EMERGING INFECTIONS PROGRAMS (EIPS)

A collection of abstracts from the
International Conference on Emerging Infectious Diseases

March 24 - 27, 2002
Atlanta, Georgia

CDC

CENTERS FOR DISEASE CONTROL
AND PREVENTION

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TABLE OF CONTENTS

III. OTHER EIP PROJECTS

ACTIVE BACTERIAL CORE SURVEILLANCE (ABCs)

Oral Presentations

Antibiotic Susceptibility and the Mechanisms of Macrolide Resistance in Invasive Group B *Streptococcu*s, Minnesota, 1998 and 2000

J. Bartkus, C. Morin, S. Vetter, E. Thompson, A. Glennen, R. Lynfield

Minnesota Department of Health, Minneapolis, MN

The Emergence of Serogroup Y Disease and the Epidemiology of Invasive Meningococcal Disease in Colorado, 1997–2001

L. M. Hammond, K. A. Gershman

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Abstracts

Outpatient Candidemia: A Population-Based Study in Connecticut

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Candidemia is currently ranked as the fourth most common inpatient bloodstream infection in the United States. However, candidemia as an outpatient infection is not well described. We conducted a population-based laboratory surveillance study to identify incident cases of candidemia in Connecticut from October 1, 1998 through September 30, 2000. We were able to distinguish patients who had outpatient candidemia (defined as a positive blood culture for *Candida* at or within 48 hours of admission to a hospital, or a positive blood culture for *Candida* without a hospital admission) from those who had inpatient candidemia. During two years of surveillance, 464 cases of candidemia were identified, for an incidence rate of 7.2/100,000. Outpatient candidemia infection occurred in 28.7% (133/464) of cases. The species of *Candida* were different in proportion for outpatient versus inpatient cases. Among outpatient cases the species were *C. albicans* 37%, versus non-albicans 63%. The speciation among inpatient cases were C. albicans 57% versus non-albicans 43% ($p < 0.01$). There were no differences in age, race and gender. Among cases, 62% of outpatients and 43% inpatients had required hospitalization in the three months prior to the diagnosis of candidemia. Although outpatient candidemia cases were less likely than inpatient cases to have an indwelling catheter in place at the time of candidemia the proportion was still large (69% versus 96%). Antecedent use of immunosuppressive therapy was documented among 32% of outpatient and 50% of inpatient cases. Pulmonary disease was present in 56% and 81% of outpatient and inpatient cases respectively. A similar proportion of outpatient candidemia cases and inpatient candidemia cases had co-existing malignancy, diabetes mellitus, cardiac, neurological, renal, or liver disease. The median length of stay for outpatient cases was

11 days (range 0-98 days) compared to 36 days (range 5-497 days) for inpatient cases. The crude mortality rate was 26% for outpatient and 51% for inpatient cases ($p < 0.01$). Outpatient candidemia cases are more likely to be non-albicans, many of which are known to be azole resistant. Although candidemia does occur among outpatients, our findings (the large proportions of persons with catheters, underlying illness and prior hospitalizations) indicate that these infections are still health-care related. Clinicians need to maintain a high index of suspicion for candidemia among high-risk outpatients. Additionally, infection control methods that are usually applied in hospitals need to be applied in the outpatient setting in order to prevent these infections.

Secondary Transmission of Invasive Group A Strep in a Group Home for the Disabled

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Background: Although 200 - 300 cases of invasive Group A Streptococcal disease (GAS) are reported in New York State each year, secondary transmission is rare. In February 2001, a group home with 10 residents and 14 employees reported 2 cases of invasive GAS (one resident, one employee). This report describes the epidemiologic investigation and use of chemoprophylaxis to prevent additional cases.
Methods: A site visit was conducted by representatives of the New York State Department of Health (NYSDOH) to review patient/employee records and inter-view care providers. Throat cultures were collected from clients and staff. Positive cultures from the clients and the two invasive GAS cases were sent to the NYSDOH laboratory for pulse field gel electrophoresis (PFGE).
Results: Two cases of invasive GAS meeting the CDC case definition were found. Case 1 involved a 40 year-old profoundly retarded male who had onset of fever on February 7th and pneumonia on February 10th, at which time he was hospitalized. He expired on February 13th due to GAS sepsis. The patient's exposure history was unremarkable except for minor dental work on February 7th. Case 2 involved an otherwise healthy 47 year-old visiting nurse, who assisted in collecting throat cultures of other residents at the group home on February 12th. On February 13th, she had fever, chills, shoulder pain, and subsequently was hospitalized and diagnosed with necrotizing fasciitis. The wound site was positive for GAS. She recovered and returned to work. Throat cultures from four (44%) of nine consumers and 0 of 14 employees were positive for GAS. The PFGE patterns of the throat cultures matched the two invasive cases.
Control Measures: All residents and employees were treated prophylactically with penicillin G benzathine and rifampin or with azithromycin. No additional cases occurred.
Conclusion: Secondary transmission of invasive GAS occurred at a group home for the disabled involving one resident and one employee. A follow-up identified four additional residents with throat colonization. All cultures matched by PFGE. No cases occurred following prophylaxis.

Evaluation of Active Bacterial Core Surveillance Methodology for Invasive Group A Streptococcus Infection and Effects on Incidence Rates

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Background: A primary goal of CDC's Active Bacterial Core Surveillance (ABCs) is to determine the incidence and epidemiologic characteristics of five invasive bacterial infections based on active, population-based surveillance. The ABCs case definition for Group A Streptococcus (GAS) is more inclusive than for the other four pathogens; in addition to sterile sites isolates, tissue isolates collected during surgical procedures and wound infections accompanied by necrotizing fasciitis or toxic shock are included as cases. We investigated the possible effect of variability in surveillance methods on GAS incidence rates.

Methods: Distributions of GAS cases by source of bacterial isolate (e.g. blood, joint, surgical specimen) were compared among ABCs areas for 2000 (eight areas) or 2000/2001 (one area began surveillance July 2000). For two of three ABCs areas that conduct GAS surveillance statewide, rates for the main metropolitan area were calculated. Age and race adjusted incidence rates were calculated for GAS cases identified through blood cultures for the eight metropolitan areas. Qualitative assessment of GAS surveillance methods was performed by telephone interviews of ABCs staff in each area. For one area, the distribution of emm types among blood isolates was compared to isolates from other sources.

Results: Incidence rates of invasive GAS ranged from 1.9 to 8.0 per 100,000 persons among the nine ABCs areas (median=3.4). The proportion of GAS cases isolated from blood ranged from 49% to 89% (median=77%). The ABC's area with the highest GAS rate had the highest proportion of surgical specimen/aspirate isolates; the two areas with the lowest GAS rates had no surgical specimen/aspirate isolates. Age and race adjusted incidence rates of GAS identified through blood cultures among the eight metropolitan surveillance areas ranged from 2.2 to 4.7 per 100,000 (median=2.9). In the area with the highest proportion of non-blood isolates, the distributions of emm types of blood isolates versus all other isolate sources were significantly different (Chi-Square, P=.05). Qualitative assessment of surveillance indicated substantial variability among ABCs areas in the degree to which invasive GAS tissue isolates are actively ascertained; this roughly correlated with the proportions of surgical specimen/aspirate isolates among surveillance areas.

Conclusions: Although variability in GAS incidence rates among ABCs surveillance areas is multifactorial, differences in surveillance methods appear to be one important factor. Current surveillance for GAS may underestimate the true incidence of invasive infection due to under-ascertainment of invasive tissue infections diagnosed through surgically obtained tissue specimens. ABCs surveillance for GAS should be better standardized to more accurately ascertain the incidence and epidemiology of this important bacterial disease.

The Epidemiology of Community-Onset Methicillin-Resistant *Staphylococcus aureus* (MRSA) Infection/Colonization in the Atlanta Metropolitan Area, 2001

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Background: Methicillin resistance in *Staphylococcus aureus* is becoming a public health concern because of its emergence in the community setting. Most reports have been hospital-based and limited to medical record review.
Objectives: To determine the epidemiology of community-onset (CO) MRSA infections/colonizations in the 8 county Atlanta metropolitan area, population approximately 3.1 million.
Methods: Prospective review of laboratory reports of MRSA isolates from hospital laboratories and reference laboratories serving 32 hospitals and many outpatient settings. A case of MRSA is considered healthcare (HC)-associated (HCA) if ANY of the following criteria are present: hospitalized >48 hrs prior to MRSA culture; previous MRSA isolation; dialysis, surgery, or hospitalization in the past year; or a percutaneous or indwelling device in place at the time of culture. Cases are initially screened by consulting hospital personnel and by reviewing medical records. If no HCA criteria are documented, the case is inter-viewed to identify previously unrecognized HC associations. If no HCA criteria are present, it is considered a CO case.
Results: Data for January 1 through June 30, 2001 identified 2041 incident cases of MRSA. On initial screen, 141 (6.9%) of the cases met no documented HCA criteria and required a telephone interview. 42 of the 141 have been interviewed; 29/42 (69%) were confirmed as CO. 21 of the 29 (72.4%) had clinically relevant infections: skin infection (10), sinusitis (3), soft tissue infection (2); and one each of osteomyelitis with secondary bacteremia, endocarditis, primary bacteremia, conjunctivitis, diverticulitis, and bronchitis. 1 (3.5%) was considered a contaminant; 7 (24.1%) were of indeterminate relevance. The median age for CO cases was 39.5 yrs compared with 69 yrs for HCA cases ($p<0.01$). 69% of the CO cases were male compared with 48% for HCA cases ($p=0.02$). At the time of interview, HC exposures were identified that fell outside of the HCA criteria in 18 (62%) of the 29 CO cases: 15 cases received antibiotics and 3 were employed in the HC sector in the previous year; 9 had been hospitalized in the prior 2-5 years.
Conclusion: Preliminary results indicate that CO MRSA represents < 7% of all MRSA in Atlanta. CO cases were more common in younger males and involved skin and soft tissue infections in more than half of the clinically relevant cases. Healthcare exposures were identified during the interview that may provide insight into the acquisition of MRSA in the community.

Susceptibility Testing Practices for *Streptococcus pneumonia*e, 2000: Are Laboratories Prepared To Monitor Antibiotic Resistance?

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Background: Pneumococcus causes 63,000 invasive infections and 6,100 deaths per year in the US. A high proportion of pneumococci have become resistant to antibiotics. Because antibiotic susceptibility results are increasingly important for guiding therapy decisions and for monitoring emerging resistance patterns, we conducted a survey to assess laboratory practices for susceptibility testing in 2000.

Methods: The survey was sent to clinical laboratories located in the nine Active Bacterial Core surveillance (ABCs) areas in 2000. Survey questions addressed the susceptibility testing methods used for invasive isolates, compliance with current National Committee for Clinical Laboratory Standards (NCCLS) guidelines, selection of antibiotics for routine testing, and methods for reporting susceptibility results.

Results: Of 659 laboratories surveyed, 547 (83%) responded. Three hundred and fifty-three (65%) laboratories reported doing at least some susceptibility testing of pneumococcal isolates in-house. More than half (n = 188, 53%) of the laboratories performed oxacillin disk screening before doing confirmatory minimum inhibitory concentrations (MICs) testing for invasive isolates, a practice discouraged by NCCLS because it delays reporting of the MIC results. Nearly all (n = 351, 99%) of the laboratories performed MIC either in house or at a reference laboratory. Of the 250 laboratories performing in-house MIC testing, the majority (n = 222, 88%) of laboratories used appropriate MIC methods for penicillin susceptibility testing. Most laboratories (n = 190, 76%) performed susceptibility testing for penicillin, cefotaxime or ceftriaxone, and vancomycin on isolates from patients with life-threatening infections as recommended by NCCLS. Only 39% (n = 98) of laboratories performed susceptibility testing against fluoroquinolones, a first-line agent for community-acquired pneumonia. Some laboratories reported either the exact MIC values (n = 35, 14%) or the interpretations (i.e., susceptible [S], intermediate [I] or resistant [R]; n=66, 26%), rather than reporting both (n = 137, 55%) as recommended.

Conclusions: Although the majority of clinical laboratories were using appropriate methods for pneumococcal susceptibility testing, there were some inconsistencies with NCCLS guidelines. Because of the recent increase in fluoroquinolone use, both to treat pneumonia and in response to the recent anthrax attack, more laboratories should consider testing isolates for fluoroquinolone resistance.

Correlation of Epidemiologic Trends in Meningococcal Infection with the Strains of Neisseria Meningitidis Causing Invasive Disease

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Background: The incidence of meningococcal disease in persons 15-24 years of age increased from 1990-97, before declining in 1998-99. An increase in this age group is characteristic of a clonal outbreak of meningococcal disease. From 1990-99, the incidence of meningococcal disease steadily increased among persons at least 25 years old.
Methods: Pulsed-field gel electrophoresis (PFGE) was performed on N. meningitides isolates obtained from active, laboratory-based surveillance from Maryland during 1992-99. PFGE-based clonal groups were defined as strains at least 80% genetically related by dendrogram. The degree of genetic relatedness between strains was calculated using the mean of the Dice coefficients.
Results: Among the 84% (246/293) of the cases with known serogroups, 46% (29/62) of persons 15-24 years old were infected with a serogroup C strain compared to 21.5% (20/93) of adults at least 25 years old ($p < 0.01$). Likewise, 32% (19/62) of persons 15-24 years old were infected with a serogroup Y strain compared to 44% (41/93) of adults at least 25 years old ($p = 0.09$). From 1992-97, the mean of the Dice coefficients was 83.7 for persons 15-24 years old versus 67.1 for children < 15 ($p < 0.01$) and 66.8 for persons at least 25 years old ($p < 0.01$). During 1999, 88% (7/8) of the serogroup C infections in persons 15-24 years old were due to an unique PFGE pattern which was not present in previous years. Seventy-six (58/76) percent of the serogroup Y strains could be classified into 2 clonal groups (1 and 2). The proportion of clonal group 2 strains increased from 11% (1/9) in 1992 to 57% (12/21) in 1999 ($p = 0.01$, Chi square for trend); this trend was seen among adults at least 25 years old, but not in the < 15 and 15-24 year age groups.
Conclusion: During the rise in meningococcal incidence in persons 15-24 years old, serogroup C strains were more genetically related in this age group than in the other two age groups. Interestingly, during the decline of meningococcal disease, a serogroup C clone emerged in persons 15-24 years of age. Among adults at least 25 years old, the increase in meningococcal disease was partially due to an increase in one serogroup Y clonal group.

Antibiotic Susceptibility and the Mechanisms of Macrolide Resistance in Invasive Group B *Streptococcu*s, Minnesota, 1998 and 2000

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Background: Group B Streptococcus (GBS) is the leading cause of invasive neonatal infections in the U.S. Intrapartum antibiotic prophylaxis with penicillin or ampicillin is recommended to prevent neonatal disease. For women allergic to B-lactam antibiotics,

clindamycin (C) or erythromycin (E) is recommended. Although resistance to penicillin has not been confirmed, resistance to macrolides and lincosamides is well described. In GBS, resistance is typically conferred either by methylation of the 23S ribosomal subunit *(er*m) or by efflux pumps *(me*fA, *me*fE). Methylation usually results in cross-resistance to macrolides, lincosamides and streptogramin B (MLS phenotype) while the efflux mechanism confers resistance only to macrolides (M phenotype). Few studies have evaluated MLS resistance mechanisms in GBS. Our objectives were to determine the prevalence of E and C-resistance and to characterize the resistance mechanisms among invasive GBS isolates.
Methods: Invasive GBS infection is reportable in Minnesota. Cases are reported to MDH through a statewide active surveillance system. Surveillance includes collection of epidemiologic data and submission of isolates to MDH for antimicrobial susceptibility testing by broth microdilution. Resistant strains were evaluated by PCR and isolates were tested for inducibility of the MLS phenotype for the *mef* and *erm* genes.
Results: Among the 101 isolates tested in 1998, 21 (21%) were E-resistant and 8 (8%) were C-resistant. Among the 220 isolates tested in 2000, 50 (23%) were E-resistant and 27 (12%) were C-resistant. All C-resistant strains were E-resistant. Sixty-four of the 71 E-resistant GBS isolates were evaluated by PCR. Of the 20 1998 isolates, 7 with an MLS phenotype contained *er*mB (3) or *er*mTR (4). One MLS resistant strain failed to yield products with the primers tested. Twelve 1998 isolates had M phenotype; all contained *me*fE. Of the 44 year 2000 isolates, 18 had M phenotype and 26 had MLS phenotype. All 44 isolates contained the *er*mB gene. E minimum inhibitory concentration values were higher in *er*mB-containing strains ($p<0.02$). Twelve MLS phenotype isolates tested were of the constitutive MLS type, while 15 of the M phenotype (by broth microdilution) isolates from 2000 were of the inducible MLS type. Three M phenotype isolates, all of which contained *mef* as well as *er*mB, failed to induce MLS resistance.
Conclusion: Although there was no increase in E-resistance in invasive GBS between 1998 and 2000, there was a trend towards increased C-resistance. This was accompanied by an increase in the prevalence of the *er*mB gene in both MLS and M phenotype isolates. The reason for this shift in resistance determinants in not known, but could be a consequence of selective pressure by use of these antibiotics. E and C resistance have important implications for prophylaxis and treatment of GBS disease; these susceptibility patterns need to be monitored.

Epidemiology of Community-onset Methicillin-resistant Bloodstream Infection with Staphylococcus aureus in Connecticut, 2000-2001

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Background: A previous Connecticut (CT) study demonstrated that community-onset (CO) bloodstream infection with methicillin-resistant *Staphylococcus aureus* (MRSA) is an important public health problem. Starting in 2000, laboratories were required to report all bloodstream MRSA isolates in CT residents. In 2001, the system was expanded to

include all invasive (sterile site) MRSA isolates. The objectives of the surveillance system are to determine the incidence, epidemiology, trends and risk factors for CO-MRSA.

Methods: A case of CO-MRSA was defined as a person with an isolate of MRSA obtained as an outpatient or no later than 2 days after admission to a hospital and who was not a resident of a long-term care facility (LTCF) or a hemodialysis patient. A standardized medical record review was done for all CO-MRSA. Patients were further classified as either a) healthcare associated (HA) if they had a hospital admission, outpatient surgery, previous MRSA infection, or resided in a LTCF in the past year, or b) community-acquired (CA). In addition, they were independently classified as either having an underlying illness (UI) predisposing to SA infection or not. Individuals identified as CA-MRSA are being interviewed using a standard questionnaire to determine if other risk factors exist.

Results: In 2000, 676 reports of MRSA bloodstream isolates were identified; 128 (19%) were CO-MRSA. Medical record review for year 2000 is complete on 117 (91%). Overall incidence of CO-MRSA was 3.8 per 100,000 population. The rate of CO-MRSA was highest in individuals over 65 years of age (14.9), residents of towns >100,000 in size (4.9), blacks (4.7) and males (4.4). Only one case was <18 years old. For 2001 as of December 1, 220 additional persons with CO-MRSA were identified, of whom 164 (75%) had bloodstream isolates. The projected year 2001 rates for all invasive CO-MRSA and for bloodstream cases are 7.0 and 5.3 per 100,000, respectively. Medical record reviews have been completed for 240 (69%) cases of CO-MRSA from years 2000 and 2001 combined. Of these, 205 (85%) were both HA and had UI, 5 (2%) were HA only, 29(12%) appeared to be CA with UI, and 1 was CA with no UI. Of the 210 HA cases, 180 (86%) had been hospitalized and 126 (60%) had undergone surgery. UIs were present in 233 of the cases; status of one case was unknown. The most common UIs were heart disease (44%) and diabetes (39%). HIV was present in 5%; underlying injection drug use was present in 6%.

Conclusions: CO-MRSA is common and appears to be increasing in CT. The epidemiology is similar to that found in a previous pilot study. Rates are highest among those over 65 years and residents of urban areas. Most CO-MRSA is health-care-associated. Invasive community-acquired MRSA in persons without underlying conditions is rare. Continued surveillance and examination of risk factors in those with apparent community-acquired MRSA is needed.

Trends in Invasive Pneumococcal Disease, Connecticut, 1996-2000

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Background: Since 1995, the CT ABCs project has conducted statewide active population-based surveillance for invasive pneumococcal disease (IPD), monitored

antimicrobial resistance and, since 1998, serotype trends. Our objectives were to assess the 5 year trends in rates of IPD, antimicrobial resistance and serotypes covered by vaccine by demographic subgroups.
Methods: Case data was obtained by medical record review. IPD isolates were sent to a reference laboratory for antimicrobial testing and to CDC for serotyping. Rates of IPD were determined per 100,000 population-specific groups. Vaccine coverage of serotypes was determined based on the 7-valent vaccine (PCV) for 0-4 year olds and the 23-valent vaccine (PPV) for >4 year olds.
Results: Over 5 years, the rate of IPD decreased from 24 to 20.3 cases per 100,000. Between 1999 and 2000, when PCV was introduced for infants, the largest drop in rates was in the <2 year age group (23%). Comparing 2000 rates to the 1996-99 average, rates in <2 year olds decreased most in Hispanics (31%) and whites (22%) but less in blacks (7%). Blacks <2 years still have the highest rate of IPD (250 cases/100,000). Penicillin-resistant IPD (PRSP) increased from 11% to 13.6% of isolates over 5 years. Percentage (%) that were resistant increased for all antimicrobials, except for vancomycin (still 0%). The largest increases in % resistant were for erythromycin (5.2 to 15%), amoxicillin (4.3 to 12%), cefotaxime (3.4 to 7.2%), and meropenem (2.1 to 6.4%). Percentage resistant to erythromycin (ERSP) increased in both penicillin susceptible (2.2% to 4.8%) and non-susceptible isolates (19.2% to 52.7%). The % of isolates that are ERSP increased in all age groups. The % that were ERSP and that were PRSP were significantly lower in blacks than whites (5.4% vs. 10.8%; 8.4% vs. 13.5%, p 17 years old. At least 86% of serotypes in CT IPD isolates have been covered by PCV (children) or PPV (adults). No distinct age-specific decrease in % of isolates with serotypes covered by vaccines was seen from 1998-2000. When resistant were compared to susceptible isolates for % vaccine coverage, ERSP were less likely than ESSP isolates to be covered (77% vs 88%, p<.00001), unlike PRSP compared to PSSP isolates (92% vs 88%, p>.05)
Conclusions: In CT, overall IPD rates may be decreasing. Distribution of PCV may already be having an effect on IPD incidence in infants, but use among blacks may be lagging. Antibiotic-resistant IPD is progressively increasing, especially erythromycin resistance. Fluoroquinolone resistance may be emerging. The association between erythromycin resistance and having a lower percentage of serotypes contained in the vaccines needs further exploration.

Erythromycin Resistance Among Invasive Group A Streptococcal Infections in the United States, 1999

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Background: Group A streptococcus (GAS) is a common cause of both invasive and noninvasive infections. Although GAS has remained universally sensitive to penicillin, macrolides are often used as alternate therapy. Resistance to erythromycin and other macrolides has risen to high levels in many countries outside of North America (20% to 60%). We sought to determine percent of erythromycin resistance among invasive isolates in geographically diverse regions of the United States using CDC's Active Bacterial Core Surveillance (ABCs) system.
Methods: ABCs conducts active laboratory- and population-based surveillance for invasive GAS infections. Bacterial isolates obtained from invasive GAS infections identified by participating ABCs sites (CA, CT, GA, MD, MN, NY, OR) in 1999 were tested for resistance to penicillin, ampicillin, erythromycin, clindamycin, vancomycin and cefotaxime by broth microdilution. According to NCCLS guidelines, strains with mean inhibitory concentrations (MIC) of 0.5 mg/ml and > 1.0 mg/ml to erythromycin were defined as intermediate (EryI) and resistant (EryR), respectively. Emm typing was performed on isolates using standard methods.
Results: In 1999, 772 cases of invasive GAS were identified; 547 (71%) isolates were available for antimicrobial susceptibility testing. Of these, 6.4% (n=35) were EryR and four were EryI. Significant variation in % EryR was noted among sites: 0% (GA), 2.8% (CT), 3.9% (MN), 5.5% (MD), 7.7% (NY), 13.7% (CA) and 13.8% (OR). Upon comparison of patients with EryR to patients with EryS isolates, no significant differences were noted for the following variables: sex, race, hospitalization, outcome, and type of infection. Age > 18 years was associated with having an EryR infection (P=0.028); persons age 35-49 years had the highest % EryR (10.3%). Emm typing was completed on 521 (95%) of the available GAS isolates. EryR was identified among 12 of the 50 different emm types identified but was most common in types emm114 (13 of 16 strains), emm83 (4 of 7 strains), and emm58 (4 of 8 strains). Twelve of 16 emm114 isolates were from GAS cases in CA and OR; nine (75%) were EryR. The remaining four emm 114 strains, found elsewhere (MD=1, MN=3), were EryR.
Conclusion: Erythromycin resistance among invasive GAS isolates shows significant geographic variation, with the greatest resistance noted in ABCs sites located in two states. Resistance is more common in certain emm types; predominance of resistant strains of emm 114 in the western U.S. could be due to expansion of a resistant clone, although local antibiotic use is likely also a factor.

Antimicrobial Susceptibility and Serotype Patterns of Invasive Group B *Streptococcus* Isolates from Georgia, Minnesota, New York and Oregon, 1996-2000

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Background: Maternal carriage of Group B *Streptococcus* (GBS) poses a risk for vertical transmission to neonates. Intrapartum GBS chemoprophylaxis recommendations implemented in the 1990's reduced invasive early-onset neonatal disease by 65% (1.7 to 0.6 per 1000 livebirths during 1993-1998). Nonetheless, GBS remains the leading cause of neonatal invasive disease and is an important pathogen for peripartum women and nonpregnant adults. Identifying susceptibility and serotype trends is critical for guiding chemoprophylaxis recommendations and vaccine formulation.
Methods: Active population-based surveillance for GBS was conducted in four states during 1996-2000. Case-patients were defined by isolation of GBS from a sterile site; analyses were performed on perinatal (neonates and pregnant women) and adult case-patients. Isolates were tested for susceptibility by broth microdilution and serotyped. Preliminary
Results: Of 3,399 case-patients; 1,043 (31%) had susceptibility data and 1,638 (48%) were serotyped. No isolates were resistant to penicillin, vancomycin, cephalothin, or cefazolin. Clindamycin resistance was found in 110 (11%) and erythromycin resistance in 196 (19%) isolates. Comparing 1996-1998 with 1999-2000, erythromycin resistance increased from 16% to 21% ($p=0.025$) and clindamycin resistance from 8% to 12% (not significant). Perinatal isolates were commonly serotype III (40%), Ia or Ia/c (27%) and V (17%). Adult isolates were most often serotype V (30%). Serotype V was associated with clindamycin or erythromycin resistance among perinatal ($p<0.001$ for both) and adult isolates (clindamycin, $p=0.009$; erythromycin, $p=0.02$).
Conclusions: Clindamycin and erythromycin are alternatives to penicillin for intrapartum prophylaxis in penicillin allergic women; however, resistance to both was found. Cefazolin or vancomycin may be preferable alternative agents. Clindamycin or erythromycin resistance was associated with serotype V. Vaccine strategies should consider predominant serotypes and/or serotypes associated with resistance.

Penicillin-Resistant *Streptococcus Pneumoniae* in New York State: Population Variability

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Background: *Streptococcus pneumoniae* (SPN) is the leading bacterial cause of a number of diseases including pneumonia, meningitis, otitis media, and bacteremia resulting in high morbidity and mortality in the U. S. The prevalence of drug resistant SPN strains has increased since resistance was first reported in the early 1990s. Drug resistant, invasive SPN disease became reportable in New York State in July 1995. In 1999, all invasive pneumococcal infections became reportable in the 15 Albany and Rochester counties that comprise the Active Bacterial Core (ABC) component of the NYS Emerging Infections Program (EIP). The purpose of this report is to characterize populations at risk for invasive disease and, more specifically, those at risk for penicillin-resistant SPN.

Methods: Confidential case reports were completed for all culture-confirmed invasive cases among residents of the NYS EIP during the period 1999-2000. Isolates were tested locally for penicillin resistance and results were coded according to NCCLS guidelines. In this analysis, intermediate and fully resistant cases were collapsed into a single 'resistant' category. Patient information included demographic characteristics, length of hospitalization, outcome, and underlying medical conditions.
Results: During the two-year period 1999-2000, 831 invasive SPN cases were reported in the NYS EIP for an annual incidence rate of 19.9/100,000. Eight cases with 'unknown' susceptibility results were excluded from the analysis. Of the remaining 823 cases, 658 were classified sensitive (15.8/100,000 per year), and 165 resistant (4.0/100,000). Females had slightly higher rates of infection compared to males (21.1 vs. 18.7/100,000 per year) and a higher percent resistant (22.3% vs. 17.3%), but these differences were not significant. The difference in overall incidence rates between blacks and whites was highly significant (44.5 vs. 17.9/100,000; OR=2.48, $p<.00001$) but there was no difference in the percent resistant between the two groups (20% resistant within each race). Younger (< 5 years; 69.1/100,000) and older (> 65 years; 58.2/100,000) individuals were at significantly greater risk for infection (OR=4.25, $p<.00001$ and OR=4.27, $p<.00001$ respectively) compared to all other age categories but there were no significant differences in the percent resistant by age.
Conclusions: Although both age and race were shown to be independent risk factors for invasive pneumococcal disease, this analysis did not identify any significant risk factors for infection with penicillin-resistant strains. Identification of risk factors associated with drug-resistant SPN infection will continue to gain importance as the prevalence of these strains rises.

Pulsed-Field Gel Electrophoresis (PFGE) Comparison of Pharyngeal and Sterile Site Group A Streptococcal Isolates

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Background: The Minnesota Department of Health (MDH) does PFGE subtyping of all group A streptococcal (GAS) isolates from invasive sites in MN. PFGE subtypes from invasive GAS isolates were compared with throat culture isolates collected during a 5-month period. An earlier MN study found that during a community-wide outbreak of invasive GAS disease, the PFGE sub-type of the outbreak strain matched the predominant strain found in pharyngeal isolates.
Methods: Cases of invasive GAS disease are reported to MDH through active surveillance and isolates are submitted to the MDH laboratory. Five clinics representing different regions of the state sent up to 30 consecutive pharyngeal isolates collected each month for the first 5 months of 1999. PFGE on all invasive isolates obtained during the study period were compared to a representative sample of throat isolates.
Results: Isolates were available for 96 of 108 (89%) of invasive GAS cases during the study period. The most common PFGE subtypes were: GA3 (12, 13%); GA131, GA34 and GA86 (7, 7% each); GA1 and GA5 (6, 6% each); and GA2 (5, 5%). Thirty-five other

PFGE subtypes were identified, including 8 that were unique. Two hundred forty-three (45%) pharyngeal isolates were subtyped. The most common were: GA131 (71, 29%); GA3 (25, 10%); GA5 (6, 2%); GA1 (5, 2%); and GA2 and GA9 (4, 1% each). Sixty-two other subtypes were identified, including 11 that were unique. Geographic variation was noted for the distribution of the pharyngeal GA131 subtype, which accounted for 0-52% of isolates at each clinic. The GA3 subtype was the most evenly distributed with a range of 7-18%. Of 19 invasive cases from facilities in the same regions, 13 (68%) had a PFGE subtype that was found in throat cultures in that region.

Conclusions: The most common PFGE subtypes for invasive GAS disease were also the most common for GAS pharyngitis. Although regional variability of certain PFGE subtypes was noted for both pharyngeal and invasive isolates, a similar distribution of PFGE subtypes was found among pharyngeal and invasive isolates from the same region. This concordance between invasive and pharyngeal GAS PFGE subtypes at a statewide level in a non-outbreak setting is consistent with findings from a previous regional study during an outbreak of invasive GAS disease. Monitoring pharyngeal isolates may be useful for detecting the presence of strains that have potential to cause an increased incidence or severity of invasive disease, and may be useful in guiding development of a GAS vaccine.

FOODBORNE DISEASES ACTIVE SURVEILLANCE NETWORK (FOODNET)

Oral Presentations

Is Drinking Water a Risk Factor for Endemic Cryptosporidiosis in the Immunocompetent General Population of the San Francisco Bay Area?

A. Khalakdina, D. J. Vugia, J. Nadle, J. M. Colford, Jr.

Division of Public Health Biology and Epidemiology, Centers for Family & Community Health and Occupational & Environmental Health, School of Public Health, University of California at Berkeley, Berkeley, CA, California Emerging Infections Program, Oakland, CA, Community Health Epidemiology and Disease Control, San Francisco Department of Public Health, San Francisco, CA, Division of Communicable Disease Control, California Department of Health Services, Berkeley, CA

Prevalence and Consequences of Fluoroquinolone-Resistant *Campylobacter* Infections: NARMS 1997-2000

J. McClellan, S. Rossiter, K. Joyce, K. Stamey, A. D. Anderson, and the NARMS Working Group

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High Prevalence of Antibiotic Resistance in Enterotoxigenic *E. coli* (ETEC); Minnesota 2000–2001

J. M. Besser, K. Smith, C. Taylor, P. Gahr, C. Medus

Minnesota Department of Health, Minneapolis, MN

Three Outbreaks of *E. coli* O157 Infections Due to Retail Ground Beef in Minnesota, 2000: Detection, Investigation, and Characteristics

K. Smith, E. Swanson, E. Wagstrom, F. Leano, D. Boxrud, J. Adams, J. Besser, R. Danila, H. F. Hull

Minnesota Department of Health, Minneapolis, MN

Epidemiology of Shiga Toxin–Producing *Escherichia coli* (STEC) Infections in Connecticut, February 1, 2000–January 31, 2001

T. McCarthy, P. Mshar, C. Welles, R. Howard, T. Rabatsky-Ehr, J. L. Hadler

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Microbiologic Testing to Identify Shiga Toxin-producing *E. coli* in HUS Patients: FoodNet 1997-2001

J. C. Lay, E. Boothe, D. J. Vugia, N. Dumas, B. Shiferaw, E. Wagstrom, S. Tong, S. Burnite, S. M. Thomas, S. Hurd, and the EIP FoodNet Working Group

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Risk Factors for Sporadic *Escherichia coli* O157 Infections in the United States: A Case-control Study in FoodNet Sites, 1999-2000

M. H. Kennedy, T. Rabatsky-Ehr, S. M. Thomas, S. Lance-Parker, J. Mohle-Boetani, K. Smith, W. Keene, P. Sparling, F. P. Hardnett, P. S. Mead, and the EIP FoodNet Working Group

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Yersinia enterocolitica Surveillance in Minnesota

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Quinupristin/Dalfopristin-Resistant *Enterococcus faecium* Isolated from Human Stools, Retail Chicken, and Retail Pork: EIP Enterococci Project

K. Gay, K. Joyce, J. E. Stevenson, F. J. Angulo, T. Barrett, and the NARMS Working Group

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Antimicrobial Resistance in *Salmonella* Is Associated with Increased Hospitalization: NARMS 1996-2000

J. K. Varma, K. Mølbak, S. Rossiter, M. A. Hawkins, T. F. Jones, S. H. Mauvais, T. Rabatsky-Ehr, S. Stenzel, D. J. Vugia, M. Park, K. Joyce, K. Stamey, H. Chang, F. J. Angulo, and the EIP FoodNet Working Group

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Emerging Fluoroquinolone Resistance among Non-Typhoidal *Salmonella* in the United States: NARMS 1996-2000

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Abstracts

Three Laboratory-Associated Infections of *Escherichia coli* O157:H7, New York State 1999-2000

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Background: Transmission of shigatoxin producing *Escherichia coli* O157:H7 (EC) occurs mainly by the ingestion of undercooked beef, raw milk or contaminated water. Laboratory acquired infection of EC was first documented in 1993. The small infectious dose (as few as 10 organisms) of EC and its prolonged survival on environmental surfaces may be contributing factors to laboratory-acquired infections. This report summarizes three laboratory-associated cases of EC in New York State within a one-year period.

Methods: The investigation included: 1) a review of lab procedures, 2) case interviews to identify potential sources of expo-sure and 3) comparison of Pulsed-Field Gel Electrophoresis (PFGE) results of the case isolates to laboratory isolates temporally associated with their exposures.

Results: Two cases occurred in Medical Technologists (MT) and a third in a child of a lab worker. Each case was associated with a different Microbiology laboratory. Two were temporally related to a large county fair outbreak. MT#1 developed bloody diarrhea 3-4 days after initial exposure to working with an outbreak patient's EC isolate. MT#1's PFGE pattern matched the isolate of a fair attendee identified in this lab. MT#2 did not become infected herself, but her one-year old son developed symptoms of fever and diarrhea 7 days following the mother's work exposure. The child's PFGE pattern matched one of the main outbreak strains tested by this laboratory. No household member had visited the fair but the child attended a facility-related daycare where his mother nursed him twice daily. No other children attending the day care were symptomatic. The mother was asymptomatic and a stool specimen submitted for culture was negative. MT#3 developed bloody diarrhea 4 days after working with EC isolates. An isolate with a matching PFGE pattern was tested in this laboratory prior to onset of symptoms. A review of laboratory procedures showed no obvious breeches in technique. Neither MT#1 or MT# 2 had frequent work exposure to EC prior to the outbreak.

Conclusions: The PFGE patterns of the laboratory-associated cases of EC were indistinguishable from isolates handled in the laboratory 3-7 days prior to the onset of illness. We were unable to identify breeches in lab procedures to explain the infections. These cases reinforce the need for meticulous adherence to precautions, particularly among lab workers who handle large volumes of EC cultures as in an outbreak situation. Further studies are needed to identify protocols that decrease the likelihood of transmission in the laboratory setting.

Epidemiologic Analysis of Statewide Restaurant Inspection Scores in Tennessee

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Background: Virtually every licensed restaurant in the United States is inspected regularly to ensure adherence to food safety guidelines. Despite this, few data exist regarding restaurant inspection scores or their correlation with foodborne illness.
Methods: We analyzed restaurant inspection data from July 1993 through June 2000. Routine inspections of all restaurants holding permits during this period for preparing and serving food were included in the analysis. Inspections were performed by state or regional health department employees using standardized forms with a scale of 0-100. Data were entered in a centrally-maintained database.
Results: In Tennessee, over 19,500 hours of inspector time are spent each year on routine inspections of approximately 17,000 restaurants. The average scores of individual inspectors were distributed in a bell-shaped curve with a median of 82 and a range from 69 to 92. Mean scores by county ranged from 75 to 88. From 1993 to 2000, the mean inspection score rose steadily from 80.2 to 83.8, and the average number of violations cited per inspection fell from 11.1 to 9.9. None of the 12 most commonly cited violations were among those designated as "critical" food safety hazards. While restaurants with a score over 60 tended to have fairly stable scores on subsequent inspections, establishments scoring under 60 had a mean improvement of 16 points on the subsequent routine inspection, with an additional mean increase of 5 on the following inspection. Fast-food restaurants (mean score=79.9) had slightly lower mean scores than independent (80.9) or chain (82.1) full-service restaurants. Some variation was noted in mean scores of restaurants serving certain types of cuisine, such as barbecue (82.9), pizza (82.3), Chinese (77.7) and Mexican (77.4) foods.
Conclusions: Restaurant inspection scores vary substantially over time and by region and inspector. The most commonly cited violations are not those believed to be most important in maintaining food safety. Being cited for a poor score does appear to lead to some sustained improvement. These data suggest that restaurant inspections may not be performed uniformly even within a single state, and that substantial resources may be invested in monitoring issues which do not directly affect food safety. A recent study in Dade County found that restaurant inspection scores did not predict outbreaks there. Given the tremendous resources expended in regulating this huge industry, food safety agencies should consider ways to improve the utility of restaurant inspections in preventing foodborne illness.

Environmental Health Specialists Network (EHS-Net) — The Development and Implementation of a Systems Approach To Investigate Foodborne Illness

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The Environmental Health Specialists Network (EHS-Net) is composed of environmental health specialists and epidemiologists located at the federal, state and local levels. Based in a systems approach, this collaboration is to improve the understanding of the underlying causes and interactions of factors that lead to foodborne illness and to use the knowledge gained to prevent future cases of such illness. The EHS-Net activities are conducted in conjunction with the Centers for Disease Control and Prevention's (CDC) Foodborne Diseases Active Surveillance Network (FoodNet). A component of CDC's Emerging Infections Program (EIP), FoodNet is a collaborative project of CDC, nine EIP sites, the U.S. Department of Agriculture, and the Food and Drug Administration (FDA). FoodNet consists of active surveillance and studies designed to help public health officials gain a better understanding of the epidemiology of foodborne diseases in the United States. The EHS-Net is a combined effort between the FDA, CDC, and eight of the nine EIP sites. In collaboration with FoodNet activities, EHS-Net projects will provide insights to understanding the environmental causes of foodborne illness. Current EHS-Net activities describe food safety systems in restaurants and other establishments where food is eaten outside the home. Survey tools have been designed by EHS-Net to collect data in both outbreak and non-outbreak settings. Data collection encompasses the entire food preparation process from delivery of ingredients, through preparation and cooking, to the actual service of the food item. Both univariate and multivariate analyses are used to assess potential risks present in food establishments. By documenting the entire food preparation process, such as bare-hand contact with food, preparation of raw meats and poultry, and egg handling practices, we will be able to analyze the role of food handling and preparation practices, in foodborne illness. On the basis of this information, data may support existing food handling guidelines as well as suggest revision of current guidelines and policy where necessary to improve food handling and preparation practices. The data gathered will provide a unique opportunity to explore associations between eating outside the home and the occurrence of foodborne illness from agents such as *E. coli* O157:H7, *Salmonell*a, and *Campylobacte*r. Thus, the EHS-Net project will aid in understanding FoodNet results and provide a more effective approach to reducing foodborne-related illness.

Knowledge, Attitudes and Practices Regarding Use of Irradiated Meats and Pasteurized Eggs in Health Care Institutions, Universities, and Restaurants in Connecticut

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Background: Contaminated meats and eggs have been implicated as a major source of foodborne diseases. In recent years, several significant food safety technologies have been approved for commercial use: irradiation of meats and pasteurization of both egg-product and in-shell eggs. Widespread use could reduce the occurrence of Shiga toxin-producing *Escherichia coli* infection, salmonellosis, campylobacteriosis, listeriosis and toxoplasmosis by an average of 50%. As a prelude for a public health initiative to promote their use, a survey was undertaken to deter-mine the extent to which these technologies are currently being used in Connecticut.
Methods: A standardized questionnaire was developed to assess the knowledge and attitudes toward the use of irradiated meats and pasteurized eggs and the extent to which they are currently being purchased and used. The surveys were mailed in February 2001 to the food services of all universities and acute-care hospitals and a representative sampling of long-term care facilities (LTCF) and restaurants in Connecticut. A second mailing to non-respondents was conducted in March 2001.
Results: Of the 391 surveys sent, 211 (54%) were returned: 24/34 (71%) from hospitals, 113/167 (68%) from LTCFs, 17/40 (43%) from universities and 57/150 (38%) from restaurants. Nearly all respondents reported using hamburger, chicken, and eggs in their operations. Seventy-five percent (75%) of facilities use pasteurized egg product (PEP), but no facility currently uses irradiated hamburger or poultry, and only 16% use pasteurized in-shell eggs (PSE). Restaurants (14%) and universities (56%) were less likely than LTCF or hospitals (96% each) to use PEP. The majority of respondents requested more information concerning PSE (66%) and most (79%) would be willing to consider buying irradiated meat products if given additional information. Significant predictors ($p<0.05$) of willingness to buy irradiated meat products include being a hospital or LTCF (88% vs 62%), having a manager with >20 years food service experience (89% vs 66%), believing that irradiation kills harmful bacteria (89% vs 63%), and believing that a person will not get irradiation exposure from eating irradiated meat (94% vs 63%). Significant predictors associated with the cur-rent use of PSE include having received prior information (44% vs 6%) and belief that consumers will accept the product (22% vs 7%). While 53% of respondents thought that DPH should encourage use of PSE, only 17% thought that DPH should encourage use of irradiated meats.
Conclusions: Pasteurized egg product is already widely used in hospitals, LTCFs and universities in CT. There is considerable potential to improve the use of irradiated meats and pasteurized in-shell eggs in food service establishments, beginning with provision of more information.

Risk Factors for Sporadic *Campylobacter* Infections in Maryland

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Background: *Campylobacter* is the leading cause of bacterial diarrhea in the United States and among CDC's Foodborne Diseases Active Surveillance Network (FoodNet) sites. Data from FoodNet show that Maryland has a remarkably low incidence of culture-confirmed *Campylobacter* infections, where it is the third reported most common cause of diarrhea. In this analysis, we sought to examine risk factors for sporadic infection in Maryland to determine if differences in exposure may explain the difference between Maryland and other FoodNet sites.
Methods: Between March 1998 and February 1999, a *Campylobacter* case-control study was conducted in FoodNet sites (Connecticut, Georgia, Minnesota, Oregon, and selected counties in California, Maryland, and New York). A case was defined as a person with *Campylobacter* infection identified by a clinical laboratory; and diarrhea, with onset <10 days before the positive stool culture. Each case was matched with a control from the same age range and telephone exchange. Subjects were interviewed regarding diet, kitchen practices, travel, and animal exposure in the 7 days prior to illness onset (cases) or interview (controls). Risk factors among Maryland's cases and controls were compared using «2 analysis.
Results: Of 157 cases identified by surveillance in the Baltimore metropolitan area of Maryland, 119 were enrolled. The mean age of the cases was 35.6 years (range 2 months to 93 years); 17 (14.3%) cases were hospitalized. Cases were more likely than controls to be white ($p<0.01$), to have recently eaten in a restaurant ($p=0.01$), traveled internationally ($p=0.01$); eaten chicken luncheon meat ($p=0.03$), or ham ($p<0.01$); had contact with a puppy ($p=0.01$), dog ($p=0.03$) or cat ($p=0.02$); or visited a petting zoo ($p=0.04$). Cases were less likely than controls to have purchased ($p=0.01$), stored ($p=0.01$), or cooked ($p=0.01$) raw chicken. Cases who purchased chicken reported leakage from the package onto other items in their grocery bag more often than controls ($p<0.01$). The remainder of kitchen practices did not differ between groups.
Conclusions: Except for the handling of raw chicken, Maryland's site-specific analysis identified similar risk factors for *Campylobacter* infection as the analysis of FoodNet-wide data, and previously published reports, suggesting that exposure to poultry and animals, eating outside the home, and international travel are risk factors for disease. The reason for the unusually low incidence of *Campylobacter* infections in Maryland remains unexplained, but suggests exposure to contaminated chicken may be lower. Other factors, including those leading to identification of *Campylobacter* as the etiologic agent in a case of diarrhea, warrant further study to clarify the low incidence of *Campylobacter* infections in Maryland.

Enhanced Surveillance for Antimicrobial Resistance Among Enteric Bacteria: NARMS Retail Food Study

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Background: The food supply, including meat and poultry, is an important source of enteric bacteria, including *Campylobacte*r, *E. col*i, *Salmonella* and possibly enterococci. Antimicrobial resistance among these foodborne bacteria is not uncommon and often is associated with the use of antimicrobial agents in food animals. Retail food represents the point of exposure that is closest to the consumer and, when combined with data from slaughter plants and on-farm studies, provides a more representative picture of the prevalence of resistance in foodborne pathogens. To focus efforts to mitigate antimicrobial resistance and to better understand the contribution of the food supply to antimicrobial resistance among enteric bacteria, the National Antimicrobial Resistance Monitoring System (NARMS) for Enteric Bacteria is extending surveillance of antimicrobial resistance to bacteria isolated from food.
Program Description: The NARMS Retail Food Study is a collaborative effort between the Centers for Disease Control and Prevention (CDC), five FoodNet sites (Connecticut, Georgia, Maryland, Minnesota and Tennessee) and the U.S. Food and Drug Administration (FDA). The NARMS Retail Food Study has adopted a standard method to monitor the prevalence of antimicrobial resistance among *Campylobacte*r, *E.col*i, *Salmonella* and enterococci isolated from a convenience sample of meat and poultry from selected grocery stores in the United States. Data collection will begin January 1, 2002. Each site will visit at least one grocery store per month, not returning to the same store for at least two months, and purchase packages of meat or poultry including 10 packages of chicken breasts, 10 packages of pork chops, 10 packages of ground turkey and 10 packages of ground beef. Isolation procedures have been adapted from the FDA's Bacteriological Analytical Manual. Each site will culture the rinse from each sample for the presence of *Salmonella* and *Campylobacte*r. In addition, Georgia, Maryland and Tennessee will culture the rinse for *E. coli* and enterococci. Isolates will be forwarded to FDA for antimicrobial susceptibility testing.
Conclusion: This collaborative surveillance project will provide data and isolates useful for focusing efforts to mitigate antimicrobial resistance in enteric bacteria. Enhanced efforts are needed to mitigate the increasing prevalence of antimicrobial resistance among foodborne bacteria. By examining the prevalence of antimicrobial resistant enteric bacteria we will better understand the extent of antimicrobial resistance in the food supply and will be better equipped to implement mitigation strategies.

Surveillance and Genotyping of Norwalk-like Virus (NLV) in Specimens of Viral Gastroenteritis Outbreaks in New York State (NYS) Over a Twenty-Month Period

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NLVs have been recognized as one of the leading causes of viral gastroenteritis with an estimated 23 million cases nationwide per year. Based on trend analysis of 1979-1995, approximately 3,000 adult deaths occurred annually from an estimated 267 million disease episodes. But an etiologic agent could be detected in <10% of these cases due to unavailability of sensitive and specific diagnostic tests. Molecular methods now available enable the detection of NLVs in clinical specimens. Consequently, NLV strains can be identified and linked to outbreaks in multiple locations, tracing them to their sources in contaminated food and water. The endemic disease burden caused by NLVs remains unknown. Furthermore, contributions by other diarrhea-causing viruses like rota, enteric adeno and some enteroviruses have not been thoroughly investigated. In a collaborative study with the CDC and other EIP sites, this investigation was designed to assess the contribution of viruses to gastroenteritis outbreaks in NYS. From January 2000 to August 2001, we tested approximately 180 non-bacterial stool specimens received from 43 gastroenteritis out-breaks throughout the state. Methods used were RT-PCR and nucleotide sequencing for detecting NLVs; ELISA for rota-; and tissue cultures (RhMK, A549, RD) with IFA and neutralization for entero- and enteric (types 31, 40, 41) adenoviruses. Two primer sets and automated nucleotide sequencing analyzed the strains from both genogroups I and II of NLV in these outbreaks. The patients, mostly adults, with the majority female (54% : 43%) exhibited symptoms such as diarrhea, nausea, vomiting, fever, abdominal cramps and headache. NLVs were the sole viral agent detected in 54% (81/150) of all specimens tested from 30 out of 43 outbreaks (70%). Genogroup II NLV strains predominated in >90% of the outbreaks, including Spykenisse and Gwynedd. The outbreaks appeared to be more frequent (69% in 2000, 61% in 2001) in the 6 warm weather months, perhaps relating to increased outdoor activities involving food. Interestingly, two NYS counties experienced multiple outbreaks during 2000 and 2001. In one county, the same genogroup II virus caused more than one out-break, while in the other, viruses of different genogroups were responsible. Thus, it is evident that NLVs are a predominant pathogen of non-bacterial gastroenteritis in NYS. Furthermore, trends of NLV-infections can now be investigated both among and within regions across the counties in NYS with a focus on connections between genogroups and geographic location. (Supported in part by a CDC/EIP Viral Gastroenteritis Project Grant).

Stool Specimen Practices in Clinical Laboratories, FoodNet Sites, 1995-2000

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Background: Clinical laboratory practice influences pathogen isolation rates and may affect the interpretation of laboratory-based surveillance data trends. To determine laboratory practice in the Centers for Disease Control and Prevention's Foodborne Diseases Active Surveillance Network (FoodNet) sites, microbiologists at clinical laboratories which process stool specimens from FoodNet residents were surveyed in 2000 and results were compared to previous surveys conducted in 1995 and 1997. In 2000, FoodNet sites included Connecticut, Georgia, Minnesota, and Oregon and select counties in California, Colorado, Maryland, New York, and Tennessee.
Methods: We ascertained laboratory methods for routine testing of stool specimens for *Salmonell*a, *Shigell*a, *Campylobacte*r, *Escherichia coli* O157:H7, *Yersini*a, and *Vibrio* species, and estimated the number of stool specimens processed per year by clinical laboratories. FoodNet conducted active surveillance in those laboratories for all culture-confirmed cases of those pathogens.
Results: Four hundred fifty-six laboratories processed stool specimens from FoodNet residents; the laboratories processed an estimated 440,000 stool specimens per year. The number of stools processed per 100,000 persons in all sites was 1504(range, per site, 823 to 2675 per 100,000 persons.) These lab-oratories reported routinely testing for *Salmonell*a, *Shigell*a, and *Campylobacte*r; only 63% of laboratories routinely tested for *E.coli* O157:H7, 50% for *Vibri*o, and 49% for *Yersini*a. Among all stools submitted, the mean isolation rate for *Campylobacter* was 1.2% (range: 0.8% to 1.7%), 0.9% for *Salmonell*a, (range: 0.5% to 1.1%), 0.4% for *Shigella* (range: 0.2% to 0.5%), and 0.2% for *E. coli* O157:H7 (range: 0.1% to 0.4%). Among the 160 laboratories surveyed in all three years, the proportion that reported routinely testing for *E. coli* O157:H7 increased from 59% in 1995 to 68% in 2000. Discussion: Variation in the identified rate of culture-confirmed illness caused by these pathogens may be explained, in part, by variation in laboratory practice; other potential factors include variation in physician practice and rates of illness in the population. Adherence to recently published IDSA/CDC guidelines for diagnosis and management of diarrheal diseases may help to balance concerns for patient management and public health surveillance in the era of managed health care.

Surveillance for Guillain-Barré Syndrome in Oregon

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Background: Guillain-Barré syndrome (GBS) is an acute demyelinating condition that may complicate *Campylobacter* or upper respiratory infections. GBS is not reportable in Oregon, and its incidence is not known in that state. We sought to determine the burden and the proportion of GBS cases attributable to *Campylobacter* infection in Oregon.
Methods: *Campylobacter* infections reported in Oregon during 1997 were reviewed.

Oregon 1997 hospital discharge data (HDD) were queried for ICD-9 code 357.0. Hospitals with cases so identified were asked to review their own records for additional cases. Duplicates due to repeat admissions were removed. Data were abstracted from discharge summaries and laboratory records. Cases were classified as definite, probable, possible or non-cases according to published criteria.
Results: Eighty-two cases of GBS were identified through the initial HDD query, including 24 cases identified by hospitals. Four medical charts were unobtainable. Twenty-two (28%) of the remaining 78 were classified as definite cases, 12 (15%) were probable cases, 10 (13%) were possible cases, and 34 (44%) were non-cases. Treatment modalities included plasmapheresis (32%), and IVIG (54%). The majority of the patients were discharged home (64%), 32% were discharged to extended-care facilities, and one person died. The mean number of days in the intensive care unit was 13 days. The statewide incidence of definite, probable, and possible cases was 1.4/100,000. Persons $\geq$ 65 years of age older had a higher incidence than younger persons (2.1 vs 1.3/100,000). Men had higher rates than women (1.6 vs 1.2). Of the 44 definite, probable or possible cases, 8 (18%) reported preceding gastrointestinal illness; 3 (7%) had confirmed *Campylobacter* infection. Seven-hundred thirty-seven cases of laboratory-confirmed *campylobacter*iosis were reported in Oregon during 1997.
Conclusion: GBS caused 1 death and substantial morbidity in Oregon in 1997. Diagnosed *Campylobacter* infection was associated with at least 7% of GBS. About 0.4% of laboratory-confirmed *Campylobacter* infections were complicated by GBS. Efforts to prevent *campylobacteriosis* are likely to result in a decreased incidence of this serious complication.

Outbreak of Multidrug-resistant *Salmonella* Newport Associated with Consumption of Italian-style Soft Cheese, Connecticut

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Background: In the previous few years, multidrug-resistant *Salmonella* Newport (MDR-SN) has emerged in multiple states as an important cause of human illness. In Massachusetts where a sustained increase has been seen, infection with MDR-SN was associated with exposure to dairy farms. In April 2001, the Connecticut (CT) Department of Public Health (DPH) Epidemiology Program noticed through routine surveillance an increase in reports of S. Newport isolates and began an investigation. Initial typing by pulsed-field gel electrophoresis (PFGE) suggested that the increase was caused by a single MDR strain, indistinguishable from the Massachusetts strain.
Methods: To determine the magnitude and source of the outbreak, we reviewed previous surveillance data and conducted a case-control study and an environmental investigation. A case-patient was defined as a person reported to the DPH with illness onset April 1-25 and an isolate of the same PFGE type as the initial cases. Two or more controls for each case-patient were obtained through progressive digit-dialing matching on local prefix and age group. Environmental investigation included collecting raw milk and cheese samples

from the subsequently implicated cheese manufacturer and leftover cheese from ill cheese consumers. Samples were cultured for S. Newport and assayed for alkaline phosphatase.
Results: Before April, only sporadic cases of S. Newport with a matching PFGE pattern were reported, averaging one every 2-3 months since January 2000. From April 1 through May 31, 26 MDR-SN isolates were reported. Case-patients lived in five CT counties; median age was 56 years (range: 15-88); 20 (77%) were female. Twenty-three case-patients received antibiotics for their illness. Eight cases were hospitalized, none died. The 15 case-patients included in the case-control study were more likely than their 40 controls to have consumed any of three fresh soft Italian style cheeses (100% versus 38%, $p<0.0005$). Results from consumption of basket cheese revealed the strongest association (73% versus 0%, $p<0.00001$). The implicated cheese maker obtained raw milk from a large multistate consortium. The cheese making process involved a heating step but not a formal pasteurization step. The outbreak strain was isolated from a sample of raw milk, but not cheese. Alkaline phosphatase was detected in four of eight cheese samples obtained from ill persons during the outbreak period.
Conclusions: This outbreak was most likely caused by periodic inadequate heat treatment of contaminated raw milk used to make soft cheese. Beginning the on-site cheese making process with raw milk might add an unnecessary element of risk to cheese making, particularly for fresh soft cheese. The emergence of an MDR strain of S. Newport as a cause of human illness associated with dairy farm contact and/or consumption of dairy products appears to be a growing problem in the U.S. n-Hispanics.

Higher Incidence of *Listeria* Infections among Hispanics: FoodNet, 1996-2000

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Background: Listeriosis, a disease caused by infection with *Listeria monocytogene*s, carries high morbidity and mortality. Infection with *L. monocytogenes* has been most commonly associated with the consumption of unpasteurized milk, soft cheeses, hot dogs, and deli meats. Prominent outbreaks among Hispanic communities in Los Angeles and North Carolina have been associated with the consumption of Mexican-style soft cheese made with unpasteurized milk. We sought to determine if people of Hispanic ethnicity have an increased rate of listeriosis in general.
Methods: Active surveillance for listeriosis has been conducted in FoodNet sites since 1996. In 2000, listeriosis surveillance was conducted in eight FoodNet sites (California, Connecticut, Georgia, Maryland, Minnesota, New York, Oregon, Tennessee) encompassing approximately 29.5 million persons, or 11% of the US population. We

analyzed demographic data on all cases of culture-confirmed listeriosis identified by FoodNet from 1996 to 2000.
Results: From 1996 to 2000, a total of 474 culture-confirmed cases of listeriosis were reported in FoodNet sites. The five-year average incidence for all sites was 0.4 per 100,000 population, ranging from 0.3 in MN to 0.7 in CT. The average incidence was 0.2 per 100,000 among non-Hispanics and 0.7 among Hispanics during the study period. Among non-Hispanics, the incidence was 0.2 in Native Americans, 0.2 in blacks, 0.2 in whites, and 0.4 in Asians. Although the incidence remained higher in Hispanics across almost all age groups, the disparity between Hispanics and non-Hispanics was greatest among infants < 1 year of age (11.9 per 100,000 vs. 1.0 per 100,000 respectively) and among Hispanic women of childbearing age (15-39 years, 1.1 per 100,000 vs. 0.1 per 100,000 respectively). The highest incidence of illness among Hispanic women of childbearing age was observed in the 30-34 age group (2.7 per 100,000). When comparing incidence by gender, Hispanic females (0.9 per 100,000) had a notably higher incidence than Hispanic males (0.5 per 100,000); incidence was similar by gender for non-Hispanics.
Conclusion: In FoodNet sites from 1996 to 2000, there was a higher incidence of listeriosis among Hispanics compared with non-Hispanics, particularly in infants and women of childbearing age. Hispanic infants had a 12-fold greater incidence of listeriosis than their non-Hispanic counterparts; for Hispanic women 30-34 years of age, the incidence was 13-fold greater than for non-Hispanic women in the same age group. Additional studies of listeriosis focusing on these groups are needed to determine specific risk factors for infection. To reduce the burden of listeriosis, prevention strategies and educational campaigns that focus on protecting infants and women of childbearing age should be targeted towards the Hispanic community.

Comparability of FoodNet and United States Populations

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Background: A key objective of the Centers for Disease Control and Prevention's Foodborne Disease Active Surveillance Network (FoodNet) is to estimate the burden of foodborne illness in the United States. FoodNet activities, however, are conducted within selected state health departments. The selection of these sites was not chosen to be representative of the U.S. population. We therefore evaluated the comparability of the FoodNet population to the U.S. population on the basis of several demographic characteristics and health indicators.
Methods: Using 1996 U.S. Census data, we performed a demographic comparison of the original FoodNet population (Minnesota, Oregon and selected counties in California, Connecticut and Georgia) and U.S. population on the basis of age, gender, race and urban residence (metropolitan statistical area (MSA) distribution). Using Community Health Status Indicator (CHSI) Project data, we also compared the two populations on the basis of population density (persons per square mile) and percent at or below poverty. For the

purpose of this investigation, poverty is defined as having a household income less than the poverty thresholds established by the U.S. Census Bureau. These thresholds vary by family size and composition.
Results: The original FoodNet (count: 14,281,096) and U.S. (count: 265,189,794) populations had similar age and gender distributions, but differed slightly with regard to race. The Asian population was over represented (FoodNet: 6%, U.S.: 4%). The Black and Hispanic populations were underrepresented (FoodNet: 11% and 6%, U.S.: 13% and 12%, respectively). The populations also differed in their proportion of urban residents (FoodNet: 99%, U.S.: 80%). County-level comparison indicated a lower population density among the 135 FoodNet counties (FoodNet: median= 31 persons per square mile; U.S.: median= 41 persons per square mile). The FoodNet population also had a smaller percentage of persons living at or below poverty (FoodNet: 11%; U.S.: 15%).
Conclusions: The generalizability of FoodNet studies is some-what limited due to slight demographic differences (e.g., Hispanic and Asian populations). Despite these differences, however, the distribution of the FoodNet population across several other demographic factors and health indicators is similar to that of the U.S. population. These data support the generalizability of FoodNet data to the U.S. population for the purpose of understanding the epidemiology of foodborne illness. Every year since its inception, the FoodNet catchment area has increased from approximately 14 million in 1996 to 34 million in 2001. Further analysis is being conducted to compare the expanding FoodNet population with the U.S. population.

Age, Ethnic and Racial Disparity in *Salmonella* sertotype Enteritidis (SE): FoodNet, 1998-2000

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Background: *Salmonella* serotype Enteritidis (SE) emerged as the most common *Salmonella* serotype in the United States in the mid-1990s, reaching a peak in 1995. SE infections are most often associated with consumption of raw or undercooked shell eggs. The objective of this analysis is to describe the variation in SE incidence rates among the CDC's Foodborne Disease Active Surveillance Network (FoodNet) sites by state, age group, race, and ethnicity to determine where prevention efforts might be targeted.
Methods: Since 1996, FoodNet sites have been conducting active laboratory-based surveillance at clinical laboratories for selected foodborne pathogens including *Salmonell*a. Clinical laboratories forward *Salmonella* isolates to public health laboratories

for serotyping. In 2000, FoodNet sites included Connecticut, Georgia, Minnesota, and Oregon, and selected counties in California, Tennessee, Maryland, and New York (29.5 million); 11% of the U.S. population.
Results: In 1998-2000, 11,657 *Salmonella* cases were ascertained, of which 12% (1425) were SE. Enteriditis was the 2nd most common serotype. SE incidence rates were 1.9 per 100,000 in 1998, 1.7 in 1999 and 2.0 in 2000. Average annual incidence was highest in Maryland (4.8/100,000), followed by Connecticut (3.7) and was lowest in Georgia (0.9). The average annual age-specific incidence of SE was highest among children <5 years of age (4.2/100,000) and 5-9 years of age (2.1/100,000). There was no difference in age-specific incidence rates by gender. Of the 939 (66%) SE cases over 3 years of age whose race/ethnicity was known, average annual incidence was highest among Blacks (2.0/100,000) followed by Hispanics (1.2), and Whites (1.1). Incidence among Blacks was highest in Maryland (3-year average 7.4/100,000).
Conclusions: Incidence of SE varied by site with the highest incidence in Maryland and Connecticut. Children under 5 years of age had an incidence of SE twice as high as other age groups. The incidence of SE in Blacks was higher than in other racial or ethnic groups. These differences in SE incidence warrant further study to identify risk factors for infection that may explain these variations. Surveillance data are useful for identification of groups for targeted educational programs to reduce the incidence of SE infection.

A Pilot Study in FoodNet of the Use of Stool Collection Kits Delivered to the Home to Improve Confirmation of Etiology in Gastroenteritis Outbreak Investigations

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Background: In 68% of foodborne disease outbreaks reported to the Centers for Disease Control and Prevention (CDC), no etiologic pathogen is identified. In two-thirds of outbreaks of unconfirmed etiology, no stool specimens are submitted for laboratory testing. We studied the utility of using stool collection kits delivered to the homes of patients to improve rates of specimen submission and identification of an etiology in food-borne disease outbreaks.
Methods: CDC and Foodborne Diseases Active Surveillance Network (FoodNet) sites in California, Maryland, and Tennessee initiated a prospective pilot project to collect stool specimens using kits during gastroenteritis outbreaks. Each site designed, implemented, and evaluated easy-to-use kits specific to the needs of their populations and health department laboratories. All kits included instructions, shipping labels, transport and packaging material, and a stool collection “hat” for the toilet. Two sites used a single specimen collection container, and one site used separate bacterial and viral collection

containers with different media. The sites employed commercial and health department couriers and U.S. mail to deliver and retrieve the kits.
Results: From April 1 to October 31, 2001, stool collection kits were deployed in 12 outbreaks (7 in Tennessee, 4 in Maryland and 1 in California), involving 248 ill persons. Kits were distributed to 59 ill persons, and 42 (71%), which included > 1 specimen from 11 of the 12 outbreaks were returned to state lab-oratories. Of these, 28 were returned via courier and 14 by U.S. mail. "Inability to produce a specimen" after receiving the kit from the health department was the most common reason for non-sub-mission. The mean time from start of the outbreak investigation to receipt of specimens at the laboratory was 4.9 days. Of the 11 out-breaks for which kits were returned, an etiologic organism was confirmed in eight (72.7%); 6 Norwalk-like virus, 1 *Staphylococcus aureu*s, and 1 *Salmonella* serotype Enteritidis.
Conclusion: In over two-thirds of gastroenteritis outbreaks in which these stool collection kits were successfully deployed, an etiologic organism was identified. Delivery of kits to patients homes to improve rates of stool collection in outbreaks in which specimens might otherwise not be submitted could substantially reduce the number of outbreaks with an unknown etiology. However, these preliminary findings are based on a small number of outbreak investigations. The cost-effectiveness and feasibility of routine use of these kits requires further evaluation.

Eating in Restaurants: A Risk Factor for Foodborne Illness? Findings from FoodNet to Be Explored by EHS-Net

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Background: Over 80% of Americans eat out at least once per week, and 46% of the U.S. food dollar is spent on food away from home. The Centers for Diseases Control and Prevention's Foodborne Disease Active Surveillance Network (FoodNet) provides a unique opportunity to investigate the potential relationship between foodborne illness and consumption of food outside the home.
Methods: We compiled results of a random digit dialing telephone survey and several multi-state case-control studies, pertaining to consumption of food outside the home as a risk factor for foodborne illnesses.
Results: Among 12,755 respondents to the 1998-1999 population survey, 83% said that they eat out at least once per week, and 16% ate out an average of 5 or more times per week. In a case-control study of *Salmonella* serotype Enteriditis with 182 cases enrolled, among persons with no recent international travel, consumption of chicken outside the home was associated with a matched odds ratio (mOR) of 2.1 (95% CI 1.2-3.4) and a population attributable risk of 25%. In a case-control study of E. coli O157:H7 with 200 cases enrolled, among persons consuming ground beef, eating a hamburger at a restaurant that was not part of a major fast-food chain was associated with a mOR of 10 (CI 1.3-82). In a case-control study of *Salmonella* serotype Heidelberg with 44 patients enrolled, illness was associated with eating eggs prepared outside the home (mOR=6.2, CI 1.2-

31.7), particularly runny eggs (mOR=11.1, CI 1.22-63.1), with population attributable risks of 33% and 56%, respectively. In a case-control study of 64 persons with fluoroquinolone-resistant *Campylobacte*r, among persons without recent international travel, illness was associated with eating chicken or turkey at a commercial establishment (mOR 4.3, CI 1.2-15).
Conclusions: Findings from a number of FoodNet case-control studies suggest that consumption of food outside the home is associated with increased risk of specific foodborne illnesses. Refining data on the period of exposure for common risk factors will be important in better understanding this issue. The CDC's Environmental Health Specialist Network (EHS-Net) is a new program developed to improve our understanding of environmental causes of illness. Its initial focus will be evaluating risk factors associated with eating outside the home. Given the numbers of persons eating in restaurants regularly, further study is warranted to better understand the nature of those risks.

Drinking Water Exposures and Perceptions among 1998-1999 FoodNet Survey Respondents

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Background: In 1996, Congress mandated that EPA and CDC produce a report to define a national estimate of waterborne illness attributable to municipal drinking water. As part of the report process, it was determined that there was a need to better characterize the drinking water consumption, behaviors, and exposure outcomes of the U.S. population.
Methods: The Emerging Infections Program's Foodborne Diseases Active Surveillance Network (FoodNet) conducts population surveys that collect demographic, medical and food consumption information. EPA and CDC integrated water consumption and exposure questions into FoodNet surveys administered via random digit dialing to households within 7 FoodNet sites from February 1998 through February 1999.
Results: Among 12,755 respondents, 63.8% identified municipal water, 17.8% bottled water, and 15.0% private well water as their primary source of drinking water. Residents of rural or farm areas were more likely to drink private well water than municipal or bottled water ($p=0.001$). Reasons for drinking bottled water included improved taste or odor (49.1%), avoiding chemicals (28.0%), and avoiding germs (16.5%). Bottled-water drinkers with children were more likely to express concern about germs in water ($p=0.02$). Thirty percent of tap water drinkers treated their water. The most cited treatment method, filtration (76.0%), was associated with higher income and higher education ($p<0.001$). Those with annual incomes less than $15,000 who treated their water favored pitcher filters or boiling their water. The reasons for choosing to treat water did not vary by income or education. Respondents (65.0%) did not know if their filter removed *Cryptosporidiu*m. Respondents did not consistently use the primary source of drinking water to prepare beverages. One-third of those who drank bottled or treated tap water reported using untreated tap water to prepare cold beverages. Diarrheal episodes (3 or more stools lasting 1 day or more or impairing daily activity, except episodes linked

with chronic illness) did not show any significant associations with water exposures by univariate analysis.
Conclusion: The results from the 1998-1999 population survey indicate socioeconomic factors and geographic location may influence the type of drinking water source and selection of treatment. Responses generally indicate that the public chooses water treatment for palatability, rather than to prevent harm from possible chemical or microbial contaminants. Continued data collection will indicate whether these patterns and beliefs remain temporally and geographically consistent as more FoodNet sites are included and will assist in the development of a national estimate of waterborne illness.

Population-based Incidence of Infection with Selected Enteric Bacterial Pathogens for Children under 5 Years of Age, FoodNet, 1996-1998

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Background: Previous studies have shown that the disease burden of bacterial enteric infections falls disproportionately on children under 5 years old. This study describes population-based incidence rates of laboratory-confirmed infections with *Campylobacte*r, *E. coli* O157, *Listeri*a, *Salmonell*a, *Shigell*a, and *Yersinia* in children < 5 years of age in the CDC's Foodborne Diseases Active Surveillance Network (FoodNet), 1996-1998.
Methods: Culture-confirmed cases of infection with these 6 pathogens were ascertained through active laboratory surveillance. The FoodNet catchment area included Minnesota, Oregon, and selected counties in California, Connecticut, Georgia, Maryland and New York. Incidence rates for each pathogen per person-year of observation (py) were calculated by year, site, season, sex, and age. Age-specific postcensus estimates for the 3-year period were used to calculate the FoodNet population. Incidence rate ratios and 95% confidence intervals (CIs) were used to estimate relative risk (RR) in those < 5 years.
Results: There were 3,488,746 py for children < 5 years and 51,115,328 total py for all ages; children <5 accounted for 7% of total py. For children < 5 years, there were 5,210 cases of infection with any of the 6 pathogens, accounting for 21% of cases for all ages. By pathogen, the number of cases and percent of cases for < 5 years out of all reported FoodNet cases was: *Campylobacter* 1505 (13%); *E. coli* O157 359 (29%); *Listeria* 25 (10%); *Salmonella* 1941 (27%); *Shigella* 1133 (28%); *Yersinia* 247 (53%). Culture-confirmed cases per 100,000 py for those < 5 were 43.1 for *Campylobacte*r, 10.3 for *E.coli* O157, 0.7 for *Listeri*a, 55.6 for *Salmonell*a, 32.5 for *Shigell*a, and 7.1 for *Yersini*a. For age < 5, RRs compared with age 5 and older for the respective pathogens were 2.1

for *Campylobacte*r, 5.7 for *E. coli* O157, 1.4 for *Listeri*a, 5.1 for *Salmonell*a, 5.4 for *Shigell*a, and 15.3 for *Yersini*a. Incidence rates varied widely across the 7 FoodNet sites. In general, for the 5 pathogens other than *Listeri*a, sites with higher incidence rates for age < 5 also had high rates for age 5 and older, compared with other sites. However, for *Campylobacte*r, *E. coli* O157 and *Shigell*a, sites with higher rates for age < 5 also had a greater contrast between age < 5 and age 5 and over than did other sites.
Conclusion: This population-based study confirmed a disproportionate disease burden or these enteric bacterial infections in children < 5 as both percent of cases and per 100,000. The absolute and relative disease burden for age < 5 years differed by pathogen and by FoodNet site. This disease burden suggests that investigation of risk factors specific to his age group and a review of current prevention and control strategies and their enhancement specifically for young children might lead to appreciable reductions in illness.

Hospitalizations Among Cases with the Most Common Serotypes of *Salmonell*a: FoodNet, 1996-2000

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Background: *Salmonella* is a leading cause of gastrointestinal illness in the United States. Although there are over 2000 known serotypes of *Salmonell*a, four serotypes account for the majority of reported infections. This analysis assessed severity of illness among the major serotypes of *Salmonella* cases reported to the Centers for Disease Control and Prevention's Foodborne Disease Active Surveillance Network (FoodNet), as measured by hospitalization rates and duration.
Methods: A case of salmonellosis was defined as the isolation of a *Salmonella* species from any clinical source in a resident of the FoodNet catchment area during the years 1996-2000. In 1996, the catchment area included Minnesota, Oregon, and selected counties in California, Connecticut, and Georgia; subsequently, selected counties in New York, Maryland (1998) and Tennessee (1999) were added. The top four reported *Salmonella* serotypes were abstracted from the data set and analyzed for hospitalization and length of hospital stay. The median duration of hospitalization was calculated for each serotype and the proportion of hospitalized cases was compared, by serotype, using the chi-square test.
Results: Between 1996 and 2000, 15,931 cases of *Salmonella* infection were reported to

FoodNet. One hundred ninety-two cases with incomplete hospitalization data were excluded from this analysis. Of the 15,739 remaining, 2671 (17%) were hospitalized. Four *Salmonella* serotypes *(*S. Typhimurium, S. Enteriditis, S. Heidelberg, and S. Newport) comprised 53% of the hospitalized cases. Hospitalized patients with one of these serotypes had a median hospital stay of 3 days (range 1-157). S. Typhimurium accounted for 4015 (26%) cases; 778 (19%) were hospitalized and had a median hospital stay of 3 days. There were 2144 (14%) cases of S. Enteriditis; of which 322 (15%) were hospitalized with a median hospital stay of 4 days. S. Heidelberg represents 961 (6%) cases; 207 (22%) were hospitalized and had a median hospital stay of 4 days. There were 1045 (7%) cases of S. Newport, of which 102 (10%) were hospitalized with a median hospital stay of 3 days.
Conclusion: The propensity of individual *Salmonella* serotypes to cause hospitalization among residents of FoodNet sites varies, ranging from 10% *(*S. Newport) to 22% *(*S. Heidelberg). However, the median duration of hospitalization among cases infected with the most frequent serotypes of *Salmonella* is similar, suggesting similar recovery rates independent of the serotype causing infection. Further studies are needed to determine reasons for the elevated hospitalization rates between S. Heidelberg and S. Typhimurium.

Restaurant-Associated Behavior from the FoodNet Population Survey, 1998-99

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Background: A large proportion of foodborne outbreaks reported in the United States are associated with restaurants, but little is known about risk factors for sporadic acute gastrointestinal illness associated with restaurants. It is estimated that 46% of the average U.S. household's food-dollar is spent in restaurants.
Methods: From March 1998 through February 1999, the Centers for Disease Control and Prevention's Foodborne Diseases Active Surveillance Network (FoodNet) conducted a random-digit dialing telephone survey to better understand factors potentially associated with acute diarrheal illness. The survey was performed in Connecticut, Minnesota, and Oregon and selected counties within California, Georgia, Maryland, and New York (population 21 mil-lion persons). We attempted to interview 150 persons each month in each state. Persons of all ages were eligible. Respondents were asked about restaurant patronage in the past 7 days and food preferences.
Results: The questionnaire was administered to 12,755 persons. Of these, 463 (4%) reported eating at a fast food or sit-down restaurant frequently (7 times in the past 7 days). Among males, 7% ate out frequently as compared to 3% of females ($p<0.001$).

Over 10% of persons between the ages of 16 and 25 years of age and 6% of young adults (26-45 year-olds) ate out frequently. Blacks (7%) were more likely to eat out =7 times in the previous week than whites (4%, $p<0.001$). Of all respondents, 10% ordered their restaurant hamburgers cooked rare or medium-rare. Of these, 87% considered a hamburger having pink on the inside to be cooked, compared to 20% of those who ordered medium, medium-well, or well-done restaurant hamburgers ($p<0.001$). One third (33%) of rare or medium-rare hamburger eaters cut their hamburgers to check how they were cooked as compared with two-thirds (66%) of non-rare hamburger customers ($p<0.001$).

Conclusions: A large proportion of this survey's respondents ate =7 meals per week at fast food and sit-down restaurants. A substantial number of respondents admit to preferring established higher-risk foods, such as undercooked hamburgers, when they eat out. Further studies are necessary to explore the association between frequent restaurant patronage and acute diarrheal illness.

Marked Regional Variation in the Incidence of Laboratory-Confirmed Bacterial Foodborne Illness: FoodNet, 2000

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Background: Each year in the United States, an estimated 5 million persons contract bacterial foodborne illnesses. The Foodborne Diseases Active Surveillance Network (FoodNet) is the principal foodborne disease component of the CDC's Emerging Infections Program. FoodNet strives to monitor the burden of foodborne illnesses and interventions designed to reduce them.

Methods: In 2000, FoodNet conducted population-based active surveillance for laboratory confirmed cases of *Campylobacte*r, *E. coli* O157, *Listeri*a, *Salmonell*a, *Shigell*a, *Vibri*o, and *Yersinia* infections in Connecticut, Georgia, Minnesota, and Oregon, and selected counties in California, Maryland, New York, and Tennessee (total population 29.5 million). FoodNet contacts approximately 450 clinical laboratories at least monthly to ascertain cases.

Results: 12,125 cases were identified; 4640 *Campylobacte*r, 4237 *Salmonell*a, 2324 *Shigell*a, 631 *E. coli* O157, 131 *Yersini*a, 101 *Listeri*a, and 61 *Vibri*o. The incidence per 100,000 population was highest for *Campylobacter* (15.7), followed by *Salmonella* (14.4), and *Shigella* (7.9). Lower incidences were reported for *E. coli* O157 (2.1), *Yersinia* (0.4), *Listeria* (0.3) and *Vibrio* (0.2). Substantial variation in incidence was reported among sites. The incidence of *Campylobacter* infections ranged from 6.6 per 100,000 in TN to 38.2 in CA. The incidence of *Salmonella* infections was less variable ranging from 8.9 in OR to 18.0 in GA. Rates for infections with specific *Salmonella*

serotypes also varied; infections with S. Typhimurium ranged from 1.9 in CA to 3.7 in TN, S. Enteritidis from 1.0 in NY and TN to 5.1 in MD, and S. Newport from 0.3 in OR to 3.5 in TN. *Shigella* infections ranged from 1.1 in NY to 18.8 in MN. *E. coli* O157 infections ranged from 0.5 in MD to 4.6 in MN. Incidence also varied by age, especially for C*ampylobacter* and *Salmonella* infections; for children <1 year of age, the incidence was 88.4 and 33.6, respectively, substantially higher than for other age groups. **Conclusion:** *Campylobacter* was the most frequently diagnosed pathogen; however, substantial regional variation occurred. The incidence of *Campylobacter* and *Salmonella* among infants is particularly high. Focused research into the reasons for these local differences may provide information about prevention that is of general use. Further prevention efforts are needed to meet the Healthy People 2010 objectives for *Campylobacter* (12.3/100,000 population), *Salmonella* (6.8/100,000 population), and *E. coli* O157 (1.0/100,000).

The Burden of Diarrheal Illness in FoodNet, 2000-2001

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Background: An estimated 76 million food-related illnesses occur annually in the United States. Since 1996, the Centers for Disease Control and Prevention's Foodborne Disease Active Surveillance Network (FoodNet) has conducted periodic surveys of the population to determine the prevalence of diarrheal illness, and frequency at which persons with diarrhea seek medical care and submit stool specimens. These data are useful in determining the burden of foodborne diseases.
Methods: The FoodNet population survey was designed to ascertain demographic, health, and food preference information among residents of Connecticut, Georgia, Minnesota, Oregon, and select counties in California, New York, Maryland, and Tennessee (population 29.5 million). The 131-item questionnaire was administered by telephone using standard Behavioral Risk Factor Surveillance System methodology. One member of each household contacted was randomly selected to complete the interview. Participants were asked about activities in the month prior to interview. We attempted to interview 150 persons per month in each of the FoodNet sites between March 2000 and February 2001. We defined acute diarrheal illness as =3 loose stools in 24 hours with impairment of daily activities or duration of diarrhea >1 day.
Results: Of the 14,647 persons inter-viewed, 5761 (39%) were male; the median age was 41 years. Of the 14,046 respondents who denied a chronic gastrointestinal disease, 659

(5%) reported an acute diarrheal illness during the month prior to the interview. The prevalence of illness was highest among children less than 5 years (9%) and lowest among those over 65 years (2%). Rates of illness were similar among education, income, gender, and residence groups but ranged from 2% in Asian/Pacific Islanders to 10% in those of mixed race. Of those with an acute diarrheal illness, 18 (3%) reported blood in their stool, 152 (23%) sought medical care; of those seeking medical care 26 (17%) were asked to submit a stool specimen, and 73 (48%) were prescribed antibiotics for their illness. Only 7 (27%) of the 26 who submitted stool samples were prescribed antibiotics.
Discussion: Diarrheal illness continues to impose a large burden of disease with a marked prevalence and high proportion of ill per-sons seeking medical care. However, few persons seeking medical care submitted a stool specimen, illustrating that there are many more ill persons for each laboratory-confirmed infection. Including a factor of 0.7 to account for test sensitivity, these data indicate there are roughly 36.5 cases of diarrheal illness for each diagnosed infection. This is similar to multipliers used to develop recent estimates, and suggests that changes in reported incidence may reflect changes in illness rates rather than changes in health seeking behavior.

Comparison of Disease Severity Between Outbreaks of Known and Unknown Etiology with >10 Ill Persons, FoodNet Sites, 1999-2000

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Background: Approximately 550 foodborne disease outbreaks are reported to CDC annually and two-thirds of these have an unknown etiology. Several factors, including disease severity and specimen collection and testing, are thought to contribute to a successful investigation.
Methods: To compare disease severity between outbreaks of known and unknown etiology with =10 ill persons, we reviewed outbreak data collected in FoodNet sites in 1999 and 2000. FoodNet, the CDC's Foodborne Diseases Active Surveillance Network, includes Connecticut, Georgia, Minnesota, and Oregon and portions of California, Maryland, New York, and Tennessee, representing approximately 29 million persons (11 % of the United States population). A foodborne outbreak is defined as two or more cases of a similar illness resulting from ingestion of a common food. Etiology was determined using the guidelines for confirming a foodborne disease outbreak [MMWR 2000; 49(No. SS-1):54-61].
Results: From 1999 to 2000, 185 foodborne disease outbreaks with =10 ill were reported from FoodNet sites. Six out-breaks of ≥10 ill persons per million population were reported in FoodNet (range 2 per million persons in TN to 11 per million persons in MN.) Of these, 96 (52%) were outbreaks with a known etiology. Among these, 57 (59%) were

due to Norwalk-like virus, 17 (18%) to *Salmonella* spp., 6 (6%) to *Escherichia coli* O157, and 16 (17 %) to other etiologies. Among the 96 outbreaks of known etiology, the median number of persons with vomiting was 12 (range 0 to 186), with diarrhea was 18 (range 0 to 243), and with fever was 9 (range 0 to 148). Among the 89 outbreaks of unknown etiology, the median number of persons with vomiting was 11 (range 0 to 72), with diarrhea was 14 (range 1 to 72), and with fever was 5 (range 0 to 30). In 18 (19%) outbreaks of known etiology, 50% or more of those ill sought health care; this compares to 2 (2%) out-breaks of unknown etiology. Outbreaks with a known etiology were also more likely to be outbreaks where ≥50% of those ill were hospitalized [4 (4%) outbreaks vs. 0 (0%) outbreaks] and where 25% of those ill had bloody diarrhea [14 (15%) vs. 1 (1%)].

Conclusions: A little more than half of the foodborne disease out-breaks with ≥10 ill persons reported to FoodNet from 1999 to 2000 had a known etiology. Outbreaks of known etiology were more likely to result in health care visits, hospitalizations, and bloody diarrhea, possibly prompting a more aggressive investigation including microbial testing. Additional efforts are needed to determine the etiology of outbreaks with less severe symptoms. The use of courier services and mail-in kits to increase the number of clinical specimens submitted for etiologic testing during outbreaks may increase pathogen yield in outbreaks where patients are less likely to seek medical care.

Foreign-Travel-Associated Salmonellosis and Shigellosis: Oregon 2000-2001

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Introduction: Salmonellosis and shigellosis are important enteric diseases, and both are reportable in Oregon; during 2000 the incidences were 8.4 confirmed cases/100,000 population and 2.4 per 100,000 (excluding outbreak cases), respectively. Efforts to reduce their incidence by making food safer are under way. However, the extent to which salmonellosis and shigellosis in Oregon are attributable to foreign travel (FT) is unknown.

Methods: Oregon's Foodborne Diseases Active Surveillance Network (FoodNet) program has conducted active, laboratory-based surveillance for *Salmonella* and *Shigella* since 1996. Clinical laboratories report *Salmonella* and *Shigella* cases to local public health officials and submit all isolates to the Oregon State Public Health Laboratory for subtyping. Local health department case investigations are submitted to the Oregon Department of Human Services Office of Disease Prevention and Epidemiology for analysis. The case-investigation forms solicit information on FT during the five days before illness onset for non-typhoidal salmonellosis, three days for shigellosis, and 21 days for typhoid fever. We evaluated case travel histories by pathogen for the years 2000-2001 and compared them to travel histories reported during the same years in a FoodNet telephone survey of a stratified random sample of Oregonians.

Results: Excluding outbreak cases, from January 2000 through October 2001, 518 salmonellosis and 168 shigellosis cases were reported from Oregon residents, for a total of 686 sporadic cases. Case-investigation forms were submitted for 665 (97%) of these. 59 (11%) of the salmonellosis cases and 46 (27%) of the shigellosis cases were associated with FT. FT was associated with 9 (82%) of 11 cases with *Salmonella* Typhi and 21 (32%) of 65 with *Salmonella* Enteritidis, but only 4 (3%) of 144 with *Salmonella* Typhimurium. 22 (31%) of 72 of *Shigella sonnei* cases and 16 (19%) of 86 *Shigella flexneri* cases were associated with foreign travel. Of the 105 FT-associated cases, 55 (52%) had traveled to Mexico; 24 (23%) to Asia; 9 (9%) to Africa; 8 (8%) to other Latin American countries; 5 (5%) to Europe; and 4 (4%) to other areas. In the 2000-2001 FoodNet population survey of 1,600 Oregon residents, only 1% reported FT in the seven days before the interview.
Conclusions: 15% of sporadic salmonellosis and shigellosis reported in Oregon are associated with FT. Some of this may reflect a bias as to who is cultured; nevertheless, the striking differences in reported FT by *Salmonella* serotype suggest that much of the observed association is real. Studies are needed to identify the sources of these infections abroad.

Prevalence and Consequences of Fluoroquinolone-Resistant *Campylobacter* Infections: NARMS 1997-2000

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Background: *Campylobacter* causes 2.4 million infections each year in the United States. Fluoroquinolones (e.g., ciprofloxacin) commonly are used in adults with *Campylobacter* and other infections. Fluoroquinolones also are used in livestock and poultry. Human infections with fluoroquinolone-resistant *Campylobacter* have become increasingly common and are associated with consumption of poultry. These, and other data, prompted FDA to propose withdrawal of fluoroquinolone use in poultry in 2000.
Methods: In 1997, the National Antimicrobial Resistance Monitoring System (NARMS) for Enteric Bacteria began monitoring antimicrobial resistance among *Campylobacter* in the Foodborne Disease Active Surveillance Network (FoodNet) sites; by 2000, the number of sites had increased to 9. Additionally, a case-control study of sporadic *Campylobacter* infections was conducted in 7 FoodNet sites between 1998-1999. Isolates collected from individuals with *Campylobacter* infections were forwarded to CDC for speciation using hippurate test and PCR, and susceptibility testing to ciprofloxacin using the E-test.
Results: NARMS tested 1202 *Campylobacter* isolates from 1997-2000; 1145 (95%) were *C. jejun*i, 44 (4%) *C. col*i, 7 (0.6%) *C. upsaliensi*s, and 6 (0.5%) other *Campylobacter* species. Fourteen percent of isolates (163/1202) were ciprofloxacin-resistant (MIC =4 µg/ml); 13% (155) of *C. jejuni* isolates, 16% (7) *C. col*i, and 0.6% (1) *C. upsaliensi*s. Among 775 patients in the FoodNet *Campylobacter* case-control study, 11% (85) had ciprofloxacin-resistant infections. Among 421 persons with a

C*ampylobacter* infection who did not take a strong antidiarrheal medication (e.g., Imodium, Lomotil, or prescription), persons with ciprofloxacin-resistant infections had a longer duration of diarrhea than persons with ciprofloxacin-susceptible infections (8 vs 7 days, p=0.05). Of these 421 persons, 126 (30%) took fluoroquinolones and no other antimicrobial agent for their illness. Among the 126 persons who took fluoroquinolones, the mean diarrhea duration was longer in patients with ciprofloxacin-resistant infections than in patients with ciprofloxacin-susceptible infections (8 vs 6 days, p=0.04). **Conclusions:** NARMS surveillance data illustrates emerging fluoroquinolone resistance of *Campylobacter* in humans. Persons with ciprofloxacin-resistant *Campylobacter* infections have a longer duration of diarrhea than persons with ciprofloxacin-susceptible *Campylobacter* infections. Fluoroquinolones commonly are used to treat human infections; additional efforts are needed to protect the efficacy of fluoroquinolones.

Comparison of Animal and Human Multidrug-Resistant Isolates of *Salmonella* Newport in Minnesota

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Background: Multidrug resistance, including resistance to ceftriaxone, has been emerging among human clinical *S.* Newport isolates submitted to the Minnesota Department of Health (MDH) since 1999. Of 56 *S.* Newport isolates submitted during 1999-2000, 13 (23%) were resistant to $\geq$5 antimicrobials, and 12 were resistant to ceftriaxone. The objective of this study was to evaluate antimicrobial resistance and molecular subtype characteristics of clinical *S.* Newport isolates from animals from a veterinary diagnostic laboratory in Minnesota and to compare them with human clinical *S.* Newport isolates in Minnesota.
Methods: S. Newport isolates from clinically ill or dead animals submitted to the Minnesota Veterinary Diagnostic Laboratory from January 2000 through September 2001 were forwarded to MDH. Animal isolates were subtyped by pulsed-field gel electrophoresis (PFGE) and tested for antimicrobial resistance at MDH using the same methods used to test human clinical isolates submitted to MDH through routine surveillance. Antimicrobial resistance testing was done by disk diffusion; Etest for ceftriaxone was done on isolates with intermediate susceptibility by disk diffusion. **Results:** Isolates from 33 animals (all from different farms or homes) were tested, including 22 cattle, 5 swine, 2 horses, 1 deer, 1 dog, 1 owl, and 1 iguana. Of the 33 isolates, 25 (76%) were resistant to > 5 antimicrobials, and 24 had resistance to at least ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, and tetracycline (R-type ACSSuT); these isolates were recovered from cattle (n=19), swine (n=2), a horse, a dog, and a deer. Of the 24 ACSSuT isolates, all were also resistant to cephalothin (Cf), 23 to ceftriaxone (Cro), 20 to kanamycin (K), and 19 to gentamicin (Gm). Nineteen of 33 animal isolates (58%) were resistant to 9 antimicrobials (R-type ACSSuTCfCroKGm), including 16 isolates from cattle. PFGE sub-typing of the 33 animal isolates yielded 16 subtype patterns. Nine PFGE subtypes represented 16 cattle isolates that were at least

penta resistant; 5 of these 9 subtypes have been associated with clinical illness in humans in Minnesota. Isolates belonging to this group of 5 PFGE subtypes were also recovered from horses (2 isolates), a pig, a dog, and a deer.
Conclusions: Clinical animal isolates of S. Newport submitted to the Minnesota Veterinary Diagnostic Laboratory during 2000-2001 were highly multidrug-resistant; over one half of isolates were resistant to 9 antimicrobials, including ceftriaxone. Cattle were the primary host from which multidrug-resistant strains of *S.* Newport isolates were recovered. PFGE subtyping revealed indistinguishable subtypes between human and animal (particularly cattle) isolates. Future studies to determine specific risk factors for infection with multidrug-resistant *S.* Newport in humans should include investigation of cattle as a potential reservoir.

Disparities in Foodborne Disease Education Among Physician Specialties that Treat At-Risk Populations

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Background: Foodborne disease is a significant problem in the United States with an estimated 70 million cases each year. Immunocompromised and pregnant individuals are at higher risk of acquiring a foodborne disease and of having a more severe illness if infected. Research has shown that consumers are not well educated about food safety, but are concerned about infectious disease. Because of the higher risk of illness in immunocompromised and pregnant individuals and the inherent lack of food safety education, physicians whose specialties are intimately involved in the treatment or management of at-risk individuals are essential in the education of these populations about foodborne disease.
Methods: In 2000, Georgia, as a member of the Emerging Infections Program, conducted a survey targeting four physician specialties that treat immunocompromised or pregnant individuals. The specialties included obstetricians, oncologists and hematologists, infectious disease (ID) physicians, and nephrologists. The survey focused on physician's beliefs, knowledge, and practices concerning education of their patients about foodborne disease risk and prevention.
Results: Three hundred nine surveys were distributed to these four specialties; 87 of the 134 questionnaires returned were used in the analysis. No difference was found in the proportion of physicians surveyed that treat at-risk individuals among the four specialties, with 98% of physicians reporting that they treated at least some at-risk patients. The proportion of patients that requested information regarding foodborne disease also did not differ among the four specialties, with 80% of physicians reporting that their patients request information on food safety and foodborne disease prevention. Thirty-eight percent of physicians reported that their practice provides information about foodborne disease to patients. ID physicians' practices were more likely to provide information than both nephrology ($p=0.001$) and obstetric ($p=0.004$) practices, while oncology/hematology practices were more likely to provide information than nephrology practices ($p=0.043$).

Conclusions: There is a disparity in foodborne disease education of patients among the four different physician special-ties. ID physicians and oncologists/hematologists are more likely to ensure that their patients receive education on foodborne disease risk and prevention. Physician specialty appears to have the greatest impact on whether a physician's practice educates patients about foodborne disease. This study highlights two physician specialties in Georgia that should be targeted for increased education about foodborne disease and its impact on at-risk individuals.

Epidemiology of Shiga Toxin-Producing *Escherichia coli* (STEC) Infections in Connecticut, February 1, 2000 - January 31, 2001

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Background: Infections with Shiga toxin-producing *Escherichia coli* (STEC) are an important public health problem. *E. coli* O157 is the most common STEC in the United States (US). However, standard culture methods for *E. coli* O157 do not detect non-O157 STEC. Studies in other countries suggest that disease caused by non-O157 STEC is as prevalent as O157 STEC. Recognizing that standard cultures do not detect non-O157 STEC, some clinical laboratories in Connecticut have begun using tests to detect Shiga-toxin directly rather than culture for *E. coli* O157. We took advantage of the change in laboratory methods to characterize the prevalence and epidemiology of non-O157 STEC infection.
Methods: To determine the relative frequency of non-O157 STEC, we conducted statewide laboratory-based surveillance for STEC at each of the 40 clinical microbiology laboratories in CT. As part of reporting requirements, clinical laboratories submit O157 isolates or shiga-toxin positive broths depending on which test they use to the State Laboratory for confirmation and further testing. Laboratory audits were performed to ensure that all cases of STEC were reported. To determine the spectrum of illness and risk factors for O157 and non-O157 STEC infections in Connecticut, we interviewed patients with STEC from February 1, 2000 through January 31, 2001. Differences between case-patients with non- O157 and patients with O157 STEC were assessed.
Results: From February 1, 2000 through January 31, 2001, a total of 90 STEC infections were reported: 61 were detected by laboratories that culture for O157 and 29 were detected by laboratories that test directly for Shiga toxin. Among STEC infections identified by Shiga toxin testing only, 17 (59%) were found on subsequent testing by the state laboratory to be O157 and 12 (41%) were non-O157 STEC, comprising nine different serotypes. Overall, 78 O157 STEC and 12 non-O157 STEC were identified. Compared with patients who had O157 infection, patients with non-O157 were less likely to have diarrhea ($p=0.017$) or bloody stool ($p=0.001$), and were less likely to be hospitalized ($p=0.005$). No differences in demographics, food, or other exposures were identified between patients with non-O157 and O157 STEC infection.

Conclusions: Based on results of Shiga toxin testing in Connecticut, non-O157 STEC was detected nearly as often as O157 STEC. Severity of illness caused by non-O157 STEC infection appears to be milder. Differences in risk factors between non-O157 STEC and O157 were not identified. Clinicians evaluating patients with diarrhea should consider infection with non-O157 STEC. Ongoing surveillance for both O157 and non-O157 STEC is needed to better define the incidence and epidemiology of STEC infections in Connecticut.

Microbiologic Testing to Identify Shiga Toxin-producing *E. coli* in HUS Patients: FoodNet 1997-2001

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Background: Hemolytic uremic syndrome (HUS) is a life threatening illness characterized by hemolytic anemia, thrombocytopenia, and acute renal failure. In developed countries, nearly all cases of HUS in children are caused by infection with Shiga toxin-producing *E. coli* (STEC), of which the most well known serotype is O157:H7. *E. coli* O157:H7 may be identified by the characteristic color of its colonies on Sorbitol-McConkey agar (SMAC). Other serotypes may be responsible for a portion of HUS cases, but their isolation from stool specimens is difficult since they do not share this distinguishing characteristic. With the advent EIA and PCR tests for Shiga toxin, and the potential for human serology to identify antibodies to STEC in HUS cases, the etiology of STEC in HUS may be better understood.
Methods: Since 1997, HUS surveillance has been part of CDC's Foodborne Diseases Active Surveillance Network (FoodNet) at all sites (California, Colorado, Connecticut, Georgia, Maryland, Minnesota, New York, Tennessee, Oregon). Pediatric nephrologists in catchment areas for sites were contacted at least monthly for surveillance. Adult cases are reported in a passive system, as are cases outside of catchment areas. Case information is collected using standard medical and microbiologic record abstraction forms.
Results: From 1997 through October, 2001, 322 cases of HUS were reported. The average incidence among sites was 0.2 per 100,000 population, with a range from 0.04 to 0.5. There were a total of 25 deaths (8%). Of 288 cases for which information was available, microbiologic testing identified STEC for 169 cases (59%). The proportion of cases with an STEC isolate identified increased from 38% in 1997 to 64% in 2000. All but 2 STEC identified were serotype O157:H7. Among all cases, 97% had stool cultured on SMAC and 38% had stool tested for Shiga-toxin. Among cases without STEC identified, only

24% had Shiga toxin testing done. This proportion increased from 5% in 1997 to 47% in 2000. A total of 21 cases had STEC serology done to identify anti- O157, O111 or O126 antibody; 10 cases (48%) had detectable antibody to O157. No antibody against non-O157 STEC serotypes was detected among these cases.
Conclusion: *E. coli* O157 causes the majority of pediatric HUS cases: the proportion caused by other STEC is uncertain. To determine the etiology of HUS in the United States, a complete microbiologic assessment should be conducted. Although SMAC culture is done for high proportion of cases, serotype indiscriminate tests for Shiga-toxin was conducted for only a minority of cases. Increased efforts by clinicians and clinical laboratories to conduct complete STEC testing will aid the specific diagnosis. Serologic testing for antibodies against the major STEC serotypes may be helpful if microbiologic tests are not done or negative.

Risk Factors for Sporadic *Escherichia coli* O157 Infections in the United States: a Case-control Study in FoodNet Sites, 1999-2000

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Background: *Escherichia coli* O157 *(E. coli* O157) infections can cause severe gastrointestinal illness, characterized by abdominal cramps and profuse, often bloody, diarrhea. In the United States, *E. coli* O157 infections cause an estimated 62,000 foodborne illnesses, 1,800 hospitalizations and 50 deaths each year. To identify new risk factors for illness and collect more information on previously identified risk factors, we conducted a matched case-control study of sporadic *E. coli* O157 infections in 1999-2000.
Methods: Culture-confirmed *E. coli* O157 cases were identified through active laboratory surveillance in 7 sites (California, Connecticut, Georgia, Minnesota, Maryland, New York, Oregon) as part of the CDC's Foodborne Diseases Active Surveillance Network (FoodNet). Age-matched controls were interviewed for each case within 7 days of the matched-case inter-view. Interviews were conducted by telephone using sequential digit dialing and a standardized questionnaire. Information was collected on demographics, clinical illness, and exposures (e.g., food, water, animal contact) in the 7 days before the case's onset.
Results: Between February 1999 and April 2000, 326 cases and 591 matched controls were enrolled. In preliminary univariate analysis, infection was associated with eating pink hamburgers in the home (mOR=2.2, 95% CI= 1.2-4.3), thawing ground beef in microwave (mOR=1.5, 95% CI= 1.0-2.2), swimming in a pond, lake, river, or stream with cattle nearby (mOR=15.8, 95% CI=1.9- 127.7), drinking pond, lake, river or stream water (mOR=3.5, 95% CI= 1.6-7.6), drinking from water fountains or pool water

(mOR=3.5, 95% CI= 1.5-8.2), living on a farm (mOR=1.9, 95% CI= 1.1-3.4), and visiting a farm <12 times a year (mOR=3.0, 95% CI= 1.1-8.5). Consumption of ground turkey, pork chops or roast pork, organic produce, bottled water, or any of 12 produce items (romaine lettuce, red leaf lettuce, raw cabbage, onions, broccoli, carrots, cantaloupe, honeydew, strawberries, watermelon, apples, parsley, cilantro) had odds ratios of less than one.
Conclusions: Preliminary analysis indicates undercooked ground beef, surface waters, and farms continue to be sources of sporadic *E. coli* O157 infections in the United States. However, unlike previous case-control studies, infections were not associated with restaurant consumption of undercooked ground beef, possibly reflecting improvements in restaurant handling of ground beef or changes in eating habits. Consumption of several produce items was negatively associated with *E. coli* O157 infections. Final interpretation awaits multivariate analysis.

Yersinia enterocolitica Surveillance in Minnesota

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Background: *Yersinia enterocolitica* is an important cause of acute febrile enteritis, accounting for an estimated 96,000 cases annually in the U.S. *Y. enterocolitica* is ubiquitous; human pathogenic strains have been associated with defined bioserogroups.
Methods: To improve our understanding of yersiniosis in Minnesota, we reviewed the clinical histories of *Y. enterocolitica* cases reported to the Minnesota Department of Health (MDH) from 1995 to 2000. We characterized *Y. enterocolitica* isolates by biotype and pulsed-field gel electrophoresis (PFGE). From the FoodNet Survey of Clinical Laboratory Practices 2000, we evaluated laboratory practices for enteric culture that might affect surveillance for *Yersinia* in Minnesota.
Results: There were 151 cases of *Y. enterocolitica* reported to MDH from 1995 to 2000. The median age of cases was 35 years (range, 2 months to 93 years), and 59% of cases resided outside the Minneapolis-St. Paul (Twin Cities) metropolitan area. Thirty (22%) of 136 patients with known status were hospitalized for a mean of 8.2 days (range, 1-33 days). Of 126 *Y. enterocolitica* isolates submitted to MDH, 52 (41%) were classified as pathogenic biotypes, and 74 (59%) were classified as non-pathogenic biotypes based on pre-existing literature. Reported symptoms and length of hospitalization were similar for cases whether isolates were characterized as pathogenic or non-pathogenic. Thirty-eight (75%) of 51 pathogenic isolates subtyped were represented by one of five closely related PFGE patterns. All 74 of the non-pathogenic isolates were biotype 1A, and all 74 had different PFGE patterns. Of 61 Minnesota laboratories responding to the *Yersinia* section of the laboratory survey, 33 (54%) routinely test for *Yersinia* as part of their enteric screen. Only two of 28 Twin Cities metropolitan area laboratories that handle enteric samples test for *Yersini*a; 31 of 33 laboratories that test for *Yersinia* are located outside the Twin Cities metropolitan area in small city or county hospitals. Overall, the number

of stool samples tested for *Yersini*a, both as part of enteric screens and specific physician requests, was 15,229 (21%) of 71,735 stool samples submitted for culture.
Conclusion: Case-patients with yersiniosis in Minnesota had similar clinical illness regardless of whether their *Y. enterocolitica* isolates were classified as pathogenic or non-pathogenic based on biotype; isolates classified as non-pathogenic accounted for 59% of all isolates submitted during 1995-2000. Therefore, the clinical significance of putative non-pathogenic strains of *Y. enterocolitica* warrants further investigation. Survey of laboratory testing practices in Minnesota indicated that a minority of stool samples submitted for enteric culture were tested for *Yersini*a; thus, yersiniosis may be substantially under-diagnosed in Minnesota.

Quinupristin/Dalfopristin-Resistant *Enterococcus faecium* Isolated from Human Stools, Retail Chicken, and Retail Pork: EIP Enterococci Project

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Background: With the emergence of vancomycin-resistant *Enterococcus faecium*, quinupristin/dalfopristin (Q/D) has become an important therapeutic for life-threatening enterococcal infections. Q/D was approved for human use in 1999. However, virginiamycin, a Q/D analogue, has been used in food animals since 1974.
Methods: Between July 1998 and June 1999, laboratories in Georgia, Maryland, Minnesota, and Oregon used gram-positive selective media (CNA agar) to culture human stools from outpatients submitted to public health laboratories for other diagnostic reasons (n=334) and from chickens purchased from grocery stores (n=407). From July 1999 until June 2000 Michigan was added to the study and culture of pork samples (n=585) replaced chicken. *Enterococcus* isolates were forwarded to CDC for antimicrobial susceptibility testing by broth microdilution and Q/D-resistant isolates (MIC 4 µg/ml) were speciated by biochemical testing.
Results: We examined enterococci isolates isolated from outpatients (n=286), retail chicken (n=984) and retail pork (n=897). Of 119 Q/D-resistant enterococci isolates isolated from humans, 3 (2%) were determined to be *E. faecium*. All 3 of the Q/D-resistant human *E. faecium* isolates had MICs for gentamicin < 250 µg/ml. Of 740 Q/D-resistant enterococci isolates isolated from retail chicken, 299 (40%) were *E. faecium*. Among the 299 Q/D-resistant *E. faecium* isolates from chicken, 80 (27%) had MICs for gentamicin 1000 µg/ml. Q/D resistance was found in 348 of the enterococci isolates isolated from pork. Of the 348 Q/D-resistant pork isolates, 7 (2%) were *E. faecium*. One of the Q/D-resistant pork *E. faecium* isolates had a MIC for gentamicin 1000 µg/ml; the other 6 had MICs < 64 µg/ml.
Conclusion: Q/D-resistant *E. faecium* are more common in retail chicken than pork and human populations. Isolates from retail chickens are more likely than Q/D-resistant *E. faecium* from pork or human stools to also express high-level gentamicin resistance. Q/D-resistant *E. faecium* from retail chicken could potentially colonize humans, posing a

serious threat to public health. The possibility that genetic determinants for Q/D resistance could be transferred from retail chicken and pork to human enterococcal isolates will be explored further.

Antimicrobial Resistance in *Salmonella* is Associated with Increased Hospitalization: NARMS 1996-2000

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Background: Non-Typhoidal *Salmonella* is a leading cause of foodborne illness, and the prevalence of antimicrobial resistance has increased. Few studies have explored the human health consequences, other than treatment failures, associated with increasing resistance among *Salmonell*a.
Methods: The Foodborne Diseases Active Surveillance Network (FoodNet) has conducted laboratory-based surveillance for *Salmonella* since 1996. In 2000, nine sites, representing 11% of the U.S. population, completed case reports on all *Salmonella* infections confirmed at one of the >400 laboratories in surveillance. Case reports included hospitalization status at the time of culture collection or up to seven days later. Clinical laboratories send isolates for serotyping to public health laboratories, which forward every 10th non-Typhoidal *Salmonella* to the National Antimicrobial Resistance Monitoring System (NARMS). NARMS performs susceptibility testing via broth microdilution using NCCLS standards for 14 antimicrobials. We linked susceptibility results from NARMS to FoodNet case reports.
Results: From 1996-2000, 15,653 cases of non-Typhoidal *Salmonella* were reported in FoodNet sites, and 1020 (7%) of these reports had both data on hospitalization and NARMS susceptibility results. Of these, 557 (55%) patients were female, and 163 (16%) were non-white. The median age was 25 years (inter-quartile range 5 to 42). The most common serotypes were Typhimurium (29%) and Enteritidis (19%). Isolates came from blood in 68 (7%), and hospitalization occurred in 238 (23%). Resistance to antimicrobials commonly used to treat *Salmonella* (cephalosporins, quinolones, or aminoglycosides) was found in 63 patients, 22 (35%) of whom were hospitalized. Patients with isolates resistant to one of these agents had a higher risk of hospitalization compared to patients with isolates susceptible to these agents (OR 1.8, 95% CI 1.1-3.2). Other risk factors for hospitalization included age, race, surveillance site, serotype, and bloodstream infection. After controlling for these factors in multivariate analysis, the association between resistance to one of these agents and hospitalization persisted (OR 2.0, 95% CI 1.1-3.7).

Hospitalization also occurred more frequently in patients with isolates resistant to any antimicrobial, compared to those with pan-susceptible isolates (OR 1.5, 95% CI 1.0-2.2).
Conclusions: Antimicrobial-resistant *Salmonella* infections were associated with an increased risk of hospitalization, particularly when isolates were resistant to commonly used agents. Given the limited number of patients studied, further research should explore factors that may have contributed to increased hospitalization, including failure of empiric antimicrobial therapy, increased co-morbidity among patients infected with resistant bacteria, and increased virulence of resistant *Salmonell*a.

Emerging Fluoroquinolone Resistance among Non-Typhoidal *Salmonella* in the United States: NARMS 1996-2000

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Background: Fluoroquinolones (e.g., ciprofloxacin) commonly are used for treating *Salmonella* infections in adults; fluoroquinolones (e.g. enrofloxacin) also are used in cattle, chickens, and turkeys in the United States. Among *Salmonell*a, cross-resistance occurs for all fluoroquinolones and usually arises from accumulation of two mutations in the *gyrA* gene. A single mutation of the *gyrA* gene confers decreased susceptibility to fluoroquinolones and has been associated with treatment failures.
Methods: The National Antimicrobial Resistance Monitoring System (NARMS) for Enteric Bacteria was established in 1996 to monitor antimicrobial resistance in *Salmonella* and other enteric bacteria. After serotyping, public health laboratories in the 17 NARMS participating sites forwarded every tenth non-typhoidal *Salmonella* isolate to CDC for susceptibility testing to ciprofloxacin and 16 other antimicrobial agents using broth microdilution (Sensititre®) according to NCCLS standards. Patients with isolates exhibiting decreased susceptibility (MIC 0.25 µ?g/ml) to ciprofloxacin, including ciprofloxacin resistance (MIC 4 µg/ml), were interviewed.
Results: From 1996-2000, 57 (0.8%) of 6970 non-typhoidal *Salmonella* isolates tested demonstrated decreased susceptibility to ciprofloxacin. The percent of isolates that demonstrate decreased susceptibility to fluoroquinolones was 0.4% (5/1326) in 1996 and 1.4% (20/1378) in 2000. Seven (0.1%) of these isolates were ciprofloxacin-resistant (MIC 4 µg/ml) and included serotype Senftenberg (n = 3), Schwarzengrund (n = 3), and Indiana (n = 1). All 7 infections were associated with international travel. Of the 50 isolates with ciprofloxacin MICs □0.25 µg/ml and < 4 µg/ml, the most common serotypes were Enteritidis (n = 14), Berta (n = 7), Typhimurium (n = 6), and Virchow (n = 5). Twenty-eight (56%) of these 50 patients were interviewed; 20 (71%) of the 28 patients interviewed did not travel internationally in the week before illness onset.
Conclusion: Emerging fluoroquinolone resistance in non-typhoidal *Salmonella* is evident. Resistant isolates were associated with international travel, whereas other isolates with decreased susceptibility were from infections acquired domestically. The sources of infection were not investigated, but many presumably were acquired through eating contaminated food. Mitigation efforts in partnership with the agricultural and

veterinary communities are needed to limit use of fluoroquinolones and to preserve the efficacy of this commonly used antimicrobial agent.

OTHER EIP PROJECTS

Oral Presentations

Prevalence of Hepatitis C and Other Chronic Liver Disease Etiologies in Primary Care Practices

T. St. Louis, V. Navarro, A. Sofair, B. Bell

Connecticut Emerging Infections Program, New Haven, CT, CDC, Atlanta, GA

Clusters of Clinical Syndromes in Patients with Unexplained Encephalitis

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Abstracts

Prevalence of Hepatitis C and other Chronic Liver Disease Etiologies in Primary Care Practices

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Background: Little is known of the prevalence of chronic liver disease (CLD) in general, and hepatitis C in particular, in primary care patient populations. We conducted a cross-sectional study among primary care practices in Waterbury, CT to estimate CLD prevalence and its attributable causes among patients seeking primary care and to explore primary care practitioners' (PCPs) CLD-diagnosis documentation and referral habits. **Methods:** All 46 PCPs located within the Waterbury city limits were invited to participate. Patient charts were selected from each participating practice's active patient roster according to a simple weighted, random sampling scheme. Demographic and clinical data, substance use history, diagnosis of CLD, and referrals to gastroenterologists were recorded. A diagnosis of CLD was assigned using standard definitions for probable and possible CLD. Standard criteria were used to assign CLD etiologies where appropriate.
Results: Of the 46 Waterbury PCPs, 31 (67%) participated, comprising 11 practices (7 group, 4 solo). A total of 1,610 charts (range 65-608 per practice) were screened. The median patient age was 42 years (range 18-96); 39% were male. A total of 60 patients met our definition for CLD, making the overall prevalence in our sample 3.7% (95% CI: 2.8-4.7%). The age, gender, and racial distributions of CLD cases were similar to the remaining 1,550 screened patients. Sufficient clinical data were available to assign an etiology for CLD in 38 (63%) cases. Of these, 18 (30%) had fatty liver and 15 (25%) had hepatitis C. Hepatitis B, alcohol-related liver disease, autoimmune hepatitis, hemochromatosis, and primary hepatic malignant disease each accounted for 2%. Of the

28 (47%) patients documented as having CLD by the PCPs, 12 (43%) were referred to gastroenterologists in a median period of 14 months after diagnosis (range 0-64 months). Hepatitis C was the most common etiology for which CLD patients were referred to gastroenterologists (6, 50%). Of the 48 patients who were not referred to gastroenterologists, 17 (35%) had fatty liver and 9 (19%) had hepatitis C.
Conclusions: In our study of a primary care patient population, we found a CLD prevalence of 3.7% and 0.9% of patients had recognized hepatitis C. However, these figures most likely reflect minimum estimates because not all patient charts contained sufficient clinical information to determine if a CLD diagnosis was appropriate, including testing for chronic hepatitis C virus infection. Fatty liver and hepatitis C were the most common etiologies for CLD. More than half of CLD cases were not documented as such or referred by the PCP, indicating the possibility of under-diagnosis and limitations in access to subspecialized care for CLD patients. This is especially important in cases of hepatitis C, where curative therapy is available.

Severe, Concurrent Lyme Disease, Babesiosis and Ehrlichiosis in a Healthy 23 Year-Old Connecticut Resident

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Background: Lyme disease (LD), babesiosis, and human granulocytic ehrlichiosis (HGE) are emergent zoonotic diseases affecting residents in the Northeastern and Midwestern United States. The etiologic agents of each disease are perpetuated in a natural cycle between vertebrate reservoir hosts and the tick vector, Ixodes scapularis. The geographical and ecological over-lap between HGE, LD and babesiosis suggests the potential for co-transmission, co-infection and co-morbidity. We describe the case of a Connecticut resident simultaneously infected with all three agents.
Case Report: A previously healthy, 23 year-old male presented to an emergency department (ED) after five days of headache, fever, sweats, myalgia, and fatigue. He recalled a tick bite about one week earlier. He was given the diagnosis of LD and treated with clarithromycin. Approximately two weeks later, the symptoms returned and he presented to our ED. Laboratory evaluation revealed leukopenia, thrombocytopenia, and a hematocrit of 41%. Liver function tests, and erythrocyte sedimentation rate were normal. LD serologies were sent. On evaluation, he was found to have tonsillar, cervical, and inguinal lymphadenopathy and splenomegaly that was confirmed by abdominal CT scan. Five days later, the patient returned to the ED with acute left upper quadrant pain, and persistent fevers. Hematocrit was 29%. Repeat abdominal CT scan demonstrated increased splenomegaly and new left flank and pelvic fluid. The patient was admitted to the surgical intensive care unit with the presumed diagnosis of splenic rupture. Laboratory data were significant for leukopenia, thrombocytopenia, elevated LDH and AST, and decreased haptoglobin. The hospital course was remarkable for persistent high-grade fevers to 104.6° F. Lymph node biopsy showed follicular lymphoid hyperplasia and no evidence for malignancy. A peripheral smear showed intraerythrocytic ring forms

consistent with Babesia. The patient was treated with clindamycin and quinine with rapid defervescence. LD serologies from the previous ED visit were positive on both ELISA and Western Blot. After completing a course of clindamycin and quinine, the patient was started on a course of doxycycline. Serum samples were sent for HGE and Babesia microti serology. Indirect fluorescent antibody staining methods revealed an HGE titer of 1:4096 and a B. microti titer of 1:640. HGE-specific ELISA was confirmatory. Nine months later, repeat testing demonstrated a $\geq$4-fold decrease in antibody titer to both HGE and B. microti.
Conclusion: This patient had concurrent infection with three I. scapularis-borne diseases. The unexpected severity of illness in this otherwise healthy host can in part be attributed to the delay in diagnosis resulting from an atypical presentation and the possible immunosuppressive effects resulting from the interplay of the three diseases.

Detection of La Crosse Virus in Cerebrospinal Fluid and Tissues by Reverse Transcription-Polymerase Chain Reaction

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La Crosse encephalitis is one of the most common causes of reported arboviral illness in the United States. The causative agent is La Crosse virus, which has been historically distributed in the upper Midwestern States — Illinois, Indiana, Iowa, Minnesota, Ohio, and Wisconsin. In recent years, human cases of La Crosse encephalitis have increased in Southeastern States — West Virginia, Tennessee, and North Carolina. Our interest continues to be the determination of the appropriate role of nucleic acid amplification methods, particularly RT-PCR, in the diagnosis of such infections. Toward this end, a reverse transcription-polymerase chain reaction (RT-PCR) method was used to retrospectively detect La Crosse virus genome in patients with central nervous sys-tem infections. The RT-PCR method was evaluated directly on cerebrospinal fluid (CSF) and autopsied tissues of patients with La Crosse encephalitis. Since La Crosse virus is a member of California (CAL) serogroup viruses, universal primers for CAL serogroup viruses and specific primers for La Crosse virus were evaluated to determine their effectiveness with clinical specimens. Ten CSF samples from 8 patients were examined with group-specific primers and PCR bands with the expected size were obtained in 3 samples. In all 9 samples with enough CSF available for additional testing, La Crosse was detected by RT-PCR with virus-specific primers. La Crosse virus RNA was also detected in both frontal lobe and spinal cord of autopsied tissues. The results indicate that PCR may be a useful technique for identification of La Crosse sequence, particularly when La Crosse-specific primers are used. PCR offers the advantage of providing a rapid diagnosis at the time of clinical presentation. Based on the results, we suggest that PCR be considered as a complementary test for laboratory diagnosis of suspected cases of La Crosse encephalitis.

NAME INDEX