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e-LA
e-Learning Anaesthesia

Sustainability:
Health and climate change

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Module Learning Outcomes

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Health implications of climate change and global warming

Populations of all animal species depend on supplies of food and water, freedom from excess infectious disease, and the physical safety and comfort conferred by climatic stability. The world's climate system is fundamental to this life-support. (WHO 2003).

Our climate is changing, and our ecosystems are now suffering the effects of a warmer planet. Humans are not immune to these changes. Climate change significantly influences the social and environmental determinants of health – safe food and water, security, and clean air. In addition to this we are now seeing the direct health impacts of our changing climate. In this section we will explore these further.

The relationship between climate change and its effects on health is complex and often modulated by interactions with other ecological processes, social conditions, and adaptive policies and behaviours. In simple terms the effects of climate change on health can be direct or consequential, secondary to environmental and ecological disruption.

Direct Effects

A Warmer Planet

Our planet is warming, and left unchecked the predictions indicate that in the UK annual mean temperatures will be 2 and possibly as much as 8°C higher by 2080, with an increased incidence of heatwaves, dryer summers and wetter winters.[1] This in turn will lead to an increased rate of morbidity and mortality associated with cardiac, respiratory and allergen-induced conditions. In the UK, heat related mortality currently accounts for around 2000 excess deaths per year. This is predicted to increase by around 540% in the 2080s.[1]

Globally, 30% of the world population spend 20 days exposed to lethal heat events.[2] If we continue along the current trend this could increase to 74% by 2100.[2] Heat related morbidity and mortality primarily affects the elderly and with an aging population this will lead to an increased demand on health systems.

Extreme Weather Events and Natural Disasters

Since the 1960s the number of weather-related natural disasters has more than tripled, resulting in over 60,000 deaths per year globally.[3] The morbidity and mortality from such disasters can be immediate (trauma, burns or drowning) or delayed in the form of mental health problems, waterborne disease and malnutrition. With more than half of

the world's population living within 60km of the sea we can expect the effects of rising sea levels to further impact this.

Indirect Effects

Water and Food Supply Impacts

Be it from fires, floods or drought the impact on safe drinking water and nutrition can be profound. As things stand, 1 in 10 people do not have access to clean water.[3] This leads to an increased rate of waterborne and diarrhoeal disease which currently kills over 500,000 children under 5 each year.[3] Unfortunately, the rates continue to rise, and we are currently seeing Yemen face the worst cholera outbreak in history with over 2.2million people being affected since it began in 2016.[4]

The relationship between food and climate is complex. Intensive agricultural methods have been shown to significantly impact our climate and soil quality yet, despite the increase in food production, more than 10 percent of the world's population are undernourished.[4] Failing to keep surface temperatures below 1.5°C, as recommended by the IPCC, will lead to droughts occurring 5-10 times more often.[4] Rising temperatures, variable precipitation and extreme weather events will likely lead to food scarcity in the poorest areas increasing the prevalence of malnutrition related deaths which currently stands at 3.1 million per year.[3]

Conflict and Migration

It is unsurprising that once environmental degradation results in uninhabitable conditions populations migrate to survive. Analysts predict that by 2050 the number of climate migrants will be between 200 million and 1 billion.[5] What leads to climate migration?

- Climate processes – rising sea levels, salinization of agricultural land, desertification and water scarcity.
- Climate events – Flooding, fires and storms.
- Non-climate drivers – government policy, population growth and community resilience to the effects of climate change.

Stresses on natural resource and mobile populations lead to an increased risk of geopolitical instability. Such impacts have already led to increased tensions in areas such as the Middle East and Africa. Dwindling fish stocks and a melting arctic are now also exposing new political and economic battle grounds.

Infectious Disease

The relationship between infectious disease and a changing climate is multifaceted and complex. There are four main types of disease transmission.

Anthroponoses (Human Source)

- Direct – HIV, Tuberculosis or leprosy.
- Indirect, via vector host / contaminated water – Malaria, Dengue or Cholera.

Zoonoses (Animal Source)

- Direct – Rabies, Avian Influenza or Ebola.
- Indirect, via vector host / contaminated water – Lyme disease, Bubonic Plague or West Nile Virus.

We have already touched on the effects of water scarcity and malnutrition and how they can lead to increased infectious disease. Mass migration also significantly impacts the transmission of infectious disease by many means such as disrupting health services and vaccination efforts, and overcrowded housing.

Variable rainfall, longer monsoons and warmer temperatures lead to significant changes in the prevalence and geography of vector borne diseases. It is predicted that global temperature rise of 2-3°C will increase the number of people at risk of malaria by several hundred million, whilst the seasonal duration of the disease would increase in many endemic countries.[6] Vector borne diseases are extending their area of prevalence. For example, Dengue Fever in Southern Europe and in August 2019 the first cases of native Zika virus were described in Southern France.[6]

Changes in infectious disease transmission are very likely to continue with a changing climate, and it is essential that we learn more about their complex causal relationships.

Summary

The ways in which climate change will influence the health of our populations is complicated and at times overwhelming. Figure 1 summarises the impact of climate change in human health and how it exacerbates existing inequalities.

Within healthcare systems it is essential that we assess risk locally and adopt adaptive management strategies to ensure resilience and preventative strategies.

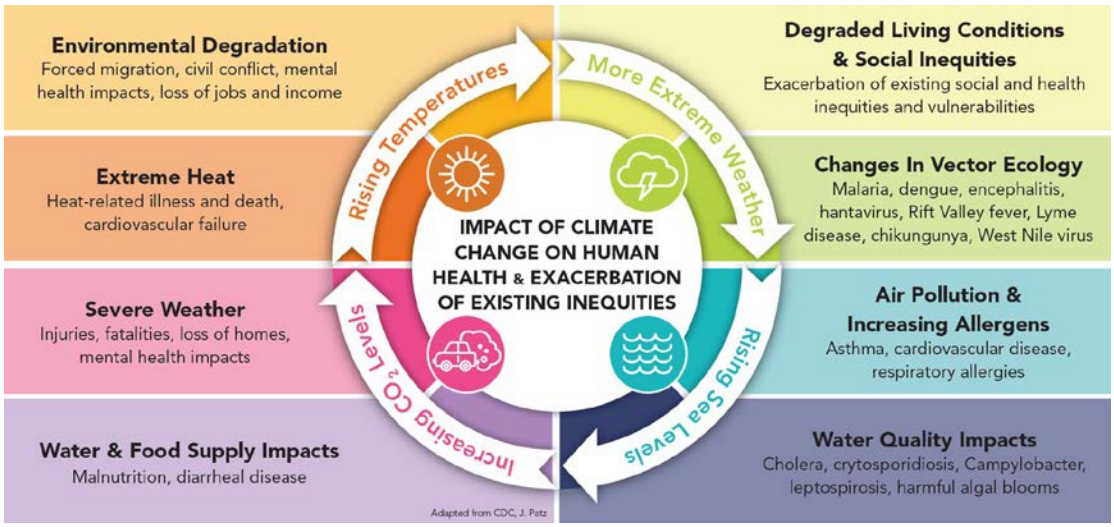


Figure 1: Impact of Climate Change on Human Health & Exacerbation of Existing inequalities.[7]

Air Pollution and Cardiorespiratory Disease

Air pollution is the biggest environmental threat to the UK's health. Exposure is linked to chronic health conditions and to a reduced life expectancy. Long term exposure is estimated to result in 28,000-36,000 deaths a year.[8]

What is meant by air pollution?

Air pollution is a mixture of both natural and man-made components (figure 2). Most urban air pollution consists of nitrogen dioxide and particulate matter (particles of various sizes and compositions depending on factors such as emission sources and location). The size of the particulate matter determines potential health effects whereby, the strongest evidence for effects is associated with fine particles. Other common pollutants include ammonia, ozone and sulphur dioxide.

Although the focus of this module is on the effects of outdoor pollution, it is important to remember that there several indoor sources of pollutants that can have adverse health effects. These include gases and particulate matter from domestic appliances (cooking, heating), tobacco smoke and compounds from cleaning products.

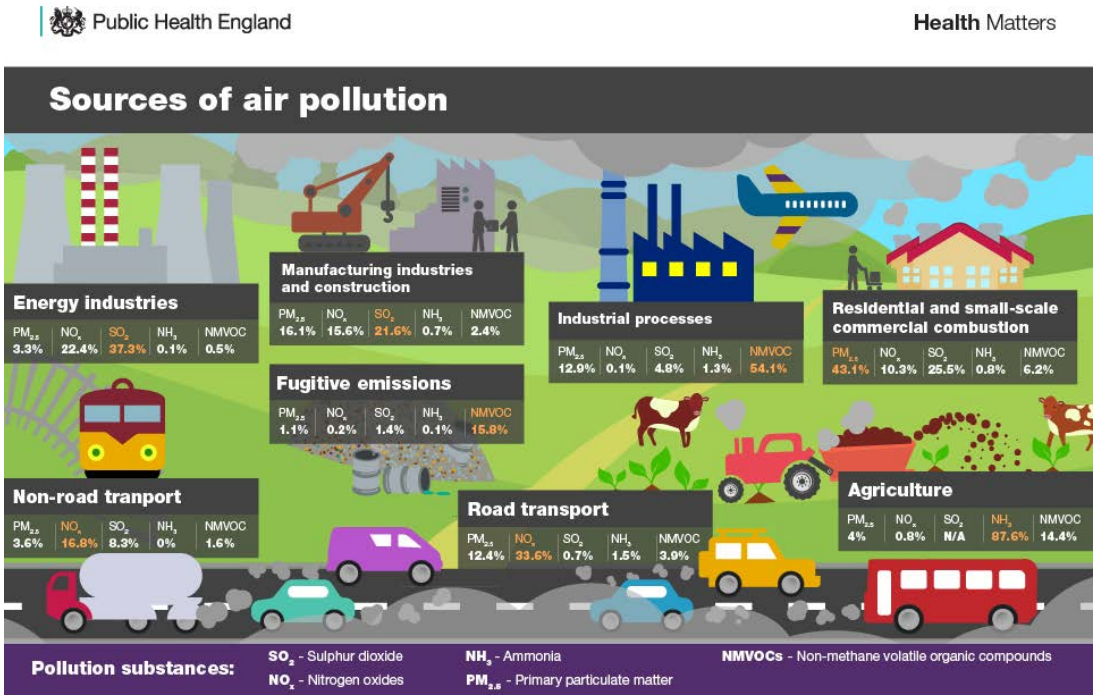


Figure 2: Sources of Air Pollution [8]

It is worth noting that there are over 9.5 billion NHS related road miles per year, which is around 3.5% of all road travel in England. This is from staff and patient travel and logistics.[9]

Health effects of air pollution

Studies have shown that both short-term and long-term exposure to air pollution can have adverse impacts on multiple organ systems such as:

- **Lungs**
  - Asthma: causation and exacerbation
  - Accelerated decline in lung function for adults and older people
  - Chronic obstructive pulmonary disease
  - Lung cancer
- **Cardiovascular system**
  - Coronary heart disease
  - Increased risk of heart failure, myocardial infarction and arrhythmias
- **Central Nervous System**
  - Stroke
  - Dementia

The impacts of exposure to poor air quality affect people across their life course[10] from pre-conception to old age (Figure 3). It also disproportionately impacts on the most vulnerable groups of people such as older persons, children, pregnant women and those with pre-existing health conditions.[10]

These health impacts result in increased hospital admissions and premature deaths. Studies have shown particulate matter to cause increased hospital admissions and deaths on high pollution days.[8]

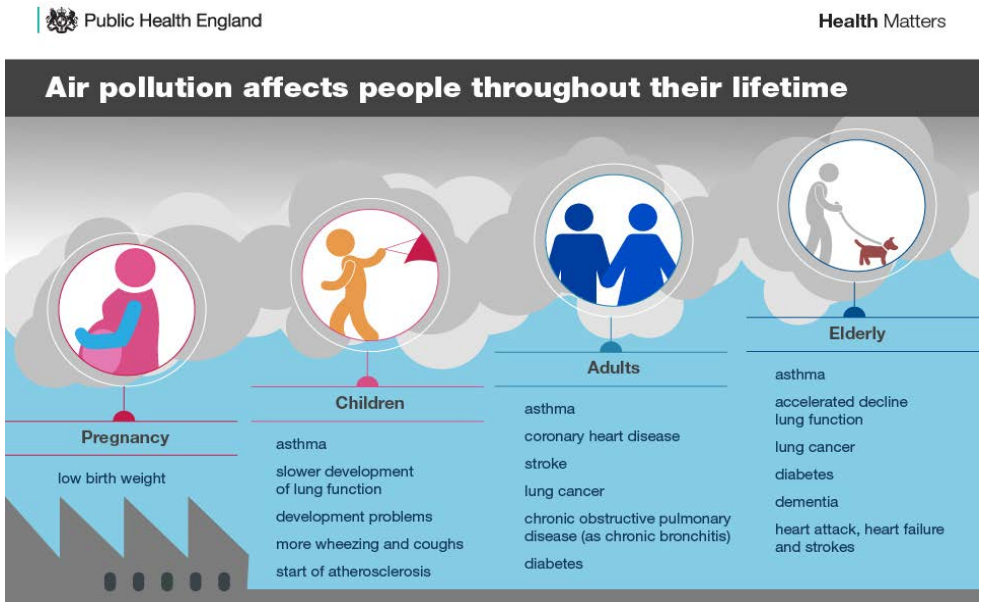


Figure 3: How air pollution affects people throughout their lifetime [8]

The scale of the problem extends beyond public health to socioeconomic costs. A 2010 report from the European Audit Committee suggested the cost of air pollution to be in excess of £8-20billion.[8] Another report from 2012 suggested the cost to economy to be £2.7 billion in lost productivity alone.[8]

Social sustainability, social inequalities and civility in healthcare

What are health inequalities?

The Kings Fund describes health inequalities as "avoidable, unfair and systematic differences in health between different groups of people".[11] Essentially, this means that factors such as socioeconomic status, gender, ethnicity and social exclusion are correlated with poorer health outcomes.

An example of this is difference in healthy life expectancy across socio-economic strata. In figure 4 the dark green dots look at life expectancy compared to income, whilst the light green dots represent disability-free life expectancy. The more deprived you are, the shorter your life is and the greater proportion of it is spent in ill health. People in the most deprived parts of England live, on average, 19 years less in good health compared to the least deprived parts.[11]

This relationship, known as the social gradient in health, exists across the whole population and is not exclusive to the extremes of deprivation. Health inequalities are therefore experienced by everyone. This relationship was described in Sir Michael Marmot's report "Fair society, healthy lives" and can be used to demonstrate other measures of deprivation such as education, access to green spaces and exposure to air pollution.[12]

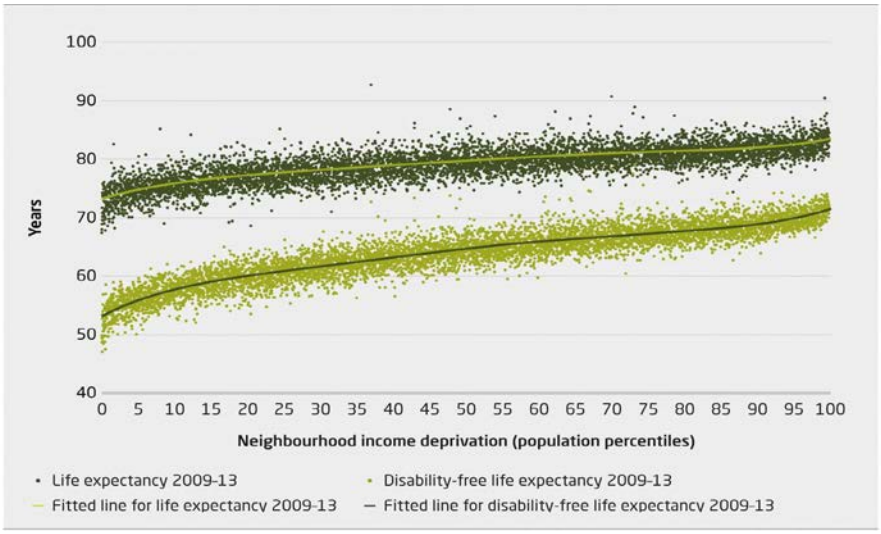


Figure 4: Inequalities in male life expectancy and disability-free life expectancy by neighbourhood deprivation 2009 – 13 [11]

Health inequalities and climate change

Health inequalities can be observed in the consequences of climate change on a national and global scale. For instance, heat-related mortality is more likely to affect older people, those with pre-existing medical conditions and those living in urban settlements. Similarly, climate change can lead to emerging infections and flooding, the impacts of which are over-represented in disadvantaged areas.

Although poor air quality affects everyone in the UK, the distribution of adverse health effects is shown to disproportionately impact on socio-economically deprived communities.[13] This could be linked to:

- higher rates of pre-existing morbidity associated with deprivation
- reduced access to health care, employment and decent housing
- increased likelihood of living in unhealthy environments such as clustering of disadvantaged communities around busy roads.

The role of public health in climate change

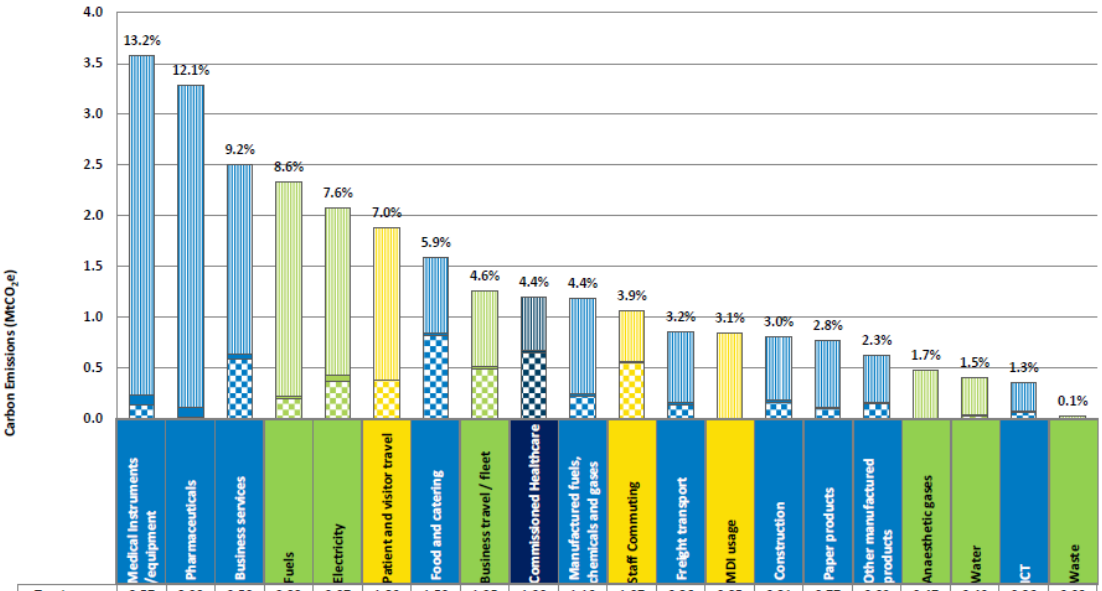
Given the wide-reaching consequences of climate change, there is a clear role for public health authorities in focusing on whole populations and on the wider determinants of health to reduce the inequalities in associated health impacts. Examples include:

- Response plans to emergencies such as heatwaves and flooding
- Health promotion interventions to improve health and wellbeing and reduce the prevalence of non-communicable diseases
- Local-based interventions to improve population health whilst reducing inequalities such as encouraging active travel to increase physical activity. This will also reduce congestion and pollution
- Surveillance of vector-borne diseases as climate-associated changes occur in the transmission and distribution

Healthcare within international agreements

This module has primarily considered the effects of the climate crisis and how the health sector and healthcare professionals need to mitigate against them. Whilst climate resilience is essential in dealing with the fallout, the sector needs to look at how it is contributing to the problem. A brief review is provided below but for more detail please read the e-modules within this series entitled '*Sustainable Healthcare' and 'International agreements'.*

Globally the health sector contributes to 4.4% of net emissions.[14] If the health sector were a country it would be the fifth largest emitter on the planet. On-the-whole this is linked to healthcare spending; those who spend more, emit more. In the UK the health sector makes up 5.4% of net carbon emissions.[14] The Sustainable Development Unit[15] described the carbon hotspots in the health and social care system within England (figure 5). Anaesthesia activity contributes to the majority of these components.



	Medical Instruments /equipment	Pharmaceuticals	Business services	Fuels	Electricity	Patient and visitor travel	Food and catering	Business travel / fleet	Commissioned Healthcare	Manufactured fuels, chemicals and gases	Staff Commuting	Freight transport	MDI usage	Construction	Paper products	Other manufactured products	Anaesthetic gases	Water	ICT	Waste
Total	3.57	3.29	2.50	2.33	2.07	1.89	1.59	1.25	1.20	1.19	1.07	0.86	0.85	0.81	0.77	0.62	0.47	0.40	0.36	0.03
%	13.2%	12.1%	9.2%	8.6%	7.6%	7.0%	5.9%	4.6%	4.4%	4.4%	3.9%	3.2%	3.1%	3.0%	2.8%	2.3%	1.7%	1.5%	1.3%	0.1%
NHS	3.34	3.18	1.86	2.11	1.64	1.51	0.74	0.74	0.53	0.94	0.50	0.70	0.85	0.63	0.66	0.46	0.47	0.37	0.28	0.03
Public Health	0.10	0.09	0.05	0.02	0.06		0.02	0.02	0.02	0.03	0.02	0.02		0.02	0.02	0.01		0.01	0.01	0.00
Social Care	0.14	0.02	0.58	0.20	0.37	0.38	0.83	0.49	0.65	0.22	0.55	0.14		0.16	0.09	0.15		0.03	0.07	0.00

Figure 5: Carbon Emissions from NHS, Public Health and Social Care in 2017.[15]

In line with international agreements the NHS recently published 'For a Greener NHS' with a commitment to reaching net zero.[16] It is essential that we work together to reduce the carbon footprint associated with how we work. When we look at non-maleficence it essential that we expand the scope of potential harm from the end of our needle to the wider populous when we make clinical decisions. We must resolve the potential conflicts between caring for our patients and ensuring we care for our planet.

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