Pollution, air quality and health

Dr Jonathan Fluxman

Covid Lead, Doctors in Unite
jfluxman@hotmail.com

Summary

1. Pollution = global heating = climate change. Poor AQ = can't deal with pandemics

2. TUCAN, Hazards Campaign and GJA – excellent sources of information and guidance for reps

3. WHO AQ standards – what they are, and where do they apply

4. List of pollutants – table of outdoor; PLUS indoor VOCs; airborne pathogens

5. How pollutants make us sick

6. Unionised workplaces are safer workplaces; the role of Health and Safety Reps

✅ WE DRINK CLEAN WATER

✅ WE EAT HYGIENIC FOOD

❌ WE DON'T BREATHE CLEAN AIR!

- Air pollution = global heating = climate change.

- Poor indoor AQ = can't deal with pandemics

- **Clean air in the workplace should be one of the fundamental demands of the trade union movement**

https://greenerjobsalliance.
co.uk/wp-
content/uploads/2024/04/
Workers-Guide-to-action-
on-indoor-workplace-air-
pollution-WEBSITE.pdf

https://gmhazards.org.uk/

https://greenerjobsalliance.co.uk/

Air quality guidelines

"More than 15 years have passed since the publication of Global (AQ guidelines) update 2005. In that time there has been a marked increase in evidence on the adverse health effects of air pollution ……………

New epidemiological studies have documented the adverse health effects of exposure to high levels of air pollution in low- and middle-income countries, and studies in high-income countries with relatively clean air have reported adverse effects at much lower levels than had previously been studied."

WHO Air Quality Guidelines 2021 Executive Summary
https://iris.who.int/bitstream/handle/10665/345334/9789240034433-eng.pdf

Major outdoor air pollutants	Indoor air pollutants	Airborne pathogens (indoor)
• Particulate matter (PM2.5 and PM 10) • Ozone (O3), • Nitrogen dioxide (NO2) • Sulfur dioxide (SO2) • Carbon monoxide (CO)	• All outdoor pollutants PLUS: • Volatile organic compounds (VOCs) X 10 outdoor level. benzene, ethylene glycol, formaldehyde, methylene chloride, tetrachloroethylene, toluene, xylene, and 1,3-butadiene. • Workplace manufacturing and processing, especially dusts and chemicals • Asbestos • Carcinogens	• Covid-19 (all year round) • Influenza (winter) • RSV (winter) • Coughs and colds viruses • Moulds from damp • In healthcare many more (see next slide)
	See TUCAN guide for full list	

"The present WHO AQ guidelines are applicable to both outdoor and indoor environments globally. Thus, they cover all settings where people spend time.

However, as in previous editions, these guidelines do not cover occupational settings, owing to the specific characteristics of the relevant exposures and risk reduction policies and to potential differences in population susceptibility of the adult workforce in comparison with the general population."

Table 1. Pathogens and Syndromes With Outbreak Potential Whose Transmission is Interrupted by Mask Wearing as Part of Standard Precautions

Pathogens/Syndromes	Examples
Viruses	Influenza
	Respiratory syncytial virus
	Rhinovirus
	Adenovirus
	Parainfluenza virus
	SARS-CoV-1
	SARS-CoV-2
	MERS-CoV
	Endemic enteroviruses and coronaviruses
	Rubeola (measles)
	Mumps virus
	Rubella virus
	Varicella zoster virus
	Monkeypox
Bacteria	*Bordetella pertussis*
	Corynebacterium diphtheriae
	Neisseria meningitidis
	Group A *Streptococcus*
Mycobacteria	*Mycobacterium tuberculosis*
Syndromes	Bronchiolitis
	Croup

Note. SARS-CoV-1, severe acute respiratory coronavirus virus 1; MERS, Middle East respiratory coronavirus.

Airborne pathogens in healthcare settings

(there are almost no airborne protections in health and social care now)

Table 0.1. Recommended AQG levels and interim targets

Pollutant	Averaging time	Interim target				AQG level
		1	2	3	4	
PM$_{2.5}$, μg/m³	Annual	35	25	15	10	5
	24-hour[a]	75	50	37.5	25	15
PM$_{10}$, μg/m³	Annual	70	50	30	20	15
	24-hour[a]	150	100	75	50	45
O$_3$, μg/m³	Peak season[b]	100	70	–	–	60
	8-hour[a]	160	120	–	–	100
NO$_2$, μg/m³	Annual	40	30	20	–	10
	24-hour[a]	120	50	–	–	25
SO$_2$, μg/m³	24-hour[a]	125	50	–	–	40
CO, mg/m³	24-hour[a]	7	–	–	–	4

[a] 99th percentile (i.e. 3–4 exceedance days per year).
[b] Average of daily maximum 8-hour mean O$_3$ concentration in the six consecutive months with the highest six-month running-average O$_3$ concentration.
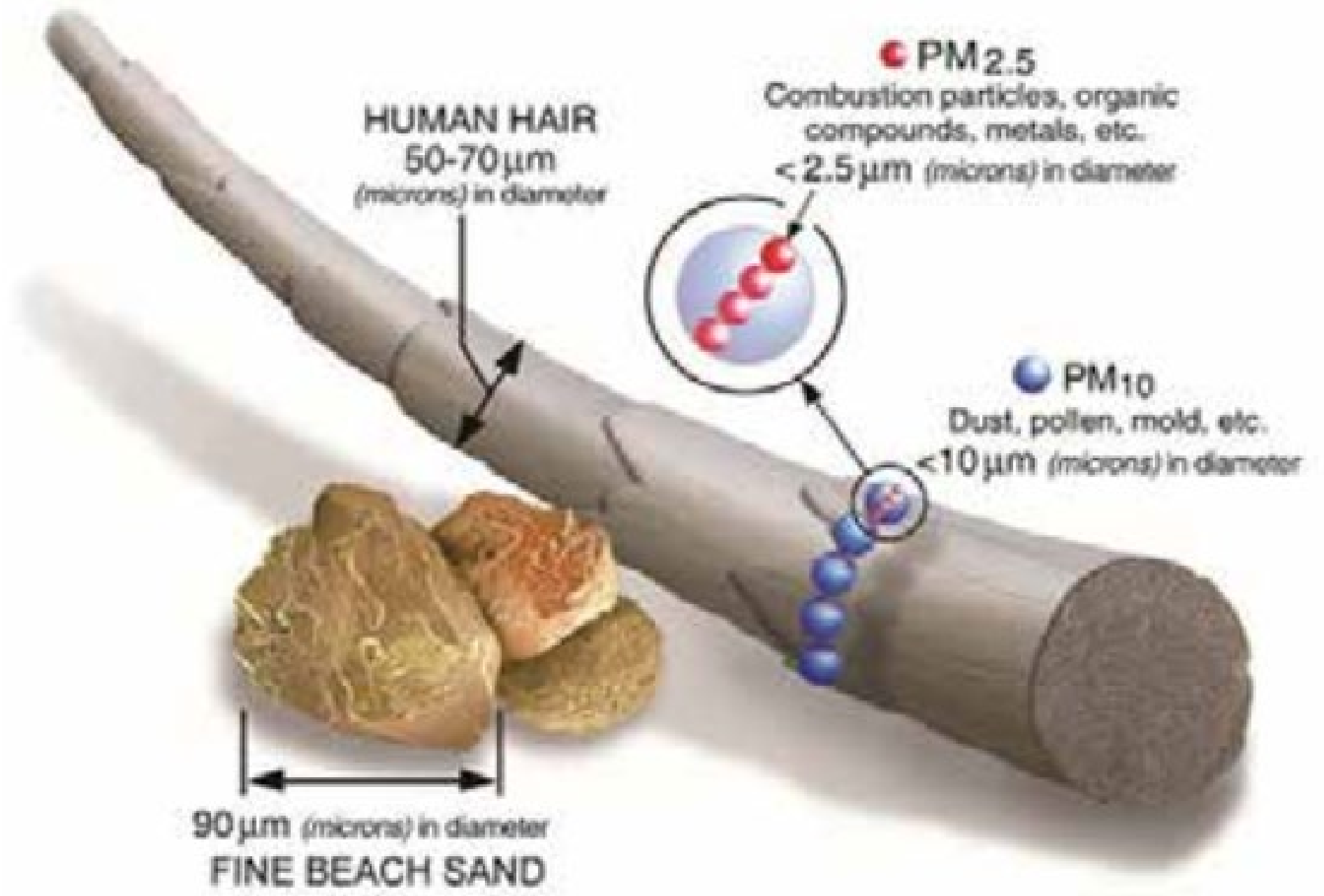
https://iris.who.int/bitstream/handle/10665/345334/9789240034433-eng.pdf

Ambient outdoor air pollution: legal levels for UK & safer WHO guidelines and COSHH WEIs

Pollutant	Averaging Time	UK Standards Outdoor	WHO Guidelines	UK WELs COSHH Regs
PM2.5 Micrograms/M³	Annual	20	5	
PM2.5 Micrograms/M³	24 Hour mean		15	No specific regulation
PM10 Micrograms/M³	Annual	40	15	
PM10 Micrograms/M³ respirable dust	24 Hour mean	50 Exceeded Max 35 times a year	45	4,000 8 hour mean
NO₂ Micrograms/M³	Annual	40	10	
NO₂ Micrograms/M³ Microgrammes = millionths of gram	24 Hour	200 Exceeded Max 18 times a year	25	960 8 hour mean

https://greenerjobsalliance.co.uk/wp-content/uploads/2024/04/Workers-Guide-to-action-on-indoor-workplace-air-pollution-WEBSITE.pdf

HUMAN HAIR
50-70μm
(microns) in diameter

PM2.5
Combustion particles, organic
compounds, metals, etc.
<2.5μm (microns) in diameter

PM10
Dust, pollen, mold, etc.
<10μm (microns) in diameter

90μm (microns) in diameter
FINE BEACH SAND

Visible pollution from ~25 hours on London underground and London buses

CO2 monitor

Particulate meter

How Air Pollution Impacts Health

Respiratory
- ▶ Chronic Obstructive Pulmonary Disease (COPD)
- ▶ Asthma
- ▶ Pneumonia
- ▶ Lung cancer

Cardiovascular
- ▶ Congestive heart failure
- ▶ Arrhythmia
- ▶ Myocardial infarction
- ▶ Stroke
- ▶ Hypertension

Maternal and Infant Health
- ▶ Premature birth
- ▶ Reduced weight at birth
- ▶ Preeclampsia

Other Impacts
- ▶ Diabetes
- ▶ Dementia
- ▶ Increased risk for death
- ▶ Reduced life expectancy
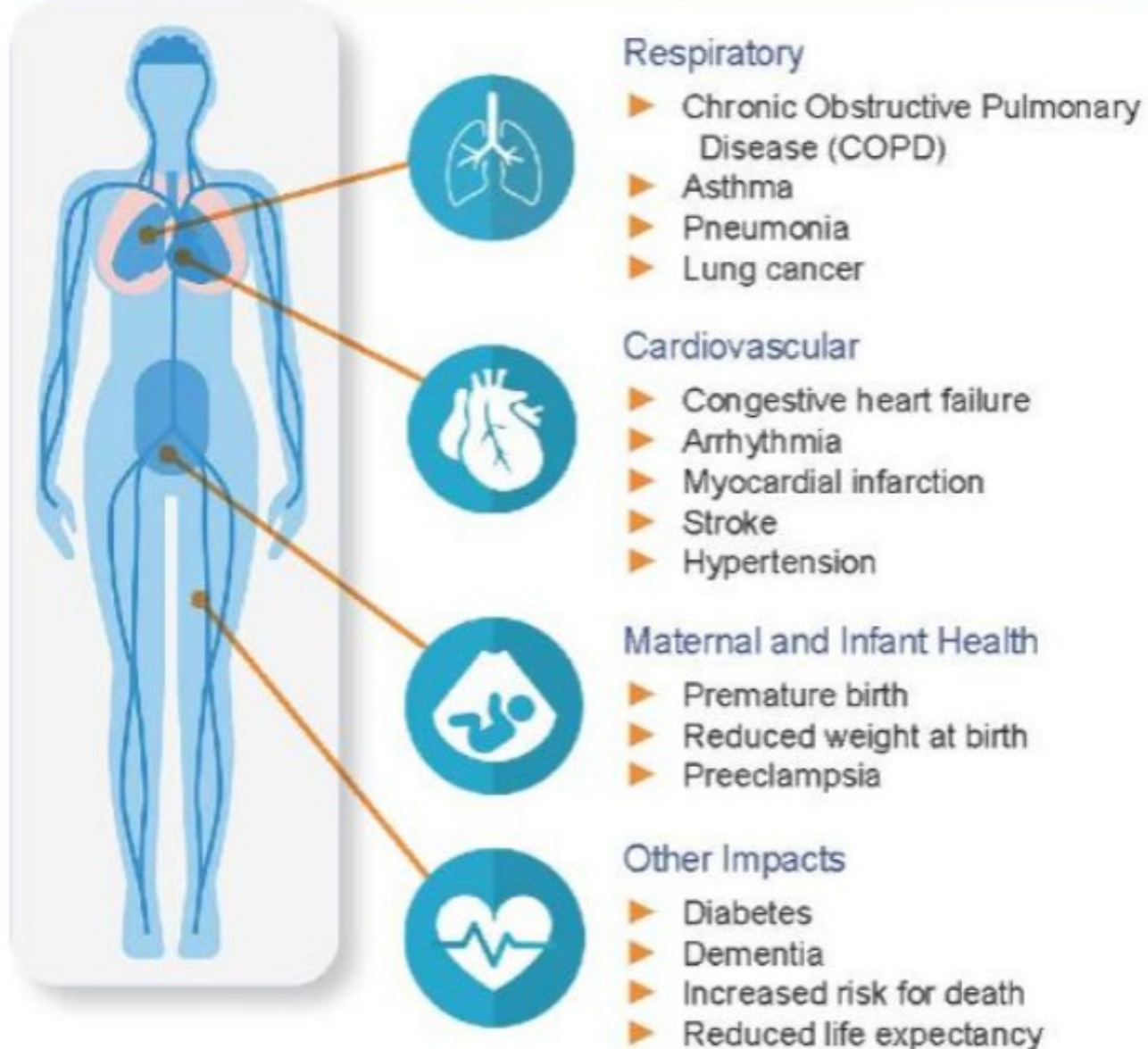
Burden of disease

- very young and old

- Global south countries

- Working class and black communities (busy roads, Edmonton incinerator)

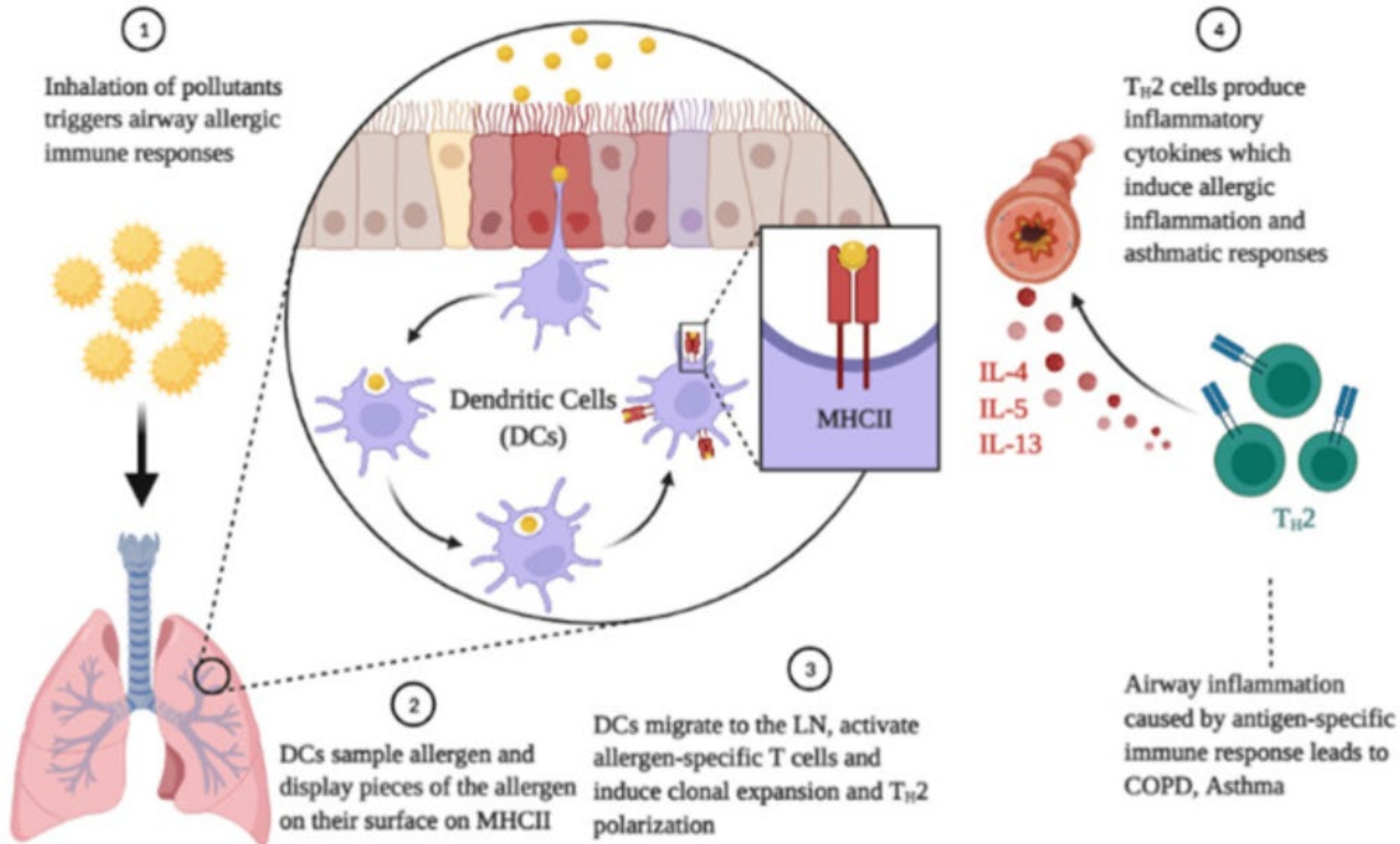https://www.stateofglobalair.org/resources/storymap/air-pollution-and-health

How do PM2.5's and PM10's cause disease

- Breathed in – smaller they are the deeper thy get into the lungs

- Airway inflammation, impairing normal immune responses of the lungs and making them susceptible to various respiratory infections

- Damage the bronchial mucociliary system, reducing bacterial clearance = COPD

- $PM_{2.5}$ and $PM_{2.5}$-induced inflammatory cytokines may cause the death of lung epithelial cells and fibroblasts, increasing epithelial barrier permeability and impairing their function as physical barriers for pulmonary innate immunity

- Alveolar macrophage function is inhibited, therefore reduced clearance of pathogens and dead cells and tissue repair

- All of these can lead to reduced pulmonary immunity and facilitate infectious illnesses, irritant and immune triggers for asthma, and chronic conditions like COPD.
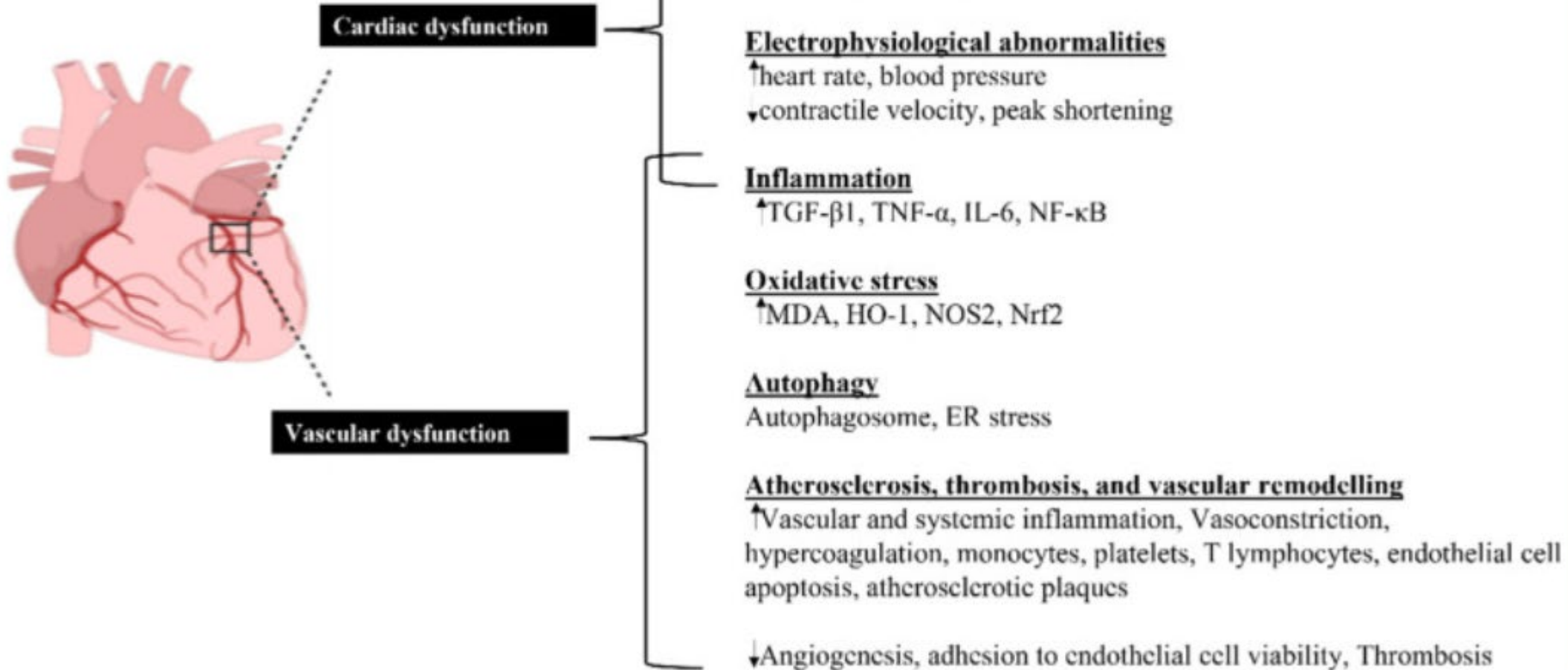
Pollution-induced airway inflammation (COPD, ASTHMA)

① Inhalation of pollutants triggers airway allergic immune responses

Dendritic Cells (DCs)

MHCII

④ T$_H$2 cells produce inflammatory cytokines which induce allergic inflammation and asthmatic responses

IL-4
IL-5
IL-13

T$_H$2

② DCs sample allergen and display pieces of the allergen on their surface on MHCII

③ DCs migrate to the LN, activate allergen-specific T cells and induce clonal expansion and T$_H$2 polarization

Airway inflammation caused by antigen-specific immune response leads to COPD, Asthma

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9223652/

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How pollutants cause heart disease

Cardiac dysfunction

Cardiac autonomic dysfunction
Parasympathetic dominance

Pathological fibrosis
$\uparrow$TGF-β1, GSK- 3 β

Electrophysiological abnormalities
$\uparrow$heart rate, blood pressure
$\downarrow$contractile velocity, peak shortening

Inflammation
$\uparrow$TGF-β1, TNF-α, IL-6, NF-κB

Oxidative stress
$\uparrow$MDA, HO-1, NOS2, Nrf2

Autophagy
Autophagosome, ER stress

Vascular dysfunction

Atherosclerosis, thrombosis, and vascular remodelling
$\uparrow$Vascular and systemic inflammation, Vasoconstriction, hypercoagulation, monocytes, platelets, T lymphocytes, endothelial cell apoptosis, atherosclerotic plaques

$\downarrow$Angiogenesis, adhesion to endothelial cell viability, Thrombosis

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9223652/
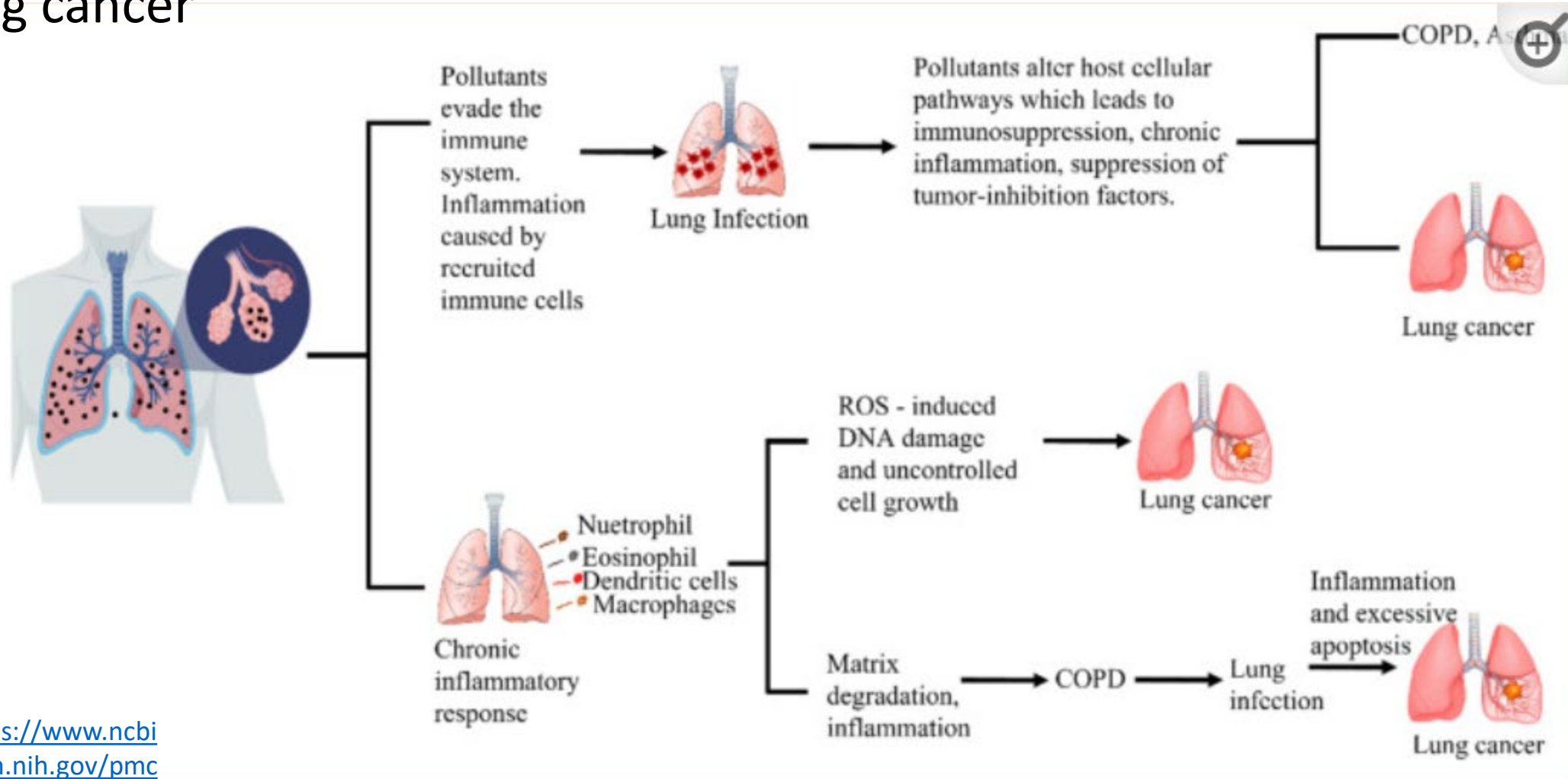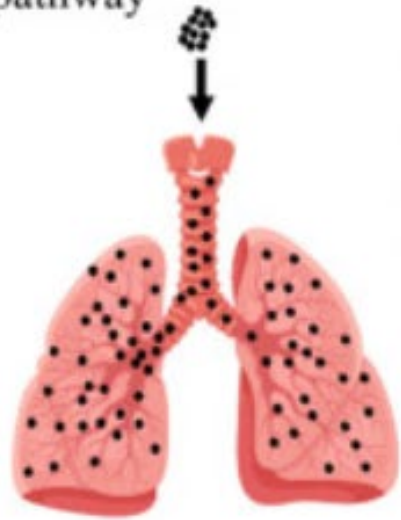
How pollutants cause lung cancer

How pollutants cause damage and loss of neurons

Inhalative uptake of particles into the lung or nasal olfactory pathway

Neuronal activation and damage:
- Indirect via autonomic lung arc reflex
- Indirect via local spreading (lung)
- Direct inflammation via particles and toxins crossing blood-brain barrier (BBB)

Neuroinflammation, cerebral oxidative stress, disruption of BBB, deposition of Aβ peptide, increase in stress hormone levels, neuronal damage and loss
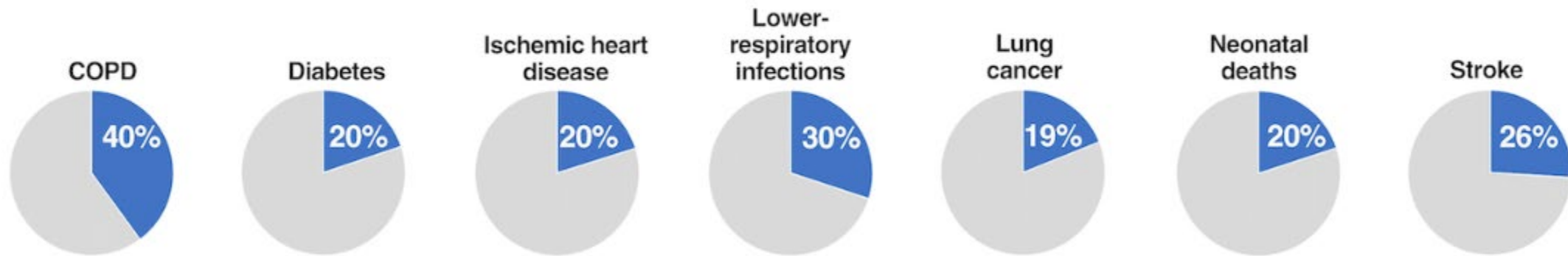
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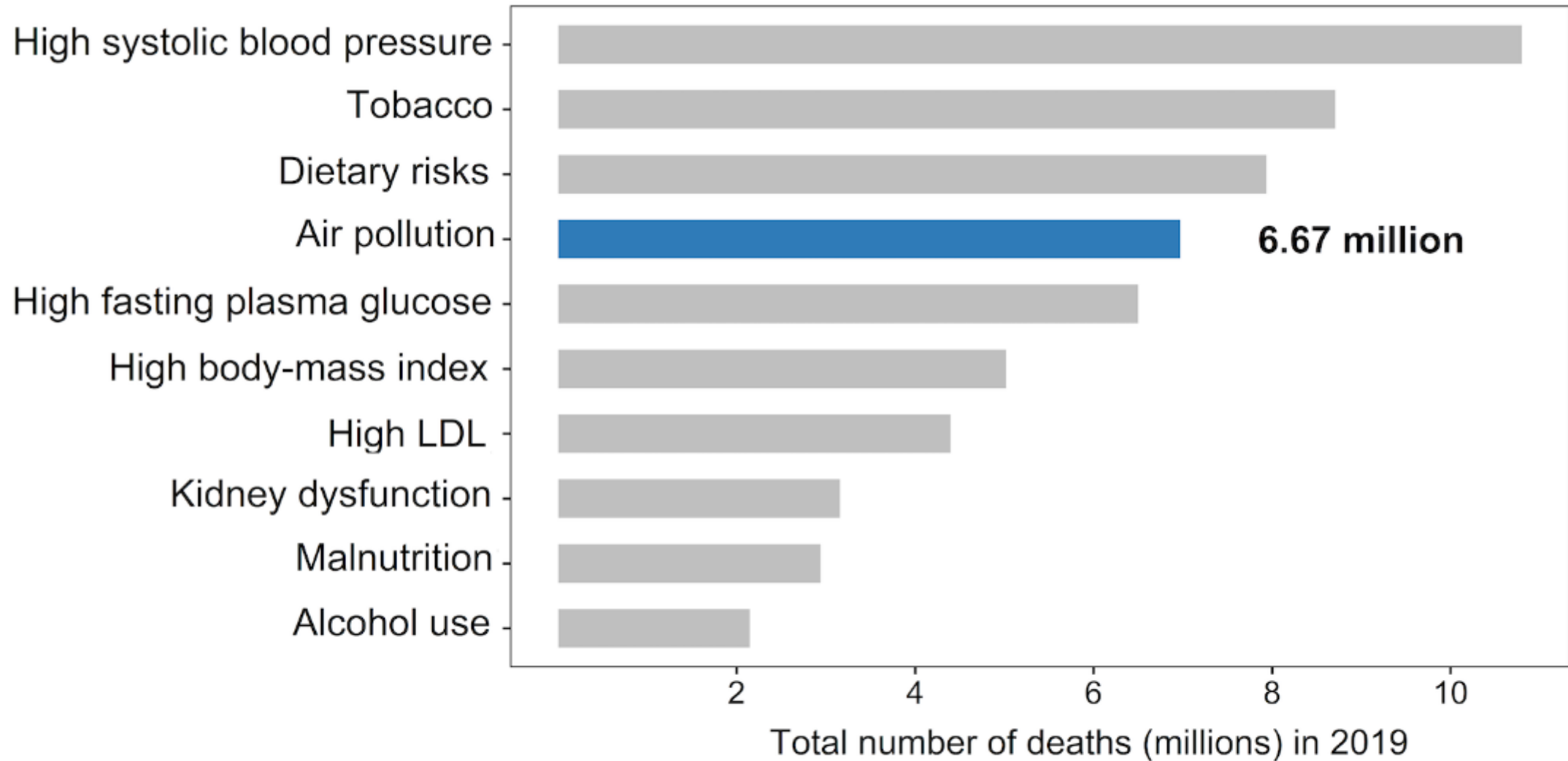
Figure N. Global ranking of risk factors by total deaths from all causes in 2019.

https://www.stateofglobalair.org/health/global

What proportion of global deaths from specific diseases are due to air pollution?

COPD	Diabetes	Ischemic heart disease	Lower-respiratory infections	Lung cancer	Neonatal deaths	Stroke
40%	20%	20%	30%	19%	20%	26%

Figure P. Percentage of global deaths from specific causes attributable to total air pollution. Use the data app to view and download cause-specific data for your country.

UK figures are significantly less (5 - 10% of deaths) but that's still a lot of people

https://www.stateofglobalair.org/health/global

UNIONS MAKE WORK SAFER

FIGHTING FOR YOUR LIFE AT WORK

HAZARDS MAGAZINE
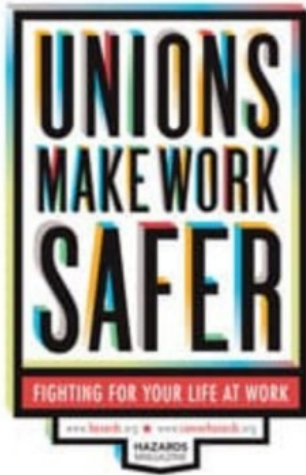
H&S reps are the unsung heroes of the trade union movement

Together against COVID 19

Time to get organised!

Online conference 28 and 29 September.
Workshops on workplaces, education and health and social care