We are (at risk with) what we eat

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In December 2015, the World Health Organization (WHO) published its first global estimates of the burden of foodborne diseases. The report considered 31 agents – bacteria, viruses, parasites, toxins, and chemicals– and reported that about one in 10 people in the world fall ill each year as a result of consuming contaminated food. Among the approximately 600 million affected annually, there are 420 000 deaths, with 125 000 of these deaths occurring in children under the age of 5 years. The most affected regions in the world are the low-income countries in Africa and south-east Asia [1].

Why did it take so long for the world's premier public health organization to recognize and report the size of the problem? Although we have known for a long time that what we eat can have unintended consequences in multiple ways, being able to measure, attribute, and present data on the more than 250 causes of food-related illness is challenging [2]. The WHO's six task forces of the Foodborne Disease Epidemiology Reference Group (FERG) chose 31 agents to study including 11 diarrheal disease agents (one virus, seven bacteria, three protozoa), seven invasive infectious disease agents (one virus, five bacteria, one protozoan), 10 helminths, and three chemicals, and evaluated incidence, mortality, and burden measured as disability adjusted life years (DALYs). This was not easy because in addition to the difficulty in determining which agents were most likely to be important, there is also the fact that not all foodborne illness is seen in a healthcare system. If a patient does present, it is not easy to recognize a causal link to food, particularly if the disease occurs days or years after exposure, as is the case with toxins. Even when disease is seen in a recognizable epidemiologic form, such as an outbreak, the lack of capacity in most low-income countries to identify enteric pathogens confounds our ability to identify and measure the true burden of a foodborne disease agent [3].

Nonetheless, the efforts of the FERG after nearly a decade of work resulted in comprehensive, but conservative estimates of 230 000 deaths annually and 18 million DALYs lost because of diarrheal disease agents transmitted through food, with deaths particularly associated with salmonellae, and noroviruses causing 125 million enteric infections annually [1]. In this issue, reviews on salmonellae from poultry and foodborne viral infections (pp. 514–519 and 495–501) cover two important pathogens, whereas additional articles provide updates on Giardia, hepatitis E, and cholera (pp. 502–507, 478–485 and 520–527), all of which can be transmitted through food, but can also be waterborne.

One of the complexities of understanding how much disease can be attributed to food is because diarrheal disease agents can be transmitted through not just food, but several can also be passed through water, fomites, and person-to-person contact, all mainly leading to ingestion and subsequent multiplication in the intestinal tract. The complex attribution methodology used by the FERG estimated that of the diarrheal pathogens, 29% of transmission was due to contaminated food, resulting in 582 million foodborne illnesses of which 38% were in young children [1].

Children are particularly vulnerable to gastrointestinal infections for a number of reasons. A contaminated environment and contaminated food and water lead to early exposure with large infectious doses in children who are at risk of early and severe diarrheal disease. Although diarrheal diseases as the second major infectious cause of morbidity have been intensively studied for several years, there are many pathogenetic mechanisms that are still not understood. For example, the role of Giardia in diarrheal disease is controversial; it appears that in some studies the presence of Giardia, counter-intuitively, may protect against gastroenteritis [4]. This begs the question of whether a cohort design might be able to better address questions of Giardia pathogenesis in first and subsequent infections than cross-sectional studies. Similarly, for hepatitis E, the reason why an enterically transmitted agent is not

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Curr Opin Infect Dis 2016, 29:476–477

DOI:10.1097/QCO.0000000000000307

common in children in developing countries is also not understood. There clearly is early exposure as in the case of hepatitis A, and disease in adults and during outbreaks [5].

Unfortunately, foodborne illnesses are most common in the areas where children already face inadequate dietary intakes in addition to an unhygienic environment. This is only just being recognized, because the countries and regions most affected were also those least able to provide the level of laboratory services needed to identify and characterize foodborne pathogens. Africa and south-east Asia have the greatest burden of foodborne illness and mortality, and both regions should be considering seriously how best to put in place measures to decrease such contamination. Exclusive breastfeeding offers some protection but this may not be sufficient in the poorest settings. Children, with a large surface area relative to their mass, are more likely to suffer dehydration from diarrhea and vomiting. Even more devastating consequences persist from gut damage, which can further compromise nutrition, and result in poor cognitive development, which in turn could affect future economic output of the community [6].

Food hygiene is particularly challenging in developing countries, where systems may be fragmented and dependent on many small-scale producers. When food passes through many handlers and processes, the risk of unhygienic environments, contamination, and adulteration increases. Poor postharvest processes and poor storage because of inadequate safe water supply, electricity, storage facilities including cold stores, and transport facilities and networks all contribute in these regions to lack of food safety. This is compounded by a lack of appropriate knowledge and expertise in the application of modern agricultural practices, food hygiene, and good food handling practices, particularly in low-income and middle-income countries [7].

Reduction of risk requires education and investment in infrastructure and processes to maximize safe handling and minimize chances of contamination. Regulatory processes for food safety require governments to be responsible for setting and implementing standards, but monitoring of food safety also requires an investment in laboratory capacity to aid the recognition and study of agents that cause foodborne illness. Nonetheless, the marked difference in prevalence and rates of foodborne illness in high-income and low-income countries points to a potentially avoidable burden of disease in the currently most vulnerable populations.

Acknowledgements

None.

Financial support and sponsorship

None.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. World Health Organization. WHO estimates of the global burden of foodborne diseases: foodborne disease burden epidemiology reference group 2007–2015. Geneva: World Health Organization; 2015.
2. Painter JA, Hoekstra RM, Ayers T, *et al.* Attribution of foodborne illnesses, hospitalizations, and deaths to food commodities by using outbreak data, United States, 1998–2008. Emerg Infect Dis 2013; 19:407–415.
3. World Health Organization. The global burden of foodborne diseases: taking stock and charting the way forward. WHO Consultation to Develop a Strategy to Estimate the Global Burden of Foodborne Diseases. Geneva: World Health Organization; 2006; http://apps.who.int/iris/bitstream/10665/43635/1/9789241595292_eng.pdf?ua=1.
4. Kotloff KL, Nataro JP, Blackwelder WC, *et al.* Burden and aetiology of diarrhoeal disease in infants and young children in developing countries (the Global Enteric Multicenter Study, GEMS): a prospective, case-control study. Lancet 2013; 382:209–222.
5. Sarguna P, Rao A, Sudha Ramana KN. Outbreak of acute viral hepatitis due to hepatitis E virus in Hyderabad. Indian J Med Microbiol 2007; 25:378–382.
6. Kosek M, Guerrant RL, Kang G, *et al.* Assessment of environmental enteropathy in the MAL-ED cohort study: theoretical and analytic framework. Clin Infect Dis 2014; 59 (Suppl 4):S239–S247.
7. Gebreyes WA, Dupouy-Camet J, Newport MJ, *et al.* The global one health paradigm: challenges and opportunities for tackling infectious diseases at the human, animal, and environment interface in low-resource settings. PLoS Negl Trop Dis 2014; 8:e3257.