

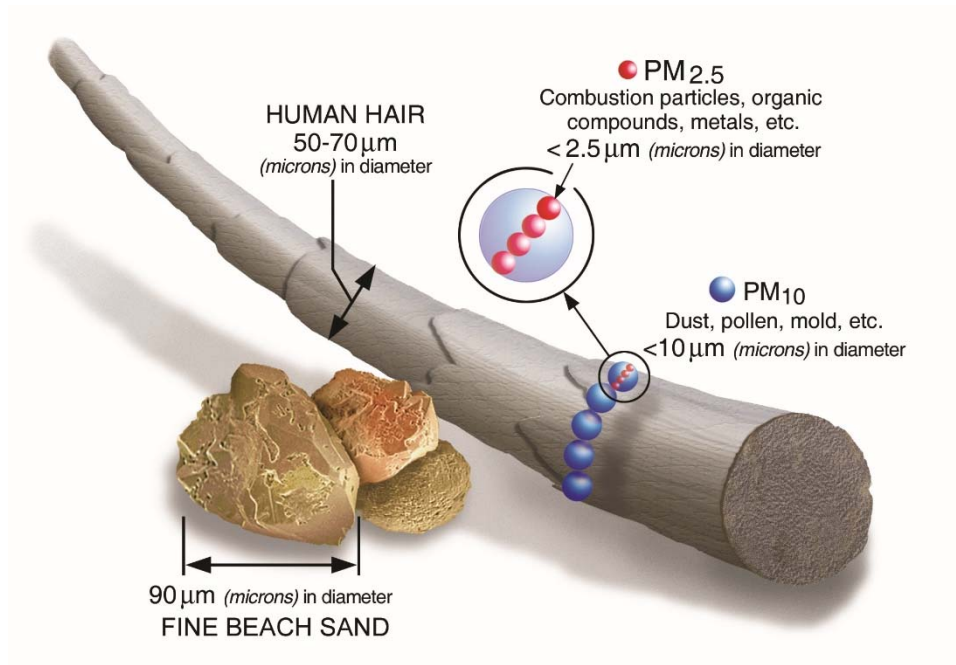
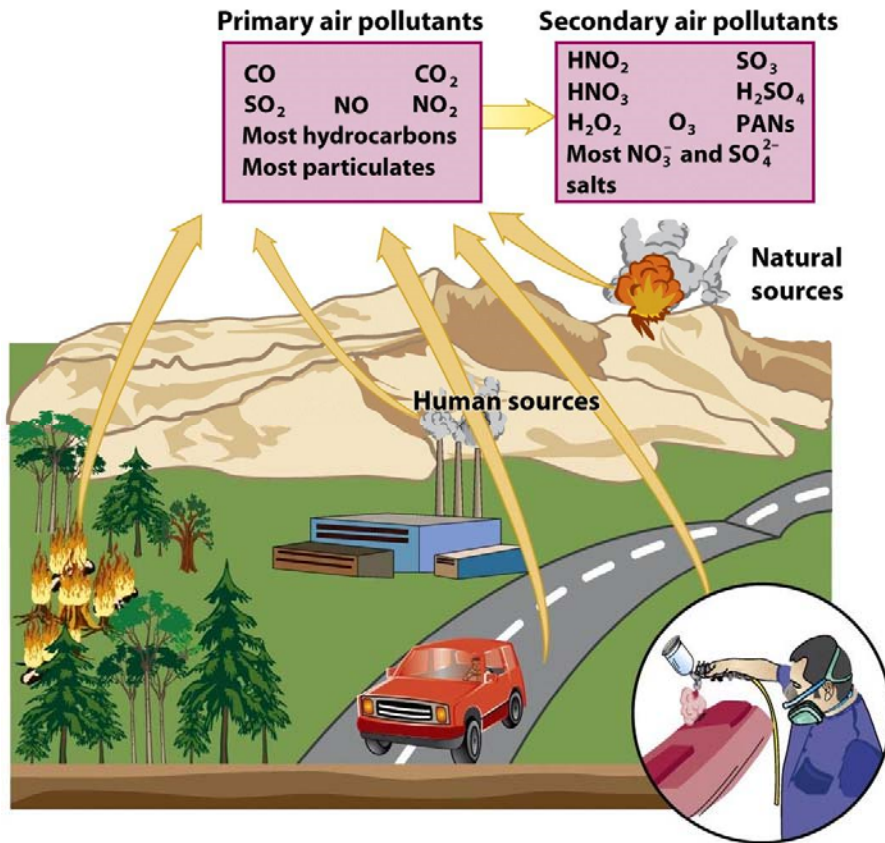
Impact of air pollution on respiratory disease

Dr Paul Whitaker

Consultant Respiratory Medicine

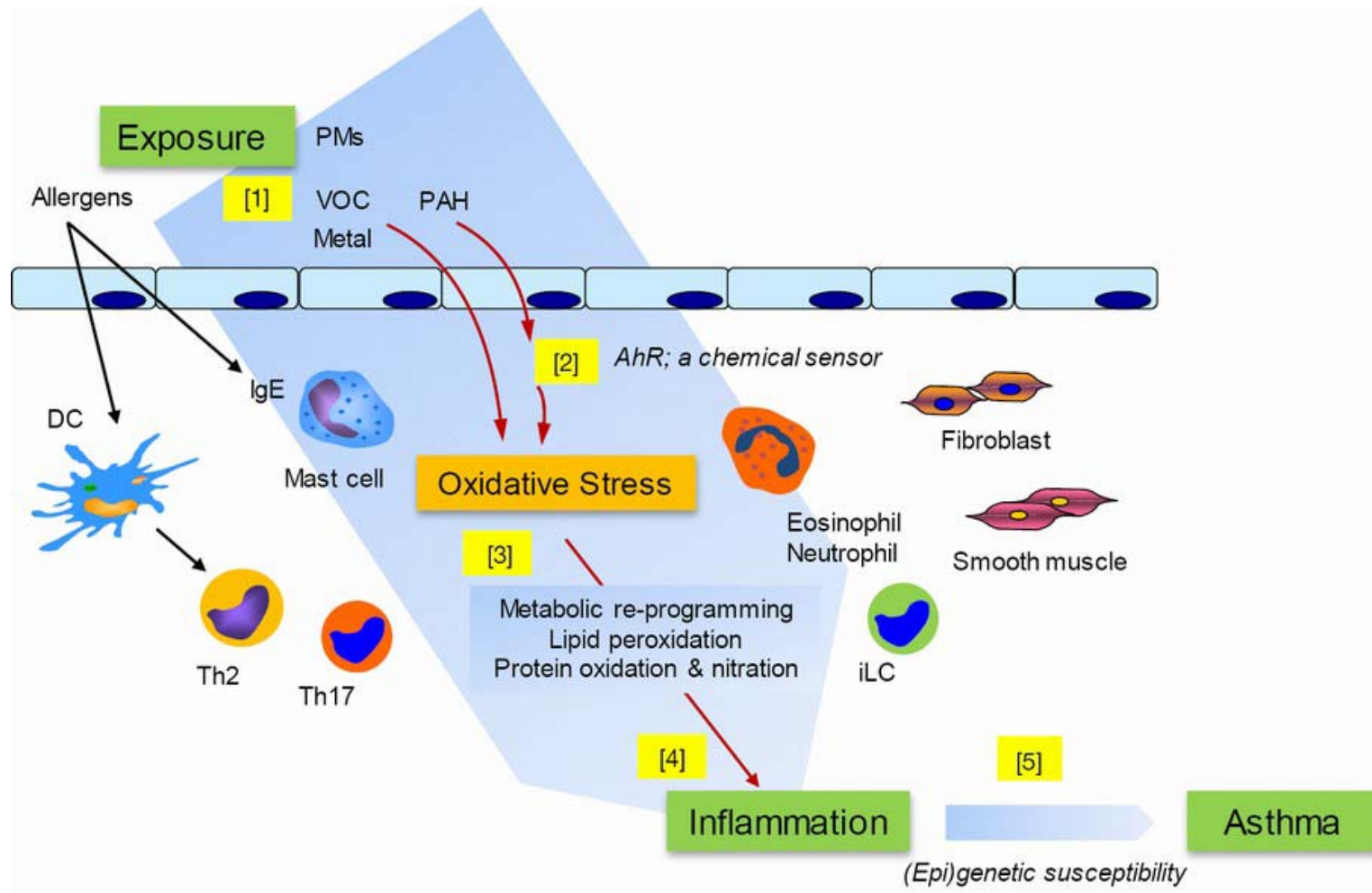
St James's Hospital

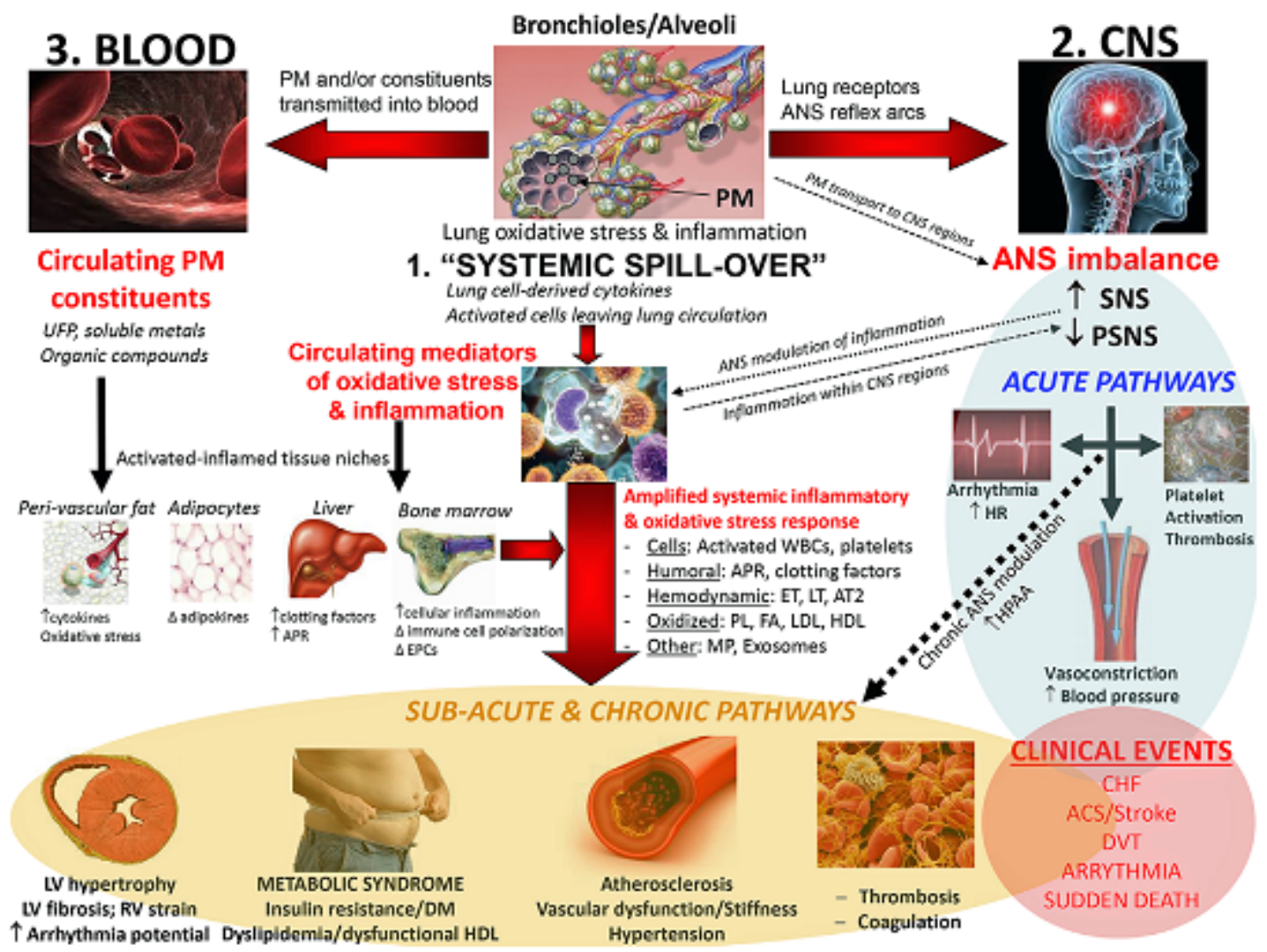
Which pollutants?



Effect of pollutants

10,000 litres air enter our lungs every day





Susceptible groups

- Children
 - Increased respiratory volume per weight
 - More sensitive to airway irritation and higher risk developing infections
- Elderly
 - Poorer immune systems and less reserve
- Pre-existing conditions
 - Asthma/COPD
- Pregnant woman
 - Low birth weight babies and increased maternal complications

Lung function in healthy individuals

- Healthy children living in more areas with higher PM2.5 concentrations (29.0 $\mu\text{g}/\text{m}^3$ vs 6.0 $\mu\text{g}/\text{m}^3$) were 5 times more likely to have low lung function
- In 4,742 adults followed for 11 years a 10 $\mu\text{g}/\text{m}^3$ decline in the mean PM10 concentration was associated with a 9% reduction in the annual rates of decline in FEV₁

N Engl J Med 2015;372:905-13

N Engl J Med. 2007;357(23):2338-47

Table 1 Long-term effects of PM on the cardiovascular system

Author	Year	PM	ΔPM (in $\mu g/m^3$)	Outcome measure	Effect (95% CI)
Dockery et al. [17]	1993	PM ₁₀	18.6	All-cause mortality	26% (8–47)
Pope et al. [18]	1995	PM ₁₀	24.5	All-cause mortality	17% (9–26)
		PM ₁₀	24.5	Cardiopulmonary mortality	31% (17–46)
Hoek et al. [28]	2002	BS	10.3	Cardiopulmonary mortality	71% (10–167)
Pope et al. [25]	2002	PM _{2.5}	10	Cardiopulmonary mortality	9% (3–16)
Pope et al. [26]	2004	PM _{2.5}	10	Ischemic CVD mortality	18% (14–23)
		PM _{2.5}	10	CHF, arrhythmia, CP arrest	13% (5–21)
Miller et al. [27]	2007	PM _{2.5}	10	Cardiovascular event	24% (9–41)
		PM _{2.5}	10	Cardiovascular mortality	76% (25–147)
Toren et al. [29]	2007	PM	Not measured	Cardiovascular mortality	12% (7–19)

PM particulate matter, ΔPM increase in ambient PM, *BS* black smoke

Air pollution kills 16,000 Brits a year and 1 in 9 deaths globally is result of air pollution-related conditions

In the UK, it is estimated that more than 7,300 people died from ischaemic heart disease linked to outdoor air pollution during 2012.

In the same year, almost 5,000 died from lung cancer and 3,700 died from strokes. More than 400 died from chronic obstructive pulmonary disease, while acute lower respiratory disease accounted for 12 deaths.

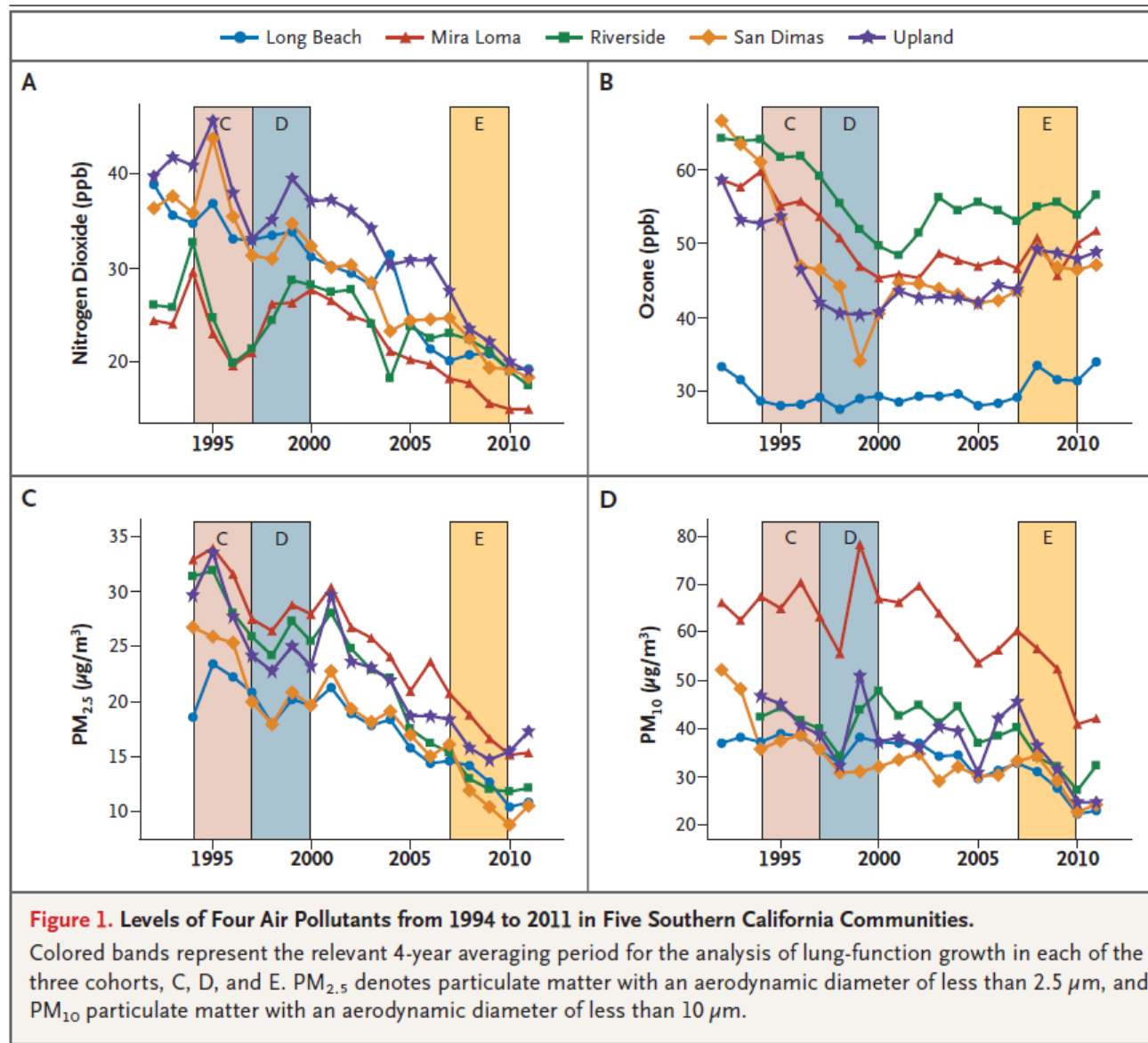
Across the world, one out of every nine deaths was the result of air pollution-related conditions in 2012, the WHO warned.

Changes can have big impact

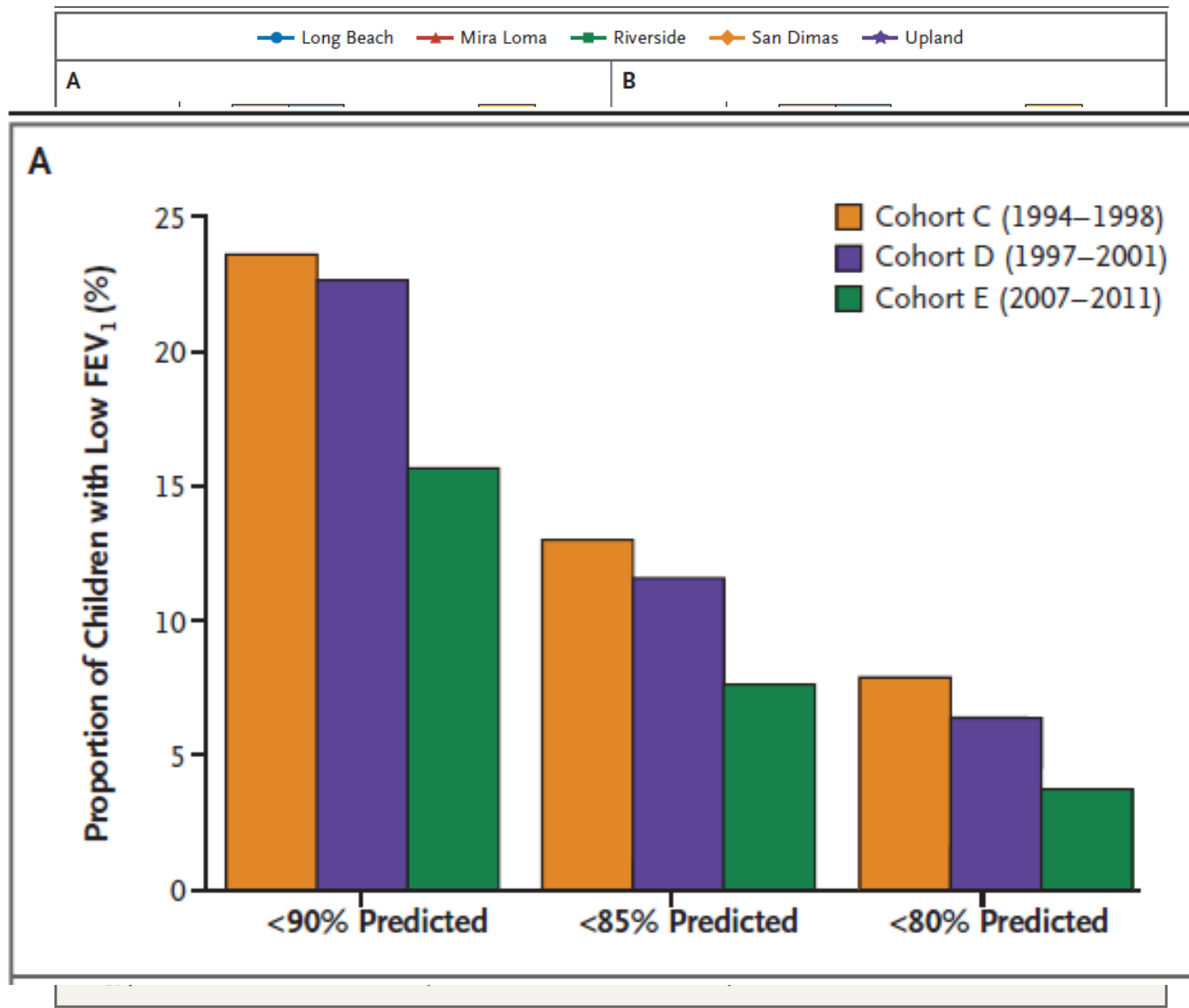


N Engl J Med 2015;372:905-13.

Changes can have big impact



Changes can have big impact



Development of disease

- Increased rates of asthma development with air pollution
 - 30% increase in adult onset asthma for every 1- $\mu\text{g}/\text{m}^3$ increase in the concentration of traffic-generated PM10
Thorax. 2009;64(8):664-70
 - Levels of PM2.5 were associated with a 28% increase in the incidence of asthma in children

Am J Respir Crit Care Med. 2010;181(6):596-603

- Increased risk of COPD
 - A 7- $\mu\text{g}/\text{m}^3$ increase in the 5-year mean PM10 concentration was associated with a 33% increase in the development of COPD and a 5.1% decline in FEV₁.

Respir Res. 2005;6:152

Also increased risks of.....

- Chest infections in children
- Pneumonia in adults
- Lung cancer
 - For every $10\mu\text{g}/\text{m}^3$ increase in PM_{2.5} there is a 36% increased risk of lung cancer

Lancet Oncology 2013 14(9): 813-22

- Heart disease

Effect on existing disease

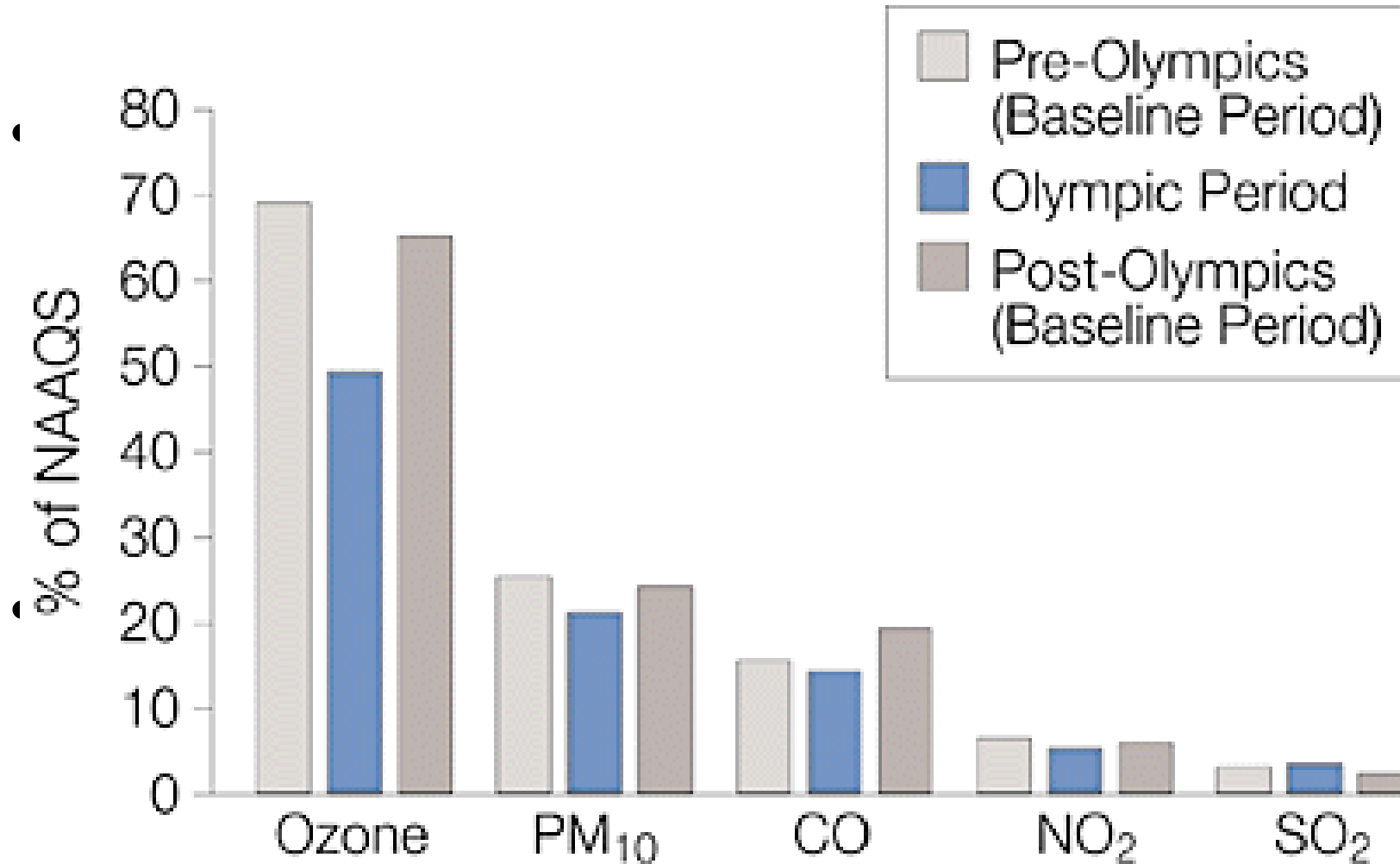
- A 10- $\mu\text{g}/\text{m}^3$ increase in PM10 and SO₂ levels was associated with a 2.2% increase and a 6.0% increase respectively, in the number of asthma-related visits.

Environ Res. 2011;111(3):418-24

- At Atlanta Olympics 40% reduction in asthma exacerbations following traffic calming measures to reduce urban pollution

JAMA. 2001;285(7):897-905

Effect on existing disease

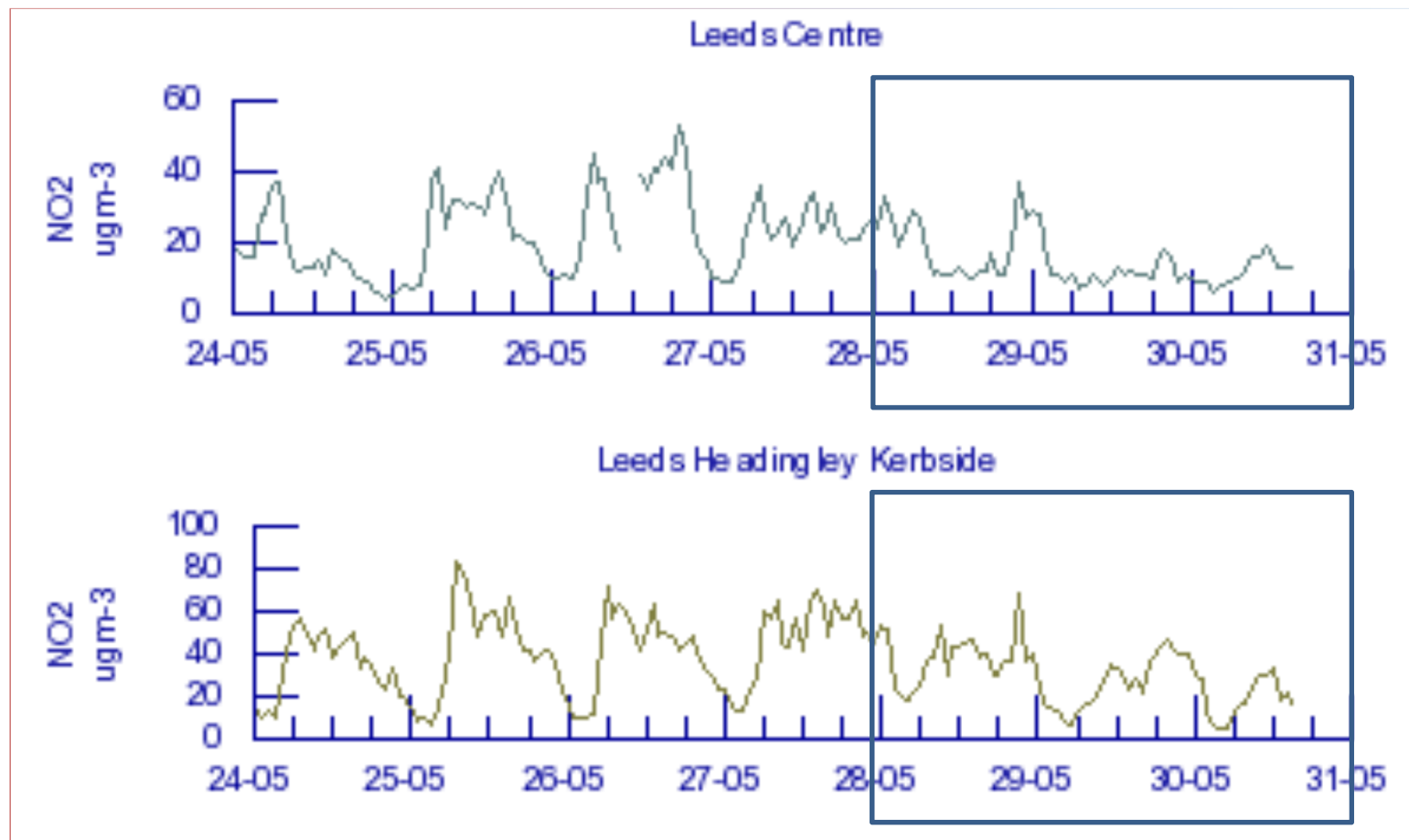


JAMA. 2001;285(7):897-905

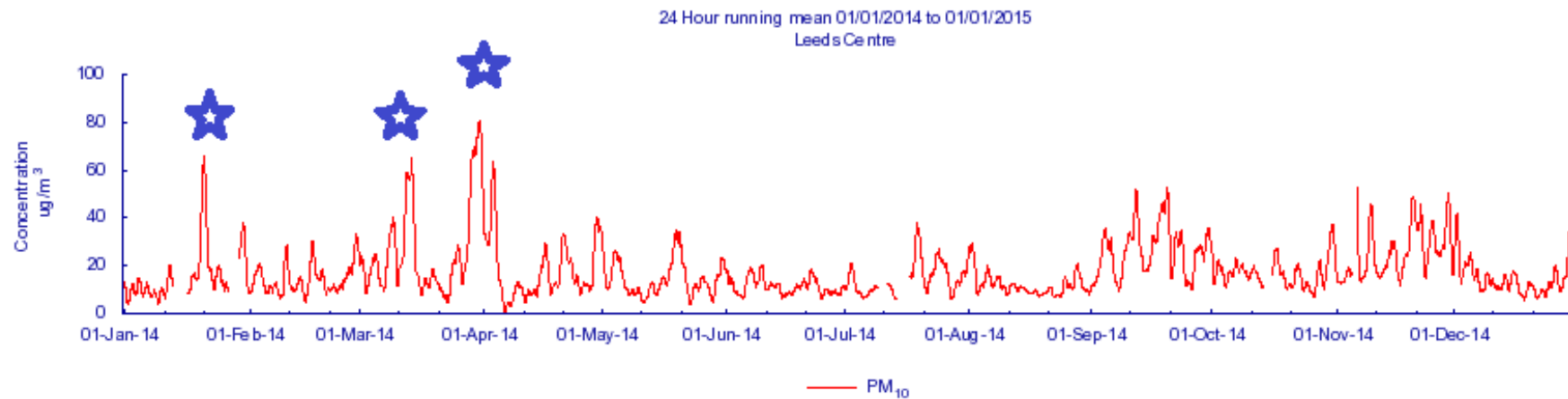
Respiratory symptoms and medication usage

- Increases in particulate matter associated with
 - Severe asthma symptoms
 - Missed school days
 - Increase in adult asthma exacerbations
 - Increased medication usage

The bank holiday effect....



Asthma patient working in Leeds



Problems with air pollution

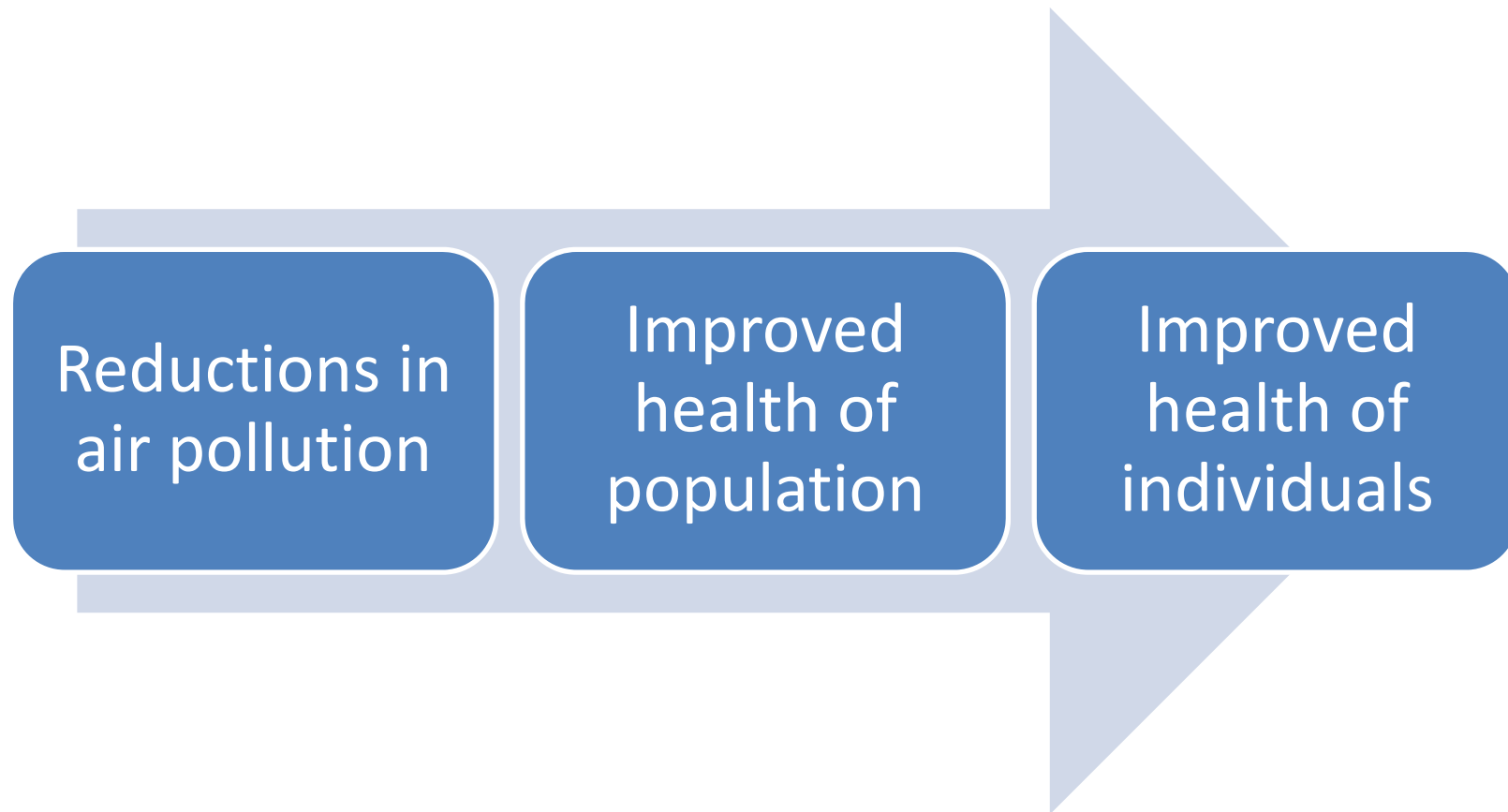


Public Health Interventions

- Smoking ban (July 2007)
 - Fall by 14% of chest infections in children
 - Reduction of 11,000 admissions a year in UK



A more productive city?



Outstanding questions?

- In every study detrimental effects are seen but: -
 - Which pollutants or combinations of pollutants are most harmful?
 - What are the mechanisms of causing disease?
 - How can you quantify individual risk?
 - What measures can an individual do to reduce the risk?