

## Neighborhood Socioeconomic Status Among Children Hospitalized With Influenza: New Haven County, Connecticut, 2003-2010

Children, especially those aged <5 years, are at increased risk for infection and complications due to influenza (1). While there are many known risk factors for influenza hospitalization in young children, few data exist on the relationship between socioeconomic status (SES) and severe influenza infections in this group.

Using population-based surveillance data from the Connecticut Emerging Infections Program (EIP), we investigated potential disparities in pediatric influenza-associated hospitalizations according to neighborhood SES measures.

### Data Sources

The Yale University office of the Connecticut EIP has been conducting surveillance for laboratory-confirmed, influenza-related pediatric (age <18 years) hospitalizations since the 2003-04 influenza season in New Haven County (pediatric population ~200,000). Data are collected by medical record review, physician survey, and patient interview. Variables include demographic information, underlying conditions, and vaccination history in addition to influenza testing, treatments, and complications. However, this program does not routinely collect information about the SES of individual cases.

To find neighborhood SES data, we looked to the Census 2000 Summary File 3 (2). This dataset contains household- and population-level information from the Census's long-form questionnaire. The neighborhood SES variables chosen for this study included measures of poverty and crowding. Census 2000 defines this poverty variable as the percent of the population living within a census tract for whom 1999 income was below the federally-defined poverty level. The crowding variable is defined as the percent of households within a census tract with more than one person per room (2).

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### Data Analysis

To evaluate associations between neighborhood SES and influenza-related hospitalization rates in children, we geocoded surveillance cases and linked them to census tract level data. This method is based on Harvard University's Public Health Disparities Geocoding Project and is used to categorize individuals in relation to the characteristics of the neighborhood (census tract) in which they live (3).

Each SES measure was broken into percentile categories based on those used by the Public Health Disparities Geocoding Project (3). We calculated the incidence of pediatric hospitalization with influenza per 100,000 person-years in both of the SES categories and used ANOVA to test the significance of the differences in rates across SES categories.

### Results

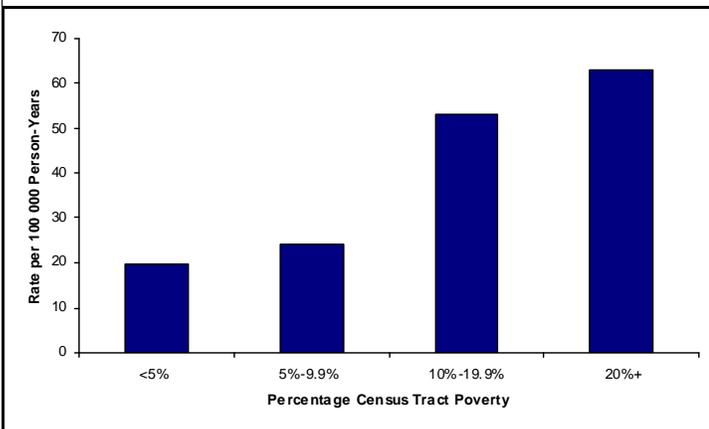
Of the 527 pediatric influenza-related hospitalization cases identified during the study period, 98% were successfully geocoded and linked to census tract-level SES data from the 2000 Census.

Poverty and crowding were each found to be independent positive predictors of influenza-related hospitalization. Our data show a distinct gradient of influenza hospitalization by both SES measures. The incidence of pediatric influenza-related hospitalization in the highest poverty census tracts was 3.2 times greater than the incidence in lowest poverty tracts ( $p < 0.0001$ ) (Figure 1). Incidence in the census tracts with the highest level of household crowding was 3.0 times greater than that in the census tracts with the lowest household crowding ( $p < 0.0001$ ) (Figure 2). When examined by influenza

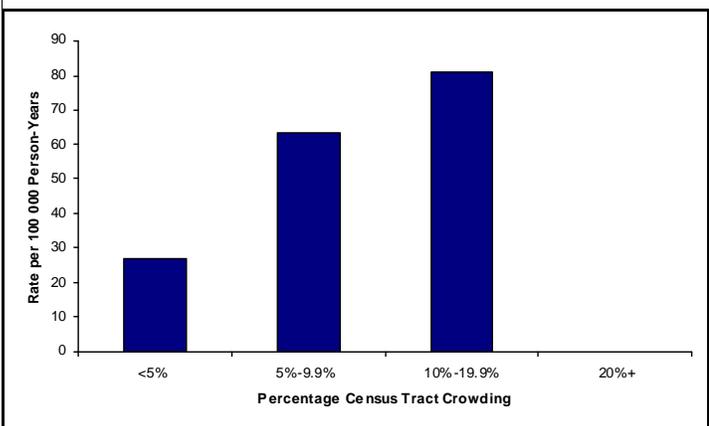
season, the same pattern was present for each influenza season during this time period, including the spring and fall 2009 pandemic H1N1 influenza waves.

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**Figure 1. Mean annual incidence of pediatric influenza hospitalization by census tract poverty level, New Haven County, 2003-2010**



**Figure 2. Mean annual incidence of pediatric influenza hospitalization by percent crowding within census tract, New Haven County, 2003-2010**



**Editorial Note:**

Influenza is a major cause of morbidity and mortality each year in the United States. By linking surveillance data with census tract information, it is possible to identify neighborhood characteristics associated with higher levels of disease burden. This analysis indicates a correlation between residence in impoverished or crowded neighborhoods and incidence of influenza-related hospitalization among children in New Haven County.

Annual vaccination for influenza is the most effective way to prevent infection and its associated complications (1). Since July 2009, the Advisory Committee on Immunization Practices has recommended annual influenza vaccination of all children aged 6 months and older (1). Despite this recommendation, vaccination rates among children remain low. During the 2007-2008 flu season, data from the National Immunization Survey indicated that only 55.1% of Connecticut children aged 6-23 months were partially vaccinated and 35.8% were fully vaccinated (4).

Given the results of this analysis and low levels of vaccination among children, special efforts to improve vaccination rates within impoverished and crowded communities are necessary. Options to improve vaccination include school-based influenza vaccination clinics, mobile vaccine clinics, and retail clinic expansion into high poverty, high crowding communities. In addition, neighborhood-based outreach efforts are needed to increase individual and community-level participation in vaccination.

Healthcare costs are an important concern for low SES populations. Direct and indirect costs of vaccination can be reduced when group vaccination at school or daycare is employed. Comparatively, appointment costs and lost income due to time away from work may not make individual vaccination cost-effective for lower income families (5). By offering a low- or no-cost alternative to pediatrician visits, mobile vaccination clinics and retail clinics could also help improve vaccination rates among low SES populations. Alternate vaccination locations may improve influenza vaccination rates among populations that are traditionally uninsured and underinsured.

**References:**

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## Vibriosis, Connecticut, 2000-2009

*Vibrio* spp. cause an estimated 8,000 infections annually in the United States (1); many of these are associated with consumption of raw seafood or wound exposure to salt water. In Connecticut, vibriosis is physician and laboratory reportable.

The Foodborne Diseases Active Surveillance Network (FoodNet), a component of the Centers for Disease Control and Prevention's (CDC) Emerging Infections Program, collects data on diseases commonly transmitted through food, including *Vibrio* spp (2). In Connecticut, FoodNet is a collaborative effort between the Department of Public Health (DPH) and the Yale University School of Public Health. FoodNet has been conducting laboratory-based active surveillance for *Vibrio* spp. from all sources, including stool, wounds and blood, since 1996. Isolates are required to be sent to the DPH Laboratory for confirmation. All case-patients are interviewed by the local health department using the CDC, "Cholera and Other *Vibrio* Illness Surveillance Report" form. Data collected on this form include the clinical features and potential exposures during the seven days before illness onset. Completed forms are sent to the CDC and entered into a national database.

The objectives of this report are to: 1) describe the frequency of *Vibrio* spp. infections in Connecticut; 2) describe the trends in incidence of *Vibrio* spp. infections over the past 10 years of surveillance; 3) describe the clinical and epidemiologic features of *Vibrio* spp. infection; and 4) make recommendations based on the findings. We analyzed surveillance data for Connecticut from 2000 to 2009.

In Connecticut during 2000-2009, there were a total of 136 *Vibrio* spp. infections reported to FoodNet;

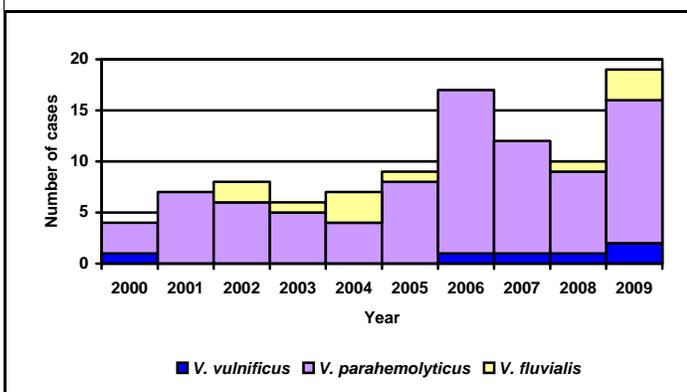
82 (60.1%) were *V. parahaemolyticus*, 19 (14.0%) *V. alginolyticus*, 11 (8.1%) *V. fluvialis*, 7 (5.1%) *V. cholera*, non-01, non-139, 6 (4.4%) *V. vulnificus*, and 11 (8.1%) other/unknown species (Figure 1). Overall, the majority (54%) of isolates were obtained from stool and 21% from wounds. However, the proportion of isolates from each source varied by species (Table 1). Vibriosis was more common among males (63%), and the number of case-patients increased with advancing age (Figure 2). The majority (72%) of the infections occurred in the months of May-July. Nearly one quarter (24%) of case-patients were hospitalized, and 2 deaths occurred.

Clinical and risk factor information was available for 126 case-patients who were interviewed. Symptoms experienced by patients whose *Vibrio* spp. was isolated from stool included predominantly diarrhea (97%), cramps (73%), and nausea (53%). For those whose *Vibrio* spp. was isolated from a wound, cellulitis was the most common symptom (57%), followed by muscle pain (30%), and fever (23%). Patients with blood infections reported fever (82%),

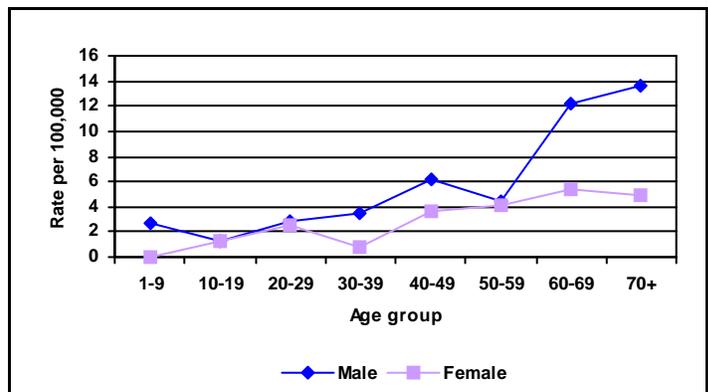
**Table 1. Percent *Vibrio* spp. by species and source, Connecticut, 2000 - 2009**

Species	Number	Stool n (%)	Blood n (%)	Wound n (%)	Other n (%)
<i>V. parahaemolyticus</i>	82	56 (68)	3 (4)	17 (21)	6 (7)
<i>V. alginolyticus</i>	19	1 (5)	1 (5)	9 (47)	8 (42)
<i>V. fluvialis</i>	11	9 (82)	1 (9)	0 (0)	1 (9)
<i>V. cholera</i> , non-01, non-139	7	3 (43)	2 (29)	1 (14)	1 (14)
<i>V. vulnificus</i>	6	0 (0)	5 (83)	1 (17)	0 (0)
Other/Unknown <i>Vibrio</i> spp.	11	5 (45)	1 (9)%	1 (18)	4 (36)
Total	136	74	13	29	20

**Figure 1. Cases of vibriosis by year and species, Connecticut 2000-2009**



**Figure 2. Vibriosis rates per 100,000 by age group, Connecticut, 2000-2009**



diarrhea (50%), cellulitis (50%), and nausea (45%). Of the 126 case-patients, 40% had a pre-existing condition; heart disease was the most frequently reported (17%), followed by diabetes (10%), and gastric surgery (8%); 6% of cases reported liver disease. There was no difference in percentage of case-patients with underlying conditions when comparing those with isolates obtained from stool to those with wound infections.

Of 67 case-patients with gastrointestinal illness with isolation of *Vibrio* spp. from stool, 94% (50/53) ate seafood and 62% (31/50) ate raw seafood: 53% (28/53) ate clams and 46% (13/28) ate them raw; 43% (23/53) ate oysters and 91% (21/23) ate them raw. Of the 31 case-patients whose *Vibrio* spp. was isolated from a wound, 81% (22/27) had their skin exposed to salty or brackish water: 16 (73%) during swimming or wading, 11 (50%) while walking on the beach, and 6 (27%) during handling of seafood.

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**Editorial**

In Connecticut, the numbers of *Vibrio* spp. infections are increasing. These bacteria thrive in warm, salty water, such as coastal seawater. Ingestion of contaminated water or food can result in gastrointestinal illness. Contamination of wounds can result in cellulitis. Onset of illness often occurs within 24 hours of exposure and is more severe in patients with compromised immune systems. Specimens from patients with compatible illness, exposure history and onset in late spring and summer may warrant specific testing for *Vibrio* spp.

*Vibrio* spp. vary by geographic region in the United States. This species variation affects the type of infection, the severity of illness, and the likely source of the isolate (e.g., *V. vulnificus* is more often identified in blood samples than stool or wounds and therefore, is likely to cause more severe infection). During 2007, in the Gulf Coast states, disease caused by *V. vulnificus* (34%) was the most prevalent, followed by *V.*

*parahaemolyticus* (27%), *V. alginolyticus* (15%), and non-toxicogenic *V. cholerae* (9%)(3). By contrast, during the same year in Connecticut, the most frequent *Vibrio* species reported was *V. parahaemolyticus* (69%), followed by *V. alginolyticus* (19%) and *V. vulnificus* and other *Vibrio* spp. (6%; 1 case each).

Most *Vibrio* spp. infections occur as a result of consuming seafood (particularly raw shellfish) or recreational seawater use. Recommendations for prevention of vibriosis for persons at increased risk, such as persons with liver disease, diabetes, or weakened immune systems, include only eating oysters or clams that have been thoroughly cooked and avoiding swimming or wading in seawater if you have open sores or wounds. Further recommendations include eating shellfish promptly after cooking and properly refrigerating leftovers, and wearing protective clothing (eg, gloves) when handling raw shellfish. In general, to minimize the risk of acquiring vibriosis, avoid cross-contamination by keeping raw seafood separate from produce and other ready-to-eat foods, and wash hands, cutting boards, countertops, cutlery, and utensils after handling raw seafood.

**References**

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3. CDC. Summary of human *Vibrio* cases reported to CDC, 2007. Accessed at: <http://www.cdc.gov/> June 9, 2010.

**Erratum: Vol. 30, No. 2**

In the article "Multiple-Serotype Outbreak of *Salmonella* Gastroenteritis at a Reception - Connecticut, 2009," an error occurred in the third paragraph of the Epidemiologic Investigation section. The sentence should read as follows: "Ill persons were significantly more likely than non-ill persons to have consumed the potato salad (odds ratio=84.0; 95% confidence limits=4.5,1564; **p-value<0.001**)."

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