microplastics (84% from road and braking emissions).<sup>2</sup>
- Evidence suggests microplastic particles that reach the lung induce inflammatory responses.<sup>3</sup>

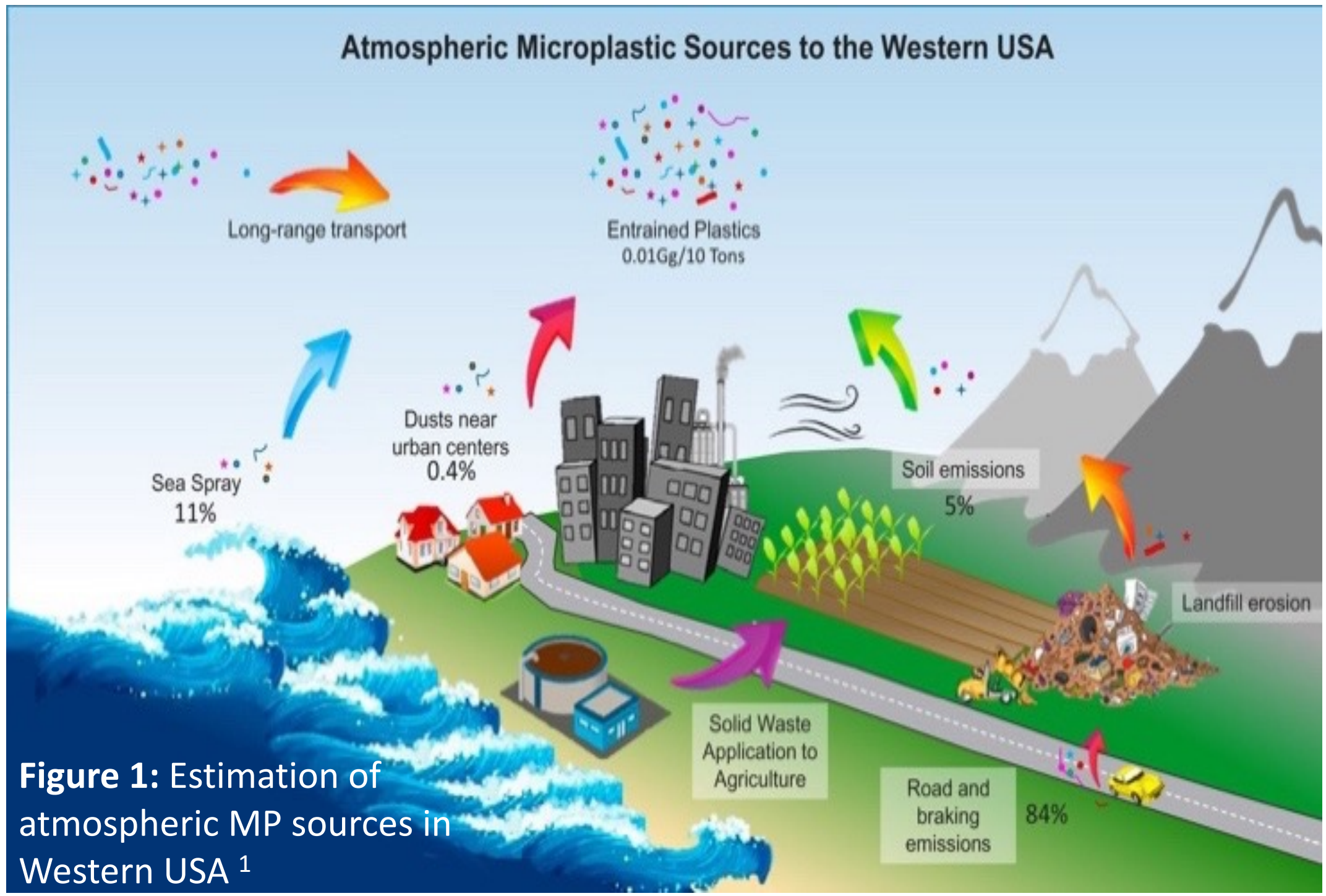


Figure 1: Estimation of atmospheric MP sources in Western USA <sup>1</sup>

## Statement of The Problem

- Tightening of emission standards have reduced tailpipe emissions, but large European cities have not experienced a sharp drop in PM<sub>10</sub> concentrations. This suggests that quantity attributed to non-exhaust emissions has been underestimated.<sup>4</sup>
- To date there is no major *in vitro* or *in vivo* information about the toxicity of environmentally weathered microplastic particles. As well as considerable variation concerning quantities, concentrations and the methodologies used to monitor them in the environment.<sup>3</sup>

Projected PM2.5 Emissions from Road Transport

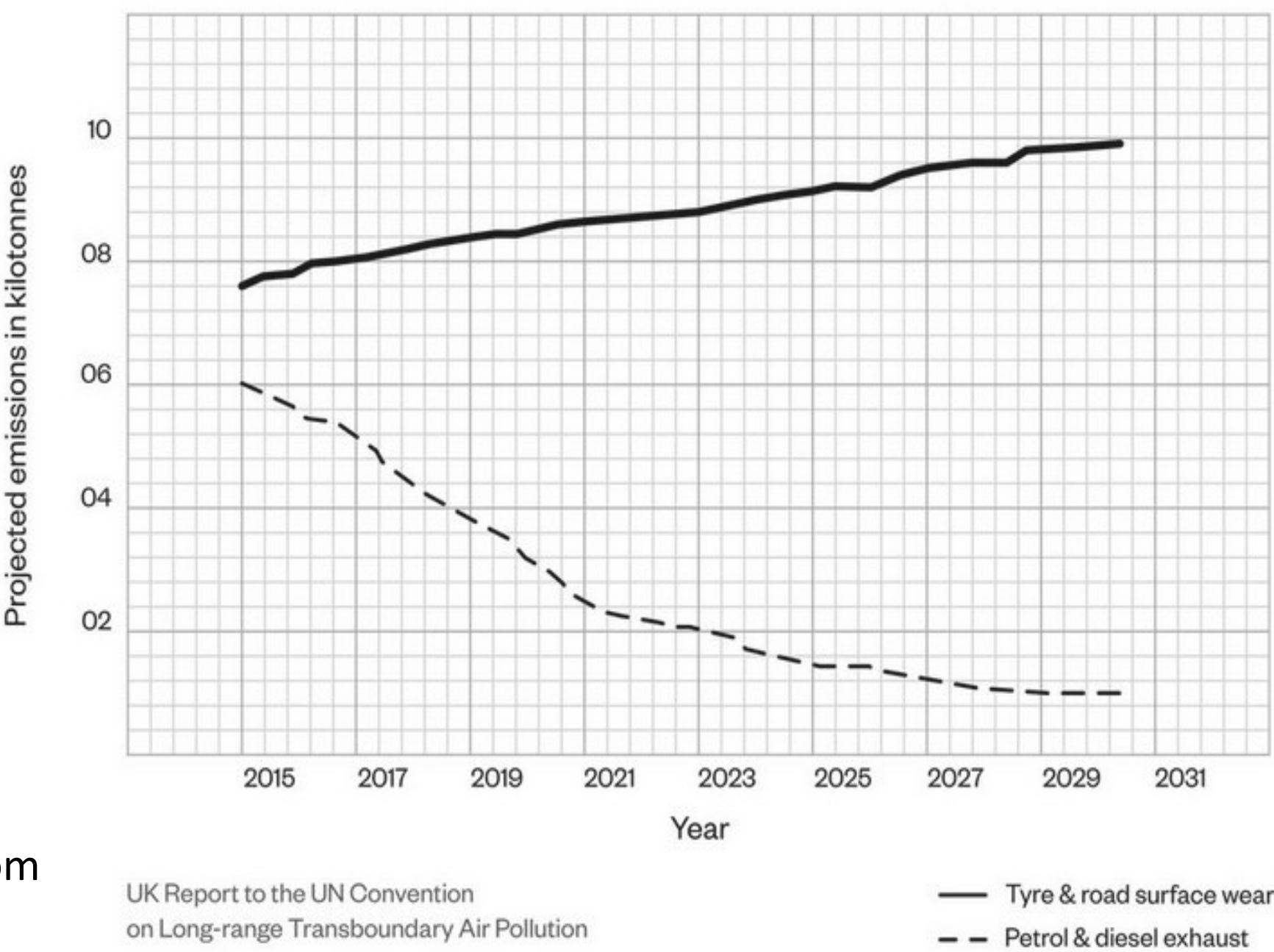


Figure 2: Projected PM2.5 emissions from road transport <sup>5</sup>

## Particulate Panel

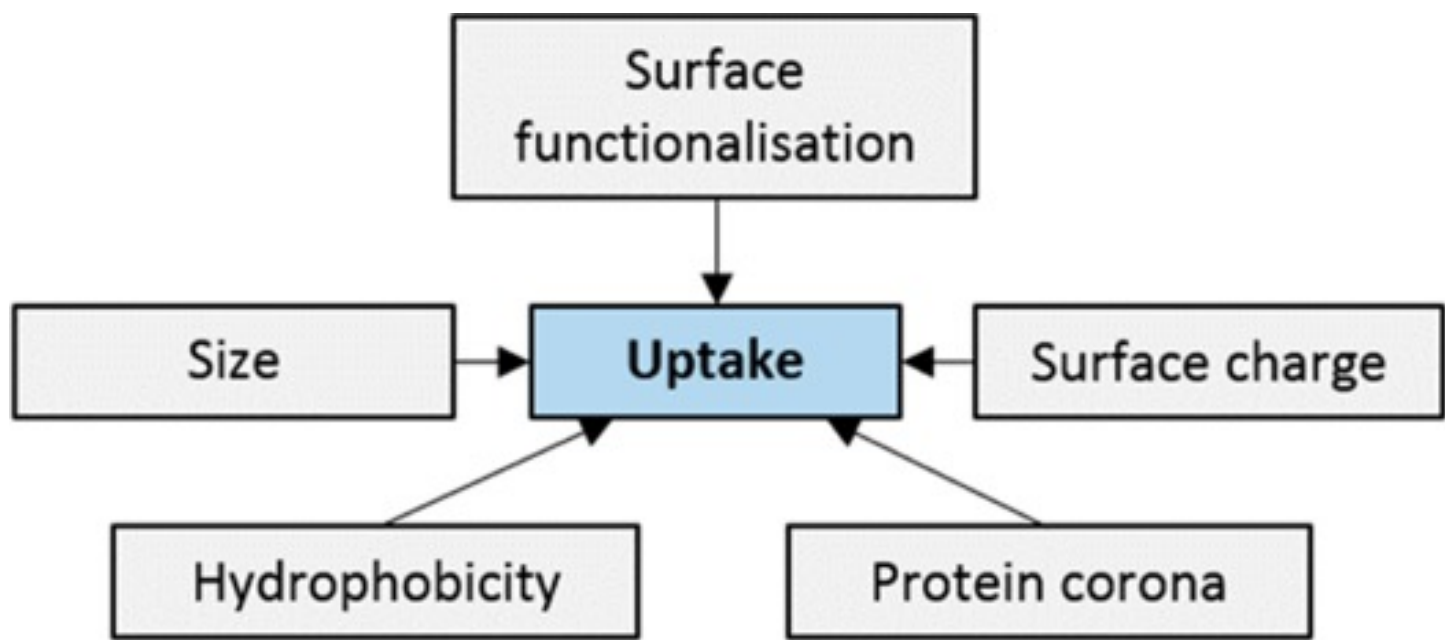


Figure 3: Microplastics uptake into cells <sup>5</sup>

### Bottom-Up Approach:

- Literature review to identify microplastics to focus on.
- Choose a selection of polymer types.
- Control particle surface chemistry, size, shape, and crystallinity.

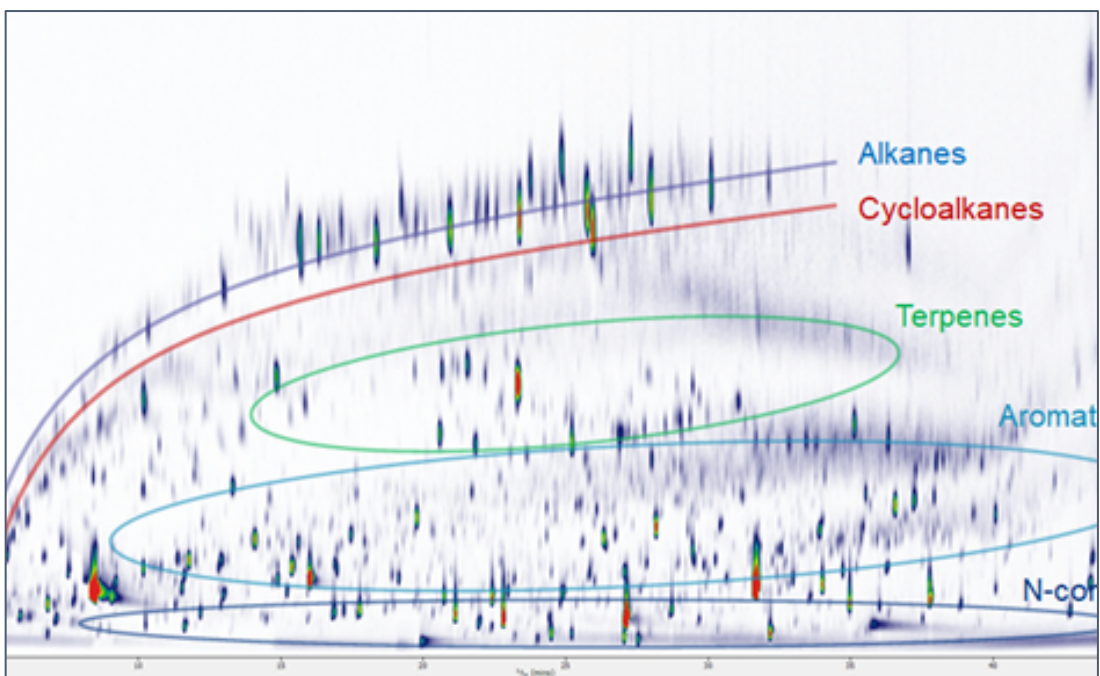


Figure 4: identification of compounds in a tyre; gas chromatograph to separate and mass spec to identify <sup>5</sup>

### Top-Down Approach:

- Obtain a number of samples from the environment e.g. road dust.
- Perform chemical analysis to identify components and percentage that are likely to come from source of interest e.g. tyre wear.

## Cellular Models

### Simple Cellular / Co-Culture Models

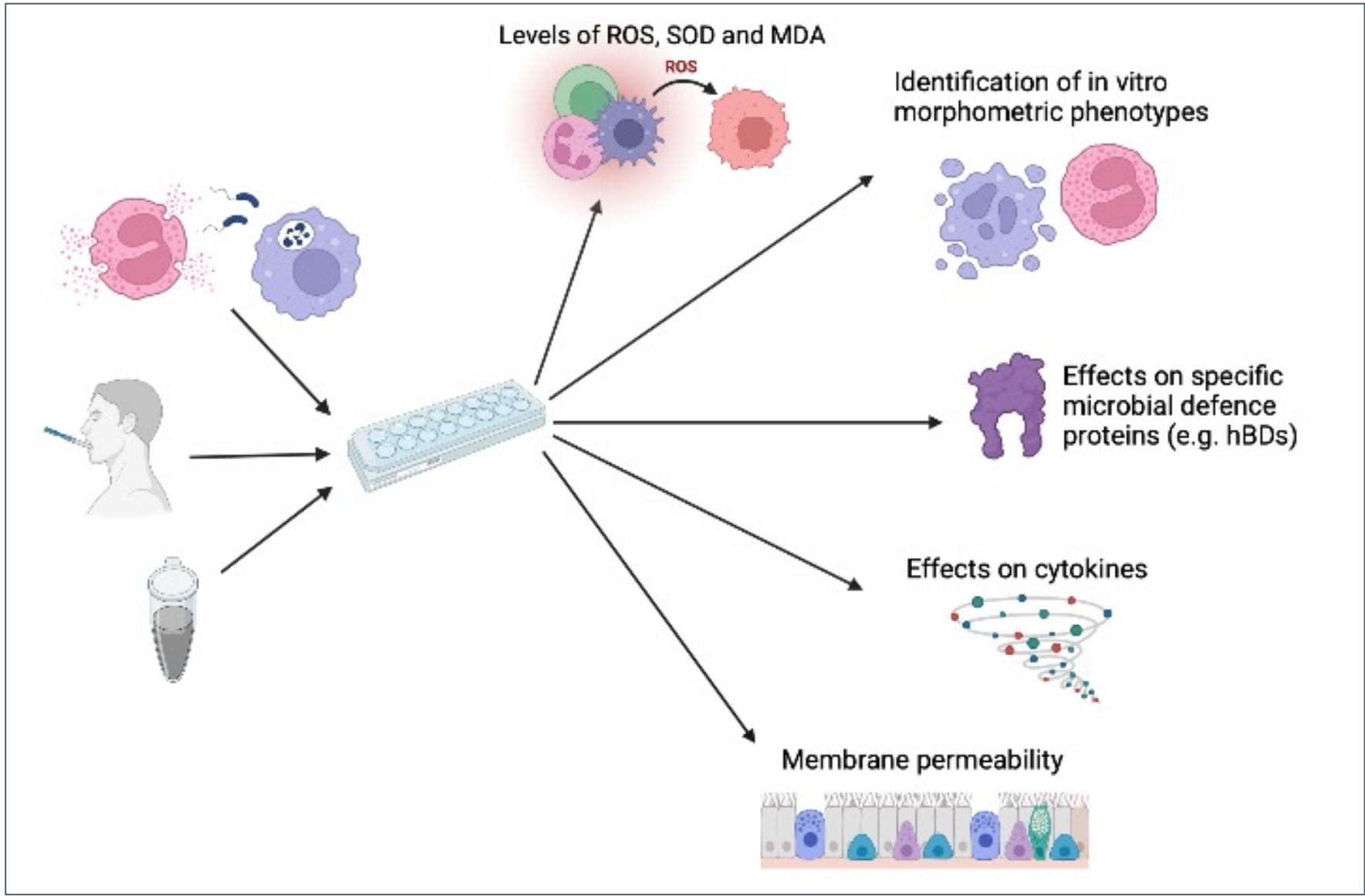


Figure 5: method for exposing simple cellular models to a particulate panel <sup>6</sup>

### ALI Models

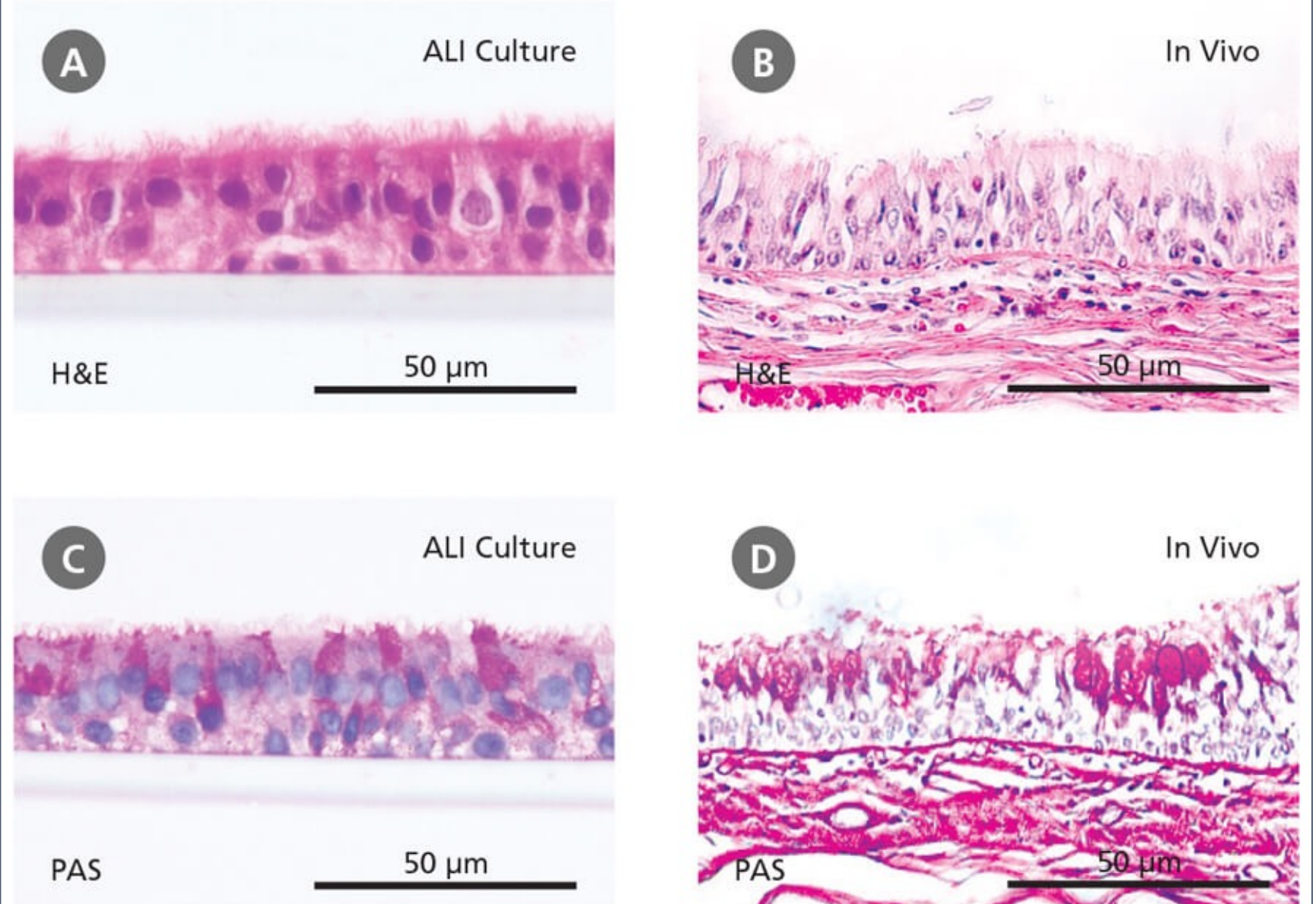


Figure 6: A & C are ALI models, whilst B & D are *in vivo* models <sup>7</sup>

### Bacteria Models

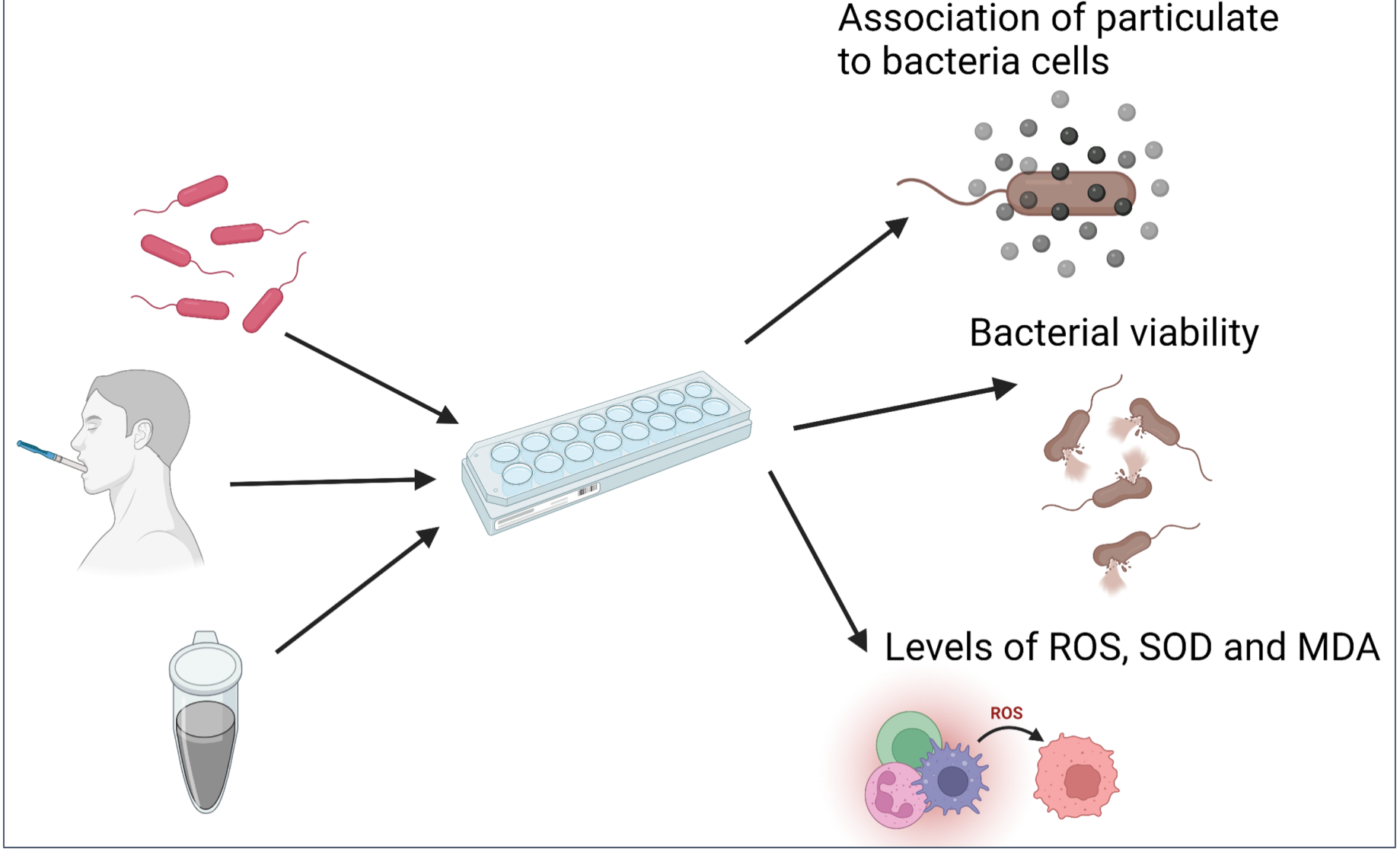


Figure 7: method for exposing bacteria models to a particulate panel <sup>6</sup>

## Policy and Scientific Innovation

- Currently no EU law in place applying to microplastics (inc. non-exhaust particulate matter).
- Tyre-wear composition and emissions is not regulated.
- Changes in vehicle emissions over past 40 years has been primarily driven by policy interventions.
- Research has the potential to influence policy and ultimately improve air quality in our cities.

## Epidemiological Study

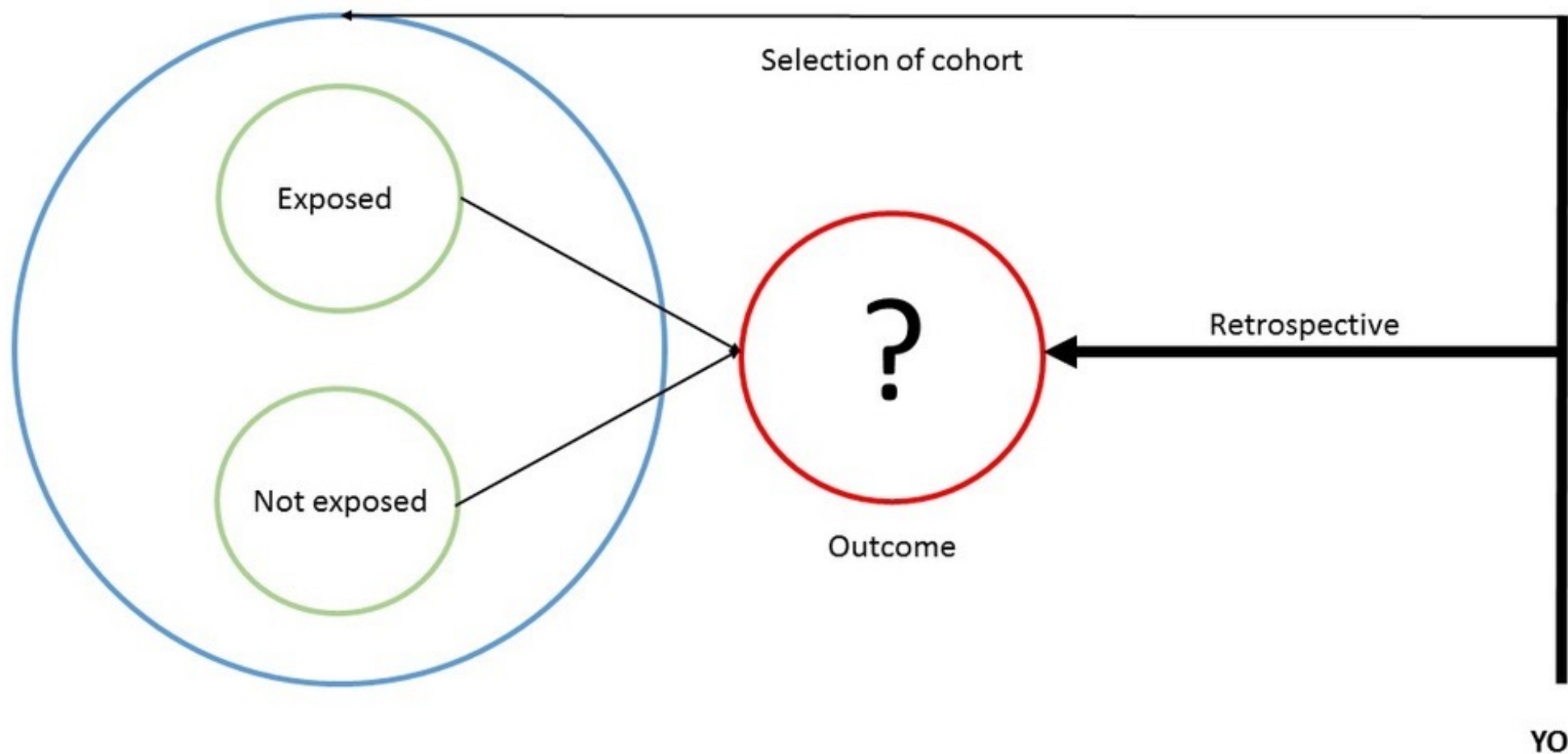


Figure 8: Graphic representation of a retrospective cohort study type <sup>8</sup>

- Extensive research into the pathogenesis of COVID-19 suggests that severe disease likely stems from an excessive inflammatory response, but the exact predisposing factors contributing to increased clinical severity and death in patients remain unclear.
- Several national and international studies have linked long- and short-term air pollution exposure to incidence and mortality of COVID-19. However, findings have mostly been drawn from ecological analyses (population level).
- NHS data from Greater Manchester will be used to perform a retrospective cohort study looking at the effects of individuals' long-term exposure to air pollution, and any connection with the severity of COVID-19 symptoms in patients that were admitted to hospital. We will also look at the effect on other respiratory infections such as COPD, and asthma.

### References:

- WHO (2020). "Ambient air pollution: Health impacts.", from <https://www.who.int/airpollution/ambient/health-impacts/en/>.
- Brahney, J., et al. (2021). "Constraining the atmospheric limb of the plastic cycle." Proceedings of the National Academy of Sciences of the United States of America 118(16).
- Amato-Lourenco, L. F., et al. (2021). "Presence of airborne microplastics in human lung tissue." Journal of Hazardous Materials 416.
- Edelstein, S. (2020). "Study: Particulate emissions from tire wear is higher than from tailpipes." from [https://www.greencarreports.com/news/1127424\\_study\\_particulate-emissions-from-tire-wear-is-higher-than-from-tailpipes](https://www.greencarreports.com/news/1127424_study_particulate-emissions-from-tire-wear-is-higher-than-from-tailpipes).
- Halvorson, B. (2020). "Tire dust is pollution, and this invention will help vehicles clean up as they go." from [https://www.greencarreports.com/news/1129809\\_tire-dust-is-pollution-and-this-invention-will-help-vehicles-clean-up-as-they-go](https://www.greencarreports.com/news/1129809_tire-dust-is-pollution-and-this-invention-will-help-vehicles-clean-up-as-they-go).
- Made using Biorender.
- Stem Cell Technologies (2019). "Air-Liquid Interface Culture for Respiratory Research" from <https://www.stemcell.com/air-liquid-interface-culture-respiratory-research-ip.html>
- Suchmacher, M. and M. Geller (2012). Chapter 1 - Study Type Determination. Practical Biostatistics. M. Suchmacher and M. Geller. San Diego, Academic Press: 3- 15.