



Health Concerns

10:35

Mark Miller



Joining Forces to Improve Air Quality and Health

Basic Concepts



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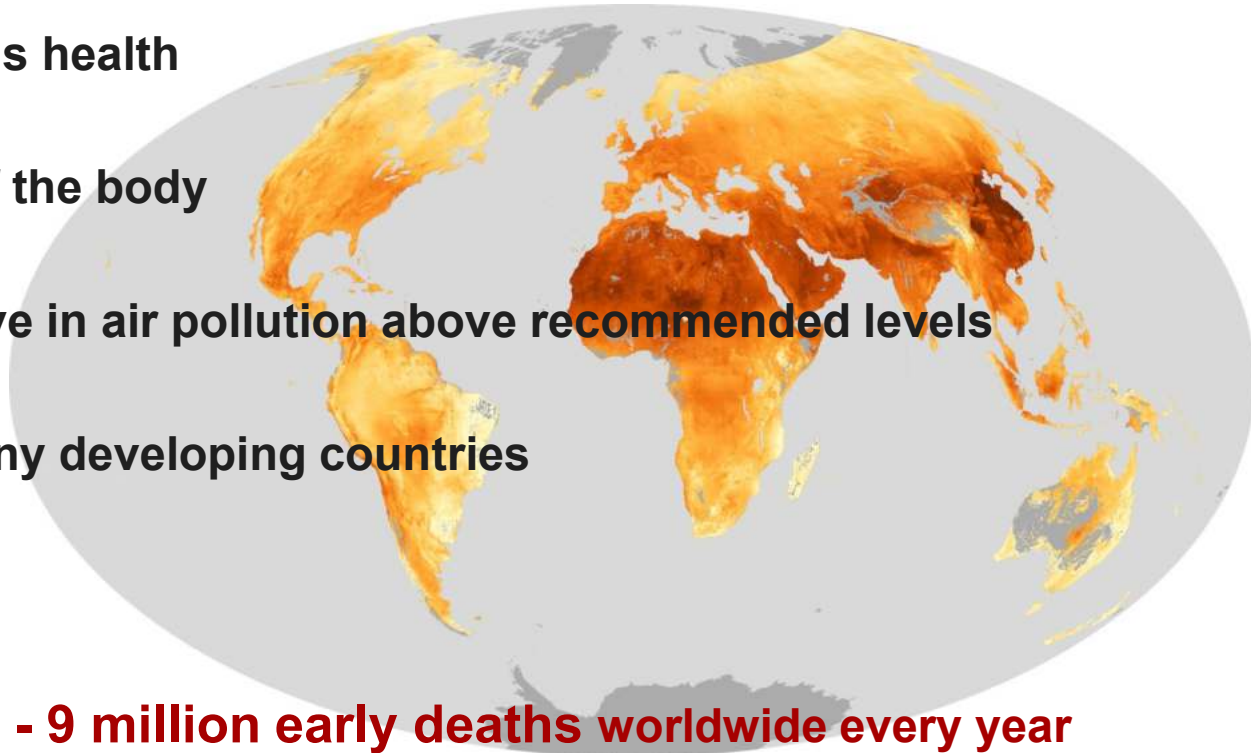
1. Possible Guiding Questions

- What do we know about how poor air quality impacts on our health (mechanisms involved, evidence of causation etc)?
- What do we still need to know?
- What do we know about indoor vs outdoor environments and their impacts?
- Are some people more susceptible to the harmful impacts than others?
- What is currently being done to improve our understanding and are there any major new initiatives/innovations that might provide a step change in our understanding?

2. 'Sales pitch'



- Air pollution damages everyone's health
- Air pollution harms all organs of the body
- 90% of the world's population live in air pollution above recommended levels
- Air pollution is on the rise in many developing countries
- No 'safe' level of air pollution
- **Air pollution is responsible for 7 - 9 million early deaths worldwide every year**

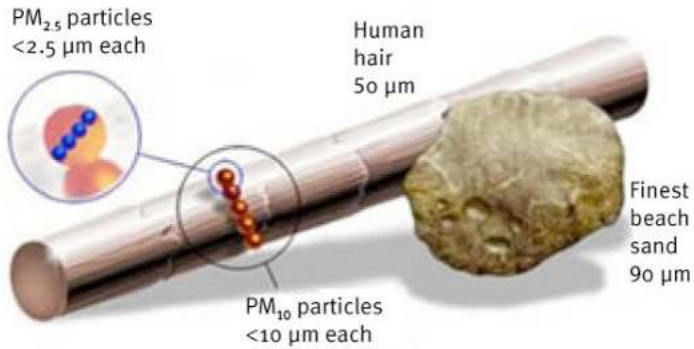


3. Categorising air pollution



- Key pollutants for health:
 PM_{10} $PM_{2.5}$ NO_x O_3
 (SO₂ NH₃ CO VOCs etc)
- All have the potential to cause harm
- Short vs long-term effects
- NO₂ & O₃ most commonly linked to **respiratory** conditions
- PM₁₀ & PM_{2.5} linked to respiratory, **cardiovascular** and other conditions
- Strongest associations are for particulate matter

4. Particles

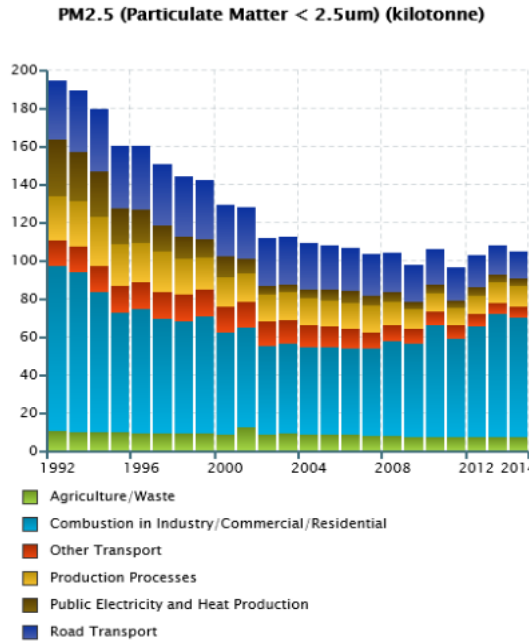


(μm)

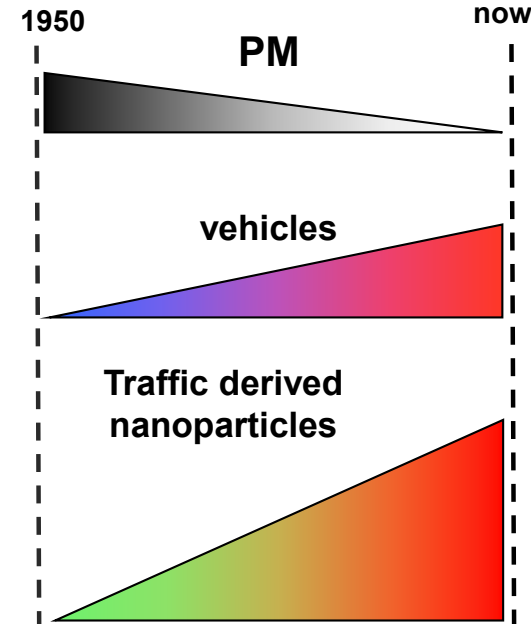
“Coarse” (PM₁₀): <10.0

“Fine” (PM_{2.5}): <2.5

“Ultrafine” (PM_{0.1}): <0.1
(nanoparticles, <100 nm)

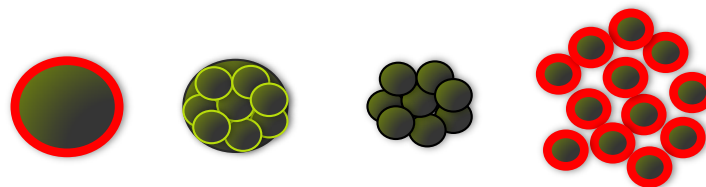


PM_{2.5} is measured as the **mass** of particles with an aerodynamic diameter of 2.5 μm or less

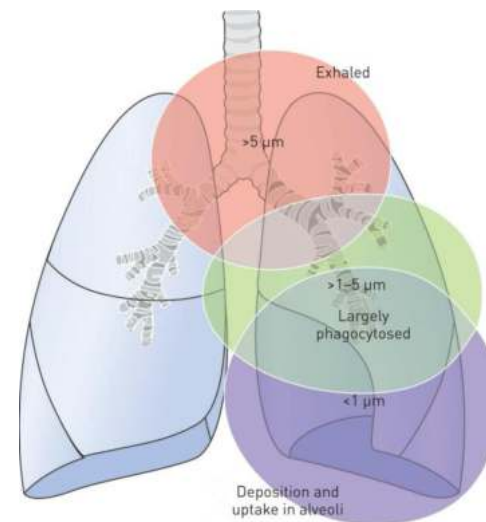
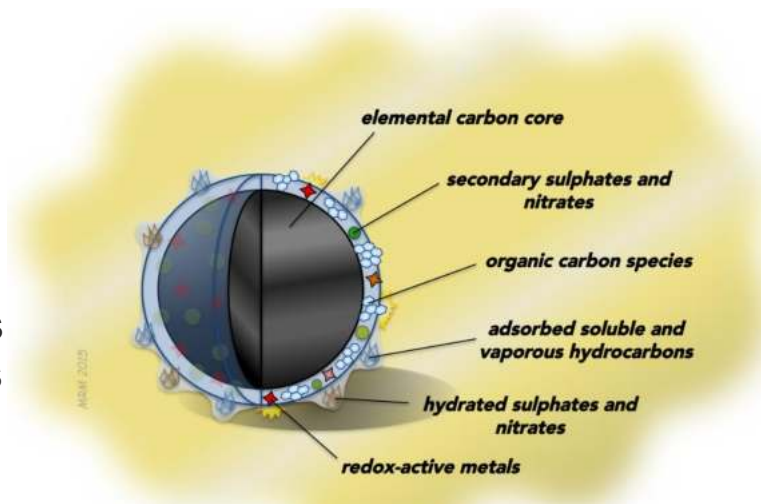


5. PM_{2.5} is not the whole story

- Not adequately measured by PM₁₀ and PM_{2.5}
- High surface area for a given mass
- Greater surface area to carry chemicals into the body
- Combustion-derived nanoparticles contain many harmful constituents

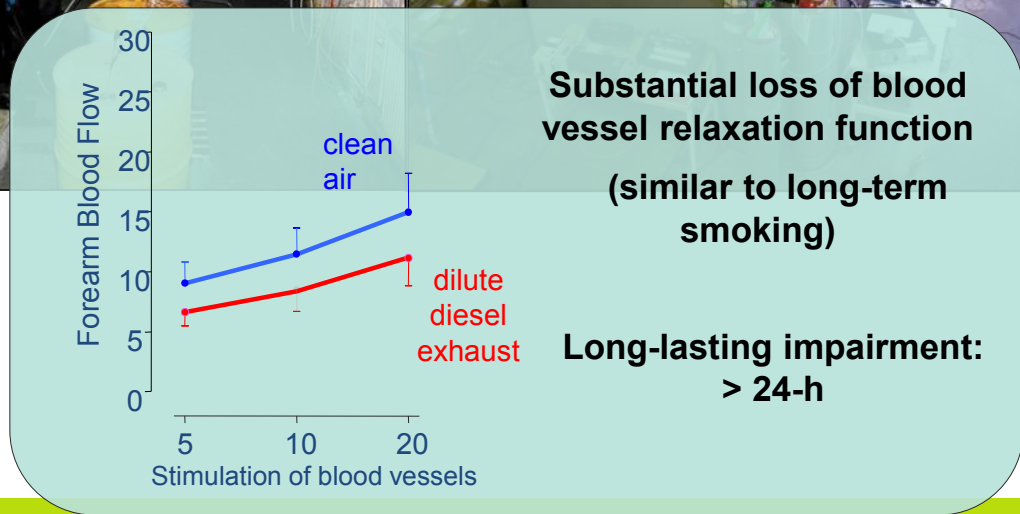
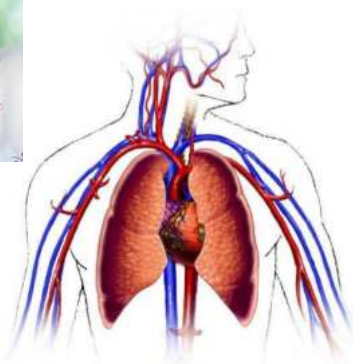
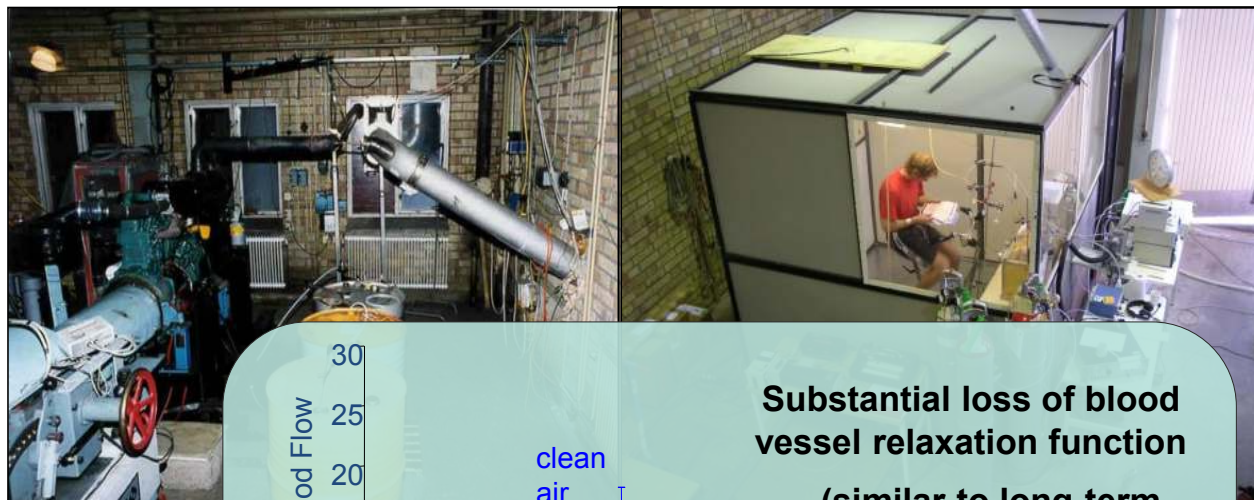


If a PM₁₀ particle weigh the same as 1,000,000 nanoparticles, the surface area of the nanoparticles would be 100x bigger

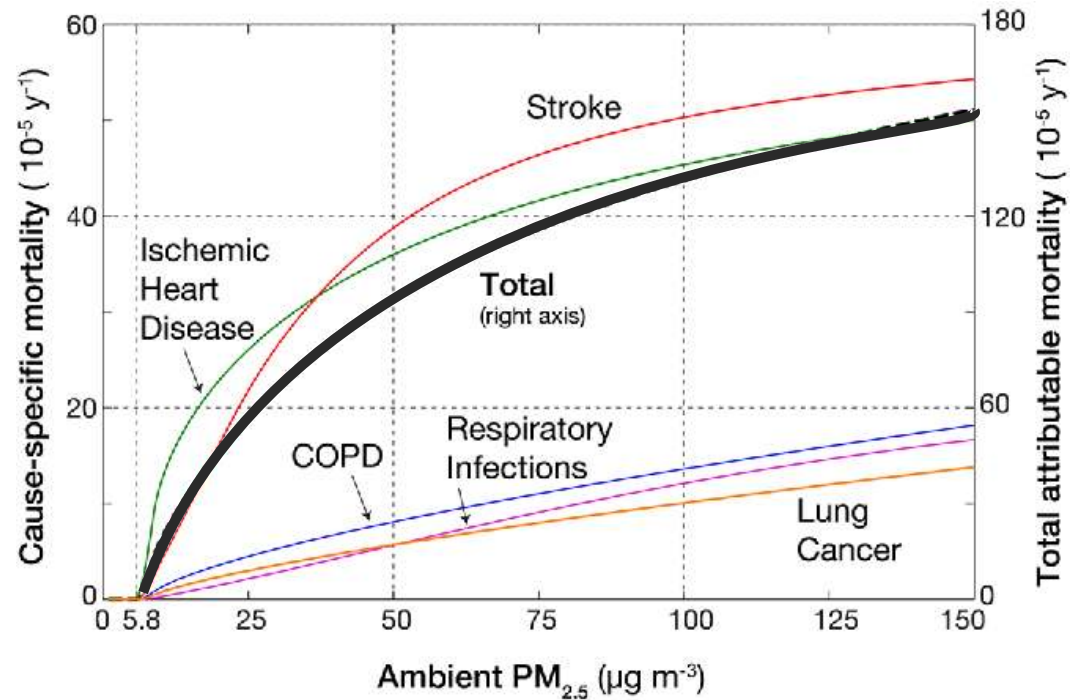
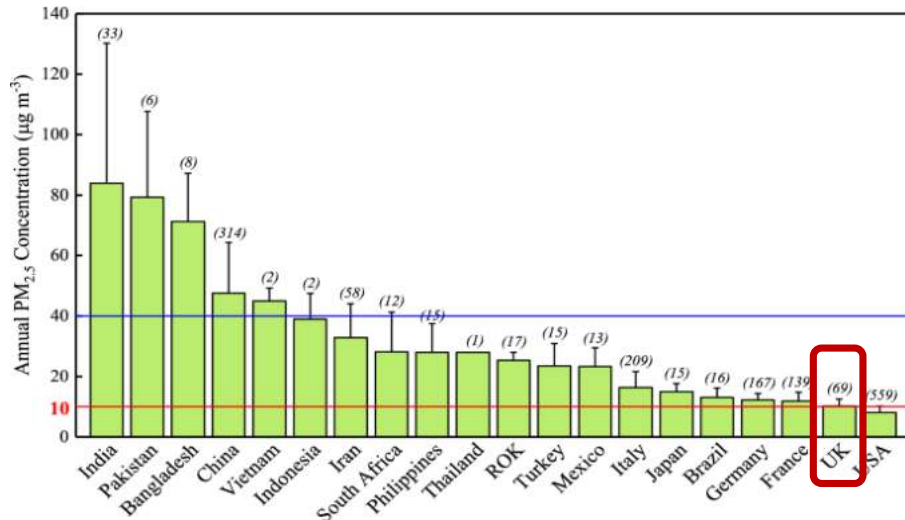


- Penetrate deep into the lungs and further
- Less efficiently cleared from the lung

6. Susceptibility to air pollution



7. Safe levels of air pollution

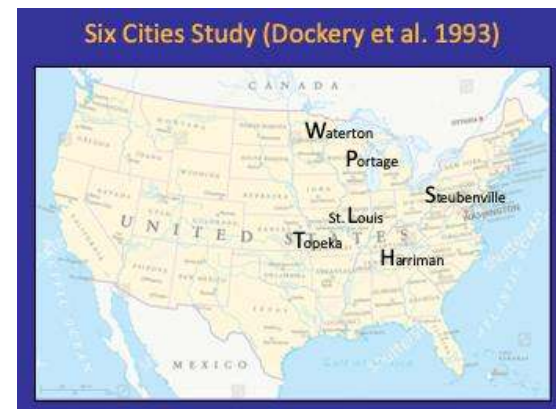


8. Deaths from air pollution



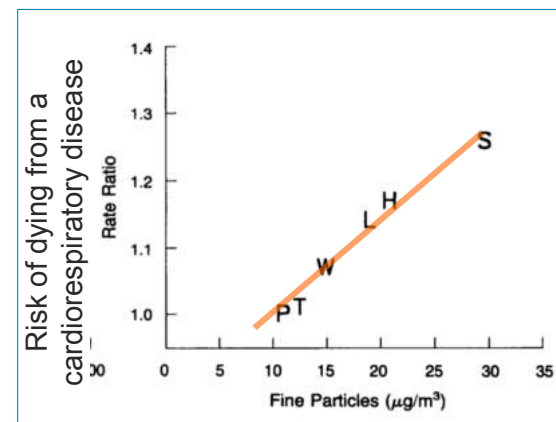
UK:

29,000 – 52,000 deaths per year
 Associated with £54 billion cost to UK economy annually
 Reduces average life expectancy by 8 months



Europe:

400,000 premature deaths per year
 Exposure to airborne particles reduce life expectancy by 1 year



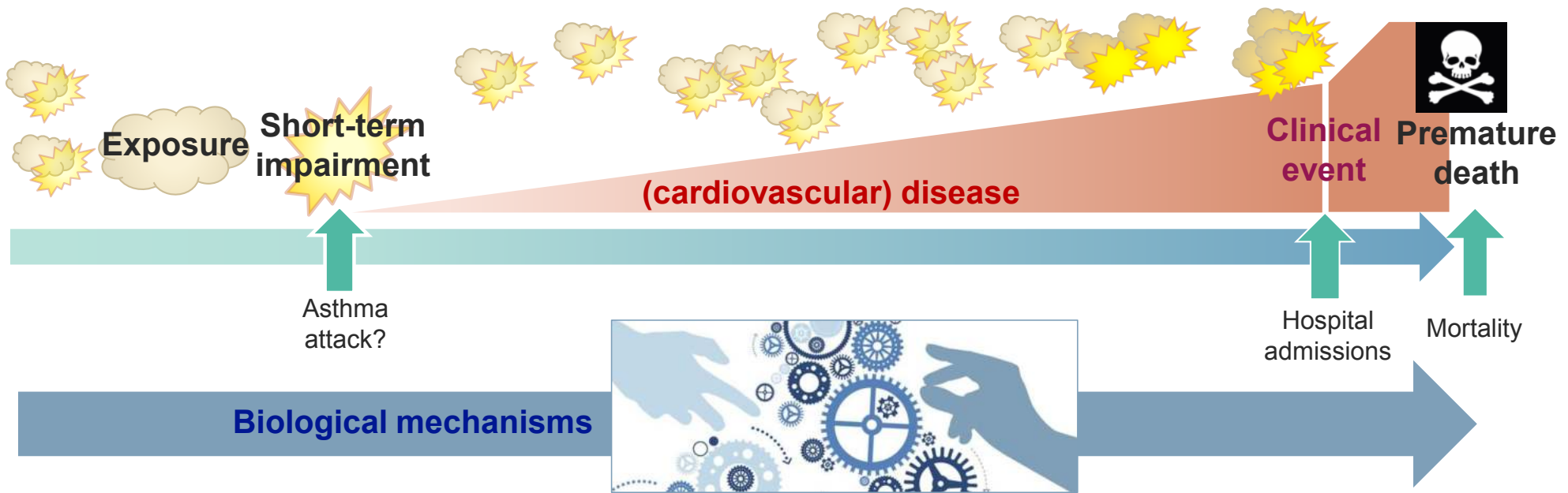
World-wide:

7-9 million deaths per year
 Responsible for 6% of all deaths globally

9. Causation: the disease process



life-time

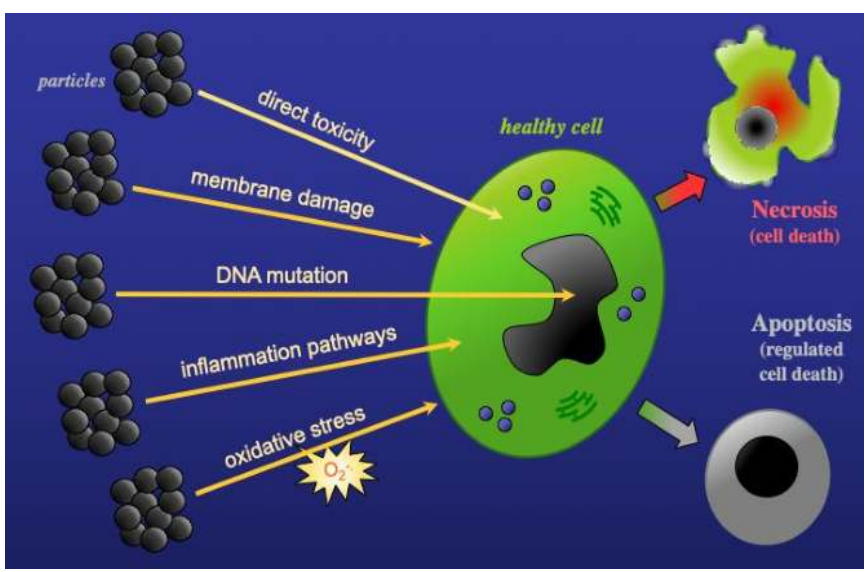


10. Biological mechanisms

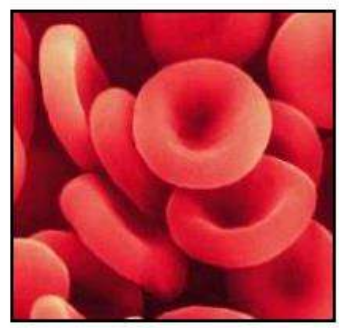


Cellular mechanisms

Mechanistic endpoints

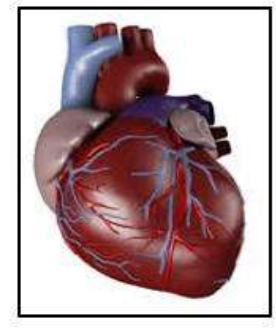


Blood



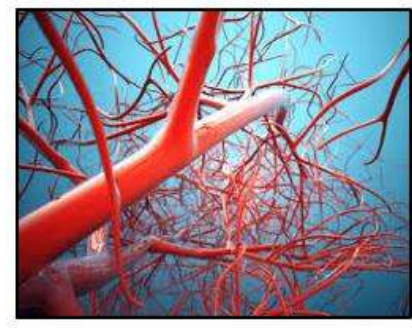
- Blood is more likely to clot
- Decreased ability to remove blood clots

Heart



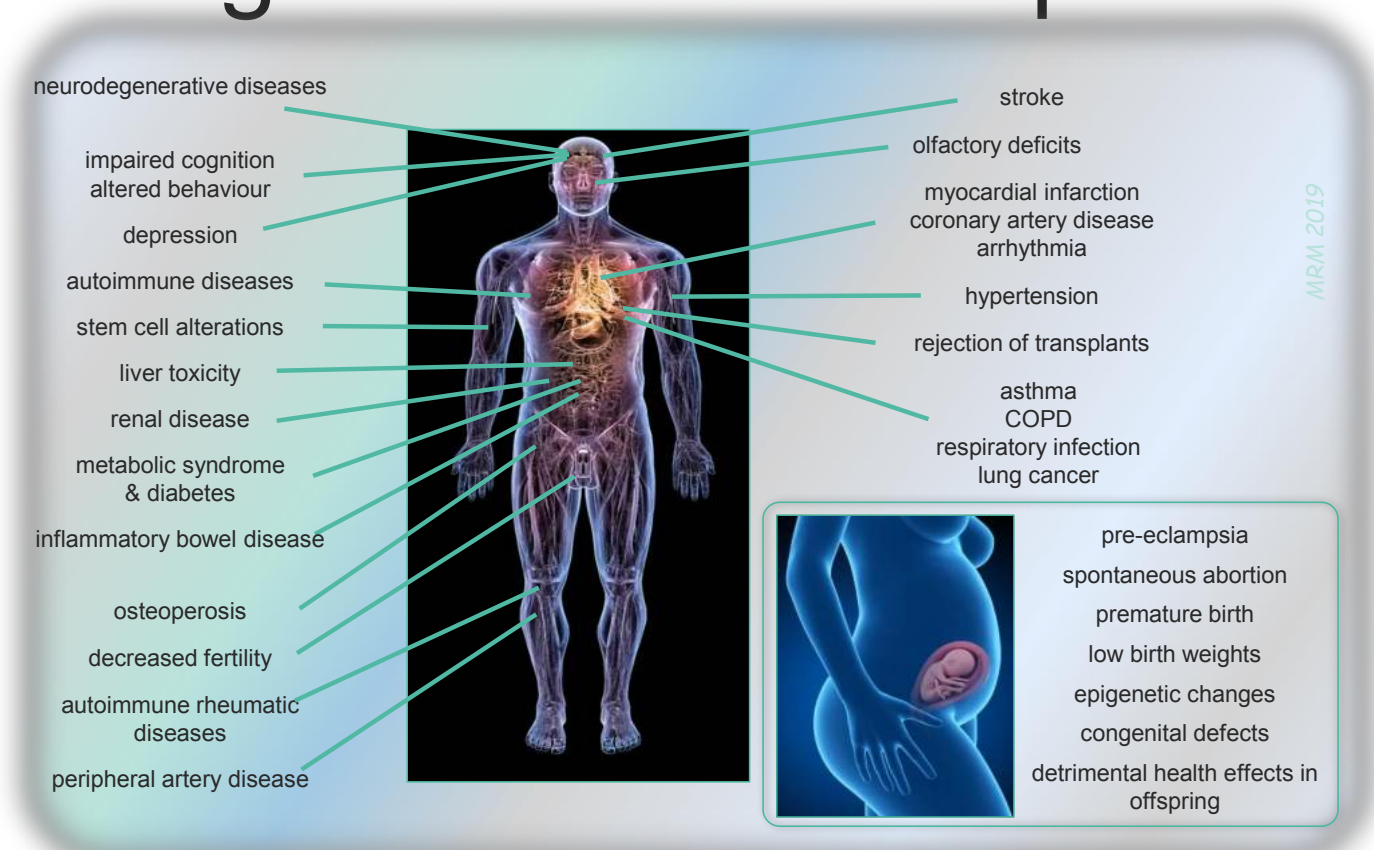
- Change in the rhythm of the heart
- Heart more susceptible to damage from lack of oxygen

Blood vessels

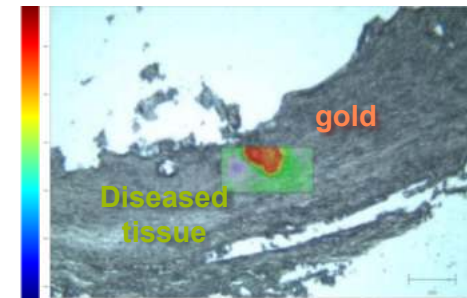
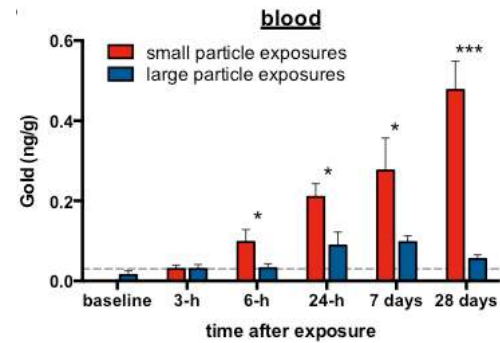
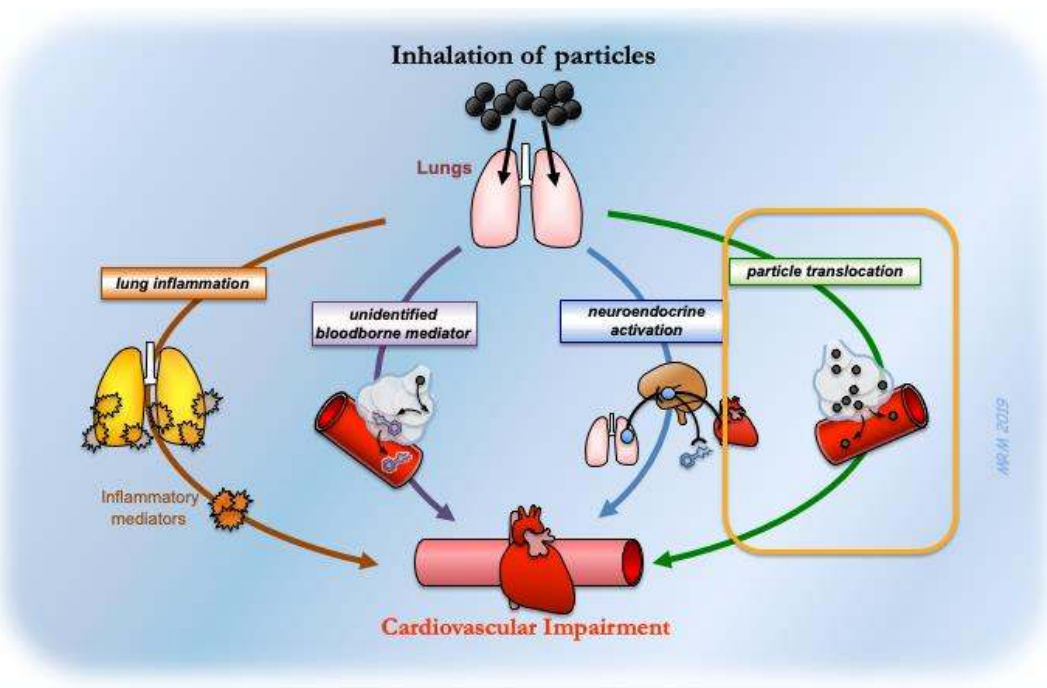


- Vasodilatation responses impaired
- Increased blood pressure
- Increased stiffness of arteries

11. Multi-organ effects of air pollution



12. Linking mechanisms – translocation

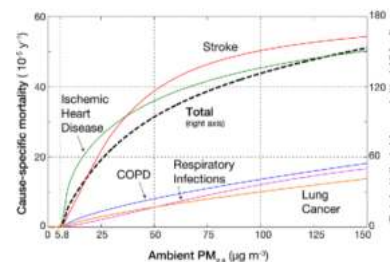
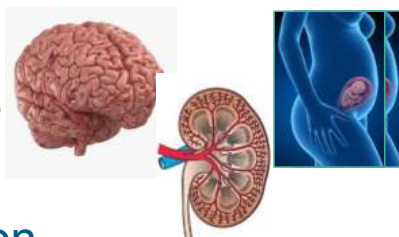


13. Future research / talking points



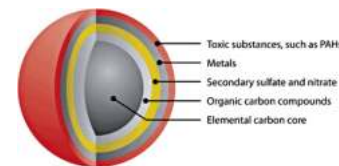
1. **Under-explored air pollutants** – other transport sources, agriculture, wood burning, indoor

2. **Under-explored organs**



3. **Low and high air pollution**

4. **Better metrics** - PM size, PM composition, mixtures?



5. **Interactions** – smoking, noise, temp, exercise, infectious diseases



6. **Policies and interventions**



14. End



Thank you for listening

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