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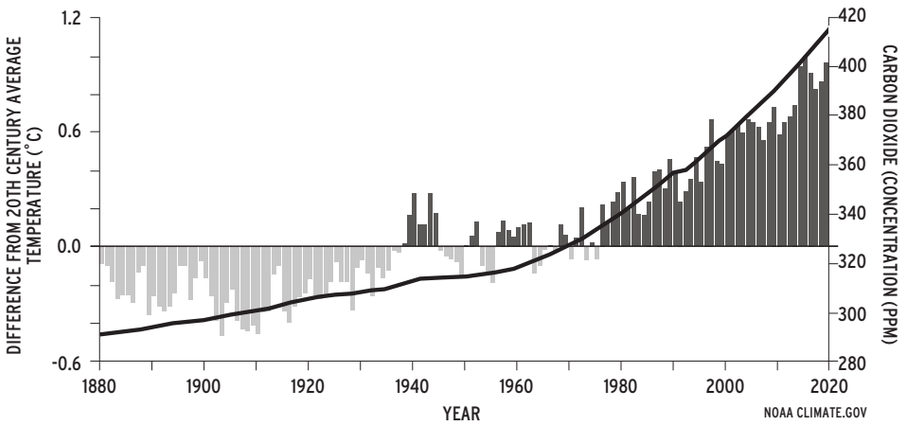
Climate change: the impact on health

By Sarah Foot

The Intergovernmental Panel on Climate Change (IPCC) estimates, with high confidence, that human activities have caused 1ºC of global warming above pre-industrial levels (Figure 1).[1,2] This rapid increase in temperature has been driven by the combustion of fossil fuels, leading to a rise in atmospheric carbon dioxide levels.[3] This increase in temperature will have a significant impact on the water cycle, causing catastrophic flooding in some areas and drought in others.

Figure 1: Atmospheric carbon dioxide and earth's surface temperature (1880 - 2019)[2]



In addition to global warming, wildlife populations have decreased by 60 per cent since 1970, and one million of the eight million species on the planet is threatened with extinction.[4,5] Waste management and plastic pollution have made headlines, whilst the coronavirus pandemic exposed the fragile nature of our food supply.[6]

This *File* is written using the consensus scientific view that anthropogenic climate change is a real risk to our planet. It is not the place to discuss the scientific evidence; I encourage you to investigate some of the resources listed at the end if you wish to understand more. Some will remain sceptical, perhaps because of media coverage given to scientists who disbelieve the theory. I ask you to consider two points: firstly, as medical professionals, we know the importance of vaccine programmes, and yet, frustratingly the amount of media coverage given to anti-vaxxers is disproportionate. Could the same not be true of climate change? The IPCC, which I quote above, has 195 member governments and has thousands of scientists around the world assessing the scientific papers published each year.[7] Secondly, there is uncertainty in the exact estimates of health impacts, particularly regarding precise locations that will be affected. However, there is a strong public health argument for limiting warming as much as possible. This uncertainty is a reason to be cautious, not complacent.[8]

> I pray that your mind can remain open to the idea that climate change is a justice issue

For Christians, there can be a range of responses evoked by the climate discussion. Some worry that focussing on the environment detracts from the real priority of the church: spreading the gospel. Some believe it is a significant concern but are wary that care for the environment is linked with pagan nature worship, New Age spirituality and anti-capitalism. Discussions can place the value of the environment above the value of human life. For others, they find that activism is focussed on human efforts, forgetting that our hope lies in Jesus' resurrection.

The uncomfortable truth is that the consequences of our actions are far removed, both in time and place, from the actions themselves. When we can see the consequences immediately, we are naturally inclined to choose wisely. However, we cannot see the repercussions of our carbon footprint immediately. Additionally, as individuals, our responsibility is so minimal compared to that of our governments and big business. Surely, we should wait until the law is changed and then we will dutifully comply?

As you read this *File*, I pray that your mind can remain open to the idea that climate change is a justice issue: the impact will fall disproportionately on those in the Global South, whilst we in the West continue to live selfish lives. As Christians, we must speak out on this, and we must act on it at home, work and church.

Why does this matter to healthcare professionals?

Considering the climate may not change every prescription we write or the care and advice we give. However, as health professionals, we all have a duty to consider population, as well as patient, health. We see this in vaccination programmes that benefit both the patient and the population, and in careful antimicrobial prescribing that treats the patient's infection while helping to prevent the development of resistance.

Initiatives like the hospice movement, too, have a dual purpose of caring for

individuals and transforming society's approach to death and dying.

The British Medical Association has already campaigned for a reduction in emissions and monitoring of air quality. [9] Additionally, the UK Health Alliance on Climate Change, formed in 2016, advocates for '*responses to climate change that protect and promote public health*'. [10] This Alliance includes many of the medical Royal Colleges, the Royal College of Nursing and *The Lancet*.

In this *File*, we will see the far-reaching consequences of climate change on population health and how '*tackling climate change could be the greatest global health opportunity of this century*'. [11] Additionally, we will see how we, as healthcare professionals, can integrate our response to the needs of the environment with care for our patients.

So, what exactly are we responding to?

Air pollution

The burning of fossil fuels adds particles to the air that contribute to local air pollution. This includes nitrous oxides, particulate matter and carbon monoxide.

In order to reduce carbon dioxide emissions, the UK introduced tax breaks for diesel cars in 2001. However, diesel cars produce higher levels of particulates, contributing to local air pollution. Since 2014 this has been increasingly recognised, and the UK is now phasing out diesel cars.

A shocking report from the Royal College of Physicians and the Royal College of Paediatrics and Child Health found that in the UK, there are 40,000 deaths due to outdoor air pollution every year. [12] Long term exposure increases the risk of lower respiratory tract infections and other respiratory diseases such as chronic obstructive pulmonary disease, asthma and lung cancer. However, it is not just lung disease. Air pollution is associated with stroke, heart disease, diabetes, obesity and dementia. [12]

Short-term exposure has also been associated with an increased risk of hospital admissions for a range of conditions such as sepsis, renal failure, thromboembolism and Parkinson's disease. [13] Across the world, there are seven million deaths from outdoor air pollution and a further 3.8 million from household air pollution. [14] These numbers are staggering and possibly surprising, but sadly rarely make headlines.

Heatwaves

Climate change increases the frequency, duration and intensity of heatwaves. [8] From the UK, this can feel like a distant problem. However, during the European heatwave in the summer of 2003, there were 70,000 extra deaths in 16 countries across Europe, compared to recent averages. [15] There are direct health impacts, such as heat stroke and dehydration, as well as increased presentations with cardiovascular, respiratory and kidney diseases. [16] Those most at risk from the effects of heatwaves are the elderly, those living in urban areas (due to the heat island effect), and those in manual jobs. Australia and the US West Coast in particular are areas where the health risks associated with forest fires caused by prolonged, dry spells are most acute.

Infectious diseases

The increased rates of infectious diseases are multifactorial. Extreme weather can damage infrastructure and contaminate water supplies. It can also result in forced migration, leading to poor sanitation, overcrowding and populations being exposed to new vectors. Changing temperatures can lead to increased replication rates of pathogen vectors and changes in their distribution.

Malaria is expected to have a longer season with an increased number of people put at risk. However, some areas will become too hot or too dry for the *Anopheles* mosquito (the primary vector for malaria), including northern China and parts of southeast Asia. The *Aedes aegypti* and *Aedes albopictus* mosquitoes, the main vectors for dengue fever, chikungunya, yellow fever and Zika virus, are projected not only to cover a wider geographic range but also to increase in number by the 2030s. [8] Climate change has already caused an increase in adverse health outcomes from Lyme disease in Canada. [8] For other vector-borne diseases, such as leishmaniasis and Chagas disease, the evidence for positive or negative impacts is less clear-cut. [8] Diarrhoeal disease from flooding, damaged infrastructure and increased temperature is also expected to rise. [16]

Malnutrition

Crop yields of wheat, rice, maise and soybean have already reduced by between three per cent and 16 per cent globally due to the rise in tropospheric ozone. [8] Additionally, the protein and micronutrient content of a range of grains is projected to be lower due to faster growth rates from elevated atmospheric carbon dioxide levels. Even if all greenhouse emissions stopped today, vital insect pollinators would see their range shrink, whilst some pests would move to new areas, bringing new challenges to farmers. [8]

These changes will result in increased rates of undernutrition and poverty from increased food prices and loss of livelihoods.

Extreme weather events

As well as heatwaves, covered above, the risk of both flooding and drought will be higher. [8] Flooding will lead to increased death and injury, with longer-term poverty from reduced income and the associated reduced health. On the other hand, drought significantly increases the likelihood of sustained conflict. [8]

The potential effects on migration have not been adequately modelled, in part because the factors affecting migration are complex. However, significant population displacement is expected from agricultural communities in the tropics. [8] An obvious example is that drought leading to malnutrition will cause migration. Additionally, sea-level rise already threatens the existence of low-lying coastal communities and island states.

With the significant effects on lifestyle, it isn't unexpected that droughts are associated with an increased incidence of suicide, [16] whilst a UK study found links between storm damage to one's home and an increased risk of mental health disorders. [17] The Environment Agency has recognised this and included mental health in its flood management strategy. [18]

The benefits of climate change

It is important to note that for some populations, climate change and global warming will bring benefit. As Arctic ice melts, the Northwest Passage, connecting the Pacific and Atlantic Oceans, is becoming more accessible, creating potential as a trade route. [19] Other examples include reduced risk of flooding in certain areas and higher agricultural productivity in extremely cold areas. However, the populations living in these areas are significantly smaller than the populations living in the equatorial

latitudes, leading to an overall negative effect on population health. [16]

The negative impact of healthcare

When considering the climate emergency, we must consider the negative impact of healthcare itself. The NHS has a vast property portfolio, employs more than a million people and accounts for around seven per cent of the United Kingdom's GDP. Within the NHS, 22 per cent of the carbon footprint comes from pharmaceuticals [20] and medical devices, followed by energy and transport. [21]
Apart from size, some hotspots within the NHS are specific to healthcare:

- Metered-dose inhalers contain propellants that are potent greenhouse gases. [22]
- Anaesthetic gases and nitrous oxide account for 1.7 per cent of the carbon footprint of the NHS.
- Single-use plastic is found in every syringe, pair of gloves, face mask and apron. Sadly, the NHS Supply Chain has currently only pledged to phase out single-use plastics from catering and office spaces. [23]
- On any one day in the UK, five per cent of road traffic is related to the NHS and accounts for 13 per cent of its carbon footprint. [24]

We've seen how climate change will impact health, let us now look at what the Bible can teach us on the environment and our response.

God loves creation

The Genesis account is very clear: God created the earth; he is separate from it, and he saw that it was '*very good*'. [25] The God whom we worship chose to create the earth and thus gives intrinsic value to his creation. [26] It is not just we humans that glorify God, but the whole earth. God's creation glorifies and worships him. [27,28] God is committed to our world. He loves his creation, and not just because it can sustain us, but because he is interested and involved in everything, from Orion's belt to an ostrich flapping its wings. [29]

Christian care for the planet

We understand that God lovingly created the earth, and cares about everything on it. If we are made in his image, [30] then that means we can relate to his ability to love his creation. He also commanded humankind to, 'increase in number, fill the earth and subdue it'. [31] Some have argued that *subdue* could mean we can dominate and do what we want with creation. However, Genesis chapter two clarifies God's command '*to work and care for it*'. [32] As followers of Jesus, we have a mandate to care for God's creation, both human and environmental.

Some consider that we do not need to worry about caring for this earth because the new creation will replace our current earth. Others argue that the '*new heaven and new earth*' [33] uses the Greek word kainós for new. This is the same word used to describe us as '*new creations*' in Christ. [34] When we welcome Jesus into our lives, we are new, but recognisably a renewed version of our old physical selves.

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Peter talks about how the earth was '*destroyed*' by the flood in Noah's time. [35] We understand this 'destruction' to be a global restart; as the earth still existed after the flood. Some of all living creatures and plants were taken onto the ark, to then multiply on the new earth. He then compares this to the destruction we will see after the fire. [36] He uses the Greek word *heurísko*. Here it is translated as *laid bare*, but generally translated as *found* or *exposed*. This can be understood to mean the fire will destroy all the sin, injustice, and damage. Earth will be found, seen for what God intended it to be all along! [37] Even without this interpretation, we are reminded that there will still be a physical order, showing us how much God values the physical.

The new heaven and new earth may well be renewed versions of our current earth; just as we care for ourselves and each other should we not also care for the earth?

Our fallen world

We know that God created the earth, that he loves it, and we need to be responsible in our actions. However, because of human sin, creation is cursed. Our earth that was so bountiful now requires painful toil to produce food. [38] God's creation is frustrated and groaning. [39] We shouldn't be surprised that, whilst the earth provides our food, energy, and clothing, it is groaning as it tries to do this. In Isaiah 24, we see an environmental judgement on those who act unjustly. The imagery of a curse consuming the earth and the world languished and withered is terrifying. [40,41]

Hope in Jesus

Whilst we may not be surprised that our broken world has resulted from human sin, we do not need to be filled with quite the same fear as atheists such as Greta Thunberg. Our hope is in Jesus, who died not just to save us, but to save the whole of creation. [42] The whole world, not just humans, will be renewed. The book of Revelation depicts the brilliant garden city of Jerusalem, whilst Isaiah paints a picture of an earth that is fruitful again. [43,44]
The Bible narrative reminds us that God is sovereign and has a plan. [45]

Christian response

Climate change is not just about care for our planet. It is arguably the biggest justice issue of our time. An increase of 0.5ºC will affect global health; our current projected increase is to 3ºC. [8] Disadvantaged and vulnerable populations will be disproportionately affected through income and community losses. By the mid-to-late 21st century, climate change will make the poor poorer and increase the total number of people in poverty. [8]

Our challenge is to fight the avaricious, selfish, unthinking aspect of human nature that indulges itself but ignores the consequences. We know that our actions have consequences on others, and there may be many more generations of God's children to whom we need to leave this earth.

Key Biblical principles

1. We are called to love our neighbours. [46] In this case, that's our global neighbours who are at risk from the actions of those of us living in industrialised nations. We have seen that the poor and vulnerable are most at risk from a changing climate; with our mandate to care for the poor, [47,48,49] it seems obvious we must respond.
2. Our resources are beautiful gifts from God: spiritual gifts, wealth, health, housing. [50,51] We must share these precious resources with our brothers and sisters. The parable of the talents [52]

reminds us that as good stewards, we must use whatever we have for God's purposes. The inaction of the third servant was not a neutral act; it was negative because he missed the opportunity to grow his master's wealth. We know that God loves creation, so we must use our gifts to bless creation.

3. As Christians, we must share the gospel, [53] and we might consider that environmental concerns distract from this core calling. However, James teaches us that we cannot have faith without action. [54] We must be determined to help those who need us.

As health professionals, we are already doing that; our vocation is helping people! However, healthcare is not merely the prescription for analgesia or the knee operation. It is about the whole person, their family and their community. As Kirk Smith puts it:

[Climate change] most threatens the poorest and most vulnerable populations in all societies, probably in close inverse proportion to income, wealth and power. The rich will find their world to be more expensive, inconvenient, uncomfortable, disrupted and colourless—in general, more unpleasant and unpredictable, perhaps greatly so. The poor will die. [55]

4. Following Christ means we live counterculturally, [56] and we must make personal sacrifices and put others first. [57] Jesus never promised it would be easy!
5. The industrial revolution has blessed us with a strong economy, comfortable homes and a healthcare system underpinned by rigorous research. We could write pages on what a blessing the use of fossil fuels has been to us. However, not all states have benefitted equally from this, and now all countries, including poorer developing nations, are facing the repercussions. Our heart for justice [58] must include consideration of the global consequences of our use of resources.
6. Jesus wasn't one for sitting by quietly. [59] The whole Bible is full of characters who stood up against the current regimes to care for the vulnerable. Consider how Moses survived his childhood! [60] For some, this will mean a calling to protest to help our governments realise the impact of climate change on our nation's health.

Good medicine is about not just considering the presenting complaint. We must, and can, consider the environment as well. What does that look like in practice?

Synergistic response

In many areas, there will be important health gains from the actions that will be necessary to reduce warming:

1. Renewable electricity generation, such as wind and solar power, produces fewer emissions, meaning cleaner air.
2. Urban design and transport policies that promote walking and cycling both reduce emissions, promote cleaner air

and encourage more exercise.

3. Beef and lamb farming are the highest producers of greenhouse emissions, whilst also being the biggest users of land for every 100g of protein produced. Even the worst-performing pulses and grains are better than the least impactful beef herds. [61] This complements current NHS guidance to limit red and processed meat as it has been linked to an increased risk of bowel cancer. [62]
4. Working from home reduces emissions from commuting and gives people more time in the day to pursue hobbies and exercise. Following the coronavirus pandemic, there will be a shift towards homeworking, and we will likely see the benefits in mental and physical health.
5. Policies and investment to support breastfeeding mothers benefits both infant and maternal health, as well as reducing formula use. Formula production creates waste, methane and carbon dioxide, using land and water resources. [63]

Adverse effects on human health

Not every mitigation action is beneficial for health:

1. Increasing the use of biofuels could affect the availability of land for agriculture, thus affecting food availability to the local populations.
2. Nuclear energy uses water and has mixed effects on human health when replacing fossil fuels. [8]
3. Carbon capture removes carbon dioxide from the atmosphere and puts it back in the ground. Whilst it reduces overall carbon dioxide in the atmosphere, it produces local air pollution through carbon dioxide leakage and in the transport infrastructure. [8]

Both lists highlight the importance of ensuring health professionals are engaged in decisions regarding reducing carbon dioxide levels. This is to ensure that policies protect and promote population health, as well as reducing greenhouse gases.

Sustainable healthcare

Finally, we look at what sustainable healthcare could mean in the future. We must remember that, as professionals, our colleagues and community will look to us to set an example. Our personal actions can impact others. My use of a Brompton bike to cycle to work continues to spark conversations, and I was repeatedly complimented for my scrubs during the COVID-19 pandemic, made from old bedsheets. We also need to educate ourselves. This File is only an introduction; please utilise the resources section at the end.

Organisations need to increase the use of renewable energy, minimise waste and consider alternatives for procurement, balancing the needs of patients with finances and the needs of the wider population. We can engage with these decisions, from participation in board meetings to quality improvement projects on the use of bins!

We can influence our membership organisations and NHS trusts. After campaigning by its members, in 2020 the Royal College of Physicians adopted a new climate policy which ended investment in companies that aren't following the goals of the Paris Climate Agreement. [65] Within Bart's Health NHS Trust, a new Green staff engagement group, has consulted on the sustainable development plan and building of a new hospital, as well as educating fellow staff and promoting sustainable quality improvement.

Small prescribing changes, such as dry powder inhalers instead of metered-dose, both benefit the patient, as they are easier to use and reduce air pollution. [65] Discussing medication compliance can minimise unused medication. For anaesthetists, routine use of nitrous oxide has been reduced, and sevoflurane is preferred over desflurane, when appropriate for the patient, as it produces one-sixth of the carbon emissions. [66]

Great Ormond Street's '*The gloves are off!*' campaign [67] encouraged staff only to use disposable gloves when necessary. There was no increase in infections, so there was no impact on patients, but there was 18 tonnes less waste to be disposed of, and the trust saved £90,000. In Newcastle, heavy, purple, rigid bins for medical waste were swapped for Bio-bins, which saved the trust £13,500 per year and 66 tonnes of carbon emission. [67]

The coronavirus pandemic accelerated the use of video consultations, both in primary and secondary care. The obvious advantages of less time and more convenience for patients, along with reduced carbon emissions, will need to be balanced with the benefits that face-to-face consultations provide.

Sustainable healthcare needs to be looking at everything from the food in the canteen, to waste management, to procurement and prescribing. Sustainable quality improvement needs to be a normal part of practice and sustainable development high on the agenda for every organisation.

Conclusion

The climate crisis is not an 'in vogue' political debate. It is the reality for every person on this planet. It is not fair and will not affect people equally; the rich, both countries and individuals, will have a greater capacity to resist the threat. As healthcare professionals, we have a duty to our patients, both the ones in front of us and those in the wider community, to reduce our carbon emissions and our resource use. Now is the time for action, both personally and professionally.

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RESOURCES ON CLIMATE CHANGE

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