TITLE
The impact of healthcare on global warming and human health: connecting the dots

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Abstract
The aim of this paper is to explore climate change and the impact that this is having on human health. The paper takes the reader through a brief history of climate change, making links between raising global temperatures and the environmental effects that are being seen across the globe. The environmental effects are then explored in relation to human health and the impact that climate change is having on physical and mental health. The paper concludes by illuminating the carbon footprint of health and care in the UK and the role of the healthcare assistant and assistant practitioner in making a positive contribution to sustainable healthcare.

Introduction
In 1896, according to Costello et al (2009), the scientist Svante Arrhenius predicted that carbon dioxide (CO_2) produced by human industry could raise the average temperature of the earth's atmosphere. It was not until the late 1980s, however, that this concept of global warming was introduced by the Intergovernmental Panel on Climate Change (IPCC) (2014) via the media. The IPCC found that greenhouse gases (GHG), mainly CO_2, created as a result of human industry, were being released into the atmosphere, trapping heat from the sun, increasing global temperatures and named it the 'greenhouse' effect. The rise in temperature around the time of the industrial revolution suggested a strong correlation between human activity and changes to the earth's atmosphere and this is known today as anthropogenic global warming (AGW) (IPCC, 2014).

Climate change
AGW is a result of rising populations and the economic activity associated with supporting that population (Luthi et al 2008). Selby and Kagawa (2010) highlight that in the globalised world there is an expectation that consumerism-fuelled growth can continue indefinitely, despite the finite resources available on earth. This concept poses two serious points for consideration: the first being that consumerism at the present rate is wholly unsustainable, the second issue is the harm that is being caused in the production of GHGs (Akenji, 2014). Climate change on a global scale can be an overwhelming concept to contemplate, therefore consider for a moment the amount of waste generated within your own clinical area every day; from disposable equipment, to paper cups, to electricity. Have you ever thought about how those products are made, where they are made and where they go once placed in the bin?

Global temperatures have already risen by 0.2^{o}C per decade since the start of the industrial revolution and Watts et al (2015) predict that by 2100 global temperatures will rise anywhere between 2.6^{o}C to 4.8^{o}C, resulting in a complex chain of events.

Extreme heat in equatorial regions

In equatorial regions, this has caused a loss of crops, infertile soil ultimately leading to mass migration away from these arid regions (Hansen et al, 2006). The loss of crops has a significant impact on global food supply, placing an additional strain on those areas that continue to produce. Food scarcity in equatorial regions is becoming a major economic concern; for example, those living in rural Iran are facing forced migration, which places a strain on urban areas as people search for food/water, work and a better quality of life (Keshavarz, 2013).

Rising sea levels

The rise in global temperature has melted Artic ice fields at a rate of 50 000km^2 per year (McMillan et al, 2014) and glacial recession has been observed in the Himalaya (Racoviteanu et al, 2013) and Antarctica (Holland et al, 2015). One effect of this has been a mean rise in sea levels by 0.19m (IPCC, 2014), which has already been devastating to low-lying populated areas such as the South Pacific. Of the 20 Solomon Islands studied by Albert et al (2016), five vegetated islands were lost between 1947 and 2014, due to rising sea levels. Several villages were affected by costal erosion and rising sea levels and while a majority of inhabitants relocated, some disadvantaged families had to build temporary homes, increasing their vulnerability to storm or wave events (Albert et al, 2016).

Storm surge and flooding

The risk of storm and wave events in the future within the US is significant: it is estimated that somewhere in the region of 3.7 million people are living within one metre of the present high-tide mark (Rahmstorf, 2012), indicating that even the smallest rise in sea levels could lead to significant displacement of costal populations. Within the Netherlands, despite advanced flood-abatement systems (dykes and beach replenishment), rising sea levels pose a threat to ecosystems, health, coastal populations and economics (Gupta et al, 2004). In contrast, Bangladesh has limited infrastructure to deal with flooding and Brouwer et al (2007) found that floodplain residents have neither the financial means nor knowledge to protect themselves from flooding, strengthening the connection between environmental risk, poverty and vulnerability.

Unforeseen events

The effects of AGW are not limited to a simple rise in temperature and sea levels. A number of adverse events are occurring that have not been predicted. For example, as glacial ice has melted, it has released GHGs that have been trapped in the permafrost for hundreds of thousands of years. One instance of this is in West Siberia, where frozen peat bogs contain 70 billion cubic tonnes of methane; if the gas is released, it will represent 16% of all anthropogenic GHG emissions from the past 150 years (Sheng et al, 2004). In addition, oceanic uptake of CO_2 has led to a 25% increase in acidity and a reduction in oxygen levels in sea water, resulting in changes to marine ecology (IPCC, 2014). Plus, deforestation fuelled by global consumer demand is simultaneously reducing the amount of CO_2 removed from the atmosphere by trees.

All of the climate changes linked to AGW witnessed to date and forecast for the future have devastating effects on physical human health and psychological wellbeing (IPCC, 2014). Therefore, the next section seeks to explore some of the effects of AGW on human health and wellbeing. Examples are drawn from across the globe to illustrate the connection between AGW and the impact on the developed western world.

Global warming and impact on health

AGW is projected to have a significant impact on human health, exacerbating the ill-health that already exists, but also increasing the susceptibility to ill-health among vulnerable populations in developing countries (IPCC, 2014). According to Watts et al (2015), the potential ramifications of global warming for human health could be catastrophic; they suggest tackling this issue is a priority for the 7 billion inhabitants of earth. The World Health Organisation (WHO) (2015) predicts that up to 250 000 additional deaths will be associated with global warming between 2030 and 2050. The health outcomes of global warming are likely to have the most significant effect on the developing countries, where health infrastructure is weak; however, developed countries will not go unscathed.

Immediate and direct risks are associated with the changing climate and the increase in severe adverse weather (McMichael et al, 2012). In 2003, Europe experienced a heatwave that resulted in extreme loss of life. The death toll in France alone was 14 800 people during a 9-day period. The loss of life was predominantly among the elderly and those with pre-existing health conditions; however, there was a worrying proportion of deaths among 45-55 year-olds (Bouchama, 2004).

Some risks associated with AGW are far removed from comfortable 'Western' living, and Lorenzoni et al (2007) describe the UK public perception that the effects of AGW are a distant threat removed by space and time. This notion is supported by Moser and Dilling (2004), who illustrate the geographical separation of those living in countries that generate the most GHGs from those who live in developing countries most affected by the impacts. Selby and Kagawa (2010) suggest, therefore, that the UK population must make the connection between globalisation, consumerism and the impact this is having on faraway people and places: joining up the dots, in other words.

Heat and ozone

Within the UK, the health risks associated with AGW are well documented. Public Health England (PHE) (2015a) forecasts that heat-related deaths will increase in the summer months, with the south-east worst affected. The World Health Organisation (WHO, 2016) reports that cases of skin cancer have doubled since the 1980s, largely due to thinning of the ozone layer through use of ozone-depleting chemicals such as chlorofluorocarbons (known as CFCs), used in the manufacture of aerosol sprays, blowing agents for foams and packing materials, as solvents, and as refrigerants. In the northern hemisphere, this has allowed more ground-level ultraviolet radiation. In the UK, an average of 86% of skin cancer diagnoses made in 2010 were connected to over-exposure to ultraviolet radiation (Parkin et al, 2011).

According to the Committee on the Medical Effects of Air Pollution (Public Health England, 2015b), ground level ozone is a growing problem within UK urban areas. Ground level ozone is a pollutant that is formed by chemical reactions as a result of anthropogenic GHGs. The health effects of ground level ozone have not been fully quantified, but there is evidence to suggest an adverse connection between ozone and respiratory morbidity and mortality (Jerrett et al, 2009).

Flooding and vector-borne disease

Despite the fact that flooding in 2007 claimed 13 lives in the UK, advances in flood defence technology and increased public awareness of the physical dangers of flooding mean that it is unlikely that this number will rise significantly, according to the Health Protection Agency (HPA) (2015). However, it is the presence of static water (flooded fields, basements) that poses a new risk, associated with mosquitoes and vector-borne disease (HPA, 2015). An example of this is dengue fever, the most prevalent mosquito-borne disease worldwide, claiming 12,000 lives a year (Bouzid et al, 2014). Extreme weather events in the UK and rising temperatures means the prevalence of these diseases (typically only ever seen in warmer climes) is set in increase.

Psychological impact

Much of the literature discussed so far focuses on climate change and the threat to physical health. Stanke et al (2012) document the lasting health effects of climate change with particular focus on mental health problems. They studied the long-term effects of traumatic experiences such as flooding and the lasting psychological impact which can lead to substance misuse. They suggest that there is a connection between poor mental health and maladaptive coping strategies resulting in a detrimental impact on resilience and recovery.

Global Policy

As a result of the health impacts, there are a number of ambitious targets in the 2008 Climate Change Act to reduce 80% of carbon emissions in the UK by 2050 (Department for Energy and Climate Change, 2008). This ambitious target was supported by the COP21 Paris Agreement (European Commission, 2016), which was the first ever legally binding climate deal, agreed by 195 countries. The Paris Agreement had a number of key features, which include the need: to limit global warming to less than 2^{o}C of pre-industrial levels; to reach the peak of global GHG emissions as soon as possible and then start reducing (known as global peaking); to agree new targets every five years; and for governments to facilitate mitigation and adaption to ensure individuals have the necessary skills to cope with climate change. Despite the recent announcement that the United States of America is withdrawing from the Paris Agreement (McCarthy, 2017) there remains global buy-in, and as time goes on more single states in the US, may follow Hawaii and pledge their commitment (James, 2017).

NHS carbon-footprint

The National Health Service (NHS) is one of the largest organisations in the UK, employing more than 1.3 million staff (NHS Confederation, 2016) and it is unsurprising that it is the biggest emitter of GHGs. Figures estimate an annual production of 22.8 million tonnes of CO_2, according to the NHS Sustainable Development Unit (SDU) (2015). GHG emissions within the NHS are connected to a number of different activities, such as procurement, building energy use, and travel (SDU, 2012).

In response to this growing carbon footprint of the UK's healthcare sector, NHS England and Public Health England created the SDU in 2008. The unit supports healthcare, public health and social care organisations to achieve sustainability from an environmental, social and financial perspective (SDU, 2016). The SDU has created guidance documents for example, how to cut down on paper usage, and toolkits, for example, the Health Outcomes Travel Tool which helps NHS organisations to measure the impact that their travel has on the local

environment. However, the SDU is able to make recommendations and provide guidance, at present their guidance is not policy and there are no penalties for non-engagement.
The SDU perform an annual 'Health Check' to assess and monitor carbon reduction programmes whereby they promote example of best practice from around the UK. For example, York NHS and City Council have been working to create healthier travel options and improve air quality, promoting cycling, car sharing and electric vehicles. A collaboration between University Hospitals North Midlands, Southern Staffordshire Community Energy Limited and Staffordshire fuel poverty charity 'Beat the Cold' have been successful in raising money to install 1000 solar panels on hospital roofs, this means cheaper energy for the trust and the surplus is used to help combat fuel poverty (SDU, 2017). Through excellent initiatives like this the NHS has managed to reduce its carbon emission by 11%. This is a great success, when considering the UK population has grown by 8 million since 1990, according to the Office for National Statistics (ONS) (2016); and the growth has led to an 18% increase in NHS activity between 2007 and 2016 (NHS England, 2016).
Despite this reduction in CO_2, much more work is needed and this will involve all staff at all levels. Healthcare Assistants and Assistant Practitioners are involved in a significant amount of frontline care and are well placed to consider their own environment and ways of working. According to the SDU (2010), HCA's and AP's can take 5 simple steps to becoming more involved in sustainable healthcare:

- Understand the basic facts: everyone has a duty to engage with this topic, this is not just about reducing carbon emissions but also about making the NHS a more efficient service that will last for future generations.
- Move and communicate better: promoting the use of healthy transport options to not only keep ourselves fit and well but to also improve air quality. Plus, the use of technology (web conferencing, telephone consultations etc) to reduce unnecessary traffic associated with health care.
- Eat and drink better: promoting the wellbeing of staff, ensuring regular breaks and a healthy diet. In addition, lobbying your local trust to buy locally sourced and prepared food and the supply of water fountains and reusable bottles to reduce plastic waste.
- Buy, procure, commission, use better: HCA's and AP's can influence ethical procurement and actively participate in the promotion of: 1) use less, 2) reuse, 3) recycle.
- Develop better models are care: HCA's and AP's are well positioned to work with patients and service users to promote health, reduce duplication and waste, and to promote patient safety.

Conclusion

Despite the carbon reduction in the NHS, it continues to contribute significantly to overall UK emissions and is contributing to ill health as a result. It is likely that without extreme mitigation there will be serious and irreversible effects of global warming on humans and ecosystems (IPCC, 2014). Therefore, it is necessary for all governments, organisations, communities and individuals to recognise the need for collective and immediate action.
As frontline staff, healthcare assistants and assistant practitioners have the ability to influence this agenda by making small changes to their practice. These changes could include: switching equipment off; promoting recycling; promoting responsible use of resources; and, looking after the human resources (each other). Small cumulative actions by every individual connect up to a significant overall impact.

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