

DIARRHEAL INFECTIONS



ESTIMATES GLOBAL CLIMATE IMPACT

2010 EFFECT TODAY

DEATHS PER YEAR

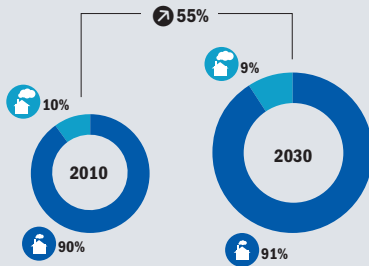
85,000

2030 EFFECT TOMORROW

DEATHS PER YEAR

150,000

MORTALITY IMPACT



SEVERITY



AFFECTED



INJUSTICE



PRIORITY



MDG EFFECT



Diarrheal disease is one of the leading causes of preventable death in developing countries, especially among children and infants

Today, diarrheal diseases kill 2.5 million people per year globally

Germs causing these infections favour warmer environments; as the planet heats, the risks of diarrheal diseases will worsen unless counteracting measures are taken

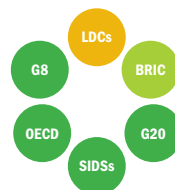
RELATIVE IMPACT



HOTSPOTS



GEOPOLITICAL VULNERABILITY



Diarrheal infections are one of the world's top communicable disease groups globally by overall death toll (WHO, 1999; WHO BDD, 2011). Food spoils more quickly and water contamination accelerates at higher temperatures, with the result that diarrheal infection rates may be 3-4 times higher in the summer than in the winter. Too much water, from flooding and contamination, or too little water, causing difficulties in treating/rehydrating the ill, are also problematic (WHO, 2009). Diarrheal disease influenced by climate change is a major concern for developing countries because risks are simply higher: inadequate refrigeration, difficult access to plumbed water in homes, or sanitation, such as basic toilet facilities (Bilenko et al, 1999; WHO, 2004; Ashbolt, 2004). In order to save lives and steadily reduce the prevalence of these diseases, simple interventions from vaccines to breastfeeding can prevent death. Systemic improvements in water, sanitation and hygiene are necessary for a more comprehensive reduction in risks (Jamison et al. (eds.), 2006).

CLIMATE MECHANISM

Several climate parameters affect diarrheal diseases from the level of infectious agents (bacteria, pathogen and viruses) through to population level practices. Direct observation of the effects of rising temperatures on infectious agents shows increases in disease replication rates and survival duration (WHO, 2004). Temperature changes also affect hospitalizations rates, with noticeable percentage increases in patient admissions as temperatures rise above normal levels (Checkley et al., 2000). Diarrheal diseases are transmitted via the fecal-oral route through food, water, human contact, or contact with objects such as cups (Dennehy, 2000). Key types of infectious diarrhea include cholera and rotavirus. Other factors such as humidity and rainfall also influence diarrhea. For instance, extremely low rainfall can force people in developing countries to make more use of polluted waters, while too much rain can contaminate unpolluted waters (Hunter, 2003; Ashbolt, 2004). Diarrheal diseases are also affected by malnutrition rates, which are influenced by climate change. This relationship is studied under "Hunger" (WHO, 2004).

IMPACTS

Owing to general temperature increase, the current impact of climate change on diarrheal diseases is estimated to lead to over 80,000 additional deaths per year in developing countries. Each year, over 100 million people are estimated to be affected by diarrheal diseases resulting from climate change. By 2030, these impacts will increase to over 150,000 deaths proportionate to the future global population, taking into account expected evolutions in the disease in relation to socio-economic development, unless measures are taken to counteract them. Over 200 million people could be affected by 2030. Africa is by far the region worst affected by diarrheal disease as result of the effects of climate change, with more than a dozen countries estimated to be experiencing similarly extreme levels of impact. Some parts of Asia, particularly, Afghanistan, Pakistan, and India are also particularly vulnerable. In general, low-income and least developed countries are significantly worse off than middle income countries. No significant impact is expected for developed countries, but primarily because of a higher level of public awareness, and not because people in

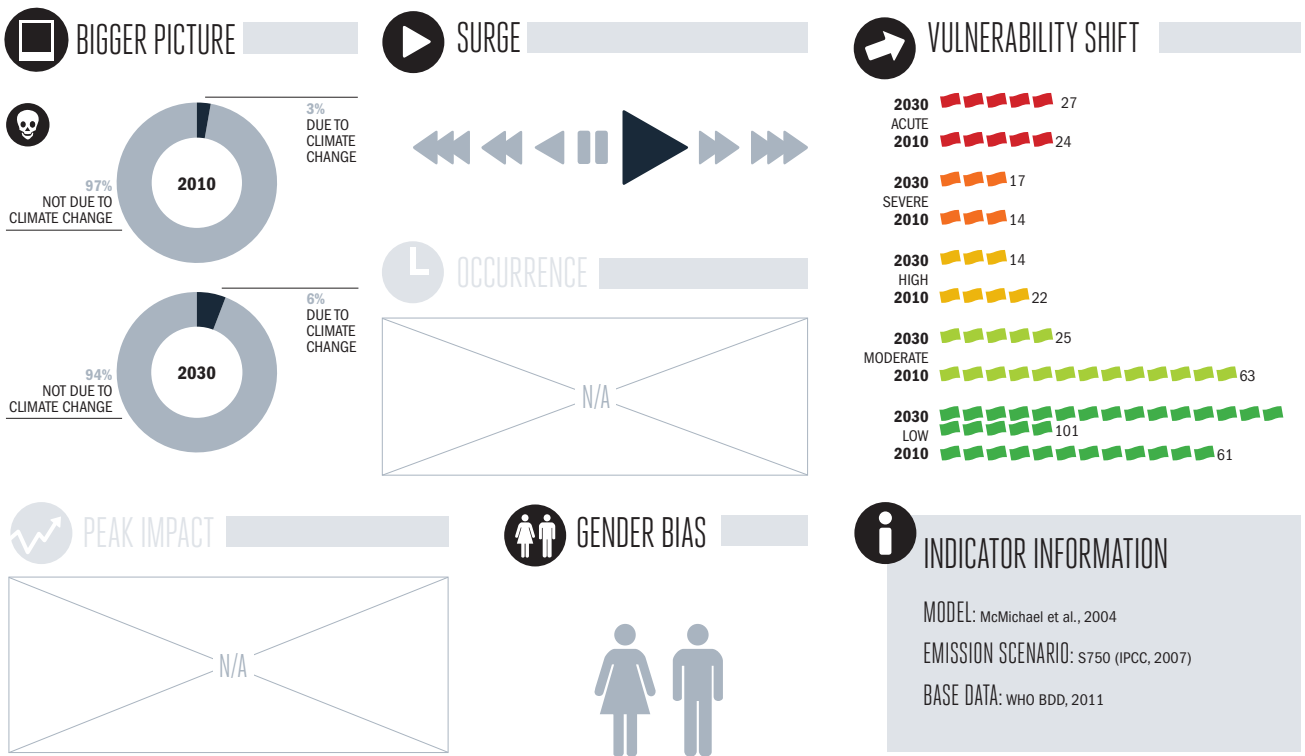
those countries are invulnerable (WHO, 2004; Bentham, 1997).

THE BROADER CONTEXT

While many preventable diseases in developing countries are seeing reductions in prevalence or declines in growth rates, diarrheal diseases have expanded rapidly since the year 2000, with nearly three quarters of a million additional deaths worldwide by 2010 (Mathers and Loncar, 2006; WHO BDD, 2011). However, different regions have evolved in different ways. In the last 10 years, Africa has worsened considerably, while East Asia has markedly diminished its burden of suffering from diarrheal disease.

VULNERABILITIES AND WIDER OUTCOMES

Less than 1% of diarrheal disease deaths occur in developed countries. Lower-income countries with already significant burdens of diarrheal infections will face serious challenges in combating the disease as temperatures continue to rise, since the same preconditions prevail. Prevalence of diarrhea is closely linked



➡ = 5 countries (rounded)

● Acute ● Severe ● High ● Moderate ● Low

to income levels for two reasons: 1) the main vulnerabilities relate to sanitation and by association, hygiene, whereby certain minimum standards in higher-income countries are enough to greatly reduce infection rates; and 2) deaths from diarrhea are easily preventable, especially among infants and toddlers, but only when either medical treatment or clean water are accessible and awareness about treatments is widespread; this is, unfortunately, not the case in many least developed contexts (Ashbolt, 2004; Jamison et al. (eds.), 2006).

While children make up more than half of the death toll, the millions who do survive what may often be repeated illnesses can, in many cases, be left with long-term cognitive impairments (Niehaus et al., 2002). Combined economic and social costs constitute a serious impediment to development progress for the world's poorest communities. With respect to the Millennium Development Goals, 2 (universal education) and 4 (child health) are particularly affected.

RESPONSES

Responses are needed at the treatment and prevention level. In terms of



treatment, simple water and salt, called "oral rehydration" solutions (ORS) cost next to nothing and can prevent death from extreme dehydration, the most common trigger of diarrheal mortality. In terms of prevention, access to clean water and basic sanitation are the central concerns (WHO, 2009). In this context, four sets of strategies are commonplace: 1) vaccination, especially against rotavirus and to a lesser extent cholera, has the potential to save up to half a million lives each year; 2) child

breastfeeding programmes which limit the transmission of infections through food and water to infants; 3) sanitation improvements, in the form of improved water sources for houses or small communities, construction of wells, and improved waste and latrine systems; and 4) education programmes, which target awareness about the other three areas and which promote personal hygiene through the use of soap and other simple measures (Jamison et al. (eds.), 2006).

THE INDICATOR

The indicator is deemed robust, particularly because of its reliance on temperature—among the most certain of climate effects—as the parameter for estimating a climate effect and because of the quality of the global health database compiled by the WHO on which the estimates are based (WHO BDD, 2011). Nevertheless, a number of improvements could be envisioned: for example, the WHO modelled the global effect on the basis of two detailed studies, which could benefit from further expansion into different areas, particularly detailed analysis of climate change effects on diarrhea in Africa (WHO, 2004). Moreover, the model does not take into account factors other than temperature, such as humidity and rainfall, nor does it take into account effects for developed countries which, while potentially low in terms of mortality, could be high in terms of the number of illnesses; one study identified a 9% increase in food poisoning causing diarrhea in the UK for every one degree increase in temperature (Bentham, 1997).

ESTIMATES COUNTRY-LEVEL IMPACT

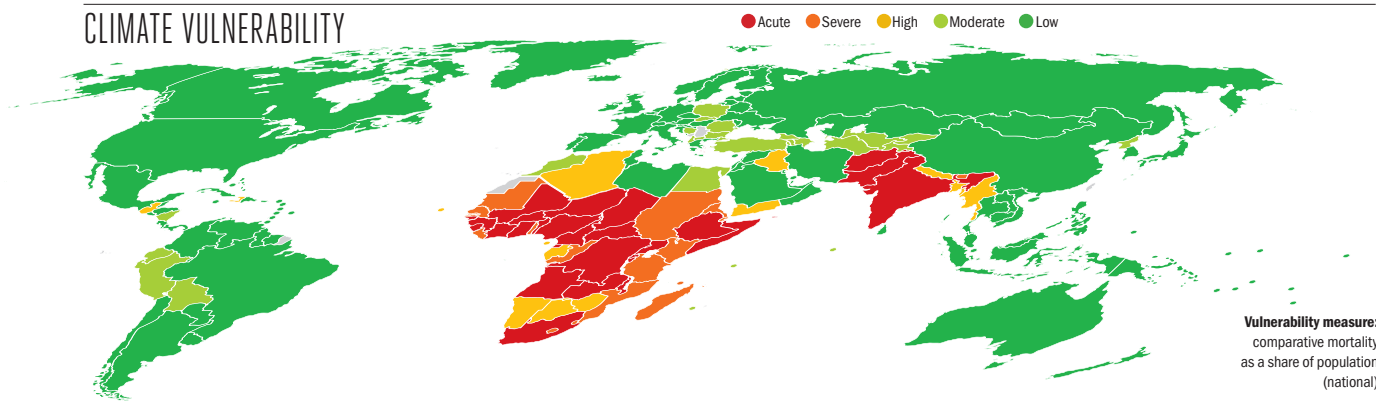
COUNTRY	☠		👤	
	2010	2030	2010	2030
ACUTE				
Afghanistan	2,000	4,000	2,500	5,000
Angola	1,250	1,750	7,750	10,000
Benin	350	450	400	550
Burkina Faso	900	1,250	1,000	1,500
Burundi	400	750	500	900
Cameroon	900	1,250	1,250	1,500
Central African Republic	150	250	200	350
Chad	900	1,250	1,000	1,500
Cote d'Ivoire	550	950	650	1,250
DR Congo	3,500	6,500	4,500	8,000
Equatorial Guinea	25	35	200	300
Ethiopia	3,500	6,500	4,500	8,250
Ghana	900	1,250	1,250	1,500
Guinea	400	550	500	700
Guinea-Bissau	100	150	150	200
India	40,000	85,000	50,000	100,000
Malawi	450	800	550	1,000
Mali	950	1,250	1,250	1,750
Niger	1,000	1,500	1,250	1,750
Nigeria	6,750	9,250	8,250	10,000
Pakistan	3,250	9,250	4,000	10,000
Rwanda	350	650	450	850
Sierra Leone	350	450	400	550
Somalia	550	1,000	700	1,250
South Africa	1,000	2,000	9,000	15,000
Uganda	1,000	2,000	1,250	2,500
Zambia	400	750	500	950
SEVERE				
Bhutan	10	20	10	25
Comoros	20	30	25	35
Congo	80	150	100	200

COUNTRY	☠		👤	
	2010	2030	2010	2030
Djibouti	15	25	85	150
Eritrea	85	150	100	200
Gambia	45	65	60	80
Kenya	800	1,500	1,000	1,750
Lesotho	25	45	30	55
Liberia	150	200	200	250
Madagascar	500	700	600	850
Mauritania	100	150	150	200
Mozambique	550	950	650	1,250
Senegal	300	400	400	500
Sudan/South Sudan	850	1,500	1,000	2,000
Swaziland	15	30	100	200
Tanzania	1,000	2,000	1,250	2,250
Togo	150	250	200	300
HIGH				
Algeria	350	500	2,250	3,000
Bangladesh	1,250	2,250	1,500	2,750
Botswana	15	25	100	200
Cape Verde	5	5	25	35
Gabon	20	30	200	250
Guatemala	150	150	850	800
Haiti	150	100	200	150
Iraq	300	850	1,750	5,000
Myanmar	550	1,000	650	1,250
Namibia	15	25	85	150
Nepal	300	550	350	650
Sao Tome and Principe	1	5	1	5
Yemen	400	850	500	1,000
Zimbabwe	150	250	150	300
MODERATE				
Albania	1	1	5	1
Armenia	1	1	5	5

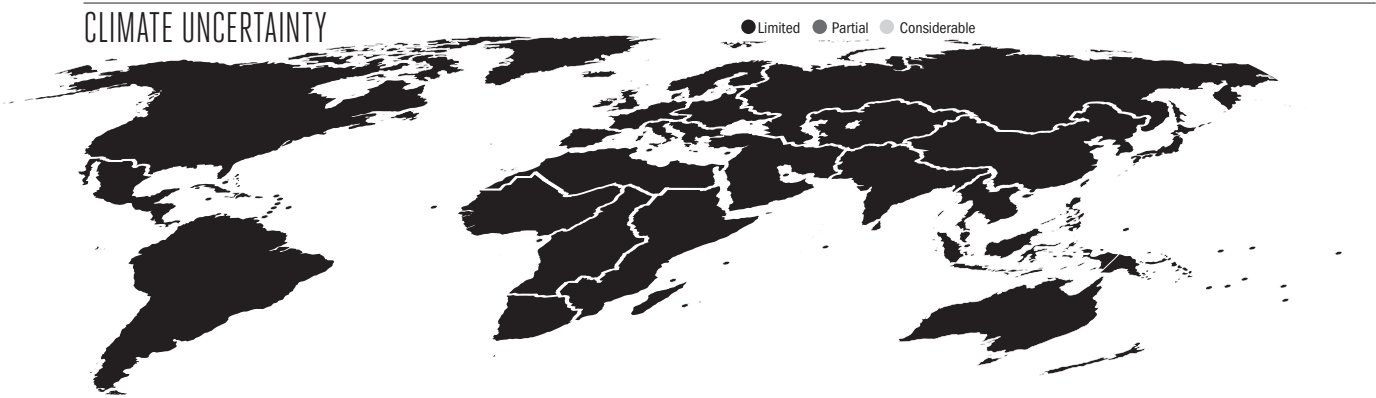
COUNTRY	☠		👤	
	2010	2030	2010	2030
Azerbaijan	15	10	95	55
Bolivia	80	70	450	450
Bosnia and Herzegovina			1	
Bulgaria	1		1	1
Ecuador	15	15	100	80
Egypt	95	150	550	1,000
Georgia	1	1	15	5
Kyrgyzstan	15	5	15	10
Macedonia			1	1
Maldives		1	1	5
Mauritius	1	1	5	10
Morocco	150	250	850	1,500
Nicaragua	15	15	15	15
North Korea	60	100	75	150
Peru	45	35	250	200
Poland	1	1	10	5
Romania	1	1	5	1
Seychelles			1	1
Slovakia			1	1
Tajikistan	45	25	60	30
Turkey	25	15	250	150
Turkmenistan	20	15	100	85
Uzbekistan	55	35	70	45
LOW				
Antigua and Barbuda				
Argentina				
Australia				
Austria				
Bahamas				
Bahrain			1	
Barbados				
Belarus				



CLIMATE VULNERABILITY



CLIMATE UNCERTAINTY



COUNTRY	☠		👤		COUNTRY	☠		👤		COUNTRY	☠		👤	
	2010	2030	2010	2030		2010	2030	2010	2030		2010	2030	2010	2030
Belgium					Israel					Russia	5		45	
Belize					Italy					Saint Lucia				
Brazil					Jamaica					Saint Vincent				
Brunei					Japan					Samoa			1	
Cambodia	100		150		Jordan	5		25		Saudi Arabia	15		250	
Canada					Kazakhstan	1		15		Singapore				
Chile					Kiribati	1		5		Slovenia				
China	550		3,000		Kuwait			1		Solomon Islands	1		1	
Colombia					Laos	35		45		South Korea	5		55	
Costa Rica					Latvia					Spain				
Croatia					Lebanon	1		10		Spain				
Cuba					Libya	5		30		Sri Lanka				
Cyprus			1		Lithuania					Suriname				
Czech Republic					Luxembourg					Sweden				
Denmark					Malaysia	5		55		Switzerland				
Dominica					Malta					Syria	15		85	
Dominican Republic					Marshall Islands			1		Thailand				
El Salvador					Mexico					Timor-Leste				
Estonia					Micronesia			1		Tonga			1	
Fiji	1		10		Moldova					Trinidad and Tobago				
Finland					Mongolia	5		5		Tunisia	10		55	
France					Netherlands					Tuvalu				
Germany					New Zealand					Ukraine	1		5	
Greece					Norway					United Arab Emirates			1	
Grenada					Oman	1		10		United Kingdom				
Guyana					Palau					United States				
Honduras					Panama					Uruguay				
Hungary			1		Papua New Guinea	30		35		Vanuatu			1	
Iceland					Paraguay					Venezuela				
Indonesia					Philippines	200		1,250		Vietnam	90		100	
Iran	100		600		Portugal									
Ireland					Qatar			1						

👤 Additional persons affected due to climate change (thousands) - yearly average change