Climate Change and Health: Framing the Issue
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Foreword

Scientific research suggests that climate change will exacerbate existing health issues, most notably in the developing world. At GSK, we are actively seeking new partnerships, and new ways of acting as a catalyst for change. We are already making huge strides in tackling some of the key diseases that are likely to be most impacted by climate change. Current knowledge has only begun to scratch the surface of what these impacts could be.

My ambition is to see GSK and the pharmaceutical industry come together to make a progressive industry response to climate change and health. There is an opportunity for us to work closely with other key stakeholders, to initiate a dialogue around the actions we can collectively take, and to stimulate innovation and research in the area. As good corporate citizens, we all need to ensure that the impact of climate change on health is better understood so that we can form an appropriate response.

This paper, developed jointly with Accenture and the Smith School of Enterprise and the Environment at the University of Oxford, is just the starting point of what I hope will be an inspirational journey. Many of the things we need to do require transformational change that could take many years, but we absolutely must start this journey today. The potential of what we can achieve by working in partnership is huge.

Climate change is now considered in many quarters to be one of the greatest new threats to health in the 21st century. Available research suggests that the health impact of climate change will be wide ranging including more frequent extreme weather events, increase in epidemics, and food and water scarcity. Although there are still important gaps in scientific knowledge, there is little doubt that the greatest health impact of climate change will be borne by developing countries already struggling from poverty and a host of other socioeconomic and health problems.

As responsible stakeholders, the healthcare industry has an important role to play in helping the global community better understand the impact of climate change on healthcare and what could be done to mitigate these impacts. On the other hand the global community has a right to know the industry’s own contribution to climate change and the range of steps it is taking to reduce its carbon footprint. Recent history suggests that businesses that take the lead in responding to climate change will ultimately put themselves ahead of the curve.

The Smith School of Enterprise and the Environment is pleased to be collaborating with GlaxoSmithKline (GSK) and Accenture on this project which seeks to highlight the impact of climate change on health.

It is my hope that this report will instigate more research and wider discussion on this extremely important topic.

In my discussions with executives around the world, it is clear that climate change is now a concern across industries and markets. The Health sector sits at the interface where climate change impacts society and stakeholders in their daily lives. However, despite much good work by a number of academics and international organisations, significant gaps still exist in our understanding of these health impacts.

It is in this context that the authors of this paper have partnered to help frame the debate, with support from an inter-disciplinary team of experts. The research findings suggest that there is opportunity for industry to better understand the issues and implications and develop an appropriate response. Through planning for the longer term – engaging stakeholders, building resilience, driving science and innovation – companies can integrate climate change and health into future strategies and be prepared to respond and adapt.

There are economic rewards at stake; up to 2030 the benefits of tackling the health impacts of climate change may be as much as 0.6 - 1.0 per cent of current gross domestic product (GDP) for sub-Saharan Africa and South-East Asia.

This paper is very much a humble first step by the partners to engage a broader set of stakeholders to frame the issues and explore solutions. But I believe that first step is an important one.
Executive Summary

**The Earth’s climate is changing**
Average world temperatures have risen over the past fifty years and are predicted to rise between 1.1 and 6.4°C (2.0 and 11.5°F) during the 21st century. Prevailing scientific opinion is that the greater the increase in temperature, the more severe and variable the effects of climate change will be. Further and more frequent warm spells, heatwaves, changes to the Earth’s humidity and rainfall patterns are anticipated. Meanwhile extreme weather events (EWEs) including drought, floods, hurricanes and acute high tides have become increasingly likely.

**Climate change will impact health**
Changes in temperature may bring some marginal improvements to health, such as the contraction of malarial zones in parts of Africa and fewer cold weather deaths in temperate regions such as the UK. However, the overall impact of climate change on health will be negative. In fact, climate change has been cited by some as the biggest global health threat of the 21st century, jeopardising the lives and wellbeing of billions of people.1 Extreme weather and heatwaves will have a direct impact on morbidity and mortality. Meanwhile an indirect effect of climate change on health will be the growing difficulty for many regions in accessing sufficient food, clean water and sanitation. Issues such as climate-induced migration will further add to the health burden.2

The pharmaceutical industry has a role to play. Understanding the impact that climate change could have on human health is important for future disease control and health infrastructure planning. It will also help to ensure that industries and governments are prepared to effectively respond and adapt. GlaxoSmithKline (GSK) recognises that climate change may adversely impact health, and that the pharmaceutical industry should prepare to respond. GSK has partnered with Accenture and the Smith School of Enterprise and the Environment at the University of Oxford to examine the science on climate change and health, increase collaboration around the issue and understanding of it, as well as inform future business strategies. This involved a review of over 200 academic articles and reports, as well as interviews with leading experts and academics in the field.

**Uncertainties**
To date, although growing, debate and dialogue on the issue of climate change and health have been limited. The ability to understand the issues is clouded by uncertainty and significant knowledge gaps. Furthermore, it is difficult to isolate the impact of climate change on health from other influencing and interrelating socio-economic factors that further complicate the relationship.

These challenges raise three questions:
- What do we know about the impacts of climate change on health?
- Where are the gaps in our current knowledge?
- What are the implications for the pharmaceutical industry?

**What we know**
Although the current evidence base does not accurately predict the scale of the impacts, it does point to the fact that the effects of climate change on health are likely to increase. Rising temperatures, more extreme weather events and changes in air quality are highly likely to have a negative impact on six existing health concerns, particularly in developing countries:

- Health effects related to EWEs
- Cardio-respiratory diseases
- Temperature-related health effects
- Malnutrition
- Vector-borne diseases
- Waterborne diseases

Eight infectious diseases have been identified as particularly sensitive to climate change. The epidemiology of malaria and cholera is particularly susceptible to changes in climate, with epidemics highly correlated to periods of increased rain and temperature.

Many of the most serious public health consequences of climate change will be experienced by the world’s poorest nations, increasing global health inequities.3 For example, malnutrition affects one in three people worldwide and is one of the most serious global health problems according to the World Health Organization (WHO).4 This is set to worsen in the face of climate change. Changing temperature, precipitation, humidity, rainfall and EWEs
will exacerbate food insecurity in many regions, and per capita calorie intake could drop by 5.7 per cent by 2050 in developing countries.

Meanwhile, neglected tropical diseases (NTDs) – the most common infections in the 2.7 billion people living on less than $2 a day – are likely to be the most sensitive to climate change. This would exacerbate the cycle of poverty, vulnerability and mortality in the developing world. South-East Asia and sub-Saharan Africa are the regions of the world most susceptible to climate change and its health effects. According to the WHO, in 2000 these two regions accounted for over three-quarters of the estimated global disability-adjusted life years (DALYs) lost because of climate change – a DALY represents one year of ‘healthy’ life.

Tackling the impacts of climate change on malaria, malnutrition and diarrhoeal disease could result in significant economic benefits; up to 2030 this could be as much as 0.6 per cent to 1.0 per cent of current gross domestic product (GDP) for sub-Saharan Africa and South-East Asia. Dealing with the impacts of climate change on specific diseases will deliver substantial economic benefits. For example, managing climate change related cases of malaria in Africa corresponds to a net economic benefit of approximately US$14 billion.

What we don’t know

Current knowledge has only begun to scratch the surface of what the impacts of climate change on health could be. Significant gaps still exist in our understanding of the timing, severity and geographical range of the health impacts of climate change. Limitations in the modelling of climate change and uncertainties in relation to the local and regional effects remain key gaps in our knowledge. There are also doubts regarding specific health and disease impacts, a lack of long-term health data, and difficulties in predicting how humans will mitigate and adapt.

Finally, there remains a need for continuing and expanding existing research to better understand the relationship between climate and health, the influence of modulating factors and profiles of vulnerable individuals and populations.

Implications

The impact of climate change on health may alter the pharmaceutical industry in the long term, but is less likely to dramatically alter business or operating models in the immediate future. Policy responses will have to be formulated under conditions of uncertainty.

Companies within the industry will need to understand the issues involved and be prepared to respond and adapt to changing demands. Through planning for the longer term – engaging stakeholders, building resilience, driving science and innovation – the industry can integrate climate change and health into future strategies.

GSK, Accenture and the Smith School of Enterprise and the Environment at the University of Oxford welcome partnership on this issue, particularly to examine the existing knowledge gaps and to begin to answer some of the questions that remain. Most importantly, we invite stakeholders to work with us to use this as a starting point for action and collaboration.
Introduction

Awareness of the links between climate change and public health has grown steadily over the last decade. Scientific reports indicate potential trends and health-related challenges that society may face as a result of the changing climate. However, they also point to the complexity of the relationship between climate change and health, as well as to significant gaps and uncertainties in current knowledge.

GlaxoSmithKline (GSK), together with Accenture and the Smith School of Enterprise and the Environment at the University of Oxford, aims to frame the discussion around climate change and health – what we know, what we don’t know and what the impacts and implications might be.

Rather than provide all the answers, we aim to increase awareness of existing knowledge. We are committed to initiating a process of multi-stakeholder dialogue on this issue with, amongst others, the pharmaceutical industry, healthcare professionals, governments and civil society.

The following chapters aim to provide a perspective on the following five questions:

- What does the science say about climate change?
- What does the science say about the impact of climate change on health?
- Where will the impacts be most felt?
- What are the societal and economic benefits of addressing climate change related health impacts?
- What are the impacts and implications for the pharmaceutical industry?

Background:

Chapters 1 and 2 in this report are based on an academic paper developed by Oxford University’s Smith School of Enterprise and the Environment, GSK and Accenture. This academic paper examined over 200 articles and papers to understand the current literature and science on climate change and health and was reviewed by a panel of leading academics from the Australian National University, Harvard University, Jawaharlal Nehru University, New Delhi, the London School of Hygiene and Tropical Medicine and University College London.

This report was also informed by interviews, conducted by Accenture, with over 20 leading experts from business, academia and non-governmental organisations (NGOs).
1. What does the science say about climate change?

World temperatures have risen over the past fifty years. The rise in global average temperature is thought to be a direct result of the build-up of human-generated greenhouse gases (GHGs) – primarily carbon dioxide (CO$_2$). Further average global temperature rises are predicted to take place during the 21st century – between 1.1 and 6.4°C (2.0 and 11.5°F) depending on future GHG emissions and the Earth’s response to changing conditions (see Figure 1.1). The Intergovernmental Panel on Climate Change (IPCC) is 90 per cent confident that as a result of rising temperatures, the world will see more frequent warm spells, heatwaves, humidity and heavy rainfall. This is anticipated to lead to an increase in extreme weather events (EWEs) including droughts, desertification, tropical cyclones, floods, hurricanes and extreme high tides.

Experts predict a variety of environmental health impacts as average global surface temperature rises (see Figure 1.2). Ecosystem services (benefits to humans supplied by natural ecosystems) such as plant pollination, food yields, oxygen production and the provision of clean water will be impacted, as well as biodiversity. Hundreds of millions of people in mid latitudes and semi-arid low latitudes will become exposed to increased water and food stress as a consequence of the dramatic decrease in water availability and the resulting reduction in cereal productivity. Meanwhile, many coastal areas will experience increased damage from floods, storms and rising sea levels.

Scientists also suggest certain thresholds or ‘tipping points’ could be triggered during this century. This would put polar sea ice and ice sheets at risk, causing potential changes in weather systems such as Atlantic thermohaline circulation, the El Niño southern oscillation, and the Indian summer monsoon.

**Box 1.1: The Intergovernmental Panel on Climate Change (IPCC)**

The IPCC is a scientific intergovernmental body that evaluates the risk of climate change and its potential environmental and socio-economic consequences. The IPCC issued comprehensive assessments in 1990, 1996, 2001 and most recently the Fourth Assessment Report (AR4), released in 2007. A Fifth Assessment is due for release in 2014.

AR4 is the most comprehensive synthesis of climate change science to date. Experts from more than 130 countries contributed to the assessment. More than 450 lead authors received input from around 800 contributing authors, and an additional 2,500 experts reviewed draft documents.

Basing its assessment mainly on peer reviewed and published scientific literature, the Panel is seen as an authoritative source. IPCC reports are widely cited in most debates related to climate change. From a health perspective, organisations that endorse the IPCC view include the American College of Preventative Medicine, the American Public Health Association, the Australian Medical Association, the World Federation of Public Health Associations, and the World Health Organization (WHO).
“Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.” (IPCC 2007)

### Figure 1.2

Experts predict a variety of environmental and health impacts as global average surface temperatures rise.

**Selected impacts of global average annual temperature change relative to 1980–1999 (°C)**

<table>
<thead>
<tr>
<th>Increase in Temperature</th>
<th>Food and Water</th>
<th>Ecosystem</th>
<th>Coast</th>
<th>Health</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1</td>
<td>Increased water availability in moist tropics and high latitudes</td>
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<td></td>
<td></td>
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<tr>
<td>2</td>
<td>Decreasing water availability and increasing drought in mid-latitudes and semi-arid low latitudes</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>Hundreds of millions of people exposed to increase water stress</td>
<td>Up to 30% of species at increasing risk of extinction</td>
<td>About 40% of global coastal wetlands lost</td>
<td>Increased morbidity and mortality from heat waves, floods and droughts</td>
</tr>
<tr>
<td>4</td>
<td>Tendencies for cereal productivity to decrease in low latitudes</td>
<td>Significant extinction around the globe</td>
<td>Millions more people could experience coastal flooding each year</td>
<td>Increased burden from malnutrition, diarrhoeal, cardio-respiratory and infectious diseases</td>
</tr>
<tr>
<td>5</td>
<td>Productivity of all cereals decrease in low latitudes</td>
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* Significant is defined as more than 40%

Source: Adapted from IPCC (2007)
2. What does the science say about the impact of climate change on health?

The health of a population – if it is to be sustained – requires clean air, safe water, adequate food, tolerable temperatures, protection from the elements and high levels of biodiversity. Climate change is expected to alter these conditions in various ways and to varying degrees throughout the world, with significant – and mostly adverse – health consequences. In both developed and developing countries the overall tendency will be for existing health inequalities to be magnified by changing climates. This will result in the most vulnerable being disproportionately affected.\(^\text{15}\)

Despite overarching uncertainties (see Box 2.1), we know that climate change is likely to have a negative impact on six existing health concerns:

- Health effects related to EWEs
- Cardio-respiratory diseases
- Temperature-related health effects
- Malnutrition
- Vector-borne diseases
- Waterborne diseases

**Box 2.1: Overarching uncertainties**

- The extent to which the climate will change
- What the local and regional impacts of climate change on health will be
- What the interplay is between climate, health and other modulating factors
- How humans will mitigate impacts and/or adapt

We know that climate change is likely to have a negative impact on six existing health concerns.
What does the science say about the impact of climate change on health?

**What we know**

The IPCC predicts an 80 per cent chance that there will be an increase in mortality and morbidity due to climate change related EWEs. In 2007, 95 per cent of the 16,000 global fatalities from EWEs could be directly attributed to climate change. As climate has altered patterns of temperature, precipitation, winds and sea levels, EWEs have changed in frequency and intensity.

The IPCC predicts that over most land areas the frequency of heatwaves, propensity of drought and intensity of tropical cyclone activity is very likely to increase. Over the past 50 years, severe drought has increased by around one to three per cent around the globe. By 2050 it is anticipated to increase to 12 per cent if global temperatures rise by 2°C above pre-industrial values. An increase in the frequency and intensity of hurricanes has already been predicted for this century. The number of people at risk from coastal flooding by storm surges is projected to increase from 75 million at the start of the 21st century to 200 million in the 2080s in a scenario of mid-range climate changes.

EWEs not only result in increased mortality, they also exacerbate disease transmission and place strain on healthcare systems. Tropical floods in Brazil, for example, have been linked to an epidemic of leptospirosis as rodents sought refuge in houses when floods washed out their natural environment. Meanwhile droughts increase communicable diseases: outbreaks of cholera are associated with the dry season in the Amazon when access to potable water is scarce. Epidemic meningitis appears to be linked with the occurrence of droughts, as reflected by the recent spread of the disease into West Africa. EWEs can also cause variation in the patterns of vector-borne diseases (diseases transmitted to humans by vectors such as mosquitoes) by creating or destroying favourable environments for vectors or by increasing human–vector contact.

Secondary issues and longer-term impacts include a loss of infrastructure and territory, and environmentally induced migration, as well as the potential to cause conflict over water, energy and other resources. The Stern Review on the Economics of Climate Change, for example, suggests that drought and other climate-related shocks could cause conflict and violence. West Africa and the Nile Basin are particularly vulnerable given their high water interdependence. The spread of disease is also a common problem after EWEs. Survivors of EWEs often have an increased risk of contracting respiratory, diarrhoeal and waterborne diseases in the aftermath of an extreme event. This is due to population overcrowding, limited or no access to potable water and food, and exposure to chemicals, pathogens and waste. There is also evidence of increased mental stress post-EWE. One long-term study found that 15–20 per cent of people affected by a natural disaster reported symptoms of post-traumatic stress disorder.

**What we don’t know**

- The extent of the localised and specific relationships between temperature extremes, EWEs and health outcomes
- The timing, frequency, geographical scope and severity of future events
- How to implement effective climate modelling and warning systems

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Climate Change and Health: Framing the Issue
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Overview 2.2 Cardio-respiratory diseases

| Likely overall impact of climate change on health | High negative |
| IPCC level of confidence that changes will occur | 80 per cent |
| Timing of marginal impact | Short term |
| Headlines | • Climate change will impact air quality and increase ground-level ozone, particularly in urban areas, leading to an increase in cardio-respiratory disease and cancer
• Young children, the elderly and those with pre-existing health conditions are especially vulnerable
• Uncertainties remain around the exact link between climate change and individual cardio-respiratory disease |

What we know
Climate change will impact air quality, especially in cities, potentially exacerbating the urban heat-island effect and increasing the prevalence of ground-level ozone (smog). Poor air quality is known to cause respiratory health problems. The IPCC is highly confident (80 per cent confidence) that there will be an increase in cardio-respiratory morbidity and mortality associated with ground-level ozone.

Ground-level ozone can damage lung tissue, and is especially harmful for those with asthma and other chronic lung diseases. Sunlight and high temperatures, combined with other pollutants such as nitrogen oxide and volatile organic compounds, can cause ground-level ozone to increase. The World Health Organization (WHO) estimated that poor air quality caused by climate change was responsible for over 2.4 million premature deaths in 2000 alone — one third by outdoor air and another third by indoor air — and accounts for approximately two per cent of the global cardiopulmonary disease burden.

Particulate matter, nitrogen oxides and sulphur oxides can also have a negative impact on health. These effects, which are associated more with air pollution but potentially exacerbated by climate change, include aggravation of chronic respiratory and cardiovascular diseases, reduced work capacity, and effects on pulmonary function.

Although climate change may increase the concentration of ground-level ozone, the magnitude of the effect remains uncertain. The effects of climate change and weather on the behaviours of other pollutants are less well studied, and results vary by region.

The populations most at risk of increased respiratory disease include children, pregnant women, people of low socio-economic status and those in congested urban areas. People living near to forests prone to fire are also at high risk; a combination of human actions and climate change is likely to increase the extent and intensity of forest fires, leading to severe air pollution.

Climate change can also expose patients with existing conditions (such as the elderly and overweight) to dangerous temperature extremes, placing additional stress on their cardiovascular systems. In Italy the summer of 2003 saw those aged over 65 years experience a 34 per cent greater risk of dying during hot days, with a significantly higher risk of respiratory disease.

Climate change could also cause more allergy symptoms due to increases in atmospheric carbon dioxide concentration and temperature. A warmer climate is expected to promote the growth of moulds, weeds, grasses, and trees that cause allergic reactions in some people. For example, climate change has already caused the spring pollen season to begin earlier in North America.

What we don't know
• The magnitude of the effect of climate change on pollen concentrations, particulates, ground-level ozone and other pollutants and the best means of adaptation
• The effects of climate change on individual cardio-respiratory diseases
• The isolated effects of climate change on cardio-respiratory diseases in comparison with other variables such as moving to lower-carbon living and other lifestyle choices
What does the science say about the impact of climate change on health?

**What we know**

Increases in average temperature will bring a small improvement in health, particularly in temperate regions. In Britain, for example, warmer winters might reduce cold weather related mortalities. Estimates suggest that 9,000 deaths per year could be avoided by 2025 in England and Wales with a 2.5°C increase in average winter temperature. Although climate change will bring some benefits — including fewer deaths from cold weather — the overall burden of rising temperatures will be negative. The negative effects will particularly be felt in developing countries where heat-related mortality and the potential secondary impact on subsistence and agriculture could be high. Uncertainties remain around our understanding of the impact in current high-temperature regions and the link between climate change, ozone depletion and skin cancer.

Although average temperatures are predicted to increase more dramatically in the northern hemisphere, the changes in developing regions may be more significant. This is due to the reliance of these areas on small-scale farming, a fragile infrastructure and limited capacity to respond to emergencies. Many African communities will be at risk, particularly subsistence farmers with low incomes in sub-Saharan Africa. Increased temperatures leading to droughts may be exacerbating poverty levels and increasing vulnerability for small-scale farmers. United Nations (UN) scientists warned in 2005 that one in six countries are facing food shortages because of severe droughts that could become semi permanent.

National communications report that climate change will cause a general decline in many subsistence crops, for example sorghum in Sudan, Ethiopia, Eritrea and Zambia; maize in Ghana; millet in Sudan; and groundnuts in Gambia. Africa already accounts for a large proportion of the total additional people at risk of hunger as a result of climate change; by the 2080s it may account for the majority.

**What we don’t know**

- What the impact of heatwaves will be in current high temperature regions such as Asia, Africa and the Middle East
- The frequency and intensity of heatwaves across various timescales

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<table>
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<tr>
<th>Overview 2.3 Temperature-related health effects</th>
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<tbody>
<tr>
<td><strong>Likely overall impact of climate change on health</strong></td>
<td>Moderate negative</td>
<td></td>
</tr>
<tr>
<td>IPCC level of confidence that changes will occur</td>
<td>50-80 per cent</td>
<td></td>
</tr>
<tr>
<td><strong>Timing of marginal impact</strong></td>
<td>Short/Medium term</td>
<td></td>
</tr>
<tr>
<td><strong>Headlines</strong></td>
<td>- Although climate change will bring some benefits — including fewer deaths from cold weather — the overall burden of rising temperatures will be negative. - The negative effects will particularly be felt in developing countries where heat-related mortality and the potential secondary impact on subsistence and agriculture could be high. - Uncertainties remain around our understanding of the impact in current high-temperature regions and the link between climate change, ozone depletion and skin cancer.</td>
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The propensitity for developed countries to experience heatwaves is increasing, with consequent impacts on levels of morbidity and mortality. Those with heart problems, asthma, the elderly and the young, and those without proper protection from excess heat (such as the homeless) can be especially vulnerable. In 2003, European temperatures rose 10–12°C higher than average during a heatwave, causing between 22,000 and 35,000 deaths. In Chicago, a heatwave in July caused at least 700 additional deaths. Analysis of American and European heatwave data suggests that by 2009 heatwaves in these regions will be 25 per cent and 31 per cent more frequent respectively.
**What we know**

The Food and Agricultural Organization (FAO) and World Health Organization (WHO) maintain that malnutrition is the most serious health problem worldwide. Currently malnutrition accounts for an estimated 15 per cent of disease in DALYs.\(^{42}\)

About 178 million children globally are stunted and 1.5 million die annually from wasting, both important indicators of malnutrition.\(^{43}\) Climate change could exacerbate this situation. The IPCC predicts an 80 per cent chance that climate change will increase malnutrition and consequent disorders, including those related to child growth and development.

Changing temperature, precipitation, humidity, rainfall and EWEs will make food security more complex.\(^{44}\) In the short term the amount of farmland suitable for cereal crops could increase in North America (40 per cent), Northern Europe (16 per cent), the Russian Federation (64 per cent), and East Asia (10 per cent), as a result of better growing conditions under warming.\(^{45}\) But in the long term, daily per capita calorie availability will drop between 2.3 per cent and 2.5 per cent by 2050 in developed countries and up to 5.7 per cent in developing countries.\(^{46}\) In 2009, most of the 960 million undernourished people lived in developing countries.\(^{47}\) Climate change is likely to increase food insecurity amongst many of these populations. Climate change will also compound existing food insecurity. According to the UN World Food Programme, the number of food emergencies every year has increased from an average of 15 during the 1980s to more than 30.\(^{48}\)

According to the UN World Food Programme, the number of food emergencies every year has increased from an average of 15 during the 1980s to more than 30.

**What we don’t know**

- How disease patterns will change in the context of climate change induced malnutrition
- The local effects of climate change on food yields, nutritional quality and price
- How best to improve food security as weather patterns change
What we know

A vector is an insect or any living carrier that transmits an infectious disease (for example mosquitoes or ticks). Changing temperatures, rainfall patterns and EWEs are likely to influence the reproductive cycles and behaviours of these vectors, leading to a more suitable environment for the spread of disease and the potential for the emergence of new ones. As temperature increases, the extrinsic incubation period (i.e. the period from when a vector acquires an infectious agent and is able to transmit the agent) becomes less. This in turn increases the infection rate of the parasites, elevating the transmission levels of the disease.

The IPCC gives an 80 per cent level of certainty that climate change will affect vector-borne diseases. The extent of the impact of climate change will depend on the region, the carrier (water or vector) and the disease itself, as well as mitigation and prevention strategies. Many of the diseases that are highly sensitive to climate change and also have a significant global impact in terms of the loss of DALYs are vector-borne diseases. Examples include malaria, dengue, leishmaniasis and schistosomiasis (see Figure 2.3).

The impact of changes in temperature and climate could vary depending on the type of vector and parasite. In the case of malaria for example, the minimum temperature required for development of the Plasmodium vivax parasite ranges from 14.5–16.5°C. For Plasmodium falciparum - the most deadly cause of malaria - it ranges from 16.5–19°C. The optimum conditions for development of the malaria parasite, however, are 20–30°C temperature and 60 per cent relative humidity. However, the effect on specific parasites remains an area that requires further research and understanding.

The impact of climate change on malaria will also vary according to geography. In some places the geographical range will contract, elsewhere the geographical range will expand and the transmission season may be changed. Senegal, for example, has seen a 60 per cent drop in malaria over the last 30 years owing to reduced precipitation. However, with rising temperatures, traditionally cool climates and higher latitudes will become more suitable reproductive habitats; already warm zones may also see an increase in mosquito populations. Malaria has returned to central and northern South America, much of Asia, some Mediterranean countries and much of the former USSR. Analysis of malaria morbidity data for development of the malaria parasite, however, are 20–30°C temperature and 60 per cent relative humidity. However, the effect on specific parasites remains an area that requires further research and understanding.
in Ethiopia indicates that higher minimum temperatures correlate with increased instances of malaria outbreaks.52 By 2080, 260–320 million more people are likely to be affected by malaria as more areas become infested with mosquitoes.53 Scientific models also infer that the geographical limits of dengue fever transmission are strongly determined by climate. On the assumption that other factors affecting dengue fever transmission remain the same, the global population at risk of dengue fever is anticipated to rise by 2 billion people by the 2080s.54

Other neglected tropical diseases (NTDs) such as schistosomiasis, lymphatic filariasis, and onchocerciasis are endemic in the tropics, primarily in the developing regions of Africa, Asia and the Americas. NTDs are the most common infections in the 2.7 billion people living on less than $2 a day55 and these diseases are likely to be the most sensitive to climate change, exacerbating the cycle of poverty, vulnerability and mortality in the developing world.56 Owing to lack of attention, little is currently known about the pattern of the spread of these diseases and their potential links to climate change. However, because insects tend to breed faster at higher temperatures, it is very likely that the prevalence of these diseases will increase with climate change. A recent study of the schistosomiasis virus in China, for example, concluded that temperature increases have altered disease transmission and extended the disease northwards into currently non-endemic areas.57 The study suggests that by 2050 the disease could cover 8.1 per cent of the surface area of China.58 Increasingly severe floods are also exacerbating the disease; flooding in the Yangtze River has been found to produce a nearly threefold increase in acute cases of schistosomiasis per annum compared with years of normal water levels.59

What we don’t know

• The effect of climate on the full spectrum of vector-borne diseases; and the full impact of temperature on rate of infection, geographic coverage and rate of breeding for specific parasites
• Sufficient results from monitoring and surveillance of disease and mortality in sensitive regions (particularly in the developing world)
• The link between climate change and neglected tropical diseases in detail
Climate Change and Health: Framing the Issue

What does the science say about the impact of climate change on health?

What we know

A vector is an insect or any living carrier that transmits an infectious disease (for example mosquitoes or ticks). Changing temperatures, rainfall patterns and EWEs are likely to influence the reproductive cycles and behaviours of these vectors, leading to a more suitable environment for the spread of disease and the potential for the emergence of new ones. As temperature increases, the extrinsic incubation period (i.e. the period from when a vector acquires an infectious agent and is able to transmit the agent) becomes less. This in turn increases the infection rate of the parasites, elevating the transmission levels of the disease.

The IPCC gives an 80 per cent level of certainty that climate change will affect vector-borne diseases. The extent of the impact of climate change will depend on Changes to the water cycle (the movement of water above and below the Earth’s surface) due to climate change will alter the frequency of extreme events including heavy rainfall, storms, floods and droughts. These events will affect water availability, quality and access, posing a threat to human populations. Water is critical to human survival and good health. Growing water insecurity brought on by climate change will impact health in a number of ways, affecting disease vectors as well as food security (see Box 2.2). Waterborne diseases are particularly likely to increase with temperature and frequency of EWEs, as drinking water from natural and infrastructural water sources will be put at risk. The IPCC predicts, with a level of 50 per cent certainty, that climate change will, for example, increase the burden of diarrhoeal diseases.

Almost two million young children die annually because of poor sanitation or the use of unsafe water. Diarrhoea alone accounts for about 40 per cent of all deaths of children under five and 80 per cent of those under two. Infection spreads through contaminated food or drinking water.

What we don’t know

- Information on prevalence, distribution and disease burden of individual diseases
- Marginal impact assessment of climate change – and the effect of improved water and sanitation infrastructure and adaptation
- The extent to which social, demographic and political conditions will exacerbate water scarcity
- The implications of different forms of local water catchment management on health

Overview 2.6 Waterborne diseases

| Likely overall impact of climate change on health | Moderate negative |
| IPCC level of confidence that changes will occur | 50 per cent (for diarrhoeal disease) |
| Timing of marginal impact | Short/Medium term |
| Headlines | • Waterborne diseases are likely to increase because water sources will be put at risk as a result of EWEs • Diarrhoea, cholera and dengue are predicted to increase in developing regions • Uncertainties remain because of knowledge gaps on existing levels of prevalence, the impacts of better water management and adaptation on water security |

In 2000, diarrhoea linked to climate change caused 47,000 deaths, most in South-East Asia. Estimates for the future of diarrhoea-induced mortality in Africa predict over 60,000 deaths in 2030. This is a 10 per cent increase in risk over what it would be without climate change. Diarrhoeal diseases – along with other waterborne diseases such as cholera – are climate sensitive (see Figure 2.3). Regional epidemics of cholera, for example, occur seasonally and are associated with periods of excessive rainfall, warm temperatures and subsequent increases in aquatic plankton populations.

Other factors that impact waterborne diseases include localised management of watershed and catchments, changes in rainfall, sanitation, water availability and access to medicine.
Box 2.2 Water security

The array of complex factors that determine access to clean water – encompassing social, political and environmental issues – means that the impacts on health have often not been well addressed. The localized nature of water challenges and watershed management issues add further complexity. In some parts of the world there will not be enough water; in others there will be too much. For example, predictions suggest that by 2025 climate change could lead to deficits in the water available from the Nile river basin, which covers three million square kilometres and ten Northern African countries including Egypt, Sudan and Ethiopia. Meanwhile many other parts of the world such as Bangladesh are at risk from rising sea levels.

Today one in three people are already facing water shortages. Over the next twenty years global water demand will outpace supply by 40 per cent. Under the pressure of potential effects of climate change, the stakes become even higher. Increased water temperatures and changes in extreme weather, including floods and droughts, are expected to affect water quality and exacerbate water pollution. This will hinder the use of water for hygiene purposes and affect food security. Increasing temperature also promotes the proliferation of microorganisms in contaminated food and drinking water.

Projections for 2050 suggest that 38 per cent of the world population across 149 countries will live in water-scarce areas. The subtropics and mid latitudes, where much of the world’s poorest populations live, are expected to become substantially drier, resulting in heightened water scarcity. This will exacerbate the problem of malnutrition and lead to the increase of many waterborne diseases. Meanwhile, most existing water treatment plants and distribution systems were not built to withstand changes now expected in precipitation and frequency of severe weather, leaving the current infrastructure without the capacity to fully capture large volumes of water, or to meet water demands in times of sustained drought.

Figure 2.3: Eight infectious diseases that are sensitive to climate change

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Significance of climate change as a factor in determining epidemics</th>
<th>Global Burdens 1 (1000 DALYs)</th>
<th>Countries affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>Primary</td>
<td>33,976</td>
<td>Tropics, Sub-tropics</td>
</tr>
<tr>
<td>Cholera</td>
<td>Primary</td>
<td>Pandemic potential</td>
<td>Africa, Asia, Russia South America</td>
</tr>
<tr>
<td>Dengue</td>
<td>Important</td>
<td>669</td>
<td>Africa, Europe, South America, South East Asia</td>
</tr>
<tr>
<td>Meningitis</td>
<td>Important</td>
<td>1,426</td>
<td>Worldwide</td>
</tr>
<tr>
<td>Leishmaniasis</td>
<td>Important</td>
<td>1,974</td>
<td>Africa, Asia, Europe India, South America</td>
</tr>
<tr>
<td>Influenza</td>
<td>Significant</td>
<td>Pandemic potential</td>
<td>Worldwide</td>
</tr>
<tr>
<td>Diarrhoeal diseases</td>
<td>Significant</td>
<td>72,776</td>
<td>Worldwide</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>Significant</td>
<td>1,707</td>
<td>Africa, East Asia South America</td>
</tr>
</tbody>
</table>


The majority of infectious diseases that are most climate sensitive fall into the Neglected Tropical Disease (NTDs) category. Over 1 billion people are infected with one of the 14 diseases defined by the World Health Organization (WHO) as NTDs – the world’s sixth leading cause of DALY loss. Although much attention in the past decade has focused on combating the “Big Three” neglected diseases – HIV/AIDS, malaria, and tuberculosis – many of NTDs are often insufficiently funded from a Research and Development (R&D) perspective. In 2007, less than 5 per cent of US$2.5 billion in total funding for neglected diseases R&D went to NTDs. There are growing signs that the pharmaceutical industry is devoting more of their research and development efforts to NTDs by developing new products and supporting community initiatives. However, the extent to which these responses factor in the diseases’ sensitivity to climate change remains uncertain.
3. Where will the impacts be most felt?

The impacts of climate change on health will be felt most acutely in countries with low levels of gross domestic product (GDP) and low investment in health per capita. South-East Asia and sub-Saharan Africa are most vulnerable to climate change and its health impacts.

Developing countries will suffer the most serious health impacts of climate change. Many of these countries have climates that are among the most variable in the world and are susceptible to EWEs. Between 1990 and 1998, 94 per cent of the world’s 568 major natural disasters and more than 97 per cent of all natural disaster related deaths were in developing countries.70

The Maplecroft Climate Change Vulnerability Index rates 166 countries according to six vulnerability factors: economy; national resource scarcity; ecosystems; poverty, development and health; population, settlement and infrastructure; institutions, governance and social capital. The Index found that Somalia, Haiti, Afghanistan, Sierra Leone, Burundi, Guinea, Rwanda, Gambia, Chad and Nigeria are the ten countries currently most vulnerable to climate change. Africa has eight of these ten countries and more than three-quarters of the 20 most vulnerable (see Figure 3.1).71

94% of the world’s 568 natural disasters and more than 97 per cent of all natural disaster related deaths were in developing countries.

Regions most vulnerable to climate change

The geographical regions of the world most vulnerable to climate change – namely South-East Asia and sub-Saharan Africa – are also likely to bear the largest health burden associated with it (see Figure 3.2). In 2000 these two regions accounted for over three quarters of the estimated global DALYs lost because of climate change. South-East Asia experienced the highest impact, with over 2.5 million DALYs lost, while Africa lost around 1.8 million. This compares starkly with the 8,000 DALYs lost in developed countries.
Figure 3.1: Africa hosts 8 out of the 10 countries most vulnerable to climate change

*Maplecroft Climate Change Vulnerability Index (2009)*

Figure 3.2: South-East Asia and sub-Saharan Africa will bear the largest health burden

*Estimated impacts of climate change in 2000 by DALYs and WHO region, WHO (2003)*
Vulnerable countries typically have low levels of GDP and low investment in health per capita (see Figure 3.3). Four countries amongst this group – India, Philippines, Kenya and the Gambia – have been selected as case studies. These countries are amongst those that are vulnerable to climate change; they have limited financial resources to deal with the health impacts of climate change and also have an increasing need for health care. Two countries each have been selected from different parts of South-East Asia and sub-Saharan Africa as these are the regions that are at most risk.
Country profiles

INDIA

<table>
<thead>
<tr>
<th>Climate-change vulnerability</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health expenditure per capita (Int. $ at PPP*)</td>
<td>24</td>
</tr>
<tr>
<td>GDP per capita (US$)</td>
<td>1,017</td>
</tr>
</tbody>
</table>

Climate-related health risks include: EWEs, vector-borne diseases such as malaria, water scarcity and malnutrition

EWEs

- India is at ‘extreme risk’ from natural disasters. Natural disasters have caused nearly 150,000 deaths since 1980 – with an average annual death toll of 3,255.
- Heavy rainfall and flooding impacts health – particularly in urban areas. In July 2005, Mumbai had 944 millimetres of rainfall in a 24-hour period (compared with the annual average of 21.7 centimetres of rainfall). The flooding was exacerbated by blocked canals and drains, causing an outbreak of infectious disease, such as cholera and typhoid fever, with the prevalence of the vector-borne leptospirosis increasing eightfold.

Disease

- Malaria zones are predicted to spread to elevations above 1800m by 2080 owing to rising temperatures.
- Access to clean water and water scarcity is an issue exacerbated by climate change – by 2050 there could be an estimated 38 per cent potential drop in per capita water availability.

Natural disasters have caused nearly 150,000 deaths since 1980


* PPP (Purchasing Power Parity) is the exchange rate that equates the price of a basket of identical traded goods and services in two countries.
The Philippines experiences approximately 20 typhoons per year, generally between July and December.
Where will the impacts be most felt?

KENYA

| Climate-change vulnerability | HIGH |
| Health expenditure per capita (Int. $ at PPP*) | 51 |
| GDP per capita (US$) | 783 |
| Climate-related health risks include: | Malaria, NTDs and water scarcity |

EWEs

- Kenya is susceptible to a number of natural hazards, including floods, droughts, landslides and wild fires.84
- Drought is the most common natural hazard; almost 70 per cent of Kenya’s land mass is affected by drought.85 In the areas of Kenya most affected by drought in the arid north of the country up to 30 per cent of children are malnourished.86
- Floods seasonally affect various parts of the country.87 The most severe floods in 1997–98 affected 1.5 million people.88

Disease

- Kenya has a high degree of risk from climate-sensitive infectious diseases such as food or waterborne diseases like diarrhoea, hepatitis A, and typhoid fever. Vector-borne diseases such as malaria, dengue fever, and Rift Valley Fever are also common.89
- High temperatures and intense rainfall events are known to be critical factors in initiating malaria epidemics in East Africa.90 Malaria affects 20 million individuals annually in Kenya and costs an overall production loss of two to six per cent of GDP.
- In the 1997 and 2006 El Niño seasons, Rift Valley Fever (RVF) caused major outbreaks in livestock and human populations. From 30 November 2006 to 12 March 2007 a total of 684 cases of RVF, including 155 deaths, were reported in Kenya; a case-fatality ratio of 23 per cent.91

Almost 70% of Kenya’s land mass is affected by drought
Where will the impacts be most felt?

### THE GAMBIA

<table>
<thead>
<tr>
<th>Climate-change vulnerability</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health expenditure per capita (Int. $ at PPP*)</td>
<td>25</td>
</tr>
<tr>
<td>GDP per capita (US$)</td>
<td>489</td>
</tr>
</tbody>
</table>

**Climate-related health risks include:**
- Diarrhoea, tuberculosis (TB), hepatitis A, malaria, schistosomiasis and malnutrition

**EWEs**
- A one-metre rise in sea level would cover almost 100 square kilometres of the Gambia’s coastal area including the capital city of Banjul.92
- Over the past 30 years rainfall has dropped by 30 per cent, jeopardising the livelihoods of many rural habitations, causing mass migration and increasing infectious diseases.93

**Disease**
- Gambia suffers a high burden of climate-sensitive diseases such as TB, acute respiratory infections, diarrhoeal diseases and schistosomiasis.94
- Malaria is an increasing problem. Around 1,000 children die per annum as a direct effect of malaria; this is escalating with the extension of the rainy season.95
- In 2003 the FAO estimated 30 per cent of Gambians were malnourished.96 By 2100, rainfall in the Gambia is expected to vary from -59 per cent to +29 per cent, which will have an impact on agricultural production. In addition, range-land productivity could decrease and livestock could be affected.97

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**Around 1,000 children die per annum as a direct effect of malaria**
4. What are the societal and economic benefits of addressing climate change related health impacts?

Tackling the health impacts of climate change will have a positive impact on both the economy and society.

- **Societal benefits**: Tackling the impacts of climate change on health will alleviate the human costs of pain and suffering, allow resources to be allocated to education and support development.

- **Economic benefits**: There are economic rewards at stake. The net economic benefits of managing climate change related incidents of malaria, malnutrition and diarrhoeal disease in sub-Saharan Africa and South-East Asian economies could range from US$33–US$54 billion between 2010 and 2030.

Even if global emissions of GHGs are drastically reduced in the coming years, temperatures are nonetheless expected to rise. The health impacts of climate change will need to be addressed through prevention, treatment and adaptation.

Tackling the health impacts of climate change will have a positive impact both on society and on the economy. Health interventions will alleviate some of the human suffering involved, including loss, pain and bereavement. It is impossible to quantify this benefit, but it nonetheless remains a primary consideration in the fight against disease.

In considering the benefits of addressing the health impacts of climate change it is also important to bear in mind the alleviation of strain for individuals and countries. At a national level, developing countries with already limited resources are further stretched by the pressures on public health systems.

Meanwhile at the household level, families will often divert spending towards medicine at the expense of other basic needs. Reducing the disease burden would allow resources to be directed to other activities – for example education – that can improve both quality of life and future earning prospects.

Benefits also extend to the wider international health and development agenda. Four of the United Nations’ Millennium Development Goals (MDGs) – although underpinned by wider economic factors – relate specifically to health and/or climate change. The goals to eradicate extreme poverty and hunger (goal 1), reduce child mortality rate (goal 4), combat HIV/AIDS, malaria and other diseases (goal 6) and ensure environmental sustainability (goal 7) could all be impacted by the health effects of climate change. Limiting GHGs and ensuring that any additional health impacts from climate change are addressed will contribute significantly to furthering the MDGs.

The net economic benefits of managing the additional health effects of climate change will also be significant.

Disease can lead to death or disability, preventing an individual from taking part in productive economic activity. Therefore each life saved – or each individual restored to health through a health intervention – represents a
benefit to the economy. It opens up the possibility that the individual will remain in (or enter) the labour force and contribute to economic output.

The net economic benefits of managing the climate change related incidence of malaria, malnutrition and diarrhoeal disease in the sub-Saharan African and South-East Asian economies are expected to range from US$33–US$54 billion from 2010 to 2030 (Figure 4.1). This represents between 0.6 per cent and 1.0 per cent of current GDP for these regions; a significant benefit, particularly in light of the prevalent poverty in many of these countries. The total annual benefit is based on the additional economic output that is gained from managing the diseases.

South-East Asian economies are estimated to yield the greatest net benefit. However, African economies will feel the benefit of tackling these issues the most owing to their current low levels of GDP. Benefits vary by disease and by climate change scenario. If a medium climate change scenario is taken as the most likely outcome, tackling climate change related malaria incidents could yield a net economic benefit of approximately US$14 billion, mainly in sub-Saharan Africa. For diarrhoeal diseases the net benefit would be around US$6 billion and for malnutrition it would be US$22 billion (of which just under US$20 billion would be in South-East Asian economies). The analysis, although dealing with the marginal impact of climate change, points to the benefits that would arise from treating the wider pool of disease (see Appendix 1 for more detail).

Figure 4.1: The cumulative economic benefit of tackling the impacts of climate change on health is significant

*Net positive economic benefit of tackling the health impacts of climate change on malaria, malnutrition and diarrhoeal disease by 2030*

Source: Accenture Analysis (for a breakdown of the methodology, countries covered in the analysis, and other variables, please see Appendix 1)

<table>
<thead>
<tr>
<th>Climate change scenario*</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
<th>Summary of total Net Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact on GDP$bn**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>12</td>
<td>14</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>South East Asia</td>
<td>Negligible</td>
<td>Negligible</td>
<td>Negligible</td>
<td></td>
</tr>
<tr>
<td>Malnutrition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>South East Asia</td>
<td>15</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Diarrhoeal diseases</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>4</td>
<td>6</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>South East Asia</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td></td>
</tr>
</tbody>
</table>

Note: Climate change scenarios are adapted from the three alternative emissions scenarios used by the World Health Organization Global Burden of Disease Study (2003). Additional incidence of disease taken from Ebi (2008).
5. What are the impacts and implications for the pharmaceutical industry?

The current understanding of the impact of climate change on health suggests that this issue is unlikely to lead to fundamental changes in the pharmaceutical business model – at least in the short term.

However, there are a number of factors which will influence the pharmaceutical industry in the more immediate future. These include increasing demand for healthcare products within emerging markets, improving access to medicine in the developing world, an increasingly stringent regulatory and operating environment, and a drop in innovation and R&D productivity. Improvements in healthcare information technology and an increase in targeted treatment solutions are also likely to be more important areas of focus for the industry.

5.1 Impacts

Despite other immediate – and seemingly more pressing – issues, it is imperative that we start to frame the debate around what the potential impacts and implications of climate change are for the pharmaceutical industry over the longer term. Doing this makes successful mitigation, response and adaptation to risks more likely. The following section highlights potential impacts identified to date in relation to four key areas:

- **Stakeholder relations**: The breadth of stakeholders the industry needs to interact with on this issue will increase.

- **Strategic planning**: Current uncertainty will continue to make strategic choices and planning on this issue difficult.

- **Skills**: New skills may be required to respond to climate change impacts.

- **Supply chains**: Pharmaceutical supply chains could be affected.

**Stakeholder relations**

Building trust and reputation is a key priority for the pharmaceutical industry. The breadth of issues and stakeholder groups with which pharmaceutical organisations may wish to interact and develop a trusted relationship is likely to increase in coming years as climate change starts to impact health. These issues could range from intellectual property rights to the R&D agenda, as well as the contribution pharma is making to climate change adaptation. Pharmaceutical companies may need to develop closer partnerships with NGOs, government agencies and other stakeholders. This move away from traditional stakeholders is a general industry trend as the role of pharmacists, payers and patients increases. The impact of climate change on health could accelerate this trend.

There is increasing stakeholder demand for pharmaceutical companies to quantify the benefits they have on the bottom line, as well as to society more broadly. This may mean that a more focused and proactive approach to tackling climate change impacts on health is required. As a result, some existing activities will increase in importance and come under more intense stakeholder scrutiny; for example building trust and reputation, examining intellectual property, access to medicines and preferential pricing schemes.
Introduction

Climate Change and Health: Framing the Issue

What are the impacts and implications for the pharmaceutical industry?

Strategic planning

Uncertainty and lack of granularity in the data around climate change and health might present strategic difficulties for organisations and for the pharmaceutical industry as a whole. Particular challenges include the ability to:

- Make strategic choices based on climate change and health
- Undertake informed choices on future R&D priorities and plans
- Model the impact of climate change on disease epidemiology and the cost-effectiveness of products
- Develop appropriate pricing and marketing approaches
- Plan appropriate supply and distribution; how much is required, where and when

The limitations presented by uncertainty and the lack of specificity in research on climate change and health are probably the biggest risks of all at present.

Skills

Climate change is unlikely to have a significant impact on the individual skills required within the majority of pharmaceutical company functions. There may be increased demand for infectious disease specialists (scientists, researchers, medics, statisticians, etc), but the degree of change is likely to be minimal and over a prolonged period; other portfolio changes are likely to have a greater, and more immediate, impact on the mix of specialism required.

The more likely scenario is that a new blend of skills will be required across the organisation, for example partnering and interdisciplinary cooperation with various stakeholders involved in the climate change and health debate. This is likely to include healthcare professionals, climate experts, biologists and social scientists, as well as governmental and multilateral organisations, NGOs, community groups, etc.

Supply chains

Finally, although the evidence is limited, it is conceivable that climate change could present a risk to the supply chain. One risk is the potential for disruption in the availability of raw materials; decreased biodiversity as a consequence of climate change will have an impact on current and new drug development. Another instance is the potential impact on distribution networks for the onward delivery of finished product. Product supply could also possibly be compromised during climate induced crises or sudden disease spread. The potential risks and impacts, however, are not well understood.

5.2 Developing a response

Pharmaceutical executives might consider the following critical questions as they address the implications of climate change and health for their organisation:

- Which stakeholders does the industry need to engage with around climate change and health? What is the most appropriate forum for collaboration?
- What tools and methods can be used to factor uncertainties into corporate planning? How can climate change be added as a variable to ensure adequate preparation for both acute and sudden impacts?
- What research methods and data already exist that can be used to model the impact of different climate scenarios on specific diseases?
- What is the best means of gathering new data on disease burden and unmet needs?
- How can R&D be geared towards lessening the health impacts of climate change as well as addressing patient needs?
- How can organisations most effectively work with governments, regulatory bodies and other agencies to create a common language and understanding around the issues and possible solutions?
- How will climate change affect the sales of different products and services? What changes, if any, are required to the sales and marketing function to meet this demand and address patient needs?
- Which manufacturing sites/supply chains/distribution networks are dependent on parts of the world that are susceptible to both the impacts of climate change and its associated health effects? How can they be made more resilient?

By embedding vigilance, flexibility and adaptability into business models, organisations will be better placed to meet customer needs in the face of the changing environment.
5.3 Implications

Given the gaps in our knowledge and many of the remaining uncertainties, we see the response of the industry covering four key areas:

- **Engaging stakeholders:** Working together with multiple stakeholders to increase awareness and understanding around the issue of climate change and health
- **Building resilience:** Partnering with the broader health community to integrate climate change resilience into existing activities
- **Driving science and innovation:** Contributing to the global research agenda around climate change and health
- **Being prepared to respond:** Integrating climate change and health as an additional consideration in future planning

**Engaging stakeholders:** Stakeholder interest on climate change and health already exists and is growing. For example the number of articles on climate change and health (still an emerging area of research) has increased significantly in the past decade (see Figure 5.1).

There will be a good opportunity for the pharmaceutical industry, healthcare professionals, policy makers and wider society to come together to discuss the challenges and opportunities presented by climate change and health. At the very least, this will help to build trust and communication. At best it will lead to innovative solutions, shared benefits, and collective awareness regarding an uncertain future.

**Figure 5.1: Academic interest in climate change and health is growing**

*Number of academic articles with ‘climate change’ and ‘human health’ in the article title, abstract or body text*

![Graph showing the increase in academic articles related to climate change and human health](source)

Source: Scopus article search (as of May 2010)

**Practical steps to engage with stakeholders could involve:**

- Initiating or co-developing a forum of key stakeholders to discuss the implications of climate change on health for a broad range of health-related sectors. Policy makers, NGOs, multilateral organisations, local health and environmental agencies as well as the private sector will be critical to the success of any such dialogue
- Engaging in open dialogue with a wider audience through public engagement and advocacy
- Developing communication and education materials. These could outline the key issues and explain actions being taken by the industry to understand and tackle the impact of climate change on health

**Building resilience:** The impacts of climate change and health will be both gradual and sudden. For some health impacts it could be decades before the impact of climate change is felt. For others such as EWEs or new emerging diseases the effect could be sudden and come without warning.

Ensuring health systems have the capacity to deal with change and continue to function in this context becomes essential. This is a particular consideration for, but not isolated to, many emerging and developing countries where weak healthcare infrastructure is already strained. Integrating climate change resilience into the development of healthcare systems will improve accessibility and availability of services when they are needed the most. Although this is not the primary responsibility of the pharmaceutical industry, there is a role for the industry to play as part of the broader community engaged in supporting public health systems.
Building capacity to ‘bounce back’, for example to respond efficiently and quickly after EWEs, is also relevant for organisations in the health and pharmaceutical sector, where continuity is essential for saving lives. By embedding vigilance, flexibility and adaptability into business models, organisations will be better placed to meet customer needs in the face of the changing environment.

**Practical steps to build resilience could involve:**

- Helping to ensure climate change is embedded into existing financial and/or technical support for capacity building and infrastructure development in emerging and developing markets
- Assisting in the development of disaster contingency plans for healthcare systems in both the developed and developing world
- Adding climate change as an additional consideration in strategic planning and operating models to allow continual adaptation to the evolving environment
- Creating a climate change resilient supply chain to provide surety of supply for consumers

**Driving science and innovation:** Lack of data is one of the biggest barriers to decision-making around climate change and health. The pharmaceutical industry could contribute to furthering the knowledge base by engaging in the global research agenda on this issue. Addressing some of the gaps in the existing body of knowledge will not only increase levels of understanding, it will also enable its resources and public policies to be targeted appropriately.

National and community-based monitoring and surveillance in particular will increase the knowledge of how climate change is affecting human health, now and in the future. This is no simple undertaking; it is likely to require a range of efforts, insights, expertise and finance from the private and public sector, academia and civil society.

**Practical steps to drive science and innovation could involve:**

- Using the pharmaceutical industry’s knowledge to contribute to the knowledge base on climate change and health
- Partnering with academia, local communities and government to support a Climate Change and Health Observatory, with a specific focus on emerging and developing markets. The remit of the such an observatory could involve:
  - Building monitoring and early-warning systems using climate change metrics and thresholds for key diseases
  - Putting in place metric tracking and management capabilities
  - Creating a repository or database to collect information
  - Developing climate change guidance for the healthcare industry and other interested parties
  - Building skills and knowledge
  - Advocating governments to provide funding for research into climate change and its impact on disease pathways and epidemiology

**Being prepared to respond:** The interplay between climate change and health should be added as a consideration in the strategic planning and risk management activities of the pharmaceutical industry. Continued monitoring and exploration will help the industry manage the uncertainty associated with climate change and health. It will also enable the industry to become more aware of potential future events and be better prepared to respond to a range of possibilities.

**Practical steps to ensure the industry is prepared to respond could include:**

- Adding climate change and health as a consideration in strategic planning and risk management activities
- Using horizon scanning and scenario planning to monitor and explore the uncertainty associated with climate change and health
- Ensuring R & D priorities factor in the impact of climate change on infectious diseases. This should especially include those that are particularly climate sensitive, including many neglected tropical diseases
- Examining how climate change could affect the health landscape in emerging and developing markets
- Understanding where the pharmaceutical industry can have the greatest impact and what the industry’s role should be on the issue
Conclusion

Science tells us that change is happening. It also suggests that climate change will exacerbate existing health issues – most notably in the developing world.

However, current knowledge has only begun to scratch the surface of what the impacts of climate change on health could be. Gaps remain in our understanding of the health impacts of climate change at a local and often disease-specific level.

Most importantly, we invite stakeholders to work with us to use this as a starting point for action and collaboration.

Like all big enterprises, companies in the pharmaceutical industry need to reduce their GHGs to contribute to the global efforts to mitigate against the effects of climate change. Additionally, from a health perspective, the industry has an important role to play in helping society adapt and respond to the changing climate.

By working with society to reduce knowledge gaps, engaging with a wide range of stakeholders, continuing to bolster healthcare systems and improving access to medicine in the developing world, both society and the pharmaceutical industry will be better prepared to adapt to an uncertain future.

GSK, Accenture and the Smith School of Enterprise and the Environment welcome partnership on this issue, particularly to examine the existing knowledge gaps and to begin to answer some of the questions identified. Most importantly, we invite stakeholders to work with us to use this as a starting point for action and collaboration.
We would like to thank the following external experts for their contributions to this report.

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Appendix 1

Approach for quantifying the economic benefit of addressing the health impacts of climate change

Background
Economic analysis for this paper focuses on the climate change related additional incidents of malaria, diarrhoeal diseases, and stunting and wasting (malnutrition) in the following three WHO-classified regions: “Afr-D” (predominantly West Africa), “Afr-E” (predominantly South and East Africa) and “Sear-D” (predominantly South-East Asia).

The analysis examines benefits across three climate change scenarios based on those used by the WHO in their Global Burden of Disease Study (2003):

1. Unmitigated Emissions (UE) – no action is taken to stabilise greenhouse gas emissions
2. S750 – emissions reductions stabilise CO2 at 750 parts per million (ppm) in 2210

Objectives were to assess lost economic output and derive estimates of net benefit in managing the three climate change related diseases.

Method
Benefits – Estimates of the additional climate change related incidence of disease in 2030 are used to generate disability-adjusted life years. This is combined with output per capita to determine total annual benefit gained from managing the diseases.

Costs – Marginal cost of intervention per case is based on existing treatment costs for all cases of these diseases adjusted for number of cases where intervention takes place.

Net Benefit – Costs and benefits are spread from 2010 to 2030, so both are discounted to Net Present Value using a rate of 3.5 per cent. This discount rate is consistent with the UK Treasury’s Green Book recommendation for policy appraisal.

Findings

<table>
<thead>
<tr>
<th>Region</th>
<th>NPV (US$ bn, PPP)</th>
<th>NPV (% of GDP, 2008)</th>
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<tr>
<td></td>
<td>S550</td>
<td>S750</td>
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<tr>
<td>Afr-D</td>
<td>6.41</td>
<td>7.52</td>
</tr>
<tr>
<td>Afr-E</td>
<td>11.44</td>
<td>14.56</td>
</tr>
<tr>
<td>Sear-D</td>
<td>15.13</td>
<td>20.51</td>
</tr>
<tr>
<td>Total</td>
<td>32.97</td>
<td>42.58</td>
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Figure A.1: Factors used to derive net benefit


9. For breakdown of net economic benefit, refer to Appendix.


13. Intergovernmental Panel on Climate Change (IPCC) (2007). IPCC has a confidence level greater than 66 per cent that EWEs will increase.


16. Ibid.


41. Ibid.

42. The measurement of disability-adjusted life years (DALYs) is an indication of the years of potential life lost due to premature mortality and the years of productive life lost due to disability.

43. Wasting is a severe form of malnutrition resulting from acute food shortages and compounded by illness.

44. Fischer, G. et al. (2002) op. cit.


58. Ibid.


68. IPCC (2010) op. cit.


75. Ibid.


80. Ibid.

81. Ibid.


85. Ibid.


88. Ibid.


94. Ibid.


97. Ibid.


99. Ibid.