From Rwanda to Wisconsin: the global relevance of diarrhoeal diseases

From refugee camps in Rwanda and Zaire to water faucets in Wisconsin, newly recognised and ancient agents of diarrhoeal disease continue to plague our ever-shrinking globe. In addition to the staggering statistics of morbidity, mortality and economic impact, recent outbreaks in developing and developed regions illustrate the continued relevance of diarrhoeal illness to a sophisticated society confronted with shrinking budgets.

The far-reaching global impact of diarrhoeal diseases can be quantified to some extent by estimates of mortality, morbidity and economic loss. For instance, it is estimated that 3.3–6 million children die annually from diarrhoeal illnesses (>9000–12 600 deaths/day), the vast majority in Asia, Africa and Latin America [1–3]. Among the highest rates of diarrhoea morbidity and mortality in the world are those in the north-east of Brazil, where attack rates exceed 6–12 illnesses/child each year in rural and urban areas, respectively [4, 5], and where childhood mortality approaches 25% in the first 5 years of life [6]. In this region, over half of all infant and childhood deaths are due to diarrhoea, and the years of potential life lost to diarrhoea may exceed those of all other causes combined [7]. The 1993 World Bank report introduced a new measure of the overall burden of different diseases—the disability-adjusted life year (DALY) index; this combines healthy life years lost because of premature mortality with those lost as a result of disability. Of the communicable diseases listed, diarrhoea ranked second only to respiratory infections, was nearly twice that due to sexually-transmitted diseases including AIDS and nearly 3 times that due to malaria, accounting for 7.3% of the total DALYs lost worldwide in 1990. Significantly, children <5 years old accounted for >80% of the DALYs lost from diarrhoea [8]. The overall economic impact of this morbidity and mortality is incalculable, but it is certain that diarrhoeal diseases play a large role in the vicious cycle linking poor health to lack of productivity and marginal economies (not to mention population overgrowth [9]) in many developing countries.

Whereas the economic impact of the diarrhoeal diseases in developing countries defies quantification, in the USA, where such illness is less prevalent, an estimated 25–100 million diarrhoeal illnesses result in 23 billion dollars/year lost in direct medical costs and productivity [10]. Furthermore, diarrhoeal illnesses in hospitals, day-care centres, and nursing homes constitute a major health threat and a leading cause of morbidity that is often overlooked [11]. Diarrhoea is also a major predisposing factor to other costly nosocomial infections such as urinary tract infections [12].

Beyond these costs, less quantifiable, but equally significant, repercussions of diarrhoeal illnesses are illustrated in several recent epidemics in the developing and the developed world. The explosive epidemic potential of diarrhoeal illnesses in crowded conditions with poor sanitation was tragically demonstrated recently in concurrent outbreaks of cholera and multidrug-resistant *Shigella dysenteriae* infection in Goma, Zaire which, in <25 days, claimed the lives of more than 41 500 Rwandan refugees [13]. The senseless loss of life in these outbreaks reflects the opportunistic nature of otherwise easily preventable diarrhoeal pathogens wrought by social upheaval. Clearly, an effective public health strategy requires sharp focus on the root causes of inadequate basic sanitary facilities and water supplies.

In the developed world, the safety of the food supply has been called into question by the more than 20 000 infections and 250 deaths associated with *Escherichia coli* O157:H7 infection in the USA each year [14]. As in most outbreaks, the largest in North America (>700 cases with four deaths) was traced to undercooked ground beef, in this case from a fast-food restaurant chain [15]. Given the far-reaching health and economic consequences of a contaminated food supply, it has been proposed that a microbiological quality grade of food products should be included on package labelling [16]. Recent outbreaks of enterohaemorrhagic *E. coli*, like those of *Salmonella* spp. [17, 18] have taught us new risks of highly industrialised food production and how extensively we share diverse global food sources. The powerful epidemiological lessons learned from these outbreaks ought to provide the stimulus for government and industry to develop creatively practical and profitable incentives to improve the microbiological safety of our increasingly industrialised food supply.

Similarly, the 1993 outbreak of cryptosporidiosis in Milwaukee, Wisconsin, the largest recognised outbreak of water-borne illness in the history of the USA, highlights the vulnerability of water supplies to this chlorine-resistant pathogen for which no proven therapy exists. Over the span of 2 months, an estimated 403 000 cases of diarrhoea occurred despite water quality measures, such as turbidity, being well within the US Environmental Protection Agency standards [19]. Thus, *Cryptosporidium parvum*, which

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accounts for 6% of cases of diarrhoea and is readily spread in developing countries [20], has profound epidemic potential even in developed countries where present water safety standards fail to protect us from potentially dangerous (and in immunocompromised patients, incurable) infections. As existing methods of filtration and chlorination are inadequate, a new policy for the treatment of water for drinking is badly needed in both developing and developed areas.

For all the untold suffering, death and devastation wrought on our planet by diarrhoeal illnesses, and amplified by political apathy, some good observation continues to save the lives of over one million children annually [23, 24]. Oral rehydration therapy works on the simple principle that intestinal absorption of sodium is coupled to that of glucose and that addition of glucose to sodium-containing solutions continues to drive sodium absorption, even in the face of on-going intestinal secretion. Still further improvements in simple oral therapy, such as supplementation with zinc [25], vitamin A [26], and possibly glutamine [27–29], hold promise for controlling diarrhoea and improving nutritional status both in developing areas and in sophisticated intensive care units.

An increasingly interdependent global economy, expanding international travel, and the recognition of certain diarrhoeal pathogens as ‘emerging infections’, many of which first plague the developing world before spreading to industrialised wealthier nations, demand an improved approach to diagnosis, prevention, and treatment of diarrhoeal diseases. These diseases teach us above all that we share not only our very destiny and identity in the human family.

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