COLLABORATION IN ANIMAL HEALTH & FOOD SAFETY EPIDEMIOLOGY: SWINE DATA

P. J. Cray¹, R. R. Kraeling*, N. E. Wineland², D. A. Dargatz², E. J. Bush², J. S. Bailey¹, S. R. Ladely¹, N. Anandaraman³

¹Richard B. Russell Agriculture Research Center, P.O. Box 5677, ARS, USDA, Athens, GA 30604 rkrailin@saa.ars.usda.gov,
²National Center for Animal Health Surveillance, APHIS, USDA, Fort Collins, CO 80526,
³Office of Public Health and Science, FSIS, USDA, Washington, D.C. 20250

Abstract The Collaboration in Animal Health & Food Safety Epidemiology (CAHFSE), a partnership among APHIS, ARS and FSIS of USDA was established to track food borne pathogens and monitor diseases from farm through plant. Sampling began in July, 2003. By December 31, 2004, 43 farms in 5 states were participating. In this period, 139 site visits were made. At each quarterly visit, a questionnaire regarding management practices was administered, blood samples were collected for Lawsonia and PRRS serology and 40 fecal samples were collected from pigs > 22 wks old for culture of enteric bacteria. All 5,161 fecal samples were cultured for Salmonella and 2066 (40%) for Campylobacter, E. coli and Enterococcus. Salmonella was cultured from 549 (9.7%) of the samples. Campylobacter, Enterococcus, and E. coli were cultured from 1465 (70.9%), 1407 (68.1%) and 1857 (89.9%) of 2,066 samples cultured, respectively. The predominant Salmonella serotypes recovered were: S. Derby (45%), S. Typhimurium var. Copenhagen (17.7%), S. Heidelberg (7.4%), S. Typhimurium (5.4%) and S. Give (4.6%). Approximately 94% of these were resistant to one or more antimicrobials.

Introduction Campylobacter and nontyphoidal Salmonella spp., respectively, are estimated to account for 2.4 and 1.4 million cases of acute bacterial gastroenteritis in humans annually in the United States (Mead et al. 1999). In recent years Salmonella and Campylobacter isolates have become increasingly drug resistant. Of particular concern is development of multi-drug resistance (MDR) in Salmonella, defined here as resistance to 2 or more antimicrobials. Zoonotic and/or pathogenic bacteria are not the only ones of concern regarding transfer and dissemination of resistance genes. Commensal bacteria are proposed as reservoirs of resistance genes (Levy, 2001) and they may transfer resistance genes among themselves as well as to zoonotic pathogens. However, definitive evidence for this process has not been established. Thus, the scientific community and public health officials have examined antimicrobial use in food animal production (Angulo, 1999; Levy, 2001; Tollefson and Miller, 2000; FDA, 1998: NRC, 1999; WHO, 1997). In addition, a multi-agency “Public Health Action Plan to Combat Antimicrobial Resistance” was developed to address these concerns about any adverse effects of using antimicrobials in food animal production (Available on the CDC web site). USDA responded by developing the Collaboration on Animal Health and Food Safety Epidemiology (CAHFSE), a partnership among the Animal and Plant Health Inspection Service (APHIS), Agricultural Research Service (ARS) and Food Safety and Inspection Service (FSIS). Overall objectives of CAHFSE are: 1) to enhance the overall understanding of pathogens that pose a food-safety risk by tracking these pathogens from the farm to the plant and 2) to monitor critical diseases in food-animal production. Specific objectives will be developed for each commodity under this general framework. These objectives and critical issues related to the relationship between antimicrobial susceptibility to antimicrobial use will be addressed on a long term continuous basis. Swine is the first commodity in CAHFSE.

Materials and Methods CAHFSE sampling began in July, 2003 and, as of December 31, 2004, 43 farms in 5 states had voluntarily participated in one or more data or sampling activities (12 in Iowa, 13 in Minnesota, 4 in Missouri, 10 in North Carolina and 4 in Texas). Selection criteria for soliciting farm participation included production types (indoor farrow-to-finish, outdoor farrow-to-finish, indoor finish only, and outdoor finish only) and size (number of pigs marketed per year; small <2,000, medium >2,000 and <7,500, large >7,500). Samples and data were collected quarterly. One hundred thirty-nine site visits were made in the first 18 months of the project. During each site visit, a questionnaire regarding animal inventory, animal health, management practices...
and antimicrobial use was completed. Blood was collected from up to 15 market pigs in each of 4 age groups (6-8 wks, 11-13 wks, 16-18 wks, and 22 wks and older) to be tested for antibodies to *Lawsonia intracellularis* and porcine reproductive and respiratory syndrome (PRRS) virus. In addition, up to 40 pen floor fecal samples were collected from pigs at least 22 wks old for isolation and subsequent characterization of enteric bacterial species. All 5,161 samples were cultured for *Salmonella* and 2066 (40%) were cultured for *Campylobacter, E. coli* and *Enterococcus*.

*Salmonella* isolates were serotyped and *Campylobacter* and *Enterococcus* isolates were specified using multiplex polymerase chain reaction (PCR). *E. coli* isolates were not typed further and are reported as non-type specific *E. coli*. Isolates were evaluated for susceptibility to a panel of antimicrobials. *Salmonella, E. coli* and *Enterococcus* isolates were evaluated using a semi-automated system (Sensititre, Trek Diagnostics, Westlake, OH) and *Campylobacter* were tested using the E-Test (AB Biodisk, Piscataway, NJ). The antimicrobial panels used were those also used by the National Antimicrobial Resistance Monitoring System: Enteric Bacteria (NARMS).

*Enterococcus* susceptibility testing data are not available yet. Selected isolates will be subjected to pulse field gel electrophoresis to determine if antimicrobial use, management strategies and/or type of facilities influence endemic bacterial strains. Sampling of pigs at slaughter (carcass swabs, lymph nodes, and ground product) will be pilot tested beginning by the summer of 2005. In-plant samples will be cultured for enteric bacterial species and isolates characterized similarly to on-farm isolates. Bacteriology results from on-farm samples and questionnaire data are expected to be linked to bacteriology results from in-plant samples and in-plant questionnaire data.

**Results** The on-farm bacteriology results for the first 18 months will be presented here. Results regarding animal health and risk factor analysis will be presented in future publications. *Salmonella* was cultured from 549 (9.7%) of the 5,161 fecal samples. *Campylobacter, Enterococcus, and E. coli* were cultured from 1465 (70.9%), 1407 (68.1%) and 1857 (89.9%) of 2,066 fecal samples cultured, respectively. Most of the *Salmonella* isolates were serogroup B (79.1%) followed by serogroup C1 (5.8%) and serogroup E1 (4.6%). The predominant *Salmonella* serotypes were: *S. Derby* (45%), *S. Typhimurium* var. Copenhagen (17.7%), *S. Heidelberg* (7.4%), *S. Typhimurium* (5.4%) and *S. Give* (4.6%). Overall, approximately 94% of these isolates were resistant to one or more antimicrobials. Of the 16 antimicrobials tested, the greatest percentage of *Salmonella* and *E. coli* isolates were resistant to tetracycline (92.0 and 92.3%), streptomycin (48.6 and 27.8%), sulfamethoxazole (42.0 and 31.1%) and ampicillin (34.3 and 24.6%), respectively. Of the 8 antimicrobials tested, the greatest percentage of *Campylobacter* were resistant to tetracycline (77.8%), azithromycin (64.6%), erythromycin (64.3%) and clindamycin (48%).

**Discussion** The National Animal Health Monitoring System’s (NAHMS) Swine 2000 study results indicated antimicrobials were fed to grower/finisher pigs on 88.5% of the swine operations, which accounted for 95.9% of grower/finisher pigs in the USA. Thus, the impact of antimicrobial use and related issues are a major interest for the pork industry. Little information is available comparing the effects of therapeutic, subtherapeutic, or prophylactic uses of antimicrobials in animal production on development and persistence of antimicrobial resistance among different bacterial species. With respect to food safety issues, CAHFSE is a long-term project which will provide on-farm and in-plant trends in prevalence, antimicrobial susceptibility, and genetic relatedness of enteric bacterial species including; *Salmonella, Campylobacter, Enterococcus* and non-type specific *E. coli*. Isolate characterization trends will be compared to management practices to help identify risk factors associated with antimicrobial resistant bacterial species in food animals and their products. In addition, results from the CAHFSE project will serve as the basis of hypotheses for on-farm and in-plant research.

**References**


