Changing Challenges of Bacterial Enteric Infection in the United States

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(See the article by Denno et al., on pages 467–76.)

The vast majority of bacterial enteric infections in the United States are sporadic, yet much of what is known about the epidemiology of these infections is driven by investigations of outbreaks. Studying sporadic infection is challenging, but critically important. The article by Denno et al. [1] in this issue of the *Journal* highlights the need for ongoing studies to understand the rapidly evolving epidemiology of sporadic bacterial enteric infection. Their work identifies a number of newly recognized risk factors for infection in children, who suffer from the highest rates of disease, and provides important data to help develop focused interventions.

We live in a society in which 46% of the US food dollar is spent on food prepared outside the home [2], fresh produce travels an average of 1500 miles to reach our plates [3], a typical dinner includes ingredients from around the world, and convenience-packaged foods are increasingly popular. The nature of enteric disease outbreaks, a large proportion of which are foodborne, continues to evolve along with our food supply system. The sources of sporadic infection are likely to be changing in a similar fashion. At the same time, however, there is increasing evidence that a variety of non-food exposures are important risk factors for infection in children. Controlling such risk factors in this population is particularly challenging and important.

While *Campylobacter* is the most common cause of bacterial enteric infection in the United States [4], outbreaks of infection are relatively rare and identifying the causes of sporadic infection is particularly problematic. Rates of campylobacteriosis vary dramatically, not only by state but also among adjacent jurisdictions within states, for unknown reasons. In the Denno et al. [1] study, a large number of risk factors for *Campylobacter* infection were identified. They included domestic travel, consumption of various foods, eating out, home food-handling practices, and various contacts with animals, water, and ill humans. With such a diverse array of risk factors, identifying interventions that will have a substantial effect on overall rates of this disease will be especially challenging.

Restaurant-associated outbreaks often attract substantial public attention. However, this work adds to the growing body of data suggesting that sporadic infection due to a variety of pathogens is also associated with eating at commercial food venues [5]. It is also one of the first studies to identify this as a risk specifically in children. If the proportion of the American diet prepared outside the home continues its steady growth, better understanding of this association will become increasingly important.

Several of the findings in this study are of particular interest in light of a number of recent high-profile, produce-associated outbreaks in the United States. Raw vegetable consumption appeared to be protective against *Salmonella* infection in this population, which is reassuring in the context of trying to encourage children to eat a diet high in fruits and vegetables for its many other health benefits. Of potentially great interest is the additional protection afforded by organic produce. Lower risk of infection is not a well-documented benefit of these products, and the finding is provocative as they become increasingly popular. All this said, the produce story is not a straightforward one. This study shows for the first time that salad from sealed retail packages, one. This study shows for the first time that salad from sealed retail packages, which has been a cause of large outbreaks, is also a risk factor for sporadic disease. Prevention of produce contamination is a difficult challenge and is currently the focus of intense discussion at the political, industry, and public health levels. It will be important to understand the particular risks associated with convenience packaging as consumer demands continue to...
evolve. This presents yet another argument for exploring food irradiation as a potential tool for ensuring a safer food supply.

Exposure to various recreational water activities was identified as a risk factor for all of the infections studied. This presents particularly vexing challenges for control. A variety of agencies typically regulate different types of recreational water sources. In Tennessee, for example, swimming pools are regulated by the Department of Health, drinking and surface water by different sections in the Department of Environment and Conservation, and other bodies of water by the US Army Corps of Engineers or US Forest Service, depending on their location. Frequently such agencies do not communicate regularly among themselves or with the public health agencies that monitor human disease. Mitigating these important risks will involve major interventions and require cooperation among a large number of nontraditional partners, including agriculture, public health, the regulatory sector, and other agencies and groups. As daunting as this may seem, we cannot afford to ignore factors responsible for population attributable risks of 20%–40% or more for bacterial enteric illnesses in children.

The factors Denno et al. [1] found not to be associated with disease were as provocative as the risk factors identified. Many of these factors were unexpected. Interestingly, breast-feeding was not shown to be protective against most of these infections, contrary to conventional wisdom. A variety of investigations have linked different pathogens with certain transmission vehicles. Curiously, in this study of sporadic infection in children, associations were not noted between consumption of chicken or eggs and *Salmonella* infection, consumption of ground beef and *E. coli* O157 infection, and day care exposure and *Shigella* infection or any other pathogens. Once again, findings from this study of sporadic infection differ from the findings in studies of outbreaks, for reasons that are enigmatic.

Finally, mothers everywhere will be dismayed at the lack of a protective effect for hand washing observed in this study, given its importance as the traditional cornerstone of infection control. There are enough other things to confuse the public with respect to this issue, such as debates over antibacterial versus non-antibacterial soap, hand sanitizers versus washing, and whether to recite the alphabet or sing the birthday song while washing to ensure adequate washing time. It is critical that we quickly get a better understanding of the findings suggested by this study.

The authors recognize that many of the findings of their study are limited by sample size and other factors. Nonetheless, they get an “A” for effort, and they raise a host of important questions that deserve additional investigation. The cases involved in this study were identified through passive surveillance. It is important to remember that the large majority of children with diarrheal disease never provide samples for culture (despite many of them receiving antimicrobial therapy) [6]. It is often difficult to make a clinical distinction between viral and bacterial infection, much less among different bacteria, without laboratory testing. From a public health viewpoint, it is important to have good data on the incidence of various etiologies of enteric infection, along with data on the risk factors for infection, to assess the overall burden of disease that might be averted by specific interventions.

A large proportion of bacterial enteric infection in children remains preventable. Although traditional consumer-oriented education and personal infection control practices are still vitally important, they will not suffice to reduce many of the environmental risk factors that are identified in this study as important as food-related exposures. Resources for disease prevention are limited and must be targeted effectively. The epidemiology of bacterial enteric infection in children is a moving target, and continued vigilance is necessary to ensure that preventive interventions keep pace with evolving risk factors among this high-risk population.

References