



Public Health
England

Gastrointestinal infection: a global problem



Mark Salter
Global Health Consultant
Public Health England





Outline

- **Gastrointestinal Infections- causes and symptoms**
- **Mortality and morbidity**
- **Incidence and prevalence**
- **Economic effects**
- **The integrated Global Action Plan for Pneumonia and Diarrhoea (GAPPD)**
- **Public Health England –genesis and structure**



Definition

- **Any infection of the digestive tract caused by bacteria, viruses, or parasites.**
- **All may have common clinical features of nausea, vomiting, diarrhoea, and anorexia**



Aetiological agents of gastrointestinal infections

Viruses - Rotaviruses (40%) Norwalk agent

Bacteria - *E. coli*, *Salmonella*, *Shigella*, *Campylobacter*, *Vibrio cholerae*

Parasites - *Giardia*, *Entamoeba*, *Ascaris*



Symptoms

- **diarrhoea or dysentery**
- **nausea**
- **vomiting**
- **abdominal cramping**
- **anorexia**



Location of infection

small intestine - watery diarrhea and/or vomiting.

large intestine - dysentery (small faecal volume, with mucus and blood)

predisposing conditions - antibiotic therapy: pseudomembranous colitis



Categorization

Location in the intestines - small vs. large intestine

Disease acquisition - food vs. water vs. person to person

Action on host - intoxication vs. gastroenteritis vs. noninflammatory diarrhea vs. inflammatory diarrhea vs. enteric fever



Incidence

Over 2 million deaths/year

Second leading cause of death in children under 5 years old

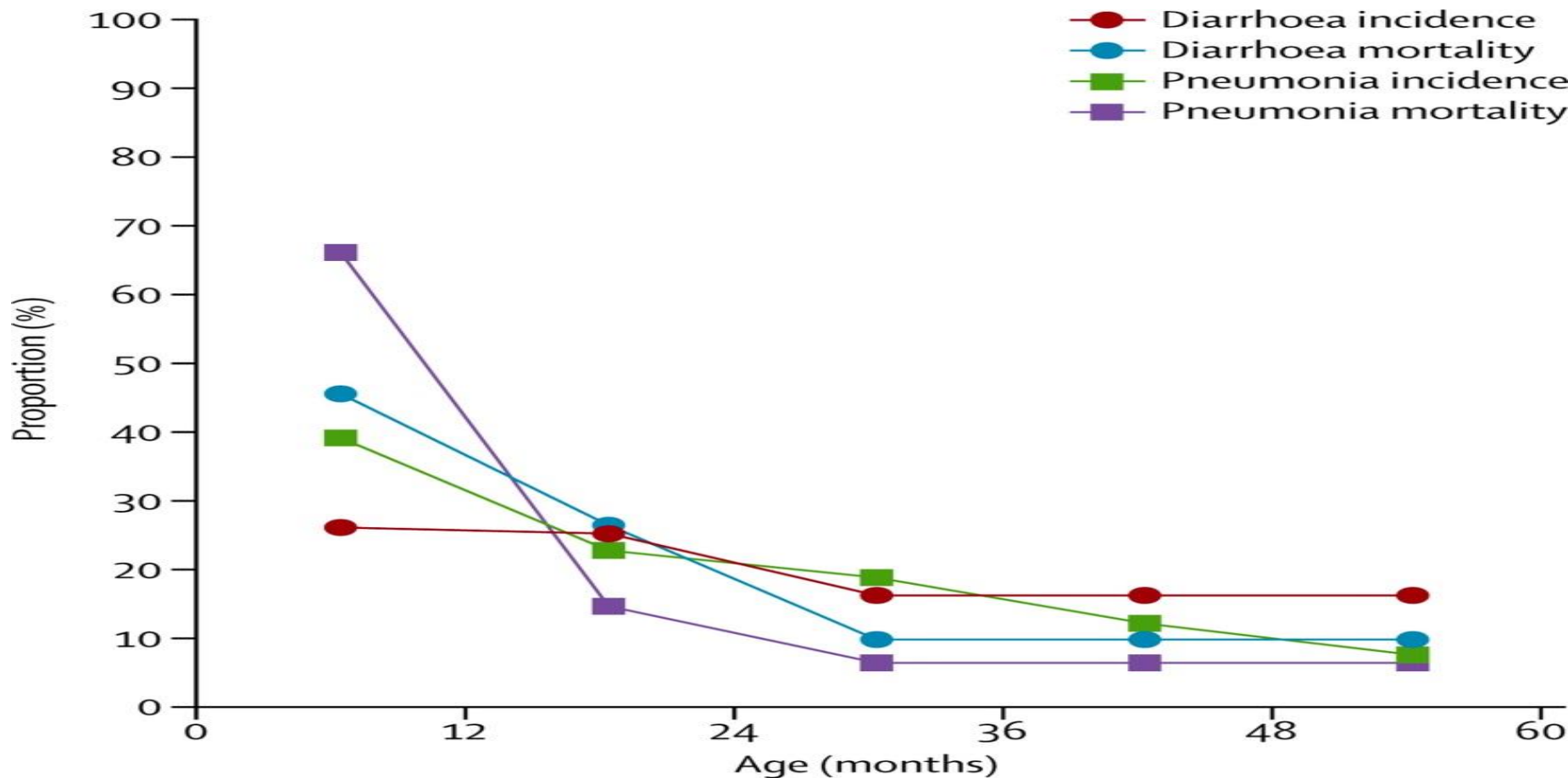
- 800,000 deaths/year 2012 in the under fives.

Approx. 2 billion cases/year

- Stable for last 2 decades



Incidence of diarrhoea and pneumonia in children under 5.





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Morbidity and Morbidity

Proportional distribution of cause-specific deaths among children under five years of age, 2004

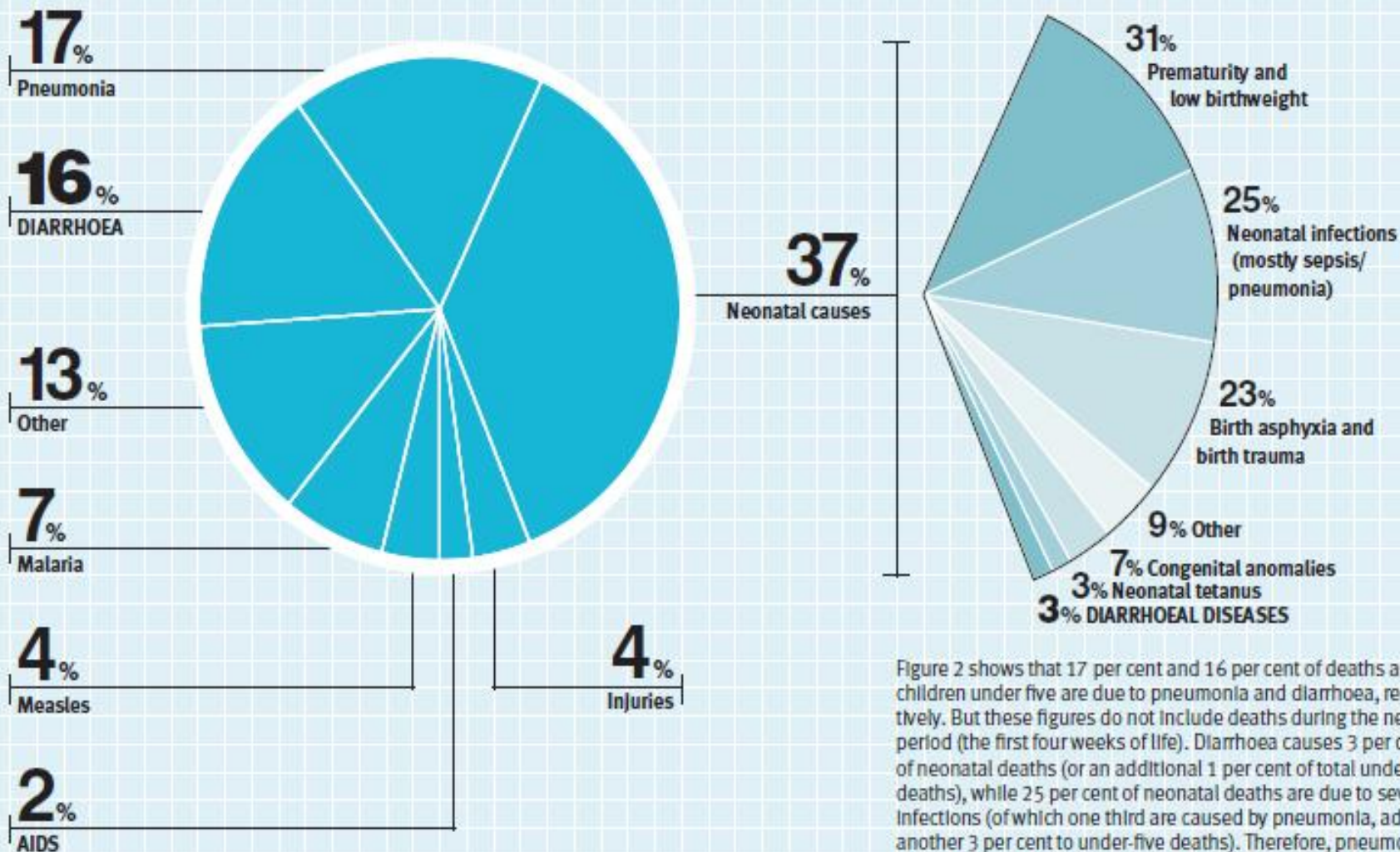
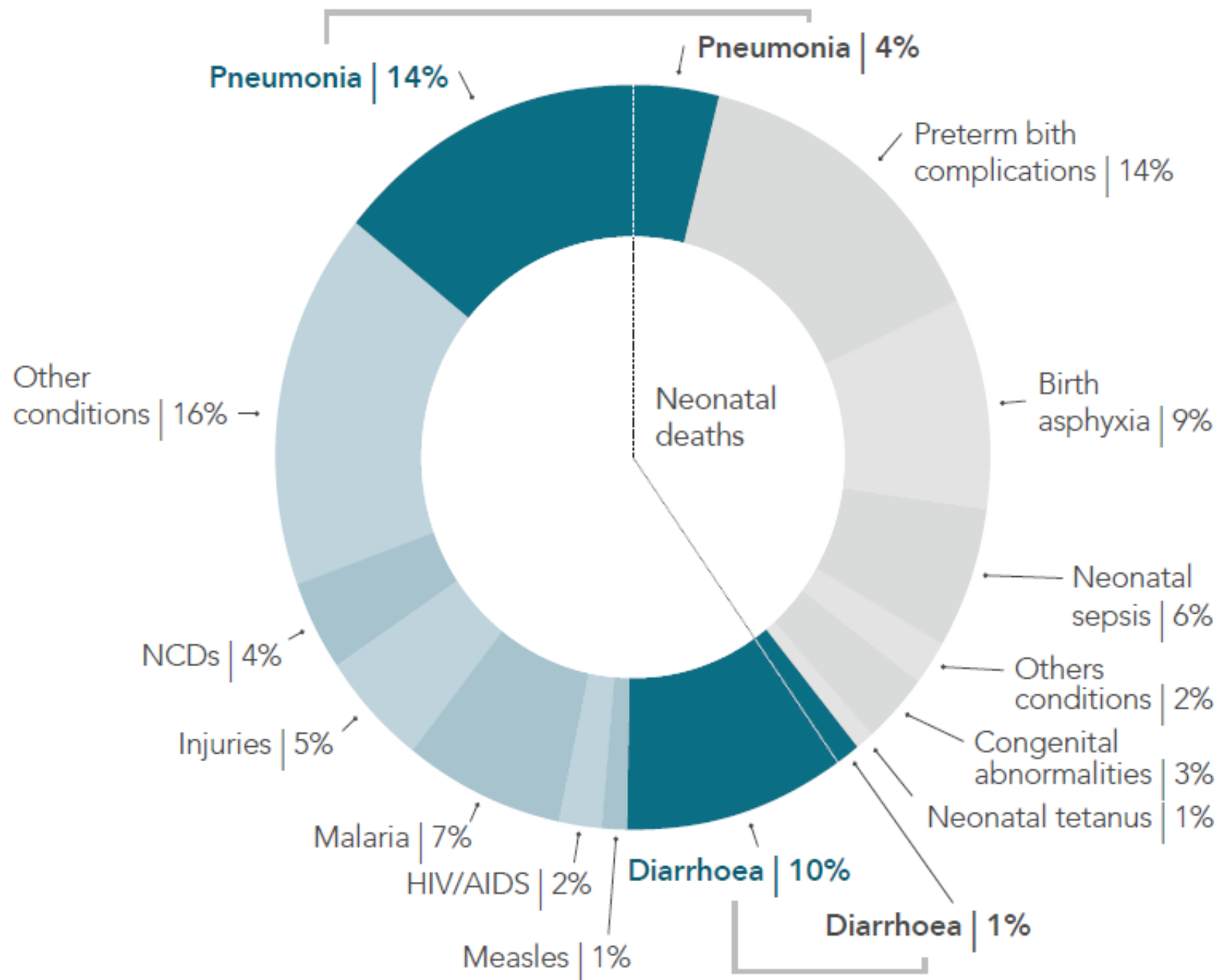


Figure 2 shows that 17 per cent and 16 per cent of deaths among children under five are due to pneumonia and diarrhoea, respectively. But these figures do not include deaths during the neonatal period (the first four weeks of life). Diarrhoea causes 3 per cent of neonatal deaths (or an additional 1 per cent of total under-five deaths), while 25 per cent of neonatal deaths are due to severe infections (of which one third are caused by pneumonia, adding another 3 per cent to under-five deaths). Therefore, pneumonia and diarrhoea actually cause about 20 per cent and 17 per cent respectively, of total under-five deaths when estimates from post-neonatal and neonatal periods are combined.

Source: World Health Organization, Global Burden of Disease estimates, 2004 update.

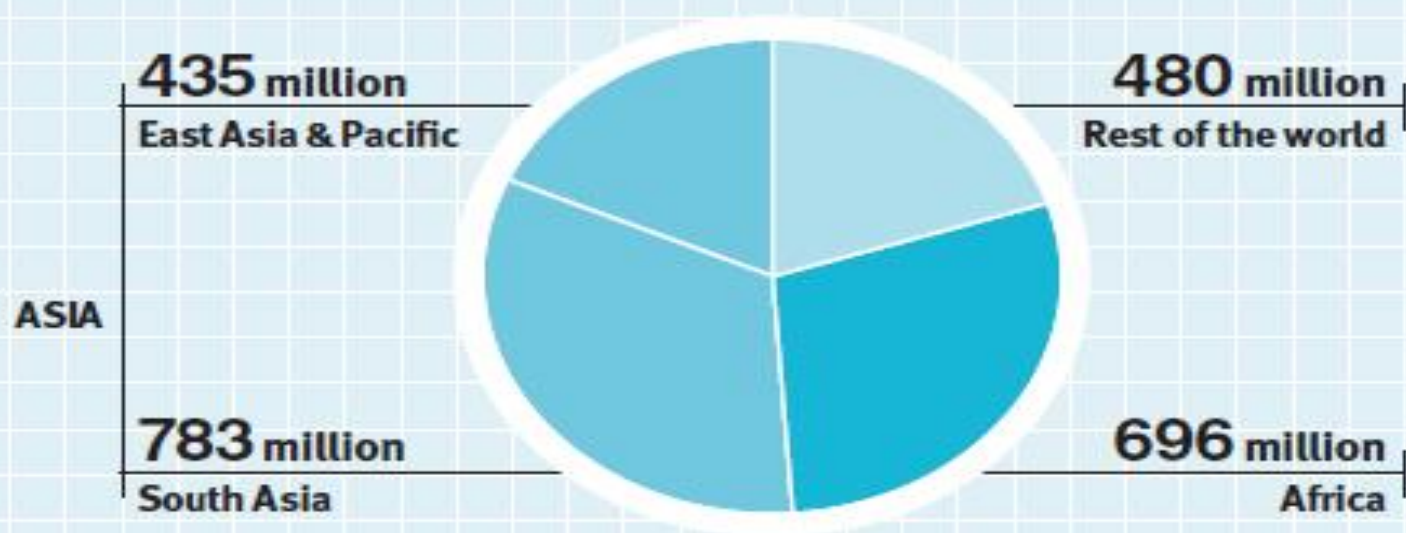
Note: Neonatal causes do not add up to 100 per cent due to rounding. Globally, more than one third of deaths among children under five are attributable to undernutrition.



	Population aged 0–4 years (2010)	Diarrhoea				
		Incidence*	Total episodes (×10 ⁶)	Total severe episodes (×10 ⁶)	Total deaths (×10 ³)	Change in mortality from 2010 (%)
African region	133 340 762	3.3 (2.1–5.0)	437.6 (282.2–669.2)	9.6 (7.1–11.3)	353.3 (195.8–564.7)	–17.1
American region	76 995 700	3.2 (2.6–3.8)	248.1 (199.6–289.2)	4.8 (3.6–5.7)	11.0 (8.2–23.9)	–3.0
Eastern Mediterranean region	72 151 965	2.9 (1.6–4.2)	208.8 (114.1–300.8)	4.3 (3.2–5.0)	96.6 (64.2–153.3)	–24.2
European region	54 605 243	2.8 (2.3–3.3)	154.3 (127.1–177.7)	2.5 (1.9–3.0)	6.3 (4.2–10.8)	–1.7
Southeast Asian region	179 956 087	2.4 (1.5–3.3)	427.4 (262.6–589.0)	9.3 (6.9–10.9)	227.7 (186.9–292.8)	–1.2
Western Pacific region	116 411 580	2.2 (1.3–2.5)	256.3 (151.7–290.6)	5.5 (4.0–6.4)	16.9 (6.0–23.7)	–27.8
World	633 461 337	2.7 (2.1–3.2)	1731.3 (1375.7–2032.8)	36.1 (26.6–42.4)	711.8 (491.1–1049.3)	–11.1

**FIGURE
1****Africa and South Asia account for
over half the cases of childhood diarrhoea**

Proportional distribution of diarrhoea cases among children under five years of age, by region, 2004



Source: Based on World Health Organization, Global Burden of Disease estimates, 2004 update. The proportional distribution for UNICEF regions was calculated by applying the WHO cause of death estimates to the most recent estimates for the total number of under-five deaths (2007).

FIGURE
3

More than 80 per cent of child deaths due to diarrhoea occur in Africa and South Asia

Proportional distribution of deaths due to diarrhoeal diseases among children under five years of age, by region, 2004

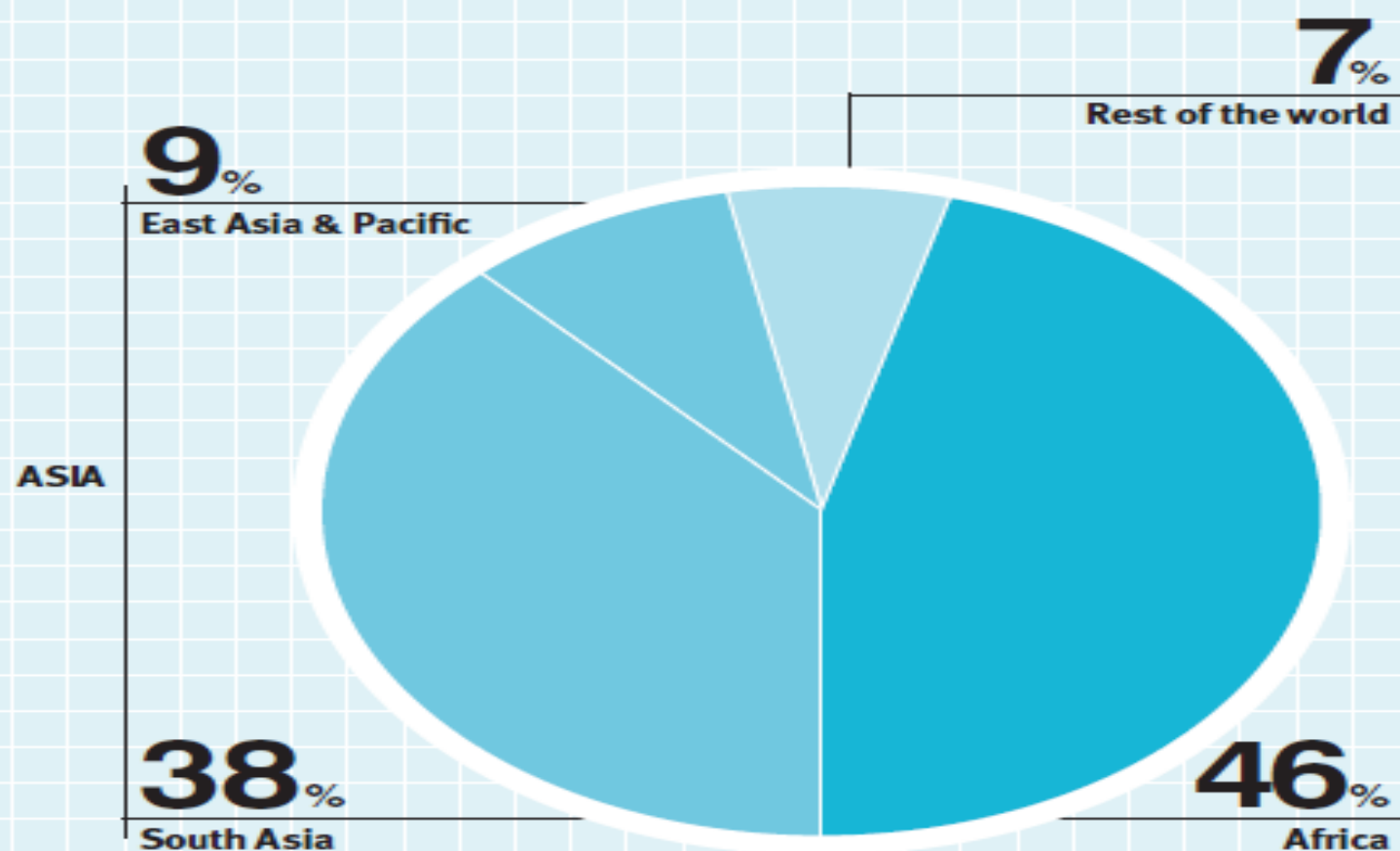


FIGURE
4**Nearly three quarters of child deaths
due to diarrhoea occur in just 15 countries**

RANK	COUNTRY	TOTAL NUMBER OF ANNUAL CHILD DEATHS DUE TO DIARRHOEA
1	India	386,600
2	Nigeria	151,700
3	Democratic Republic of the Congo	89,900
4	Afghanistan	82,100
5	Ethiopia	73,700
6	Pakistan	53,300
7	Bangladesh	50,800
8	China	40,000
9	Uganda	29,300
10	Kenya	27,400
11	Niger	26,400
12	Burkina Faso	24,300
13	United Republic of Tanzania	23,900
14	Mali	20,900
15	Angola	19,700

	African region	American region	Eastern Mediterranean region	European region	Southeast Asian region	Western Pacific region
Severe diarrhoea episodes						
Rotavirus:						
Episodes (×10 ³)	2557 (1901–3026)	1129 (833–1330)	1344 (990–1576)	660 (488–781)	2382 (1753–2790)	1781 (1312–2010)
Proportion of all severe episodes (%)	26.8%	23.4%	31.3%	25.9%	25.5%	32.6%
<i>Vibrio cholerae</i> :						
Episodes (×10 ³)	38 (28–45)	..	..	..	416 (306–488)	2 (2–3)
Proportion of all severe episodes (%)	0.4%	..	..	..	4.5%	0.04%
Diarrhoea deaths						
Rotavirus:						
Deaths (×10 ³)	95 (52.5–151.3)	2.6 (1.9–5.6)	30.2 (20.1–48.0)	1.6 (1.1–2.8)	58.1 (47.7–74.7)	5.5 (2.0–7.7)
Proportion of diarrhoea deaths (%)	26.8%	23.4%	31.3%	25.9%	25.5%	32.6%
<i>V. cholerae</i> :						
Deaths (×10 ³)	1.4 (0.8–2.3)	..	..	..	10.2 (8.4–13.2)	0.1 (0.02–0.3)
Proportion of diarrhoea deaths (%)	0.4%	..	..	..	4.5%	0.04%



Long term sequelae

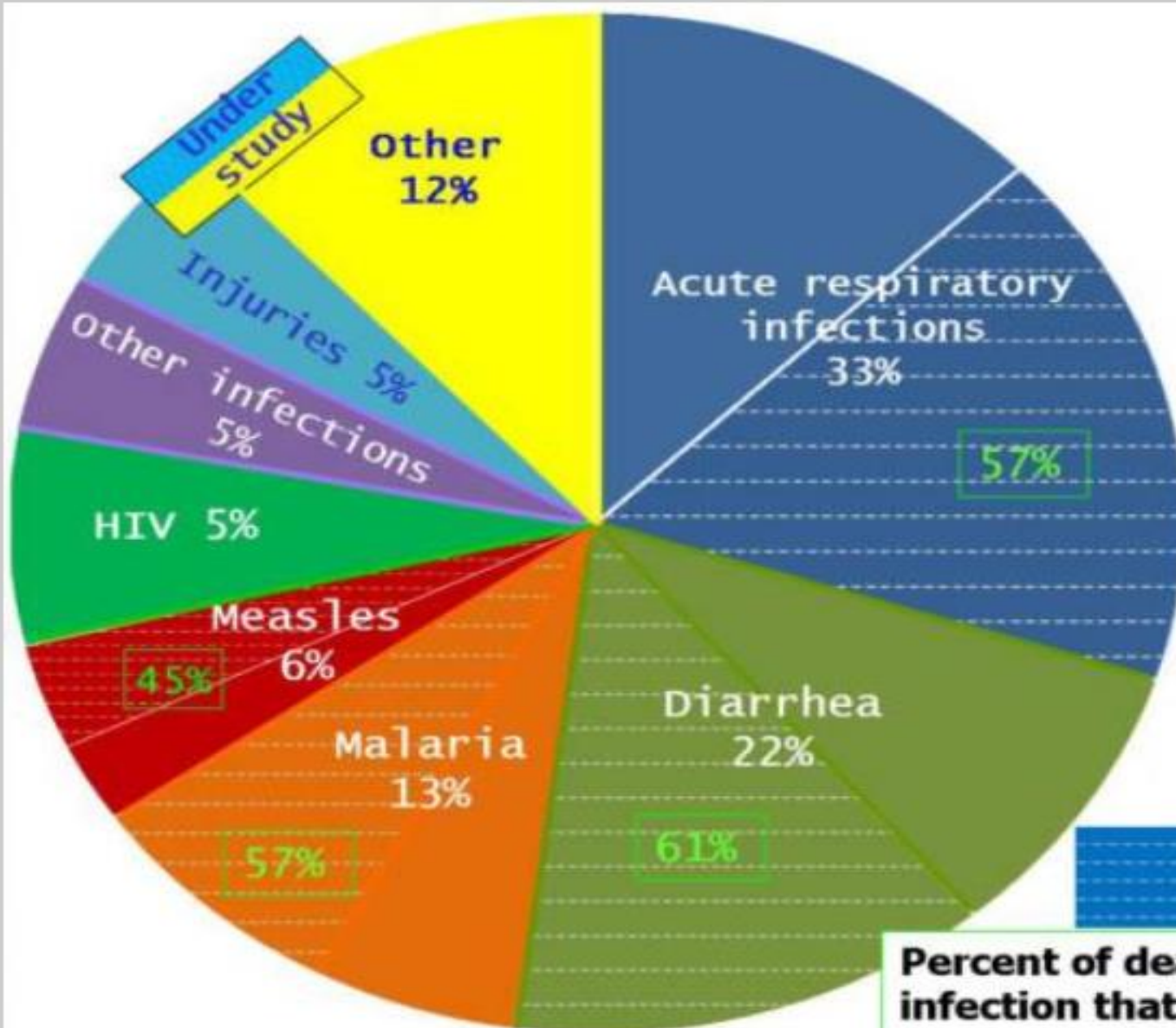
A single episode of diarrhoea is typically self-limiting.

Low-income and middle-income countries

- several episodes per year lead to nutritional deficits
- long-term consequences
- growth stunting by age 2 years

Long-term nutritional deficit is associated with

- decreased cognitive function
- Repeated episodes lead to cognitive deficits via stunting (not independently)
- Guillain-Barré syndrome, haemolytic uraemic syndrome, and reactive arthritis are rarely noted and are attributable only to selected pathogens



Percent of deaths from this infection that are due to the presence of malnutrition.

	Diarrhoea	
	Morbidity	Mortality
Not exclusively breastfeeding (0–5 months; vs exclusive breastfeeding)		
Partially breastfed	RR 1.7 (95% CI 1.0–2.8)*	RR 4.6 (95% CI 1.8–11.8)*
Not breastfed	RR 2.7 (95% CI 1.7–4.1)*	RR 10.5 (95% CI 2.8–39.6)*
No breastfeeding (6–23 months; vs receives any breastmilk)	RR 1.3 (95% CI 1.1–1.6)†	RR 2.2 (95% CI 1.1–4.2)*
Underweight (vs >–2 WAZ for morbidity and >–1 WAZ for mortality)		
–2 to <–1 WAZ	..	OR 2.1 (95% CI 1.6–2.7)§
–3 to <–2 WAZ	RR 1.2 (95% CI 1.1–1.4)‡	OR 3.4 (95% CI 2.7–4.4)§
Less than <–3 WAZ		OR 9.5 (95% CI 5.5–16.5)§
Stunting (vs >–1 HAZ)		
–2 to <–1 HAZ	..	OR 1.2 (95% CI 0.9–1.7) §
–3 to <–2 HAZ	..	OR 1.6 (95% CI 1.1–2.5) §
<–3 HAZ	..	OR 4.6 (95% CI 2.7–8.1) §
Wasting§ (vs >–WHZ)		
–2 to <–1 WHZ	..	OR 1.2 (95% CI 0.7–1.9)§
–3 to <–2 WHZ	..	OR 2.9 (95% CI 1.8–4.5)§
<–3 WHZ	..	OR 6.3 (95% CI 2.7–14.7)§
Vitamin A deficiency (vs not deficient)		RR 1.5 (95% CI 1.3–1.8)¶
Zinc deficiency (vs not deficient)	RR 1.2 (95% CI 1.1–1.2)	RR 1.2 (95% CI 1.0–1.6)



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Economic cost of gastrointestinal infections

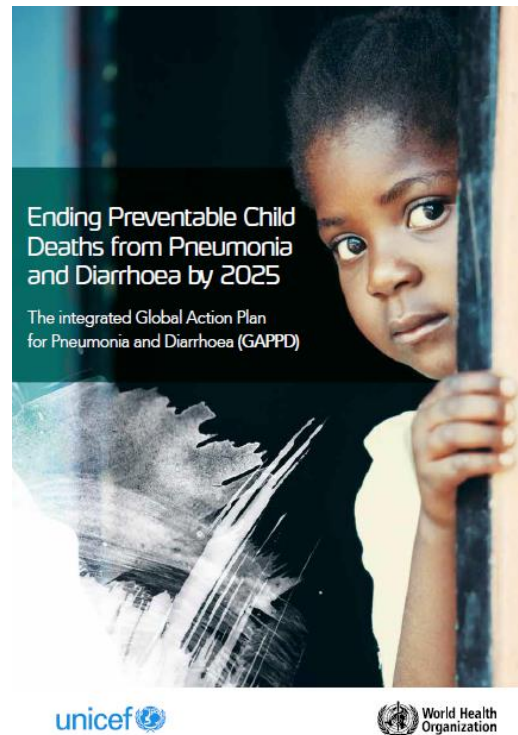
	method			costs/burden
Yule et al, 1988 ³⁹	COI	Poultry-borne salmonellosis outbreak)	Scotland	£200,000–£900,000
Todd, 1989 ⁴⁰	COI	Acute bacterial FBD	Canada	<\$1.1 billion
			United States	<\$7 billion
Roberts, 1989 ³⁴	COI	All bacterial FBD	United States	\$4.8 billion
Roberts and Pinner, 1990 ³⁵	COI	<i>Listeria monocytogenes</i>	United States	\$480 million
Roberts and Frenkel, 1990 ³⁶	COI	Congenital toxoplasmosis	United States	\$0.4–\$8.8 billion
Razem and Katusin–Razem, 1994 ⁴¹	COI	All reported FBD	Croatia	>\$2 million
Roberts and Upton, 2000 ⁴²	COI	STEC O157:H7 outbreak	United Kingdom	£11,930,347
Buzby and Roberts, 1997 ⁸	COI	6 bacteria, 1 parasite	United States	\$6.5–\$34.9 billion
Havelaar et al, 2000 ⁴³	DALY	<i>Campylobacter</i> sp.	Netherlands	1400 DALY per case
Scott et al, 2000 ⁴⁴	COI	All FBD	New Zealand	\$55.1 million
Lindqvist et al, 2001 ⁴⁵	COI	FBD	Sweden	\$123 million
Abe et al, 2002 ⁴⁶	COI	STEC O157:H7 outbreak	Japan	¥82,686,000
Frenzen et al, 2005 ³³	COI	STEC O157	United States	\$344 million
Abelson et al, 2006 ⁴⁷	COI	All FBD	Australia	AU\$1,249 million
Roberts, 2007 ⁴⁸	WTP	All FBD	United States	\$1.4 trillion



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The integrated Global Action Plan for Pneumonia and Diarrhoea (GAPPD)

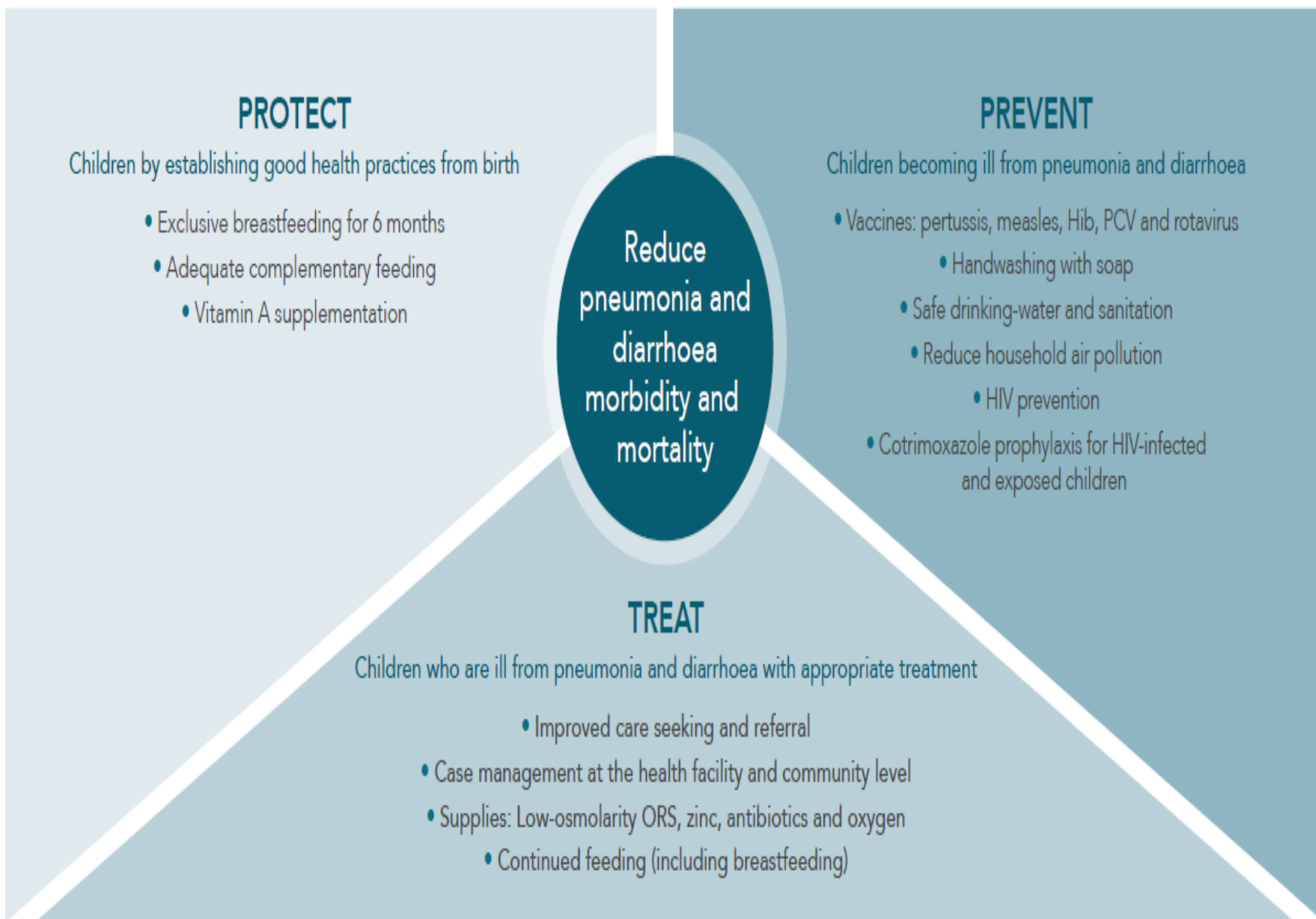
April 2013



unicef

World Health
Organization

those at the most peripheral levels, as well as communities.



Diarrhoea



Vitamin A
supplementation



Vaccination : rotavirus



Safe water
& improved sanitation



Low-osmolarity ORS, zinc
& continued feeding

Protect



Breastfeeding
promotion & support



Adequate complementary
feeding

Prevent



Measles
Vaccination



Handwashing
with soap



Prevention of HIV

Treat



Improved care seeking
behaviour and referral



Improved case management
at community and health
facility levels



Continued feeding



GAPPD Goals by 2025

Reduce mortality from diarrhoea in children under 5 years of age to fewer than 3 per 1000 live births

Reduce the incidence of severe diarrhoea by 75% in children less than 5 years of age compared to 2010 levels

Reduce by 40% the global number of children who are stunted compared to 2010 levels



GAPPD coverage targets

By 2025

- **90% full-dose coverage of relevant vaccine (80% coverage in every district)**
- **90% access to appropriate diarrhoea case management**
- **at least 50% coverage of exclusive of exclusive breastfeeding during the first 6 months of life**

By 2030

- **Universal access to basic drinking water in health facilities and homes**
- **Universal access to adequate sanitation in health facilities**
- **Universal access to hand-washing facilities in health care facilities and homes**



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Public Health England



Origins of Public Health England

Healthy Lives, Healthy People white paper

- Published November 2010 to set out a new approach to public health
- Responsibility of public health returns to local authorities from April 1st 2013
- Public Health England proposed as a replacement for the complex structures that existed before. Public Health England is to be a single dedicated service to support local innovation and provide disease control and protection



Vision and mission

Vision

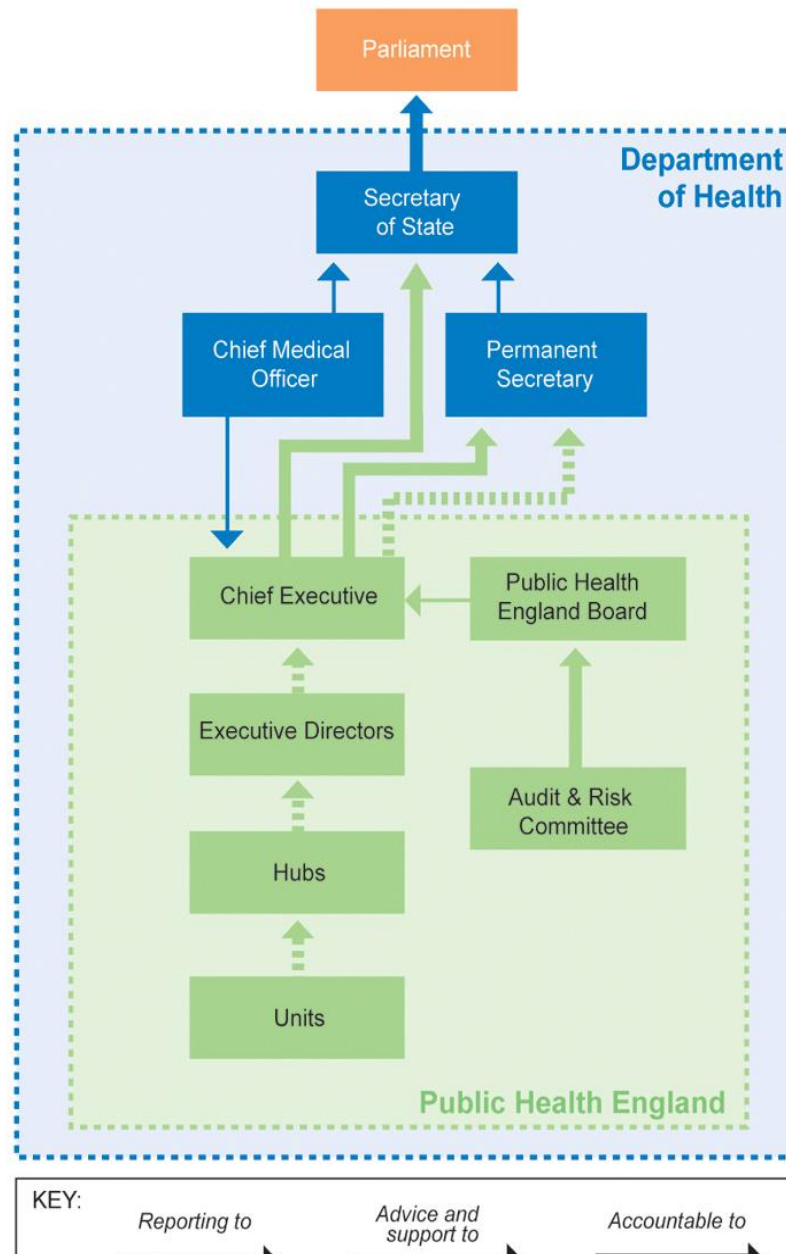
What do we want to see?

Healthy people and communities, with increased healthy life expectancy, increased wellbeing and reduced inequalities

Mission

What is our role?

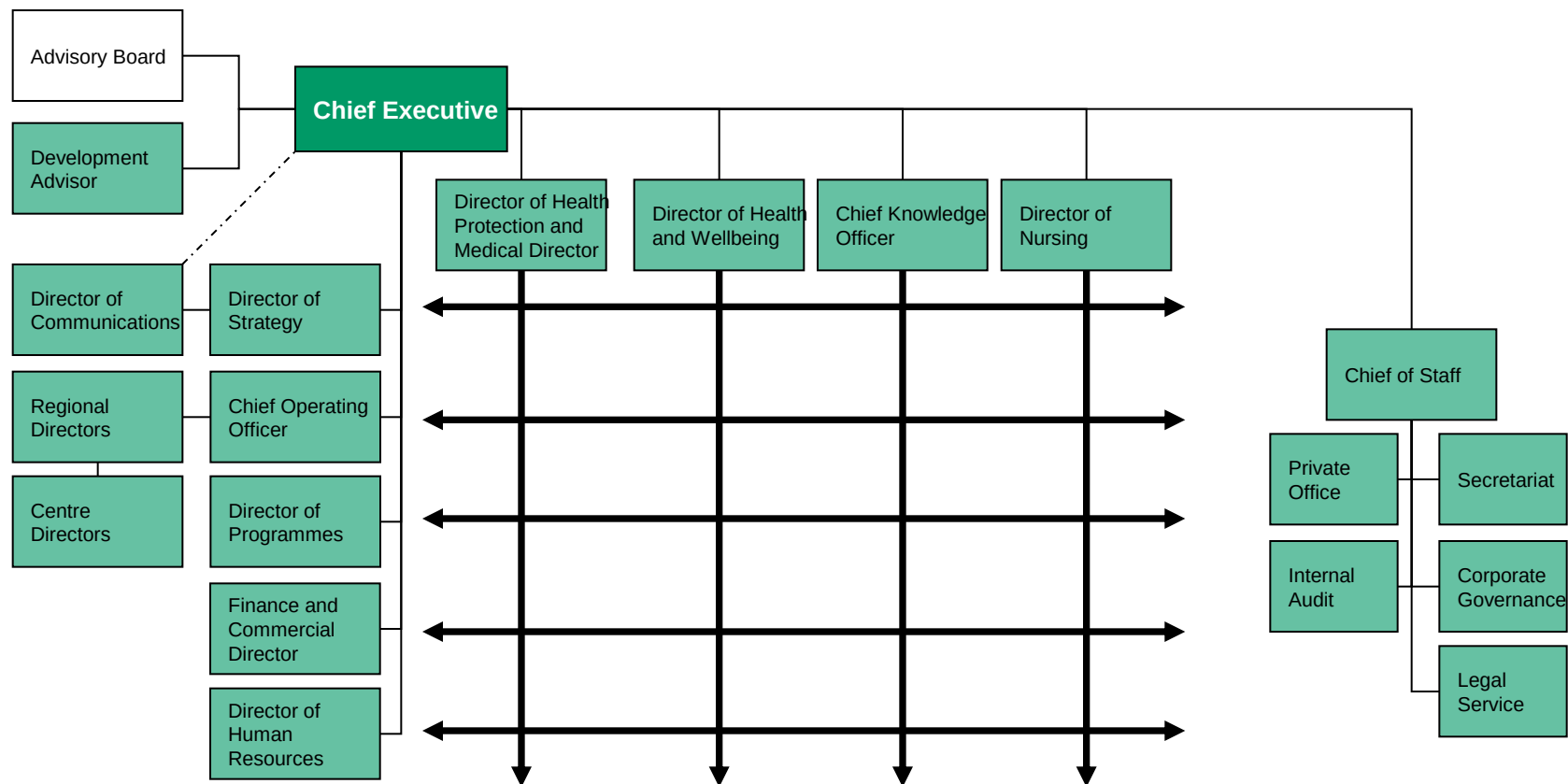
To work with and alongside others to protect and improve the public's health and wellbeing and reduce inequalities through our advocacy; application of knowledge, evidence and insight; transparent reporting of outcomes; and nurturing of the public health system and workforce



**Accountability
and governance
structure for
Public Health
England**



Structure – Public Health England





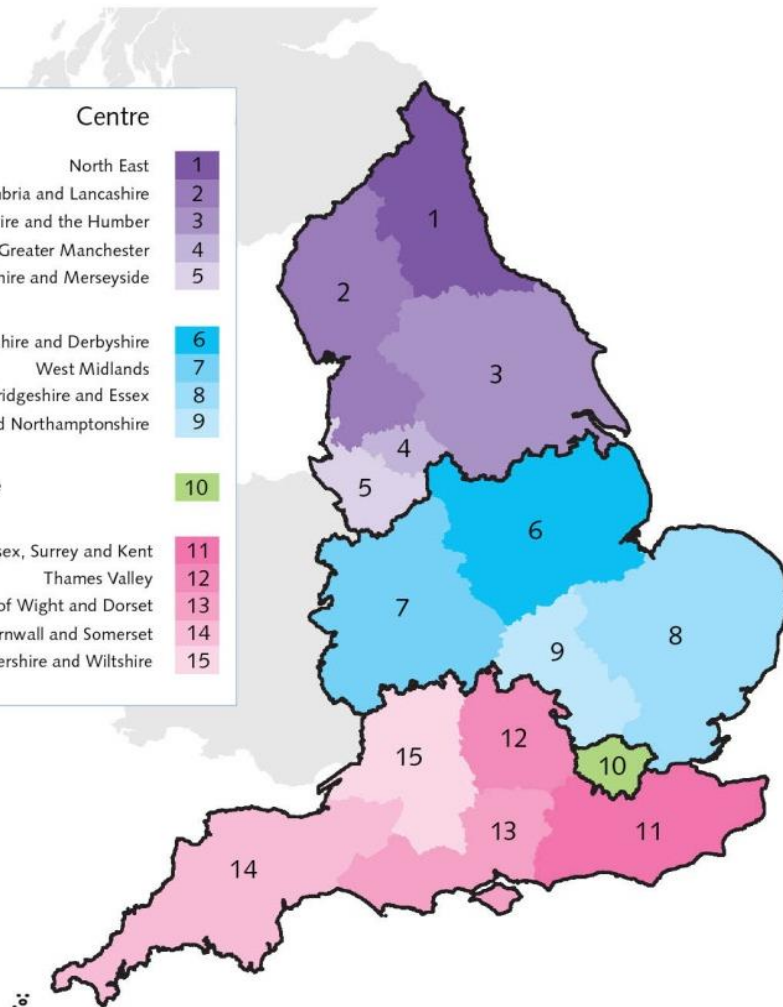
Operations

— 4 regions, 15 centres

— 8 Knowledge and Intelligence Hubs

- London
- South West
- South East
- West Midlands
- East Midlands
- North West
- Yorkshire and Humber
- North East

Region	Centre
North of England	North East 1
	Cumbria and Lancashire 2
	Yorkshire and the Humber 3
	Greater Manchester 4
	Cheshire and Merseyside 5
Midlands and East of England	Lincolnshire, Leicestershire, Nottinghamshire and Derbyshire 6
	West Midlands 7
	Norfolk, Suffolk, Cambridgeshire and Essex 8
	Bedfordshire, Hertfordshire and Northamptonshire 9
London integrated region and centre 10	
South of England	Sussex, Surrey and Kent 11
	Thames Valley 12
	Hampshire, Isle of Wight and Dorset 13
	Devon, Cornwall and Somerset 14
	Avon, Gloucestershire and Wiltshire 15



• Other local presence

- Ten microbiology laboratories
- Field epidemiology teams
- Centre for Radiation Control units



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Public health is coming home





Policy mandate (1): WHO International Health Regulations (IHR) 2005

International legal instrument binding in 194 countries that:

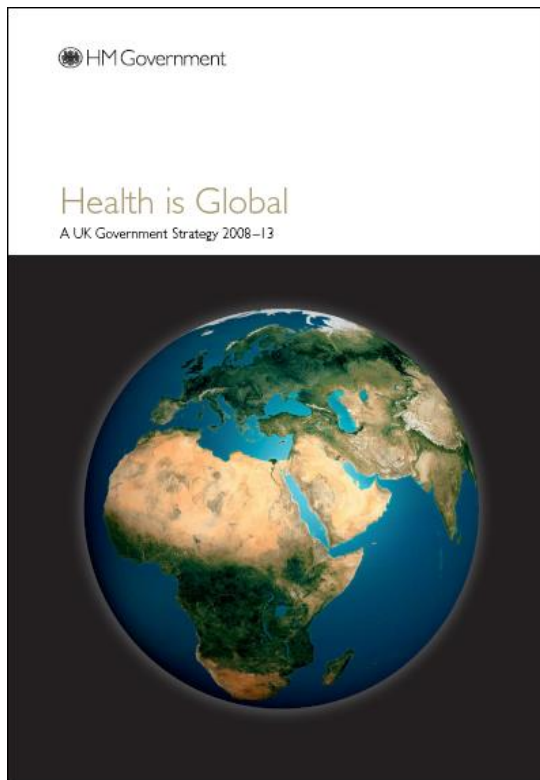
- require countries to report certain disease outbreaks/ public health events to WHO
- define country obligations to uphold global public health security
- require countries to strengthen public health surveillance and response capacity

PHE responsibilities

- Assess events that may be Public Health Emergencies of International Concern
- Notify events to WHO
- Contribute to broad IHR implementation on behalf of UK government



Policy mandate (2)





PHE global health activities: How do we determine what to do?

Locations

- UK government priorities
 - BRIC and CIVETS countries
 - Commonwealth countries
 - Overseas Territories and Crown Dependencies
 - Opportunity

Principles

- Bottom-up, working in collaboration
- Public health need: focus on capacity building and expert support
- Pragmatism
- Moral philosophical



WHO Collaborating Centres at PHE

**Diphtheria and
streptococcal
infections**

**Haemophilus
influenzae**

**Reference &
research on
hospital
infections**

**Laboratory and
diagnostic
support**

**Virus reference
& research
(special
pathogens)**

**Public health
management of
chemical
incidents**

**Reference and
Research on
Poliomyelitis**

**Mass
gatherings and
emergency
response**



3RD GLOBAL PLATFORM
for Disaster Risk Reduction

Invest Today for
a Safer Tomorrow
Increase Investment
in Local Action



World
Reconstruction
Conference



WRC High L
FDRR



Disaster Risk Management for Health

CHEMICAL SAFETY

Key Points

- Prevention of chemical emergencies includes:
 - safe location of chemical facilities away from residential areas
 - reducing the amount of stored toxic and flammable chemicals
 - building in technical controls and redundancy to provide safe use of chemicals and management of waste.
- Preparation for a chemical release includes:
 - scenario analyses and impact assessment
 - planning for, training and exercising the response, including the installation of a public warning system,
 - training and equipping responders to deal with loss of containment.
- Detection and alert includes the development of systems to recognize chemical events as early as possible and scaling up an appropriate incident response.
- Response includes the containment of the chemical release, decontamination, management of health consequences and risk assessment.
- Recovery includes activities such as risk and impact assessment in order to design care, remediation and protective actions, clean-up and investigation of the root cause to prevent recurrence.

Examples

India (1984) & France (2001)

On 3 December 1984, over 40 tons of methyl isocyanate gas leaked from a pesticide plant in Bhopal, India, immediately killing at least 3,800 people and causing significant morbidity and premature death for many thousands more.¹

A huge explosion ripped through AZF (Azote de France) ammonium nitrate fertiliser factory in an industrial zone on the outskirts of Toulouse, France on 21 September 2001. Thirty-one people died in the event and approximately 2500

Why is this important?

A chemical incident is the unexpected release of a substance that is (potentially) hazardous either to humans, other animals or the environment.²

Chemical releases arise from technological incidents, impact of natural hazards³, and from conflict and terrorism.⁵

The International Federation of the Red Cross has estimated that between 1998 and 2007, there were nearly 3 200 technological disasters, including chemical incidents, with approximately 100 000 people killed and nearly 2 million people affected.⁵

The management of chemical incidents requires a multi-disciplinary and multi-sectoral approach - the health sector may play a supporting or a leadership role at various stages of the management.

What are the health risks?

Chemical incidents can cause injury through four basic injury mechanisms which can also be strongly interrelated:

- **Fire** produces injuries through heat and exposure to toxic substances (including combustion products).⁶
- **Explosion** produces traumatic (mechanical) injuries through the resulting shockwave (blast), fragments and projectiles.
- **Toxicity** may result when humans come into contact with a chemical released from its containment, be it from storage or transport, or as reaction or combustion products. Toxicity can cause harm by a wide array of toxic mechanisms ranging from chemical burns to asphyxiation and neurotoxicity.
- **Mental health effects** are not only determined by exposure to the chemical, fire or explosion but also by "exposure to the event" itself.

Severe incidents have the potential to disrupt the lives of communities through injury, loss of relatives, property,

Disaster Risk Management for Health CHEMICALS

Disaster Risk Management for Health CHILD HEALTH

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Key Points

- 30-50 percent of fatalities arising from natural events are children
- The main causes of mortality in children are usually the same conditions that cause morbidity in non-emergency settings
- Children are vulnerable but disaster risk reduction can help minimise the risks from hazards.
- Children have a vital role to play when building community resilience and should be involved in planning for, responding to and recovering from natural disasters



Children draw maps of their village in the Irawaddy Delta, Myanmar. Two thirds of the children in the village were killed when Cyclone Nargis swept across the delta in May 2008. Photo Tina Salisbury, Save the Children.

Why is this important?

Children, especially those under the age of five are particularly vulnerable to disaster. They are more likely to be injured, lost, unable to access help or health care, or exposed to greater danger through separation from their families or caregivers.

In most disasters, between a third and a half of the dead are children.¹

It is currently estimated that around 250 million people are affected, each year, by disasters, and this number is likely to increase to 350 million over the next decade. Half this number are thought to be children.

The exact health effects from a disaster depend on the type of disaster, for example earthquakes can lead to critical multiple injuries, flooding can lead to outbreaks of diarrhoea. However disasters often exacerbate the most common causes of childhood mortality worldwide. These include acute respiratory illness, diarrhoea, malaria and measles, malnutrition and neonatal causes.

Disasters also affect development and delay the attainment of the Millennium Development Goals. The countries least likely to achieve the MDG targets are the same as those experiencing or recovering from disasters and acute or chronic humanitarian crises

Whilst children are more vulnerable to the effect of disaster, this need not be the case. Good disaster risk reduction for health can help reduce the effects of a disaster on the health of children.

What are the health risks?

Communicable diseases and vector borne illness including acute respiratory illness, diarrhoea, malaria and measles.

- These are the most common causes of child mortality globally but all of these have been shown to increase when crises occur.
- Disasters can also increase the risk of outbreaks such as cholera as a result of flooding, measles as a result of overcrowding following population displacement.

Disaster Risk Management for Health CHEMICAL RISK MANAGEMENT

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Disaster Risk Management for Health CHILDREN

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Disaster Risk Management for Health CLIMATE RISK MANAGEMENT

Key Points

Climate risks have a significant effect on public health in terms of malnutrition, diarrhoeal disease, trauma and air pollution.

A combination of increasing vulnerability and risk of weather-related hazards are expected to result in more extreme events and disasters.

Measures to reduce the health impacts from climate risks and associated climate change, include:

- strengthening public health systems based on partnerships with multisectoral actors
- enhancing capacity of health systems to reduce risks and respond to public health emergencies
- protecting hospitals and other health infrastructure from climate risks and effects of climate change
- strengthening surveillance and control of infectious disease against climate risk
- improving the use of early warning systems by the health sector
- building public health interventions at local level to increase community resilience

Examples

Europe heat wave (2003) The hot summer of 2003 in Europe produced sustained record high temperatures which resulted in markedly higher death rates than normal, particularly among the elderly population. In total, 70 000 more deaths occurred in western Europe during that summer than expected.¹

Rainfall and flooding Small changes in average precipitation can have a very large effect on the extremes of rainfall events that cause flooding, and human influence on the global climate is likely to make what would currently be considered a "very wet winter" in the United Kingdom, or a "very wet summer" in the South Asian monsoon region, about five times more frequent by the second half of this century.²

Why is this important?

Globally, the number of reported weather-related natural disasters is increasing.¹

- Reports of extreme weather events and natural disasters have more than tripled since the 1990s.
- In 2007, 14 out of 15 appeals for emergency humanitarian assistance were for floods, droughts and storms – five times higher than in any previous year.³

The last few decades have seen rapid growth in populations living in flood plains and coastal areas, particularly in cities in developing countries.

Climate change has driven extreme high temperatures and has probably contributed to more frequent and extreme precipitation events and more intense tropical cyclone activity. Together, these trends will increase the risk of weather-related hazards to human health.³

What are the health risks?

Climate change is happening now and it inevitably affects the basic requirements for health: clean air and water, sufficient food and adequate shelter.

Each year, about 3.5 million people die from malnutrition, 2.2 million from diarrhoea, 800 000 from causes attributable to urban air pollution, and 60 000 in climate-related disasters, mostly in low resource settings and also frequently in humanitarian emergency situations.²

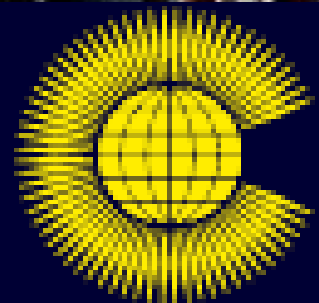
Climate change brings new challenges and costs to the control of infectious diseases as some are highly sensitive to temperature and rainfall, including cholera and the diarrhoeal diseases, as well as vector borne diseases including malaria, dengue and schistosomiasis.³

Climate change threatens to reverse the progress that the global public health community has been making against many diseases, and increase the challenges for the humanitarian community to respond to natural, biological and social emergencies.³

Global health activities



CARPHA



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Public Health
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Any Questions?

mark.salter@phe.gov.uk