

# The global burden of diarrhoeal disease in children

Umesh D. Parashar,<sup>1</sup> Joseph S. Bresee,<sup>1</sup> & Roger I. Glass<sup>1</sup>

One in 12 of the children born in 2001 have died or will die before their fifth birthday. This represents an annual total of 10.8 million childhood deaths, about 70% of which occur in infancy. Child mortality has declined from an estimated 15 million deaths in 1980, but eminently preventable and treatable conditions, such as pneumonia, diarrhoea, malaria, measles, and malnutrition, are still leading killers of children. Aggressive efforts to reduce child mortality must continue. Hard data on the cause-specific disease burden will assist in planning interventions and measuring their impact.

It is well known that diarrhoeal disease is one of the leading causes of illness and death in young children in developing countries. But how accurate are the morbidity and mortality estimates, and how can we improve them?

In 1976, Rohde & Northrup estimated that annually diarrhoea killed up to 5 million children in developing countries, and urged the scientific community to "take science where the diarrhoea is" (1). Then Snyder & Merson analysed 24 longitudinal, prospective, community-based studies of diarrhoea published between 1954 and 1979 (2). They estimated that under-five-year-olds had 2.2 episodes of diarrhoea per year, resulting in 4.6 million deaths. In 1986, a committee of the US Institute of Medicine revised the diarrhoea mortality estimate to 3.5 million deaths per year, based on published data and field experience (3). Bern et al. then updated Snyder & Merson's analysis by using studies published from 1980 to 1990 (4). They documented diarrhoea morbidity of 2.6 episodes per child per year, a similar finding to that reported a decade earlier, but with lower mortality: 3.3 million deaths per year.

Kosek et al. have recently made a further update by reviewing 60 studies of diarrhoea morbidity and mortality published from 1990 to 2000 (5). They conclude that diarrhoea accounts for 21% of all deaths at under five years of age and causes 2.5 million deaths per year, although diarrhoea morbidity remains relatively unchanged.

However, an analysis conducted in 2000 by Murray et al. estimates that

diarrhoea accounts for only 13% of all childhood deaths, amounting to 1.4 million deaths per year (6). These figures were based on information from national vital registration systems, sample registration systems, population laboratories, and epidemiological studies.

Despite the different methods and sources of information, each successive review of the diarrhoea burden over the past three decades has demonstrated declining mortality but relatively stable morbidity. The decline in global diarrhoea mortality is confirmed by detailed information from monitoring in certain countries over time (7). Increased use of oral rehydration therapy, improved nutrition, increased breastfeeding, better supplemental feeding, female education, measles immunization, and improvements in hygiene and sanitation are believed to have contributed to this decline.

Although few would disagree that there has been a decline in diarrhoea mortality, the wide range in current figures reflects the inherent uncertainty of these estimates. Earlier studies do not reflect the current situation and, in addition, cause of death was often ascertained by verbal autopsies, which have variable sensitivity and specificity. The WHO estimates were based on more recent vital registration data, but only countries from Latin America had registration coverage reaching 28%. Substantial extrapolation and modelling were needed to produce estimates for regions such as sub-Saharan Africa, with its estimated coverage of 0.4%.

Initially, cause-specific disease burden data were used for advocating broad-based health programmes to the donor community, and relatively crude estimates were adequate for this purpose. Now such data are increasingly used to prioritize disease-specific intervention programmes and allocate limited resources. For that, more accurate data are needed.

Estimating the burden of several health conditions (such as pneumonia and diarrhoea) by using similar techniques and sources of information would make it possible to compare the figures for each and make them tally with all-cause mortality figures. For countries with

adequate vital registration coverage, this task may be relatively straightforward. For those where child mortality is high and the registration systems are uncertain, however, efforts should be aimed at verifying the cause-of-death data from those systems.

Estimates then could be made by analysing these data with additional information from epidemiological studies, and perhaps subsequent modelling of cause-of-death patterns by using parameters such as all-cause mortality or income. Regional variations in cause-of-death patterns, such as the impact of malaria and HIV on child mortality in sub-Saharan Africa, should be taken into account in these calculations. A few representative, well-conducted mortality studies could provide new data to confirm or modify the predictions based on epidemiological analyses and modelling.

The recent Bill & Melinda Gates Foundation grant of US\$ 200 million to establish the Grand Challenges in Global Health Initiative would do well to begin by getting an improved accounting of where preventable deaths occur. Despite improvements over time, diarrhoeal diseases would almost certainly stand out clearly as a leading cause of childhood illness and death. ■

1. Rohde JR, Northrup RS. Taking science where the diarrhoea is. In: *Ciba Foundation Symposium. Acute diarrhoea in children*. Amsterdam: Elsevier; 1976 p. 339-65.
2. Snyder JD, Merson MH. The magnitude of the global problem of acute diarrhoeal disease: a review of active surveillance data. *Bulletin of the World Health Organization* 1982;60:605-13.
3. *New vaccine development: establishing priorities* (vol. 2). Washington, DC, Institute of Medicine, 1986.
4. Bern C, Martines J, de Zoysa, I, Glass RI. The magnitude of the global problem of diarrhoeal disease: a ten-year update. *Bulletin of the World Health Organization* 1992;70:705-14.
5. Kosek M, Bern C, Guerrant RL. The magnitude of the global burden of diarrhoeal disease from studies published 1992-2000. *Bulletin of the World Health Organization* 2003;81:3 p. 197-204.
6. Murray CJL, Lopez AD, Mathers CD, Stein C. *The global burden of disease 2000 project: aims, methods, and data sources*. Geneva: World Health Organization; 2001.
7. Victora CG, Bryce J, Fontaine O, Monasch R. Reducing deaths from diarrhoea through oral rehydration therapy. *Bulletin of the World Health Organization* 2000;78:10; p. 1246-55.

<sup>1</sup> Centers for Disease Control and Prevention, Atlanta, USA. Correspondence should be addressed to Dr Umesh D. Parashar, Viral Gastroenteritis Section, MS-G04, Centers for Disease Control and Prevention, 1600 Clifton Road, NE, Atlanta, GA 30333, USA (email: uap2@cdc.gov).