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## Foodborne Infections and the Global Food Supply: Improving Health at Home and Abroad

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## Foodborne Infections and the Global Food Supply: Improving Health at Home and Abroad

*Robert V. Tauxe* \*

### ABSTRACT

*In recent years, fourteen percent of the U.S. food supply has been imported from other countries, including many fresh and perishable foods. Although most outbreaks of illness and individual cases are related to foods from the United States, large and unusual outbreaks have been traced to imported foods that were likely contaminated in the country of origin. Investigation of these outbreaks requires collaboration across several disciplines as well as across international borders. Successful investigation can not only control the original problem, but can also inform public authorities in both countries about the need for strategies to prevent similar*

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outbreaks from happening in the future. Production of perishable foods in the developing world brings particular challenges because of the deficiencies in basic sanitation and hygiene and other elements of public health that Americans take for granted. The public health infrastructure in such countries is critical to identifying and controlling foodborne and waterborne challenges before they affect exported foods, and strengthening such infrastructure is an important part of general development efforts. Strategies to improve the health of the workers and rural populations in those countries and to increase the capacity of public health and food safety systems are likely to have long-term benefits to health in those countries, as well as preventing infections in the countries to which they export.

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#### I. HISTORICAL INTRODUCTION

Food safety is a major and current public health challenge in the United States. The burden of illness has been estimated to be 76

million illnesses and over five thousand deaths each year.<sup>1</sup> Most of the recently recognized food safety challenges, including those related to meat, poultry, produce, and raw shellfish, concern food produced in this country.<sup>2</sup> The Institute of Medicine has reviewed these general challenges and recommended approaches to making further improvements in food safety in the United States.<sup>3</sup> It is also true that imported foods have presented a challenge in the last decade. The issues surrounding these imported foods are the focus of this Article.

Americans enjoy a food supply that is more ample, more nutritious, and safer than our forebears did one hundred years ago, when the publication of Upton Sinclair's novel *The Jungle* ushered in the modern era of food safety.<sup>4</sup> In 1906, the establishment of the forerunners of the Food and Drug Administration (FDA) and the Food Safety and Inspection Service (FSIS) of the U.S. Department of Agriculture (USDA) brought federal regulatory attention to the food supply.<sup>5</sup> The evolution of our food safety system since then has been spurred by recurrent large outbreaks of illness, informed by research findings from food and agricultural scientists, and driven by the demands of the food marketplace. Pasteurization of milk, reliable high-pressure canning, and the eradication of tuberculosis and trichinosis from our food animals have dramatically improved the safety of our food and are now taken largely for granted.<sup>6</sup> The current system is based on the "farm-to-table" philosophy, in which all the participants in the sequence of production, processing, and final preparation of our food have recognized roles in making the final food safe.<sup>7</sup> In the last decade, the safety engineering method called hazard analysis-critical control point (HACCP) has been applied in

1. Paul S. Mead et al., *Food-related Illness and Death in the United States*, 5 EMERGING INFECTIOUS DISEASES 607, 607 (1999).

2. See, e.g., Editorial, *When Spinach Isn't Good for You*, N.Y. TIMES, Oct. 2, 2006, at A18.

3. See generally INST. OF MED., NAT'L RESEARCH COUNCIL, SCIENTIFIC CRITERIA TO ENSURE SAFE FOOD (Nat'l Academies Press 2003) (laying the groundwork for creating new regulations that are consistent and reliable and that ensure better protection of the health of American consumers).

4. See Robert V. Tauxe & Emilio J. Esteban, *Advances in food safety to prevent foodborne diseases in the United States*, in SILENT VICTORIES: THE HISTORY AND PRACTICE OF PUBLIC HEALTH IN TWENTIETH-CENTURY AMERICA 22 (John W. Ward & Christian Warren eds., 2007).

5. See Federal Food and Drugs Act of 1906, ch. 3915, 34 Stat. 768, 770 (repealed 1938); Federal Meat Inspection Act (Act of Mar. 4, 1907), ch. 2907, 34 Stat. 1260-65, amended by Wholesome Meat Act, Pub. L. No. 90-201, 81 Stat. 584 (1967); see also Richard A. Merrill & Jeffrey K. Francer, *Organizing Federal Food Safety Regulation*, 31 Seton Hall L. Rev. 61, 64 (2000).

6. David Cutler & Grant Miller, *The Role of Public Health Improvements in Health Advances: The Twentieth Century United States*, 42 DEMOGRAPHY 1, 2 (2005).

7. See, e.g., Michael T. Roberts, *Role of Regulation in Minimizing Terrorist Threats Against the Food Supply: Information, Incentives, and Penalties*, 8 MINN. J. L. SCI. & TECH. 199, 202 (2007) (defining "farm-to-table").

several sectors of the food industry and has seen real success in the meat industry.<sup>8</sup>

At the same time, our food has also become safer because of important changes in the health of the U.S. public, particularly in cities where more and more of us live. In the nineteenth and early twentieth centuries, food and water that were directly contaminated with human sewage were major sources of disease, causing epidemics of cholera, typhoid, and dysentery.<sup>9</sup> The “sanitary revolution” which brought us safe drinking water and sewage treatment was arguably the greatest advance in public health in the twentieth century.<sup>10</sup> The development of a robust public health system has also been an important factor. The U.S. has expanded public health notifiable disease surveillance at local, state, and national levels; introduced increasingly sophisticated methods for detecting and investigating outbreaks; and used the results of those investigations to guide continuous improvements in the prevention of foodborne disease.<sup>11</sup>

Now, many serious foodborne and waterborne infections are part of the remote past. Typhoid fever and cholera have become extremely rare, and the cases that occur in the U.S. are typically the result of travel to the developing world, where those same infections remain common.<sup>12</sup> Nonetheless, *Salmonella*, *E. coli* O157, *Campylobacter*, *Vibrio*, and other pathogens with major reservoirs in American food animals continue to cause large numbers of illnesses despite the progress that has been made.<sup>13</sup> The recent large outbreaks of infections with *E. coli* O157:H7 and *Salmonellae* associated with domestic spinach, lettuce, tomatoes, and peanut butter highlight the immediate need for major improvements in food safety here in the United States.<sup>14</sup> Many of these foodborne infections that challenge us now are the result of the contamination of our food with animal manure in this country.<sup>15</sup> The next great challenge of food safety in the U.S. may be to bring about an agricultural “sanitary revolution” to clearly separate animal manure from food and water supplies, and to make water, feed, and fertilizer for the animals and plants safer.

8. Justine Hinderliter, Comment, *From Farm To Table: How This Little Piggy Was Dragged Through the Market*, 40 U.S.F. L. REV. 739, 745 (2006).

9. Cutler & Miller, *supra* note 6, at 3.

10. *Id.* at 2.

11. See Robert V. Tauxe, *Molecular Subtyping and the Transformation of Public Health*, 3 *FOODBORNE PATHOGENS & DISEASE* 4, 4–8 (2006).

12. CENTERS FOR DISEASE CONTROL AND PREVENTION [CDC], HEALTH INFORMATION FOR INTERNATIONAL TRAVEL 2005–2006 110, 291 (Paul M. Arguin et al. eds., Elsevier Mosby 2005) [hereinafter CDC HEALTH INFORMATION].

13. Mead, *supra* note 1, at 609.

14. See, e.g., Libby Sander, *Source of Deadly E. Coli is Found at California Ranch*, N.Y. TIMES, Oct. 13, 2006, at A20.

15. See *id.*

## II. AN INCREASINGLY INTERNATIONAL FOOD SUPPLY

U.S. consumers, in pursuit of fresh foods that are available year round, appreciate an increasing array of perishable foods imported from other countries. The produce aisles of U.S. grocery stores are full of items that are produced and packed in other parts of the world, including many developing nations.<sup>16</sup> In 2001, eleven percent by weight of the entire U.S. food supply was imported, including twenty-three percent of fresh and frozen fruit, seventeen percent of fresh and frozen vegetables, and eighty-three percent of fresh and frozen seafood.<sup>17</sup> This represents a significant increase over past import figures. In comparison, back in 1980, only five to six percent of American fresh and frozen produce was imported.<sup>18</sup> Mexico is the source of twenty-seven percent of fruit imports, and other Latin American countries provide an additional forty percent.<sup>19</sup> One longstanding concern raised by these imports is the potential introduction of the Mediterranean fruit fly that would be harmful to American orchards.<sup>20</sup> This concern is overcome by irradiation, fumigation, or other treatments used to kill fruit fly larvae in fruit imported from areas known to have that insect.<sup>21</sup> The importation of fresh meat has been historically far more restricted because of concerns about animal diseases—such as hoof-and-mouth disease in cattle, or African swine fever—that have been eradicated from this country but remain endemic in other countries.<sup>22</sup> Because these animal diseases might damage domestic animal production if they are imported along with the meat from other countries, the fresh and frozen meat imported by the U.S. has come largely from Canada and Australia—countries with well-established animal disease control programs—and more recently from Argentina, after that country successfully eradicated hoof-and-mouth disease.<sup>23</sup> A curious situation thus emerges that many foods eaten without further cooking, including many fresh fruits and vegetables, are now imported from

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16. U.S. DEP'T OF AGRIC. [USDA], IMPORT SHARE OF U.S. FOOD CONSUMPTION STABLE AT 11 PERCENT (2003), available at <http://www.ers.usda.gov/publications/fau/july03/fau7901/fau7901.pdf> [hereinafter USDA IMPORT SHARE].

17. *Id.*

18. *Id.*

19. *Id.*

20. See, e.g., Editorial, *Mediterranean Fruit Flies Return to California*, N.Y. TIMES, Nov. 26, 1993, at A23.

21. *Id.*

22. See, e.g., *Russia Bans Livestock Imports from Armenia*, RUSSIA & CIS BUS. & FIN. DAILY, Aug. 29, 2007 (detailing the ban following reports of an outbreak of African swine fever in Armenia).

23. See, e.g., *Food, Beverages, and Tobacco: Argentina*, ECONOMIST INTELLIGENCE UNIT—BUS. LATIN AM., Sept. 12, 2005 (stating that “Argentina’s beef exports resumed their strong growth after the country was declared completely free of hoof and mouth disease in 2004”).

the same countries to which travelers are particularly advised to avoid fresh uncooked produce.<sup>24</sup> It is perhaps unsurprising, then, that outbreaks of foodborne illness in this country have been related to imported foods that became contaminated before they reached the U.S.

### III. THE ART AND PRACTICE OF THE FOODBORNE OUTBREAK INVESTIGATION

An outbreak of foodborne illnesses occurs when a group of people become ill with the same infection after eating the same food.<sup>25</sup> CDC collects reports of outbreaks of foodborne diseases investigated by state health departments and publishes the results of this surveillance periodically.<sup>26</sup> The data collected rarely indicate the country of origin of the implicated food, probably because this is often not determined in the investigation.<sup>27</sup> In addition, CDC assists state health departments directly in conducting some investigations, particularly when there are large, severe, or multi-jurisdictional outbreaks.<sup>28</sup> Each investigation provides an opportunity to learn about the nature and source of the contamination, particularly when a specific food is implicated and then traced back to its source. A detailed public health investigation can reveal how contamination might likely have occurred and how it might be prevented. These investigations often have two goals: to control the immediate hazard and to reconstruct how it happened, so that similar outbreaks can be prevented in the future.

Outbreak investigations are usually labor-intensive epidemiological efforts to implicate the food that was likely the vehicle of transmission. Once a food is implicated, tracing its origin depends on the review of sales records and the cooperation of the industry.<sup>29</sup> Some foods, including hamburger, mixed greens, milk, and eggs, are a blended product of many original farms, and it can be difficult to identify the exact farm of origin.<sup>30</sup> Though the implicated food may have been contaminated at any of several points from farm

24. CDC HEALTH INFORMATION, *supra* note 12; USDA IMPORT SHARE, *supra* note 16, at 3.

25. CDC, *Surveillance for Foodborne-Disease Outbreaks—United States, 1998-2002*, 55 MORBIDITY & MORTALITY WKLY. REP. 1 (2006), available at <http://www.cdc.gov/mmwr/PDF/ss/ss5510.pdf>.

26. *Id.*

27. *Id.*

28. *Id.*

29. ELISE GOLAN ET AL., USDA, TRACEABILITY IN THE U.S. FOOD SUPPLY: ECONOMIC THEORY AND INDUSTRY STUDIES (2004), available at <http://www.ers.usda.gov/publications/aer830/aer830.pdf>.

30. *Id.*

to final table, the size and shape of the outbreak can offer important clues about where the contamination is likely to have happened. For example, if the same illness struck many persons simultaneously after they ate a food item obtained at many different stores of a restaurant chain, then investigators can infer that the item must have been contaminated before it reached the final kitchen. Reconstructing how contamination occurred takes a multi-disciplinary assessment of conditions on the farm, both before and after harvest, as well as throughout the chain of processing and distribution.<sup>31</sup>

When the implicated food is produced in another country, reconstruction becomes more complex. For the investigation to successfully identify the problem, the health and agricultural authorities of both the exporting and importing countries need to collaborate. This means that the capacity and authority of the authorities in the exporting country is critical to success. Without such international collaboration, the investigation may not identify the likely problems that contributed to contamination, which makes it difficult to find immediate or long-term ways to improve the safety of the food. In the absence of such improvements, trade embargoes are a regrettable but occasionally necessary alternative.<sup>32</sup>

The source of the implicated foods is not routinely included in the reports of foodborne outbreak investigations in the United States, so it is not possible to identify the proportion of foodborne disease outbreaks caused by domestic and by imported foods.<sup>33</sup> However, in some outbreaks, the implicated food is determined to have come from another country.<sup>34</sup> These outbreaks have been caused by a variety of pathogenic agents, including bacterial, viral, parasitic, and natural toxins.<sup>35</sup> The implicated foods fall into three main categories: fresh produce from Latin America; *queso fresco* from Latin America; and fish from the Pacific.<sup>36</sup> The first category of foods has led to the largest and most serious outbreaks, and several illustrative examples are presented below. The second category, *queso fresco*, is an example of the introduction of traditional (pre-pasteurization) foods from rural Mexico and Central America through the migration of Mexicans and Central Americans to the United States.<sup>37</sup> The third category relates largely to large deep-sea fish like tuna or mahi-mahi, whose flesh

31. *Id.*

32. *See, e.g., Russia Bans Livestock Imports from Armenia, supra* note 22.

33. These facts come from the Author's own work and experience at the CDC.

34. *Id.*

35. Mead et al, *supra* note 1, at 607.

36. GOLAN ET AL., *supra* note 29

37. Pia D. M. MacDonald et al., *Outbreak of Listeriosis Among Mexican Immigrants as a Result of Consumption of Illicitly Produced Mexican-Style Cheese*, 40 *CLINICAL INFECTIOUS DISEASES* 677, 678 (2005).

contains histamine or scombrototoxin if they are held too long without refrigeration after they are caught.<sup>38</sup> A few small but distinctive outbreaks of histamine fish poisoning occur each year in this country, which are occasionally caused by imported fish.<sup>39</sup>

#### IV. ILLUSTRATIVE OUTBREAKS

##### A. *Cyclospora and Central American Raspberries*

In 1996, a series of outbreaks of an unusual parasitic infection occurred in many parts of the United States and Canada.<sup>40</sup> Before the outbreak, the parasite, *Cyclospora cayetanensis*, was known to cause prolonged diarrheal illness in persons traveling to remote parts of the world, like Katmandu, and was exceedingly rare in the United States.<sup>41</sup> That year, 1,465 cases were reported from twenty states, the District of Columbia, and two Canadian Provinces.<sup>42</sup> Many of these cases were part of fifty-five distinct outbreaks at group events, and others occurred as individual sporadic cases.<sup>43</sup> Investigation of the group events soon linked the instances of illness to eating fresh raspberries from Guatemala, which had been hand-picked and quickly air shipped in May and June.<sup>44</sup> Raspberries had recently been introduced as an export crop in Guatemala.<sup>45</sup> Extensive investigations in Guatemala, with the collaboration of the Guatemalan authorities and the berry farmers themselves, identified some possible routes of contamination—such as the use of untreated water to spray the berry plants with insecticides—but did not identify a definite animal reservoir or other source of the contamination.<sup>46</sup> Local practices were modified, and exports continued the following year when similar outbreaks occurred again in the United States.<sup>47</sup> Unfortunately, local collaborative investigations declined to identify other control measures that might be taken, and early in 1998, raspberry imports from Guatemala were halted in the United

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38. CDC, Marine Toxins: Frequently Asked Questions, [http://www.cdc.gov/ncidod/dbmd/diseaseinfo/marinetoxins\\_g.htm](http://www.cdc.gov/ncidod/dbmd/diseaseinfo/marinetoxins_g.htm) (last visited Oct. 3, 2007).

39. *Id.*

40. Barbara L. Herwaldt et al., *An Outbreak in 1996 of Cyclosporiasis Associated With Imported Raspberries*, 336 NEW ENG. J. MED. 1548, 1548 (1997).

41. *Id.*

42. *Id.*

43. *Id.*

44. *Id.*

45. *Id.* at 1553.

46. *Id.* at 1554.

47. Barbara L. Herwaldt, *Cyclospora cayetanensis: A Review, Focusing on the Outbreaks of Cyclosporiasis in the 1990s*, 30 CLINICAL INFECTIOUS DISEASES 1040, 1052 (2000).

States.<sup>48</sup> Imports continued into Canada until later that year when more illness was identified and traced to Guatemalan raspberries.<sup>49</sup> Canada then halted further imports.<sup>50</sup> Subsequent field research showed that each spring a diarrheal illness caused by *Cyclospora* and associated with drinking untreated stream or river water affected children in Guatemala.<sup>51</sup> It remains unclear whether that same water was also the source of contamination of the berries, or whether the berries and the water were both contaminated by some unidentified creature. Until the source can be clarified and corrected, one must simply conclude that this is the wrong place to try to grow raspberries. Curiously, blackberries, which are indigenous to Central America, continue to be grown and exported from the same area without health consequences.<sup>52</sup>

The *Cyclospora* story provides several lessons. It shows how a rare and obscure disease can emerge when a new food is introduced into a growing region, how that disease can swiftly spread around a continent thanks to air transport, and how, despite earnest research efforts to understand contamination, the current solution depends on geographic exclusion—some foods should not be grown in some places.

#### B. Dysentery and Mexican Parsley

In July and August of 1998, two outbreaks of dysentery, or bloody diarrhea and fever, affected persons at two separate events in Minnesota.<sup>53</sup> Both outbreaks were caused by *Shigella sonnei*, which is a relatively common bacterial cause of foodborne infections in the United States, and most often the result of an infected food handler.<sup>54</sup> It was unusual to have two outbreaks in two separate locations that did not share kitchen staff.<sup>55</sup> The state health department used a DNA fingerprinting method, as part of a new national laboratory network called PulseNet, which showed that the *Shigella* strains from the two outbreaks had matching patterns.<sup>56</sup> This meant that it was likely that the two outbreaks were connected in some way. If a common foodhandler did not work in both kitchens, then perhaps a

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48. *Id.*

49. *Id.*

50. *Id.* at 1053.

51. Caryn Bern et al., *Epidemiologic Studies of Cyclospora cayetanensis in Guatemala*, 5 EMERGING INFECTIOUS DISEASES 766, 772 (1999).

52. Herwaldt, *supra* note 47, at 1053.

53. Timothy S. Naimi et al., *Concurrent Outbreaks of Shigella Sonnei and Enterotoxigenic Escherichia coli Associated with Parsley: Implications for Surveillance and Control of Foodborne Illness*, 66 J. FOOD PROTECTION 535, 535 (2003).

54. *Id.*

55. *Id.* at 536.

56. *Id.*

common food had been served in both. In one outbreak, standard epidemiological investigations associated illness with eating foods made with parsley.<sup>57</sup> In the second outbreak, parsley was strongly suspected.<sup>58</sup> Further investigation revealed that both kitchens got their parsley from the same source.<sup>59</sup> Because parsley is not often considered as a vehicle of foodborne infections, the investigators thought that it might be easily missed in other current outbreaks, so they sent an electronic alert to public health authorities around the continent.<sup>60</sup> As a result, six outbreaks in three other states and two Canadian provinces were identified and linked to the same strain.<sup>61</sup> In each of these, armed with the parsley hypothesis, investigators either conclusively identified it as the source or found strong though not conclusive reason to suspect it.<sup>62</sup>

In addition, two other outbreaks of gastroenteritis in Minnesota were linked to a second microbe, toxigenic *E. coli*, which is the usual cause of turista diarrhea among travelers to Mexico.<sup>63</sup> These two outbreaks were linked to parsley from the same distributor.<sup>64</sup> The United States does not routinely screen for toxigenic *E. coli* and no further outbreaks were identified.<sup>65</sup> In all, 486 persons were ill with shigellosis and seventy-seven with turista diarrhea.<sup>66</sup> The combination of two different enteric diseases from the same food item suggests to epidemiologists that the contamination scenario likely included raw sewage.<sup>67</sup>

The parsley was traced back through distributors to a farm in Mexico.<sup>68</sup> Investigators from the FDA, Mexico, and CDC visited the farm and made several noteworthy observations. The parsley was rinsed and chilled with water from the municipal system and iced using unchlorinated water.<sup>69</sup> Moreover, the farmworkers themselves avoided drinking the municipal water, and specified bottled water to drink instead in their work contract.<sup>70</sup> Consequently, it is possible that water used to rinse or chill the parsley had contaminated it,

57. *Id.*

58. *Id.*

59. *Id.* at 539.

60. *Id.* at 535.

61. *Id.*

62. *Id.* at 540.

63. *Id.* at 539.

64. *Id.*

65. *Id.*

66. *Id.* at 537.

67. *Id.* at 540.

68. *Id.* at 535.

69. *Id.* at 539.

70. CDC, *Outbreaks of Shigella sonnei Infection Associated With Eating Fresh Parsley—United States and Canada, July–August 1998*, 48 MORBIDITY AND MORTALITY WKLY. REP. 285, 287 (1999), available at <http://www.cdc.gov/mmwr/PDF/wk/mm4814.pdf>.

leading to a multinational outbreak of illness. Measures to prevent such an outbreak from happening again would include automated continuous on-site water disinfection with a failsafe switch to cut off the water if the chlorine level drops. Such equipment is used in many food processors in the United States, and while it may not be required by regulatory statute everywhere in this country, it is an obvious and essential part of good agricultural practices.<sup>71</sup> Any water used to process fresh foods should be water that is fit to drink.

### *C. Jaundice and Green Onions*

In 2003, large outbreaks of Hepatitis A infections affected customers of restaurants in Tennessee, Georgia, North Carolina, and Pennsylvania.<sup>72</sup> In all, 1,023 cases were reported.<sup>73</sup> In Pennsylvania, at least 124 of the 601 identified patients were hospitalized, and three died.<sup>74</sup> The patients manifested characteristics that were typical of this infection; they suffered from jaundice, abdominal pain, fever, and prolonged malaise.<sup>75</sup> Approximately fifteen thousand persons received prophylactic gamma globulin injections.<sup>76</sup> Using a new DNA laboratory method, the cases were shown to be caused by three closely related strains of the hepatitis A virus that were all very similar to those isolated in patients on the Texas-Mexico border.<sup>77</sup> Like *Shigella*, foodborne hepatitis A infections are typically associated with an infected food preparer; however in these outbreaks, which affected many different restaurants, grocery stores, and nursing homes in the four states, the common link was not a food handler.<sup>78</sup> Instead, illness was linked to green onions, which in turn were traced back through the supply chain to four likely source farms in northern Mexico.<sup>79</sup> In Mexico, hepatitis A is a common infection in young children, among whom it most often causes a milder diarrheal

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71. *Id.* at 288.

72. Joseph J. Amon et al., *Molecular Epidemiology of Foodborne Hepatitis A Outbreaks in the United States, 2003*, 192 *J. INFECTIOUS DISEASE* 1323, 1324 (2005).

73. *Id.*

74. Charlotte Wheeler et al., *An Outbreak of Hepatitis A Associated with Green Onions*, 353 *NEW ENG. J. MED.* 890, 890 (2005).

75. CDC, *Frequently Asked Questions About Hepatitis A*, <http://www.cdc.gov/ncidod/diseases/hepatitis/a/faq.htm> (last visited Sept. 23, 2007) (describing the symptoms often occurring as a result of Hepatitis A).

76. CDC, *Hepatitis A Outbreak Associated with Green Onions at a Restaurant—Monaca, Pennsylvania, 2003*, 52 *MORBIDITY & MORTALITY WKLY. REP.* 1155, 1155 (2003), available at <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm52d1121a1.htm>.

77. Amon, *supra* note 72, at 1326–28.

78. Amon, *supra* note 72, at 1326; Wheeler et al., *supra* note 74, at 891.

79. Amon, *supra* note 72, at 1328; Wheeler, *supra* note 74, at 895.

illness.<sup>80</sup> The initial investigation indicated that contamination was likely to have occurred at or soon after the time of harvest.<sup>81</sup> On-site investigation with FDA, Mexican authorities, and CDC revealed issues of concern, including questionable quality of water used in packing sheds and for ice-making, as well as poor sanitation and handwashing facilities.<sup>82</sup> On other green onion fields, young children in diapers played on the piles of harvested produce.<sup>83</sup> Measures that might prevent such outbreaks from recurring again in the future include ensuring that water used for washing and for making ice is disinfected and high quality, and separating young children from harvested food.<sup>84</sup>

#### D. *E. coli* O157 and Alfalfa Seeds from Down Under

Another event illustrates that the source of an imported food problem is not always the developing world. In 2003, two related outbreaks of infection with *E. coli* O157 bacteria were linked to eating alfalfa sprouts.<sup>85</sup> One outbreak in Minnesota affected seven persons in January and February of that year, and another in Colorado affected thirteen persons in July and August.<sup>86</sup> The two outbreaks were caused by *E. coli* strains with matching PulseNet DNA fingerprint patterns.<sup>87</sup> The strains had not previously been identified in the United States.<sup>88</sup> Traceback indicated a common source of seeds used by two sprouters.<sup>89</sup> The seeds came from one seed producer in Australia, who harvested the seeds in order to grow more alfalfa.<sup>90</sup> A regulatory quirk applies to alfalfa seeds: because the public does not consume the seeds themselves, the seeds are

80. See CDC, PREVENT HEPATITIS A (Jan. 2006), available at [http://www.cdc.gov/ncidod/diseases/hepatitis/resource/PDFs/hepa\\_01.pdf](http://www.cdc.gov/ncidod/diseases/hepatitis/resource/PDFs/hepa_01.pdf) (explaining that people in countries where Hepatitis A is common, such as Mexico, are at a higher risk for getting Hepatitis A, and that children with Hepatitis A often have no symptoms).

81. Wheeler, *supra* note 74, at 895.

82. Amon, *supra* note 72, at 1326.

83. Wheeler, *supra* note 72, at 896.

84. See Press Release, U.S. Food & Drug Admin. [FDA], FDA Update on Recent Hepatitis A Outbreaks Associated with Green Onions from Mexico (Dec. 9, 2003), available at <http://www.fda.gov/bbs/topics/NEWS/2003/NEW00993.html> [hereinafter FDA Press Release] (identifying water quality improvement and the monitoring of worker health and the sanitary conditions as ways to reduce the risk of future foodborne outbreaks of Hepatitis A).

85. D.D. Ferguson et al., *Temporally Distinct Escherichia coli* O157 Outbreaks Associated with Alfalfa Sprouts Linked to a Common Seed Source—Colorado and Minnesota, 2003, 133 EPIDEMIOLOGY & INFECTION 439, 439 (2005).

86. *Id.*

87. *Id.*

88. *Id.* at 442.

89. *Id.* at 444.

90. *Id.*

recognized as agricultural commodities—like seed corn or tomato seeds—rather than food.<sup>91</sup> Due to this unique classification, there is no direct regulatory approach to prevent contamination of these non-food seeds with bacteria that causes human illness or, for that matter, with chemicals toxic to humans.<sup>92</sup> However, when the seeds are sprouted in a moist warm environment, they rapidly become sprouts, which are food. Bacteria present on the seed can be amplified greatly in such an environment to numbers that can make many people ill.<sup>93</sup> Attempts have been made to control this problem by dipping seeds destined for sprouting into chlorine solutions and by culturing the water used to sprout the seeds.<sup>94</sup> However, neither process was sufficient to protect the public in this case.<sup>95</sup> In these outbreaks, the implicated seeds were diverted to be planted to make more alfalfa.<sup>96</sup> Although the source of the seeds was known, the FDA reported that because no memorandum of understanding existed between Australia and the FDA to allow for the exchange of confidential commercial information, the traceback investigation did not extend to Australia, and no international trace-forward investigation was conducted.<sup>97</sup> The preventive remedy in this case is for sprouters to apply the disinfection and testing protocols more thoroughly and to hope that the Australian authorities were able to learn more about how the seeds might have been contaminated in the first place, despite the lack of communication with the FDA.

### E. Queso Fresco and *Listeriosis*

The importation that leads to illness is not always formal and commercial. In 2003, the state of Texas reported to CDC a cluster of twelve illnesses that were caused by *Listeria monocytogenes*.<sup>98</sup> As is often the case with this organism, these illnesses occurred in young pregnant women, causing severe illness in the fetus and sometimes leading to miscarriage or stillbirth.<sup>99</sup> The infections were linked to

91. Peter J. Taormina, Larry R. Beuchat, & Laurence Slutsker, *Infections Associated with Eating Seed Sprouts: An International Concern*, 5 *EMERGING INFECTIOUS DISEASES* 626, 628–29 (1999).

92. See Ferguson et al., *supra* note 85, at 446 (“[This] investigation suggested that even with compliance, current guidelines are insufficient to reliably ensure alfalfa sprout decontamination.”).

93. Taormina et al., *supra* note 91, at 629.

94. *Id.* at 629–30.

95. *Id.* at 629.

96. Ferguson et al., *supra* note 85, at 443.

97. *Id.* at 444.

98. Infectious Disease Control Unit, Tex. Dep’t of State Health Services, *Listeriosis in Texas Associated with Consumption of Queso Fresco*, EPILINK, July 30, 2007, at 1, 2, available at [http://www.dshs.state.tx.us/idcu/epilink/volume\\_64/issue\\_7/docs/640705.pdf](http://www.dshs.state.tx.us/idcu/epilink/volume_64/issue_7/docs/640705.pdf).

99. *Id.*

consumption of a Mexican-style soft, fresh cheese called *queso fresco*.<sup>100</sup> Samples of cheese collected from informal vendors in Texas yielded *Listeria monocytogenes* on culture.<sup>101</sup> The cheeses had been made in traditional ways from raw milk in homes and small firms in Mexico and brought over the border in suitcases to share with relatives or to sell.<sup>102</sup> Similar Mexican-style cheeses have caused past outbreaks of infections in the United States, such as salmonellosis, listeriosis, and brucellosis, when raw milk was used for informal cheese making.<sup>103</sup> Most recently, informal shipment of this cheese from private citizens in Mexico has been suspected as a source of an ongoing outbreak of pediatric tuberculosis in New York City.<sup>104</sup> The availability of low-cost overnight package shipping services from small towns and villages in Mexico means that family members can ship “the taste of home” to anywhere in the United States, along with any pathogens that might be included.<sup>105</sup> The remedy in this case is long-term: U.S. health and food safety authorities must educate recent immigrants about the need for pasteurization and work with their Mexican counterparts to bring the same message to the rural population of that country.

#### F. *The Unintended Consequence of a Regulation: Mangoes and Salmonella Newport*

Sometimes an outbreak can actually be caused by international trade regulations. In 1999, a particular serotype of *Salmonella* bacteria caused a large multistate outbreak of infections affecting at least seventy-eight persons in thirteen states.<sup>106</sup> Epidemiological investigation of persons infected with that strain, defined by serotyping as *Salmonella* Newport and shown by PulseNet to have a specific DNA fingerprint, strongly linked illness to eating fresh

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100. *Id.*

101. *Id.*

102. *Id.* at 3.

103. CDC, *Epidemiologic Notes and Reports, Brucellosis—Texas*, 32 MORBIDITY & MORTALITY WKLY. REP. 548, 553 (1983); MacDonald et al., *supra* note 37, at 677; Rodrigo G. Villar et al., *Investigation of Multidrug-Resistant Salmonella Serotype Typhimurium DT104 Infections Linked to Raw-Milk Cheese in Washington State*, 281 J. AM. MED. ASSOC. 1811, 1811 (1999).

104. CDC, *Human Tuberculosis Caused by Mycobacterium bovis—New York City, 2001–2004*, 54 MORBIDITY & MORTALITY WKLY. REP. 605, 605 (2005).

105. See Press Release, City of New York, 2005 Health Alert #8: *Mycobacterium bovis* in US-born children (Mar. 15, 2005), p. 3, available at <http://www.nyc.gov/html/doh/downloads/pdf/tb/Mbovishealthalert.pdf> (noting the transport of Mexican foods, including unlabeled cheeses, into New York City by “courier services”).

106. Sumathi Sivapalasingham et al., *A Multistate Outbreak of Salmonella enterica Serotype Newport Infection Linked to Mango Consumption: Impact of Water-Dip Disinfestation Technology*, 37 CLINICAL INFECTIOUS DISEASES 1585, 1585 (2003).

mangoes.<sup>107</sup> The mangoes were imported from Brazil, and had been produced at one large mango orchard that also exported mangoes to Europe.<sup>108</sup> Although European authorities use similar DNA fingerprinting methods, they were unable to find illnesses caused by the same strain.<sup>109</sup> Investigation of the orchard and packing plant by FDA, Brazilian authorities, and CDC revealed how the same mangoes could have such different impacts on two different continents.<sup>110</sup> Mangoes destined for export to the United States were required to be treated to prevent the introduction of the Mediterranean fruit fly into the United States.<sup>111</sup> Mangoes destined for Europe were simply boxed, refrigerated, and shipped, as the Mediterranean fruit fly is already native to Europe.<sup>112</sup> For many years, the standard fruit disinfection treatment had been fumigation with ethylene dioxide gas.<sup>113</sup> Because of concerns that the health of workers exposed to the toxic gas would be compromised and that the gas would harm the ozone layer, in the 1990s, the USDA required a shift to a different process.<sup>114</sup> The new process mandated dipping the mangoes into a hot water bath to kill any fruit fly larvae under the skin of the mangoes.<sup>115</sup> This was followed by a cold water dunk to stop the heat from changing the taste of the mangoes.<sup>116</sup> The hot water bath was not chlorinated, and the cold water bath was only chlorinated once a week, even though it was open to the environment and used constantly.<sup>117</sup> Unfortunately, when a hot mango is plunged into cold water, it draws some of that water into the interior of the fruit through simple suction, along with any bacteria in the water.<sup>118</sup> The microbiological implications of the water dips had not been considered seriously, and no one had recognized that dips containing contaminated water would contaminate the mangoes.<sup>119</sup> Once authorities recognized the link, the preventive remedy was clear: all water used in the dips should be routinely and continuously disinfected and protected from contamination. This should now, one hopes, be standard procedure wherever the USDA mandates the use of a hot water dip.

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107. *Id.* at 1585.

108. *Id.* at 1588.

109. *Id.* at 1586, 1589.

110. *Id.* at 1589.

111. *Id.*

112. *Id.* at 1588.

113. *Id.* at 1589.

114. *Id.*

115. *Id.*

116. *Id.* at 1588.

117. *Id.*

118. Ana Lucia Penteado, B.Shawn Eblen & Arthur J. Miller, *Evidence of Salmonella Internalization into Fresh Mangos During Postharvest Insect Disinfection Procedures*, 67 *J. FOOD PROTECTION* 181, 181 (2004).

119. Sivapalasingam et al., *supra* note 106, at 1589.

## V. TRANSLATING INVESTIGATIONS INTO IMPROVED FOOD SAFETY

These illustrative outbreaks show the insights into prevention that can be developed when food safety investigations cross borders and the likely sources and circumstances of contamination are identified. In the long run, the insights from these investigations will guide and propel sustained prevention efforts. As the food supply becomes more globalized, rapid and direct collaboration in surveillance, outbreak investigation, traceback, and prevention is critical.<sup>120</sup> International collaboration is the sine qua non of consequential investigation. In many of these outbreak investigations, close collaboration with the exporting country authorities and with the industry itself led to better prevention strategies for the long term.<sup>121</sup> Such investigations do not always occur. For example, the apparent inability of the FDA to communicate with Australian authorities about the alfalfa seeds made it less clear what happened and whether real prevention was possible.<sup>122</sup> If a country can export food or feedstuffs to another country, when a disease associated with that export occurs, communication with the food safety, public health, and agricultural authorities in that country must occur in order to investigate and resolve the problem, regardless of concerns about commercial confidentiality.

Not surprisingly, as demonstrated by the examples above, the largest outbreaks are related to imported fresh fruits and vegetables that are eaten without further cooking. These case studies demonstrate that close attention to the general principles of food safety, including the need for careful pasteurization, safe canning, good agricultural and manufacturing practices, and HACCP, is no less important in the production of food in the exporting country than it is in the United States. In particular, the quality of the water used for rinsing, chilling, and other produce treatment is critical and must be ensured with failsafe attention to water disinfection. Requirements for the safety of exported foods should be no less than those required in the United States, and may indeed need to be stronger. Certification and verification programs that reach back to the production sites are needed to make sure that safety measures are applied. This may take the form of purchase contract

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120. Robert V. Tauxe & James M. Hughes, *International Investigation of Outbreaks of Foodborne Disease*, 313 BRIT. MED. J. 1093, 1093 (1996).

121. See, e.g., Herwaldt et al., *supra* note 42, at 1555 (investigating *Cyclospora* outbreaks); Amon et al., *supra* note 72, at 1328 (investigating outbreaks in green onions); Taormina et al., *supra* note 91, at 632 (investigating outbreaks in sprouts). *But see* Sivapalasingam et al., *supra* note 106, at 1585 (showing a lack of international cooperation that resulted in a worsening of the outbreak).

122. Ferguson et al., *supra* note 85, at 444.

requirements imposed by the firms receiving the imports, or of regulations imposed by the food safety authorities in the exporting countries.

## VI. IMPROVING DISEASE PREVENTION IN GENERAL

Because food production may be occurring in countries where the general levels of water treatment, sanitation, and personal health are lower than the United States, the health of the workers in those countries, as well as their families, should also be a concern. While it is difficult to say just where the *Shigella* bacteria or the Hepatitis A virus described above came from, these are markers for contamination with feces of infected humans.<sup>123</sup> This means that reducing infections among workers, their families, and the surrounding populations would likely have a general preventive effect. Important changes are occurring. For example, up until 1991, the city of Santiago, Chile, used raw municipal sewage to irrigate the fields where the fresh produce was grown.<sup>124</sup> That year, spurred by a cholera epidemic, a sewage treatment plant was at last constructed.<sup>125</sup> In the following year, typhoid fever fell by eighty-six percent in Santiago, hepatitis fell by fifty-four percent, and cholera did not occur at all.<sup>126</sup> Provision of safe drinking water is another profound public health advance, provided either through well-maintained municipal systems, by point-of-use disinfection strategies, or both.<sup>127</sup> Spurred by the same cholera pandemic as that of Chile, Mexico embarked on a nationwide effort to reduce fecal transmission of these and other infections.<sup>128</sup> This effort has provided safe water for the great majority of the population, educated them in handwashing and sanitation measures, and improved access to medical care and preventive medicine, particularly for children.<sup>129</sup> As

123. Wheeler et al., *supra* note 72, at 890.

124. S. Alcayaga, J. Alcayaga & P. Gassibe, *Cambios del perfil de morbilidad en algunas patologías de transmisión enterica con posterioridad a un brote de colera. Servicio de Salud Metropolitano Sur. Chile*, 10 REVISTA CHILENA DE INFECTOLOGÍA 5, 5–6 (1993).

125. *Id.*

126. *Id.* at 7–8.

127. Thomas F. Clasen & Eric D. Mintz, *International Network to Promote Household Water Treatment and Safe Storage*, 10 EMERGING INFECTIOUS DISEASES 1179, 1179 (2004); Eric Mintz et al., *Not Just a Drop in the Bucket: Expanding Access to Point-of-Use Water Treatment Systems*, 91 AM. J. PUB. HEALTH 1565, 1565 (2001).

128. Jamie Sepúlveda, José Luis Valdespino & Lourdes García-García, *Cholera in Mexico: The Paradoxical Benefits of the Last Pandemic*, 10 INT'L J. INFECTIOUS DISEASES 4, 6 (2006) [hereinafter *Cholera in Mexico*]; Jamie Sepúlveda et al., *Improvement of Child Survival in Mexico: The Diagonal Approach*, 368 LANCET 2017, 2020–21 (2006).

129. *Cholera in Mexico*, *supra* note 128, at 9.

this program has advanced, the rates of pediatric diarrhea have plummeted from 7.2 per 1,000 live births in 1990 to 1.1 per 1,000 live births in 2005, and overall pediatric death rates have fallen by half in the same time period. The percentage of Mexican municipalities with potable water rose between 1990 and 1994: it was fifty-five percent in 1990, rising to eighty-five percent in 1991 and ninety-four percent in 1994.<sup>130</sup> The year 2005 marked the beginning of the next “International Decade for Action: Water for Life,” and further efforts are underway to promote access to safe drinking water around the world.<sup>131</sup> National improvement policies in other exporting countries similar to those undertaken in Chile and Mexico would be expected to make the foods imported from them safer as well.

As the *Cyclospora* saga shows, introducing new crops into subtropical and tropical areas may reveal new hazards not previously recognized in the exporting country.<sup>132</sup> The potential for introduction of pathogens from local wildlife and insects, as well as from the local water supply, must be considered. As the mango outbreak illustrates, regulations to control one part of a food safety problem that are developed without regard to microbiological circumstances can themselves lead to contamination and illness.<sup>133</sup>

The non-commercial and grey-market transport of foods across borders is a particularly difficult problem. In 1991, when the Latin American cholera epidemic was at its peak, two outbreaks of cholera occurred in the United States after crabs were brought informally from Ecuador to the United States, at about the same time as crabs were shown to be a source of cholera in Ecuador.<sup>134</sup> Though the transport of such “suitcase seafood” was not regulated, it was discouraged through education efforts in the Hispanic press and the cooperation of agricultural inspectors at airports.<sup>135</sup> Now the informal transport of “suitcase cheese,” *queso fresco* from Mexico made from unpasteurized milk, is a major challenge.<sup>136</sup> This cheese can be contaminated with a variety of pathogens, and without pasteurization it is generally unsafe.<sup>137</sup> The same cheese is sometimes made from unpasteurized milk obtained in the United

130. *Id.* at 11.

131. Christine L. Moe & Richard R. Rheingans, *Global Challenges in Water, Sanitation, and Health*, 4 J. WATER & HEALTH, Supplement 1, at 41, xx (2006).

132. Herwaldt, *supra* note 47, at 1052.

133. Sivapalasingham et al., *supra* note 106, at 1589.

134. Lyn Finelli et al., *Outbreak of Cholera Associated with Crab Brought from an Area with Epidemic Disease*, 166 J. INFECTIOUS DISEASES 1433, 1433 (1992); Ctrs. for Disease Control, *Epidemiologic Notes and Reports, Cholera—New York, 1991*, 40 MORBIDITY & MORTALITY WKLY. REP. 516, 517 (1991); J.T. Weber et al., *Epidemic Cholera in Ecuador: Multidrug-Resistance and Transmission by Water and Seafood*, 112 EPIDEMIOLOGY & INFECTION 1, 8 (1994).

135. Finelli et al., *supra* note 134, at 1435.

136. Villar et al., *supra* note 103, at 1815.

137. *Id.*

States, marketed door to door or through other unregulated means, and also causes outbreaks.<sup>138</sup> Education of those producing cheese in this country to first pasteurize the milk has had some local success, but the problem persists.<sup>139</sup> It seems likely to continue until the local standards of food safety in Mexico and Central America rise to the point of routine universal pasteurization of milk.

It is important to strengthen the public health and food safety infrastructure in exporting countries. Authorities need specific training and capacity so that local foodborne emergencies can be handled, and so that if an exported food causes illness in another country, the nature and source of the contamination can be identified and controlled. This capacity of the national public health and food safety authorities should be part of the degree of confidence we may have in the imported food itself. The basic capacities that would be relevant to food safety are: (1) surveillance of “indicator diseases,” such as salmonellosis, typhoid fever, hepatitis, and shigellosis; (2) the capacity at national and regional levels to perform laboratory diagnosis of common foodborne diseases; (3) the existence of a field epidemiology training and response team that can respond to the need to evaluate a problem at a food production facility as well as other public health emergencies; and (4) the readiness of trained food-safety authorities to conduct plant and field investigations. These capacities are now routine in most of the industrialized world.<sup>140</sup> Currently, CDC, WHO, and other countries collaborate in programs that support training in epidemiological and laboratory practice in some developing nations, such as the Field Epidemiology Training Program and WHO Global SalmSurv for laboratory training.<sup>141</sup> Requiring ongoing in-country support for similar programs as a precondition for permission to export perishable food stuffs would be one way to directly bolster the public health capacity of those countries.

## VII. MONITORING THE CHANGING RISKS

While the potential hazards are clear, it is not as clear that imported fresh produce now represents a higher actual risk than does

138. *Id.* at 1814.

139. *Id.* at 1815.

140. CDC, *Global Epidemiology: Proceedings of the Third TEPHINET Conference, Beijing, China, November 8-12, 2004*, 55 *MORBIDITY & MORTALITY WKLY. REP.* 1 (Supp. 2006) [hereinafter *Global Epidemiology*]; Eleni Galanis et al., *Web-Based Surveillance and Global Salmonella Distribution, 2000–2002*, 12 *EMERGING INFECTIOUS DISEASES* 381, 387 (2006).

141. *Global Epidemiology*, *supra* note 140, at 1; Galanis et al., *supra* note 140, at 381.

domestically produced produce. More routine identification of the origin of foods implicated in outbreaks would help in this regard. Systematic microbiological surveys would also be of use. In 2000 and 2001, the FDA carried out substantial microbiological surveys of both categories of produce.<sup>142</sup> It found that 4.4% of samples of imported fresh produce yielded evidence of a bacterial pathogen, compared to 1.6% of a sample of domestic produce.<sup>143</sup> The results of a recent similar survey are pending.<sup>144</sup> It is noteworthy that since the large hepatitis outbreaks of 2003, no other major outbreaks linked to imported produce from Latin America have been reported to CDC, though large and serious outbreaks related to domestic produce continue to occur with distressing regularity.<sup>145</sup> One may speculate that changes enacted in response to the large import-associated outbreaks early in this decade, as well as the ongoing improvement of public health in Mexico, may have further reduced contamination originating there. Though it is undetermined whether imported food is more or less safe than domestically-produced food, one may approach the prospect of prevention with some optimism that conditions on both sides of the international equation can improve further.<sup>146</sup>

Several policies might be considered to make prevention sustainable. Prevention could be enhanced in the exporting country through export taxation and program support, or through a public-private "check-off" program, which would collect a fee based on sales to support such efforts. That could include support for public health programs to educate workers about food safety issues, improve rural school-based hygiene, and with respect to drinking water safety, provide field latrines and other prevention measures on the farms. Prevention could also be enhanced through the consumer market,

142. FDA, CTR. FOR FOOD SAFETY & APPLIED NUTRITION, OFFICE OF PLANT & DAIRY FOODS & BEVERAGES, FDA SURVEY OF IMPORTED FRESH PRODUCE (2001), <http://www.cfsan.fda.gov/~dms/prodsur6.html> [hereinafter IMPORTED PRODUCE SURVEY]; FDA, CTR. FOR FOOD SAFETY & APPLIED NUTRITION, SURVEY OF DOMESTIC FRESH PRODUCE: INTERIM RESULTS (2002), <http://www.cfsan.fda.gov/~dms/prodsur9.html> [hereinafter DOMESTIC PRODUCE SURVEY].

143. IMPORTED PRODUCE SURVEY, *supra* note 142; DOMESTIC PRODUCE SURVEY, *supra* note 142.

144. DOMESTIC PRODUCE SURVEY, *supra* note 142.

145. See Allen S. Craig et al., *Hepatitis A Outbreak Activity in the United States: Responding to a Vaccine-Preventable Disease*, 334 AM. J. MED. SCI. 180 (2007) (reviewing outbreaks of foodborne Hepatitis A in the U.S. from 1994 to 2004 and finding an average of 23 incidents reported per year). The Author draws on unpublished work and experience in his office at CDC, which tracks foodborne outbreaks in the United States, for the conclusion that no other major outbreaks linked to produce from Latin America have been reported to CDC.

146. J.C. Buzby, *Globalization of the Food Supply and the Influence of Economic Factors on the Contamination of Food With Pathogens*, in FOOD CONSUMPTION AND DISEASE RISK—CONSUMER-PATHOGEN INTERACTIONS 31, 31–32 (Morris Potter ed., Woodhead Publ'g 2006).

using a recognizable logo that signals to the consumer that the producer supported a public health and food safety program. A logo for “Healthy Farms, Healthy Families” could indicate the circumstances of production for produce, allowing the concerned consumer to consider such circumstances as a basis for selection, similar to “Fair Trade” for coffee, or the “Forestry Stewardship Council” for hardwoods.<sup>147</sup>

Foodborne infections from imported foods will be a continuing problem, driven by consumer desire for fresh produce year-round, exotic foods, and, in the immigrant community, the taste of home. Requiring food safety processes in exporting nations to be the same as for foods produced in the United States is a logical starting point. However, large and well-investigated outbreaks demonstrate that this principle can be insufficient for several reasons. The food safety system of the United States remains incomplete itself. The risk of potential contamination is likely to be greater in the developing world. Entirely new and unanticipated challenges can arise. Because emerging foodborne diseases do not respect borders, our best defense is a robust public health system with good international connections.<sup>148</sup> Those connections need to include collaboration—in surveillance to detect new problems, in investigation to determine why problems occurred, and in prevention to stop problems from happening again—which lowers the risk of known problems and allows authorities to meet the challenge when new ones emerge.<sup>149</sup> Enhanced application of food safety measures is needed in the developing world; general sanitary conditions are not as good, making the risk of contamination greater. Strategies to improve the health of the workers and rural populations in those countries, as well as to increase the capacity of public health and food safety systems, are likely to have long-term benefits to public health in those countries and prevent infection in the countries to which they export.

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147. GlobalExchange.org, Fair Trade Coffee, <http://www.globalexchange.org/campaigns/fairtrade/coffee> (last visited Sept. 10, 2007); The Forestry Stewardship Council: Logo Use, [http://www.fscus.org/logo\\_use](http://www.fscus.org/logo_use) (last visited Sept. 10, 2007).

148. Robert V. Tauxe, *Emerging Foodborne Pathogens*, 78 *INT'L J. FOOD MICROBIOLOGY* 31, 31 (2002).

149. Tauxe & Hughes, *supra* note 120, at 1093–94.

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