Challenges and Opportunities to Identifying and Controlling the International Spread of Salmonella

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(See the article by Le Hello et al, on pages 675–84.)

Foodborne illnesses result from dynamic interactions among agents, hosts, and the environments in which these interactions take place. In our quest to understand the biology behind these interactions and the ultimate outcome manifesting as disease, we dissect the genomes of these agents to identify the determinants of virulence and antimicrobial resistance. In addition, because agents such as *Salmonella* are living creatures that adapt to challenges in their environment, we use changes in their genomes to map the evolution and dissemination of clonal groups from within a broader population. When favorable environmental conditions and the availability of hosts align, the spread of a novel or particularly pathogenic clonal group may be recognized through public health surveillance. When recognized repeatedly over time or across multiple surveillance systems, this adapted agent may be defined as an emerging pathogen, leading to public health interventions to attempt to control its further spread.

In the current issue of the *Journal*, Weill and colleagues have examined national *Salmonella* surveillance systems from France, England and Wales, Denmark, and the United States to document just such an emergence of a pathogenic, multidrug-resistant clonal group of *Salmonella* Kentucky that displays a high-level resistance to ciprofloxacin [1]. Their analysis of the epidemiology of reported cases and the molecular biology of the isolated strains allows them to make a compelling argument that this clone originated in Egypt during the 1990s and subsequently spread across North Africa into the Middle East. Although most of the European cases have occurred in travelers returning from Africa or the Middle East, some cases may have resulted from secondary contamination from returning travelers or through imported foods [1]. Poultry has been identified as the primary reservoir; however, the detection of this clone in the United States on several samples of spices imported from North Africa raises a particular concern. Contaminated food ingredients could result in contamination of animal feed as well as human food [2]. This could serve as a portal of entry into our production agriculture systems.

Weill and colleagues demonstrated the power and importance of linking public health surveillance systems on an international level. By assembling laboratory-based surveillance data for S. Kentucky from 2000 to 2008, they were able to present a clear picture of the emergence and current epidemiology of illness caused by this agent, identify clinical and public health challenges posed by this clone, and establish a framework to control its further spread. This was a remarkable achievement that highlights the importance of public health surveillance in a global food system. It also presents 2 major technical and policy challenges: (1) How can we better integrate public health, animal population, and food surveillance to identify the earlier emergence and spread of other multidrug-resistant *Salmonella* clones? and (2) How can public health surveillance be maintained and improved in the face of growing budget deficits across the United States and Europe?

The ability to integrate public health surveillance for *Salmonella* on an international basis is limited by differences in national surveillance systems. Weill et al report that the percentage of *Salmonella* isolates submitted from clinical laboratories to national public health reference laboratories ranged from 65% in France to 99% in Denmark. Antimicrobial sensitivity testing was conducted on 99% of isolates in England and Wales, but only on 5% of a sample of isolates in the United States. Subtyping of *Salmonella* isolates was not routine in France. Phage-typing was conducted on the major serotypes in England and Wales, and pulsed-field gel electrophoresis was conducted on...
The introduction and dissemination of poultry flocks in the United States [3]. Thus, international comparisons of public health surveillance require considerable effort, which limits the timeliness of detecting the international spread of an emerging clone. The timeliness of public health surveillance is the key to implementing effective control measures. The emergence of multidrug-resistant S. Kentucky was identified before the clone spread to poultry flocks in Europe or the United States. Producers and regulators can now look for these strains and rapidly respond to their presence. This is important because S. Kentucky is a common serovar in poultry, and a particular clone of S. Kentucky that recently acquired a virulence plasmid appears to have become widely disseminated among poultry flocks in the United States [3].

The introduction and dissemination of the multidrug-resistant clone of S. Kentucky could be a major public health threat, similar to the earlier emergence and global dissemination of Salmonella Typhimurium DT104 [4].

The emergence and spread of clinically significant clonal groups of Salmonella appear to occur on a regular basis [5]. Integrating public health surveillance with surveillance of food animal populations and monitoring of food commodities would greatly increase the likelihood of early detection of these zoonoses before they became widely disseminated. In addition, such surveillance could be useful to identify potential “hot spots” for the acquisition of novel virulence factors or resistance genes. Such hot spots, whether they be geographic areas or particular production settings or practices, would warrant additional surveillance and control efforts.

As highlighted by the effort required to look across 4 well-developed national Salmonella surveillance systems, there will be considerable challenges to effectively integrate public health, animal, and food surveillance at national and international levels. However, given the medical costs and public health impact associated with the spread of multidrug-resistant organisms, the potential benefits of such a system should far outweigh its costs. Unfortunately, the United States and many European countries are facing unprecedented budget deficits. Support for many public health activities, including primary and secondary prevention measures, such as public health surveillance, is considered discretionary. Discretionary spending is being cut. The value of prevention that may result from effective surveillance is not directly measurable as a budget item the way the cost of operating the surveillance system is. Therefore, cutting these funds does not appear to result in a direct and measurable harm. To counter this short-sighted impression, visionary and strong political leadership is needed to invest in the public health surveillance that is critical to improving or maintaining the safety of our food supply.

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