Better Use of IT Could Minimize the Next Salmonella Egg-idemic

BY DANIEL CASTRO | AUGUST 2010

Big farms mean big opportunities, but also big challenges. Answering these challenges will require smart policies and innovative technology.

The nationwide recall of over half a billion eggs due to an outbreak of Salmonella Enteritidis at two Iowa farms has reminded the public and Congress of the importance of food safety in an increasingly concentrated industry. Big farms mean big opportunities, but also big challenges. Answering these challenges will require smart policies and innovative technology. To that end, policymakers should recognize the important role that information technology (IT) can and should play in improving public safety and health.

Today, IT is widely used in agriculture: farmers use wireless sensor network to monitor moisture and soil conditions thereby improving irrigation and reducing the use of pesticide; farmers use RFID tags to track the growth and production of livestock; and farmers use computer modeling to predict everything from crop yields to interest rates. Even Robert Lane, the CEO of John Deere which makes tractors and other heavy farm machinery, argued that his company no longer made tractors but instead "sophisticated mobile information factories." The use of GPS allows farmers to automate plowing and seeding. As Lane says, the tractors "practically drive themselves, while the driver uses the Internet to sell corn."[1]

IT has taken on a greater role in agriculture in the past few decades in part because of greater concentration in the food sector. Since the 1980s the United States has seen a trend towards greater consolidation in agriculture. For example, the Government Accountability Office (GAO) reports that at the farm level "less than 2 percent of farms accounted for 50 percent of total sales in 2007."[2] Similarly, GAO found that in the pork sector, "the market share of the largest four hog slaughtering firms increased from 36

percent in 1982 to 63 percent in 2006."[3] Economies of scale mean that larger farms are more likely to be able to afford and reap the benefits of advanced technology. As a result, greater concentration in the food industry has encouraged more technological innovation thereby improving productivity and lowering the cost of food.

One downside of greater concentration is that the impact of an outbreak of a foodborne pathogen on a large farm is felt nationwide. The recent outbreak of *Salmonella Enteritidis* in shell eggs is part of a larger trend in serious outbreaks of foodborne illness in the United States over the past few years. In January 2009, over 500 people fell ill after eating tainted food linked to a salmonella outbreak at the Peanut Corporation of America. In 2007, over 1,400 people were sickened by salmonella found on jalapeno and Serrano peppers from Mexico. In 2006, three people died and almost 200 became ill because of an E. coli epidemic caused by eating California spinach.[4]

Salmonella is the most common intestinal infection in the United States and is the cause of the recent egg recall. The *Salmonella Enteritidis* bacterium lives in the intestinal tracts of animals and birds, and humans can become infected by eating raw or undercooked eggs. In particular, the elderly, infants and individuals with compromised immune systems are at greater risk for a severe illness if the infection spreads from the intestine to the blood stream. Given the aging population of the United States, food safety issues like this will be even more important in the future.

Detecting and preventing *Salmonella* outbreaks is a non-trivial problem. While in the past *Salmonella* spread to eggs through fecal contamination, *Salmonella Enteritidis* spreads through infected ovaries in hens that otherwise appear healthy and contaminates the eggs before the shells are formed. Moreover, a hen may lay both infected and non-infected eggs making detection the source of an infection difficult on large farms. The Food and Drug Administration (FDA) introduced new egg safety regulations on July 9, 2010 for egg producers having 50,000 or more hens (smaller farms have until 2012 to implement the new regulations). While the new rules came too late for the most recent outbreak (and have been under debate since 2004), the FDA expects the new rules to reduce *Salmonella* infections by 60 percent, preventing 79,000 illnesses and 30 deaths every year.[5]

While these new rules will help prevent the spread of harmful pathogens, they cannot eradicate diseases. The next line of defense is food inspection—the U.S. Department of Agriculture (USDA) and the FDA inspect produce, meat, seafood, poultry and eggs to ensure food products are safe and correctly labeled. However, because of the volume of food, inspectors only examine a fraction of total food. For example, the United States imports over 60 percent of fresh fruits and vegetables and 80 percent of seafood and the FDA only examines approximately 1 percent of these products.[6] However, the FDA has invested in a multi-million dollar computer screening program—PREDICT—which allows it to use criteria such as a product's history, country of origin, facilities inspection data, and other information to strategically target which shipments to inspect for possible violations of FDA regulations.

Even with targeted inspections, inevitably some tainted food will still slip through the cracks. Again, IT has an important role to play in helping to identify possible outbreaks.

PulseNet, a nationwide network of public health and food regulatory agency laboratories, is one such information system that is using IT to improve food safety that has entered the food supply chain. The Centers for Disease Control and Prevention (CDC) developed PulseNet to detect foodborne disease case clusters. Scientists at state health departments, local health departments, and federal agencies use pulsed-field gel electrophoresis (PFGE) to create DNA fingerprints of bacteria collected from infected individuals or food processing equipment. They then upload these unique PFGE patterns to a national database at the CDC where epidemiologists can analyze the data and study any abnormalities.

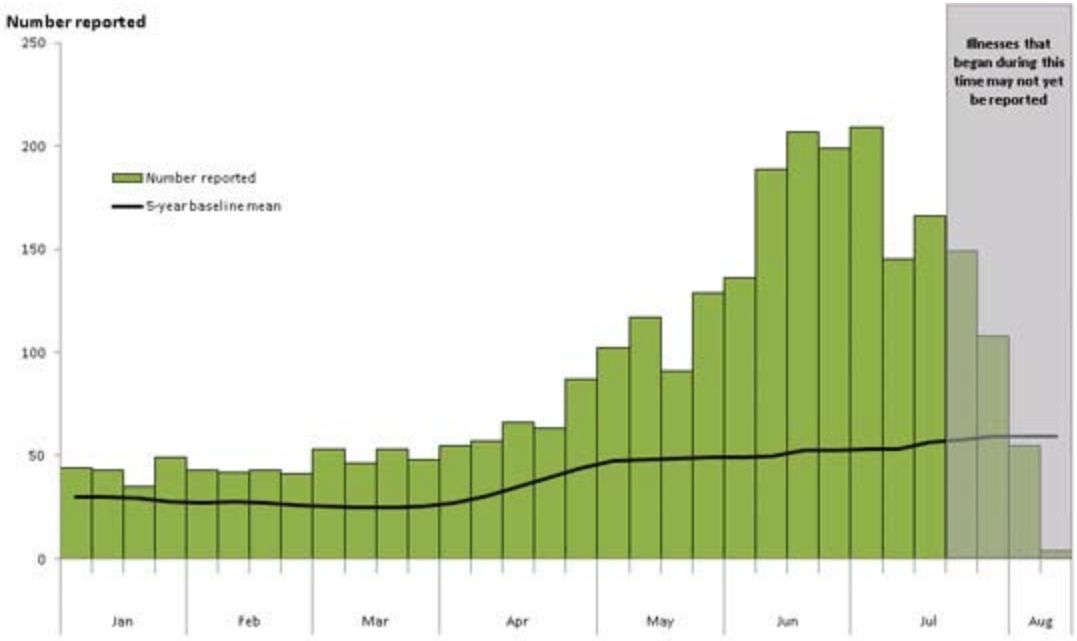

Figure 1: Number of Salmonella Enteritidis cases matching PFGE pattern JEGX01.0004 reported to PulseNet, United States, 2010[7]

PulseNet played a key role in identifying the recent outbreak on *Salmonella*. In May 2010, the CDC identified a spike in the number of cases of a specific strain of *Salmonella* Enteritidis reported to PulseNet (as shown in Figure 1). This abnormality triggered epidemiologic investigations by public health officials which led investigators to trace the source of the infections back to two common sources of eggs in Iowa. While the investigation was a success, arguably the recalls for the two farms did not occur quickly enough. The affected farms did not issue recalls until August 13, 2010 for Wright County Egg and August 18, 2010 for Hillandale Farms, a delay of well over two months. Currently, over 1,200 individuals in over 22 states have reported illnesses as a result of the outbreak.[8]

In the future, better information could allow public health officials to identify and trace outbreaks more quickly. For example, if a nationwide system of interoperable electronic health records were made available in real-time for public research, this could allow epidemiologists to track outbreaks from unreported or undiagnosed illnesses by looking at data on reported symptoms. The FDA is also developing new technologies to rapidly

capture, analyze and share data on foodborne pathogens through a web-based, interactive system.[9] Already researchers are using "rapid-learning" health networks to aid in biomedical research, effectiveness research and drug safety studies. For example, health informatics will allow medical researchers to determine the effectiveness of a particular treatment for a given population or to discover the harmful side-effects of a drug.[10] Researchers have launched many promising projects in this area including:

- The cancer Biomedical Informatics Grid (caBIG), a project to harness bioinformatics to advance cancer research
- The National Institutes of Health's National Electronic Clinical Trials and Research (NECTAR) network to share clinical research data between researchers and institutions
- The National Electronic Disease Surveillance System (NEDSS), a program to monitor public health for disease trends and outbreaks
- The FDA's Sentinel Initiative to monitor the safety of drugs and other medical products

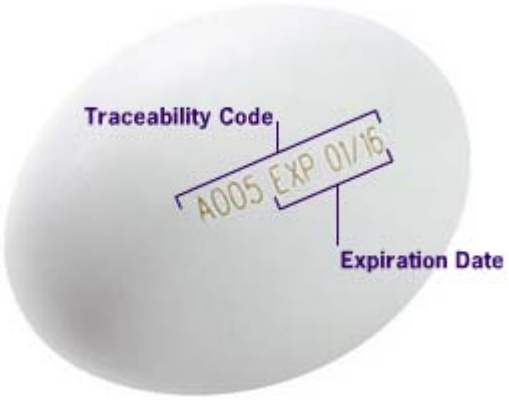

Figure 2: EggFusion tracking code and expiration date

How do we achieve this vision of real-time data on food products from farm to fork? Most of the pieces of the puzzle are already here. For example, the company EggFusion puts a code on every egg it sells which allows consumers to log onto the company's website and find information about the freshness of each individual egg (see Figure 2). Other technologies, such as electronic medical records, are still in development.[11] However, we need national leadership to focus on connecting the pieces. Many of these improvements are included in the FDA Food Safety Modernization Act (S. 510) which has been pending in Congress for over a year. The Act would require the relevant federal agencies to create common formats to facilitate information sharing among laboratories, improve recordkeeping to allow faster tracking and tracing of contaminated food, and further develop and improve surveillance systems to more rapidly detect and respond to foodborne illness outbreaks. As ITIF has argued previously, additional reforms, such as establishing a legal framework to facilitate sharing medical data for research and public health and creating standards for sharing anonymous aggregated data while still protecting privacy, would help in the development of rapid-learning health networks.[12]

Is more IT the only solution to *Salmonella* outbreaks? Of course not. But policymakers should remember that IT has an important role to play in monitoring, detecting and responding to public health threats and protecting the safety of our food supply.

ENDNOTES

[1] "Green revolutionary; Face value," *The Economist*, April 7, 2007.

[2] "U.S. Agriculture: Retail Food Prices Grew Faster Than the Prices Farmers Received for Agricultural Commodities, but Economic Research Has Not Established That Concentration Has Affected These Trends," Government Accountability Office, June 30, 2009, http://www.gao.gov/new.items/d09746r.pdf.

[3] Ibid.

[4] "Factbox: Recent outbreaks of foodborne illness in the U.S," Reuters, August 23, 2010, http://www.reuters.com/article/idUSTRE67M5EO20100823.

[5] "FDA: New Final Rule to Ensure Egg Safety, Reduce Salmonella Illnesses Goes Into Effect," U.S. Food and Drug Administration, press release, July 9, 2010, http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm218461.htm.

[6] "Food Safety: FDA Has Begun to Take Action to Address Weaknesses in Food Safety Research, but Gaps Remain," Government Accountability Office, April 23, 2010, http://www.gao.gov/new.items/d10182r.pdf.

[7] "Investigation Update: Multistate Outbreak of Human Salmonella Enteritidis Infections Associated with Shell Eggs," Centers for Disease Control and Prevention, August 20, 2010, http://www.cdc.gov/salmonella/enteritidis/epi_curve.html.

[8] "Egg recall points up need for Senate action on food safety," Washington Post, August 24, 2010, http://www.washingtonpost.com/wp-dyn/content/article/2010/08/23/AR2010082304247.html.

[9] "FDA-TRACK CFSAN Science and Research Dashboard," U.S. Food and Drug Administration, July 7, 2010, http://www.fda.gov/AboutFDA/Transparency/track/ucm205987.htm.

[10] Daniel Castro, "The Role of Information Technology in Medical Research," 2009 Atlanta Conference on Science and Innovation Policy, October 28, 2009, http://www.itif.org/files/2009-it-medical-research.pdf.

[11] Daniel Castro, "Explaining International Health IT Leadership,"

[12] Castro, "The Role of Information Technology in Medical Research."