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## 2009 *Journal of Environmental Health* Abstracts

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### January/February 2009

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#### **Food Safety Educational Intervention Positively Influences College Students' Food Safety Attitudes, Beliefs, Knowledge, and Self-Reported Practices**

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Valentina M. Remig, Ph.D., R.D., F.A.D.A.  
Mary Meck Higgins, Ph.D., R.D./L.D., CDE.

#### Abstract

In this study, the authors evaluated college students' food safety attitudes, beliefs, knowledge, and self-reported practices and explored whether these variables were positively influenced by educational intervention. Students ( $n = 59$ ), were mostly seniors, health or non-health majors, and responsible for meal preparation. Subjects completed a food safety questionnaire (FSQ) prior to educational intervention, which consisted of three interactive modules. Subjects completed module pre-, post-, and post-posttests. The FSQ was also administered after exposure to intervention and five weeks later to determine changes in food safety attitudes, beliefs, knowledge, and self-reported practices. Students' FSQ attitude scores increased from 114 to 122 ( $p \leq .001$ ); FSQ belief and knowledge scores improved from 86 to 98 ( $p \leq .001$ ) and from 11 to 13 ( $p \leq .001$ ), respectively. Food safety knowledge was also measured by module pre- and posttests, and improved significantly after intervention for all students, with health majors having the greatest increase. Intervention resulted in improved food safety self-reported practices for health majors only. The educational intervention appeared effective in improving food safety beliefs and knowledge. For health majors, attitudes and some self-reported practices improved. For all areas, the strongest effects were seen in health majors.

#### **Investigation of Bacterial Pathogens on 70 Frequently Used Environmental Surfaces in a Large Urban U.S. University**

Joanna S. Brooke, M.S., Ph.D.

John W. Annand  
Angela Hammer, M.T., M.S., C.I.C.  
Karen Dembkowski, M.T.  
Stanford T. Shulman, M.D.

#### Abstract

After reports of increased severity of bacterial infections from community institutions, a broad spectrum of 70 surfaces was sampled for potential bacterial pathogens in the morning and afternoon of one day per week over three consecutive weeks in a large U.S. university. Surfaces included public telephone mouthpieces, water fountain drains, student computer keyboards and desks, and buttons on elevators, vending machines, and photocopiers. A total of 420 samples was obtained. Bacterial counts were high on telephone mouthpieces, up to 168.8 colony-forming units (CFUs)·cm<sup>-2</sup> of surface area. *Stenotrophomonas maltophilia* was isolated from 60% of fountain drains. Ninety percent of the keyboards showed positive bacterial cultures in the afternoon sampling. *Staphylococcus aureus* was identified on keyboards, telephone mouthpieces, and an elevator button. No *S. aureus* were methicillin-resistant. The swab sampling method reduced bacterial counts to less than or equal to 2.0 CFU·cm<sup>-2</sup> on keyboards and telephone mouthpieces. Disinfectants for possible use in cleaning of telephones, water fountain drains, and keyboards are discussed.

#### **Potential Pathogens and Effective Disinfectants on Public Telephones at a Large Urban United States University**

John W. Annand  
Nikesh Bajaj  
Anand Sheth  
Jaqqwon Burgess  
Joanna S. Brooke, M.S., Ph.D.

#### Abstract

Telephones can carry potential bacterial pathogens, posing a risk for transfer of pathogens to users' hands. This study examined 25 mouthpieces of public telephones at a large urban U.S. university located in an area of rising incidence of community-acquired staphylococcal infections. Coagulase-negative staphylococci were most commonly isolated (64% of mouthpieces). Potential pathogens isolated included *Staphylococcus aureus*, vancomycin-susceptible *Enterococcus*, and *Klebsiella ozaenae*. The efficacy of disinfectants on reducing bacterial counts on telephone mouthpieces was also investigated. *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Enterococcus faecalis* were inoculated onto mouthpieces and challenged with disinfectant wipes. Bacterial counts were reduced substantially for all three organisms by wipes containing either 70% isopropyl alcohol, 1.84% sodium hypochlorite, or quaternary ammonium compounds. The sodium hypochlorite-based cleaner demonstrated 100% efficacy at removing or killing test organisms from telephone mouthpieces. These data suggest that tested cleaners may be appropriate and needed for public telephone disinfection.

## **Environmental Health Risks Associated with Off-Campus Student-Tenant Housing**

Erin Johnson, M.P.H.  
Eugene C. Cole, Dr.PH.  
Ray Merrill, Ph.D., M.P.H.

### **Abstract**

While previous studies have established an association between poor housing conditions and adverse health effects, none has specifically addressed health and safety risks to the college student population in rental housing. A needs-assessment survey was conducted to determine the prevalence of adverse health and safety conditions in off-campus student housing associated with a large university in the western United States. Results from 1,959 student-tenant surveys revealed problems with installed appliances (39.6%); visible mold (39.3%); heating/cooling systems (31.9%); indoor dampness/water damage (24.9%); security locks (23.4%); ants (17.1%); electrical wiring (11.3%); malfunctioning or missing smoke alarms (11.2%); broken steps/handrails (7.8%); and mice (4.8%), among other problems. Reported health effects associated with housing included headaches, coughing, sneezing, nausea, and dizziness, and these effects were found to significantly correlate with increased environmental problems. The results of this study indicate a need to inform college students about environmental health and safety problems in leased housing, to promote responsibility of landlords to provide safe and healthful environments, and to raise awareness of this issue for public health and housing officials in university communities across the country.

## **Seasonal Abundance of Vectors at Outdoor Environments in Endemic and Nonendemic Districts of Dengue in Kaohsiung, South Taiwan**

Hsiu-Hua Pai, Ph.D.  
Yi-Ling Lu, M.S.

### **Abstract**

This study was designed to determine the seasonal variation in abundance of dengue vectors at open spaces, empty houses, parks, and markets in endemic and nonendemic districts of dengue. Ovitrap were placed in these sites from March 2003 to January 2004 in Kaohsiung Area (Kaohsiung City and Kaohsiung County), South Taiwan. The index peaked in May, June, and September in the endemic districts and in May and October in nonendemic districts. The egg production of the vectors increased from April on and peaked in September. *Aedes albopictus* had a significant higher proportion than *A. aegypti* throughout the study period and in both districts. Although ovitrap indices at open spaces, empty houses, and parks were significantly higher than those in nearby households, no significant difference was found between markets and households. Moreover, the outdoor ovitrap index was significantly higher than the indoor one. No significant difference was found between the endemic and nonendemic districts in egg production, vector maturation, vector abundance at the outdoor environments, or nearby households. These findings indicate the importance of the environmental

conditions surrounding the human dwelling sites in the transmission of dengue. Measures applied to remove dengue vectors should include these sites but also outdoor environments as well.

### **Molecular Epidemiological Characteristics of *Shigella* spp. Isolated from River Narmada During 2005–2006**

Anjana Sharma, M.Sc., Ph.D.  
Susheel Kumar Singh, J.R.F., Ph.D.  
Lokesh Kori, J.R.F., M.Sc.

#### **Abstract**

Shigellosis is an acute gastroenteritis caused by *Shigella* species. Forty isolates of *Shigella* spp. were obtained from the river Narmada during 2005–2006. Twenty-three isolates were identified as *S. flexneri*, 10 as *S. sonnei*, and seven as *S. dysenteriae* on the basis of biochemical tests and serotyping. All the isolates harbored at least one plasmid (range: 1–4) and exhibited 12 distinct plasmid profile patterns. Out of 40 isolates, 90% were found to be resistant against more than two antibiotics. All of the isolates were resistant to ciprofloxacin. It is noteworthy that all of the *S. dysenteriae* strains were resistant to chloramphenicol and trimethoprim, and that all of the *S. flexneri* and *S. sonnei* strains were resistant to cephalexin, amikacin, and norfloxacin, which can be used for the treatment of shigellosis. Forty-two and a half percent of *Shigella* isolates were found to be Congo red positive. Since the Congo red binding test is cheap and simple, it can be used to determine the virulence properties of *Shigella* species. We could not find a specific correlation between serotype, antimicrobial resistance, and plasmid profile.

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## **March 2009**

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### **Prevalence of Fragrance Sensitivity in the American Population**

Stanley M. Caress, Ph.D.  
Anne C. Steinemann, Ph.D.

#### **Abstract**

This study determined the percentages of individuals who report adverse effects from exposure to fragranced products in the U.S. population and in subpopulations of those with asthma or chemical sensitivity. Data were collected through telephone interviews from two geographically weighted, random samples of the continental U.S. in two surveys during 2002–2003 and 2005–2006 (1,057 and 1,058 cases, respectively). Respondents were asked if they find being next to someone wearing a scented product irritating or appealing; if they have headaches, breathing difficulties, or other problems when exposed to air fresheners or deodorizers; and if they are irritated by the scent from laundry products, fabric softeners, or dryer sheets that are vented outside. Results

aggregated from both surveys found that 30.5% of the general population reported scented products on others irritating, 19% reported adverse health effects from air fresheners, and 10.9% reported irritation by scented laundry products vented outside. This study reveals that a considerable percentage of the U.S. population reports adverse health effects or irritation from fragranced products, with higher percentages among those with asthma and chemical sensitivity.

### **Using Health Inspection Scores to Assess Risk in Food Services**

Ji-Eun Lee, M.S., R.D.  
Barbara A. Almanza, Ph.D., R.D.  
Douglas C. Nelson, Ph.D.  
Richard F. Ghiselli, Ph.D.

#### **Abstract**

This study gathered health inspectors' opinions about appropriate weightings of critical, noncritical, and repeat violations under the current food inspection system, and developed a classification of violations for high-, medium-, and low-risk restaurants. Results showed that health inspectors thought that the appropriate weights were five points for a critical violation, one point for a noncritical violation, and double points for a repeat violation. In addition, health inspectors thought that the maximum numbers of critical violations for a high-, medium-, and low-risk category were 2.05, 3.02, and 4.83, respectively, and for noncritical violations, 4.59, 7.30, and 10.37, respectively. A paired *t*-test was used to compare these values with estimations based on the traditional health inspection scoring system. Results indicate that the maximum number of critical violations for medium risk and maximum numbers of noncritical violations for low-, medium-, or high-risk restaurants were significantly different between health inspectors' opinions and mathematical estimations. Health inspectors appear to be stricter than the traditional health inspection scoring system about violations, particularly repeat violations, and their importance in enforcement of food safety.

### **Analysis of Foodborne Disease Outbreaks for Improvement of Food Safety Programs in Seoul, Republic of Korea, from 2002 to 2006**

Jib Ho Lee, M.S.  
Joon-Hak Lee, Ph.D.  
Moo Sang Kim, Ph.D.  
Seog Gee Park, Ph.D.

#### **Abstract**

Foodborne disease (FBD) is a common food safety problem in Seoul, Republic of Korea. To identify target areas for improvement of the food safety programs, FBD outbreaks from 2002 to 2006 were analyzed with regard to facility, monthly occurrences, and causative agents. A total of 147 FBD outbreaks were reported, with an average of 29.4 FBD outbreaks per year and 49 cases per outbreak. Restaurants and school lunches were two main facilities associated with 76.2% of the outbreaks. A majority of FBD cases (73.1%) were from school lunches. The highest number of

outbreaks and cases occurred in June, followed by March. Among the seven identified causative agents, norovirus was the most significant in the number of outbreaks and cases. Among the outbreaks and cases with causative agents identified, norovirus and *Staphylococcus aureus* were responsible for 61.7% of outbreaks and 81.5% of cases. The analysis indicates that the efficiency of current food safety programs could be enhanced if critical control points in school lunch programs are identified and incorporated in the training and inspection. Identifying risk factors for contamination of norovirus and *Staphylococcus aureus* would also be beneficial.

### **Treatment of Septic Tank Effluents by a Full-Scale Capillary Seepage Soil Biofiltration System**

Chihhao Fan, Ph.D.  
Fang-Chih Chang, Ph.D.  
Chun-Han Ko, Ph.D.  
Chia-Ji Teng, M.S.  
Tzi-Chin Chang, M.S.  
Yiong-Shing Sheu, M.S.

#### **Abstract**

The purpose of this study is to evaluate the efficiency of septic tank effluent treatment by an underground capillary seepage soil biofiltration system in a suburban area of Taipei, Taiwan. In contrast to traditional subsurface wastewater infiltration systems, capillary seepage soil biofiltration systems initially draw incoming influent upwards from the distribution pipe by capillary and siphonage actions, then spread influent throughout the soil biofiltration bed. The underground capillary seepage soil biofiltration system consists of a train of underground treatment units, including one wastewater distribution tank, two capillary seepage soil biofiltration units in series, and a discharge tank. Each capillary seepage soil biofiltration unit contains one facultative digestion tank and one set of biofiltration beds. At the flow rate of 50 m<sup>3</sup>/day, average influent concentrations of biochemical oxygen demand (BOD), suspended solid (SS), ammonia nitrogen (NH<sub>3</sub>-N), and total phosphates (TP), were 36.15 mg/L, 29.14 mg/L, 16.05 mg/L, and 1.75 mg/L, respectively. After 1.5 years of system operation, the measured influent and effluent results show that the treatment efficiencies of the soil biofiltration system for BOD, SS, NH<sub>3</sub>-N, TP, and total coliforms are 82.96%, 60.95%, 67.17%, 74.86%, and 99.99%, respectively.

### **Foodborne Outbreaks and Agricultural Practices: Should Public Health Prevention Start in the Field?**

Fanta A. Waterman, M.P.H.  
Jennifer K. Ibrahim, Ph.D., M.P.H.

Food safety is getting increased attention from health officials and the public, including ongoing concerns about terrorist attempts to intentionally contaminate the food supply. In

July 2007, U.S. Representative Bennie Thompson warned that if food safety concerns were not addressed appropriately, "... a poorly prevented or recognized event [will cause] people to question the safety of food regionally or nationally ... the United States will lack a coordinated national approach to protect against agroterrorism (Thompson, 2007)."

Despite these concerns, the incidence of contaminated food as a result of poor hygiene in everyday practices—*not* intentional contamination—has been the culprit in recent food-related morbidity and mortality (Mead et al., 1999). Over 5,000 foodborne incidents occurred between 1991 and 2004, resulting in approximately 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths in the U.S. (DeWaal, Johnson, & Bhuiya, 2006; Mead et al., 1999). In 2003, a Pittsburgh restaurant was the site of the largest recorded foodborne hepatitis A virus (HAV) outbreak; more than 500 people contracted HAV and three people died (Data et al., 2003). The outbreak was eventually traced to green onions originating in Mexico. During summer 2004, *Salmonella* found in tomatoes was linked to three outbreaks occurring in 18 states and one Canadian province, affecting over 550 people (Corby et al., 2005). In September 2006, an *E. coli* outbreak sickened over 70 people in several states and was eventually linked to lettuce served at Taco Bell restaurants (Centers for Disease Control and Prevention [CDC], 2006a).

Foodborne outbreaks continue to result from poor hygiene and sanitation during cultivation, processing, and manufacturing of food. Agricultural practices have increasingly facilitated the development of these outbreaks. Since many foods are consumed raw, once a food product has been contaminated during the agricultural process, an outbreak may be inevitable. Global improvements to surveillance of agricultural field practices and better protection of agricultural workers can help to decrease the health-related costs associated with outbreaks worldwide.

### **Sacramento County's Retail Food Program Enhancements and its Food Safety Rating and Disclosure System—2008 Crumline Award Winner**

Alicia Enriquez, R.E.H.S.  
Zarha C. Ruiz, R.E.H.S.  
Jannine Talusik, R.E.H.S.

*Editor's Note: The Samuel J. Crumline Consumer Protection Award for Excellence in Food Protection, named in honor of one of the most renowned U.S. public health sanitarians, is presented each year to a local public health agency by a jury of leading environmental health officials and public health sanitarians. The Crumline Award is the most prestigious recognition that a public health agency can receive for excellence and improvement in food protection. Agencies that win the Crumline serve as models for other public health and safety programs across the nation.*

*In this report, readers will find a review of the program that won the 2008 award—the Sacramento County Environmental Management Department. The description is adapted from information the department submitted on its Crumline application. For more information about the Crumline Award, please contact Lynn Dyer, director of Market Development and Programs at the Foodservice & Packaging Institute (FPI), at (703)538-2800. For more information about the Sacramento County*

Environmental Management Department, contact Val F. Siebal, director, at SiebalV@SacCounty.net, John Rogers, division chief, at RogersJo@SacCounty.net, or Alicia Enriquez, program manager, at EnriquezA@SacCounty.net. A copy of Sacramento County's entire award-winning application is posted on the FPI Web site at [www.fpi.org](http://www.fpi.org).

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**April 2009**

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### **Prevalence of *Giardia* and *Cryptosporidium* in Muskrats in Northeastern Pennsylvania and New Jersey**

Adenike Bitto, M.D., M.P.H., Dr.P.H., C.H.E.S., F.R.I.P.H.  
Abdalla Aldras, M.S.P.H., SC.D.

#### **Abstract**

*Giardia* spp. and *Cryptosporidium* spp. are intestinal parasites that affect humans and animals throughout the world. Although infection with *Giardia* spp. is usually self-limiting, some cases result in mild to severe enteritis. Giardiasis can be treated with modern drugs. The increasing incidence of well-documented outbreaks of Cryptosporidiosis has resulted in a growing awareness of the danger of this infection. In this study, the authors examined beavers and muskrats to determine their role as reservoir hosts in the spread of these two pathogens. The authors obtained fecal samples from trapped animals and examined them to detect simultaneously the presence of *Cryptosporidium* oocysts and *Giardia* cysts. Water samples collected from the trapping locations were also tested for the same pathogens. The study showed that 65.9% of the tested muskrats were positive for *Giardia* spp., 50% were positive for *Cryptosporidium* spp., and 29.3% were infected with both parasites. The surface water tests showed three sites were positive for *Cryptosporidium* spp. and none for *Giardia* spp. These findings suggest the muskrat may be an important reservoir host for both *Cryptosporidium* spp. and *Giardia* spp.

### **An Evaluation of the Effectiveness of the Gunderboom<sup>®</sup> in Protecting Waters from Bacteria**

Anna K. Yeung-Cheung, Ph.D.  
Nicole M. Benevento  
Donatella M. Pavel

#### **Abstract**

Beaches located in the narrow inlet of Long Island Sound frequently contain high concentrations of bacteria. A Gunderboom<sup>®</sup> BPS<sup>™</sup> (Beach Protection System) filter was installed in Harbor Island Park of Mamaroneck Harbor, New York, in 2002 to reduce bacterial levels in the water. Water and sediment collected inside and outside the

Gunderboom<sup>®</sup> and other areas within Mamaroneck Harbor (Shore Acres Beach, Guion Creek, and Mamaroneck River) were tested for *E. coli* and total coliform bacteria and compared weekly from May through September 2006. The results showed that concentrations of *E. coli* and total coliform bacteria in water and sediment were significantly lower inside the Gunderboom<sup>®</sup> when compared to the other sites. One-third of the samples were collected within 48 hours of rainfall, and a positive correlation occurred between rainfall and bacterial levels in water. These results indicate the Gunderboom<sup>®</sup> has the potential to reduce bacteria in both beach water and sediment.

### **Association Between Swimming Pool Operator Certification and Reduced Pool Chemistry Violations—Nebraska, 2005–2006**

Bryan F. Buss, D.V.M., M.P.H.

Thomas J. Safranek, M.D.

Julie M. Magri, M.D., M.P.H.

Thomas J. Török, M.D., M.P.H.

Michael J. Beach, Ph.D.

Brett P. Foley, M.S.

#### **Abstract**

Previous studies have recommended mandatory education for all public pool operators, but substantiating data are limited. This study evaluates associations between pool operator certification and chemistry violations by using 2005–2006 Nebraska routine pool inspection reports. Training and certification for nonmunicipal pool operators are only required in two Nebraska counties. Free chlorine violations for nonmunicipal pool inspections were compared in counties with and without certified operator requirements. To control for water supply pH, inspections from nonmunicipal pools with shared-source water in two counties (one requiring certification) were compared for concurrent pH and free chlorine violations. Compared with locations that require certified operators, free chlorine violations and concurrent pH and free chlorine violations were twice as likely in locations without certification. As a result, pools without required operator certification might pose greater health risks. These results demonstrate the benefit of requiring pool operator certification to help prevent recreational water illnesses.

### **An Observational Study on the Effectiveness of Point-Of-Use Chlorination**

Laura A. McLaughlin, M.S.

Karen Levy, M.P.H., Ph.D.

Nicola K. Beck, M.S.

Gwy-Am Shin, M.S., Ph.D.

J. Scott Meschke, M.S., J.D., Ph.D.

Joseph N. Eisenberg, M.P.H., Ph.D.

## Abstract

Although the efficacy of chlorine disinfection under controlled laboratory conditions is well known, the effectiveness of chlorine under field point-of-use (POU) conditions is still not clearly understood and may be impacted by a variety of factors. This study evaluated the effectiveness of POU chlorine disinfection in rural Ecuador under typical use conditions and compared this effectiveness with the efficacy in controlled laboratory conditions. While reductions of indicator organisms were slightly higher in households that used chlorination, no significant differences were seen between households employing POU chlorination and the households with no chlorination (1–1.5  $\log_{10}$  median reductions for chlorinating households and 0.31–0.55  $\log_{10}$  for nonchlorinating households, depending on the indicator organism). In contrast, significant reduction of all test organisms was found when simulating POU conditions in the laboratory. This study demonstrates that POU chlorination can be considerably less effective under actual field conditions than would be predicted based on its laboratory efficacy (3–5  $\log_{10}$  median reductions for chlorinated and 0–0.3  $\log_{10}$  for nonchlorinated samples). Human factors (including improper storage and chlorine dosing) and uncontrolled water quality effects are hypothesized to impact significantly the effectiveness of chlorine disinfection.

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**May 2009**

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## **The Use of Third-Party Review to Reduce Health and Environmental Hazards from Surfactants and Cleaning Products in the Janitorial Industry**

Kazuhiro Okumura

### Abstract

The demand for environmentally preferable products is increasing in the area of Institutional and Industrial (I&I) cleaners. The GreenBlue Institute (GreenBlue) and U.S. Environmental Protection Agency's (U.S. EPA's) Design for Environment (DfE) launched two programs to review surfactant ingredients and final cleaning products, with the National Sanitation Foundation (NSF) conducting third-party reviews. The Local Hazardous Waste Management Program (LHWMP) in King County, Washington, has a strategic goal to reduce the risk of exposure of hazardous chemicals to vulnerable populations such as janitorial workers. This report summarizes the NSF partnership with GreenBlue, CleanGredients, and U.S. EPA's DfE to perform third-party reviews of cleaning product ingredients and its relevance to LHWMP's interest in reducing risks to workers in the janitorial industry. Due to information barriers, workers in the janitorial industry are at risk daily to these hazardous chemicals. The surfactant and formulator review program will make positive contributions towards the reduction of toxic chemical exposure to the employees of the janitorial industry. With proper communication and an increased use of less toxic cleaners, exposures to vulnerable populations can be reduced.

## **Efficacy of “Green” Cleaning Products with Respect To Common Respiratory Viruses and Mold Growth**

Ed Light, M.S., C.I.H.

### **Abstract**

Some disinfectants have been demonstrated to be effective against surface mold growth and/or viruses responsible for the spread of common respiratory infections. Antimicrobial efficacy of green cleaning products has generally not been established in these areas. In this survey, the author found that out of 27 products approved by Green Seal as hard surface cleaners, 26 do not claim antimicrobial capability. While some contained hydrogen peroxide, a compound with limited spectrum disinfection capabilities, only one was registered with the U.S. Environmental Protection Agency as antimicrobial. The need for additional research and documentation is discussed.

## **Seasonal Changes in Airborne Fungi and Bacteria at a Dairy Cattle Concentrated Animal Feeding Operation in the Southwest United States**

Carla S. Alvarado, M.P.H.

Angelina Gandara

Carissa Flores, M.P.H.

Hernando R. Perez, M.S., Ph.D.

Christopher F. Green, M.S., Ph.D.

William W. Hurd, M.S., M.D.

Shawn G. Gibbs M.S., Ph.D.

### **Abstract**

The objective of this study was to evaluate a dairy located in the arid southwest United States to determine the concentrations and seasonal variation of airborne fungi and bacteria and to determine the percentage of antibiotic resistant *Staphylococcus aureus*. The authors used two-stage ambient air sampling systems to measure the culturable airborne fungal organisms and bacteria on a monthly basis. The authors recovered the most fungal, bacterial, and *S. aureus* organisms during the spring months. The most common fungi identified were *Cladosporium*, *Aspergillus*, and *Stemphylium*, which were most common in the spring and least common in the summer. *S. aureus* made up 4.2% to 5.5% of the total bacteria, and greater than 50% of this bacteria were found to be resistant to ampicillin, penicillin, or cefaclor, with the greatest incidence of antibiotic resistance occurring in the fall. The incidence of *S. aureus* resistant to at least two antibiotics ranged from 14% in the spring to 54% in the fall.

## **Biomedical Waste Generation in Puducherry Government General Hospital and Its Management Implications**

U. Jagadeesh Chandira boss, M.S.

G. Poyya Moli, M.Sc., Ph.D.

Goutam Roy, M.D.  
K.V. Devi Prasad, M.Sc., Ph.D.

#### Abstract

In India, not much attention has been paid to the management of biomedical waste (BMW). The present paper describes the collection and disposal of BMW in the Government General Hospital (GH) of Puducherry, India. The authors document (a) the lack of segregation between infectious and noninfectious BMW as well as a failure to implement the prescribed rules for proper management of BMW; (b) improper treatment and transportation and the final disposal of BMW along with municipal garbage; and (c) an inadequate training of personnel, insufficient personal protective equipment, and a lack of knowledge regarding the proper use of such equipment. The authors recommend the establishment of standards and periodic monitoring along with effective training of personnel.

#### **Water Quality of Modern Water Parks**

Tracynda Davis, M.P.H.

#### Introduction

Water parks are a rapidly growing element of the U.S. tourism industry. These parks offer creatively themed designs from water slides to interactive water activities. As the designs for the attractions become more creative, the possibilities of injury or infections to the users become multiplied (Photo 1).

The public health responsibility for regulating the operation and design of water park facilities involves injury prevention and reduction and control of the spread of waterborne disease. Park designers are challenged to reduce abrasion and impact injuries by cushioning surfaces at pool basins and edges with various pad materials. Often, the padded surfaces are designed within a themed décor to enhance the attractiveness of the park. But these same features that protect against injuries may actually increase the risk of waterborne disease by harboring and distributing bacteria. For example, foam padding in high traffic areas may provide interstitial spaces for opportunistic bacteria to escape pool water disinfectants and potentially infect swimmers.

The Wisconsin Department of Health completed a two-year study of five indoor and five outdoor water parks throughout the state. The study was initiated to survey the sanitary conditions at these parks, in order to update existing regulations to encompass new designs found in modern water parks. This approach was to provide data for regulators to make better-informed judgments for the health and safety of pool patrons and their children.

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**June 2009**

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**A Potential Risk Assessment of a Dengue Outbreak in North Central Texas, USA  
(Part 1): Abundance and Temporal Variation of Dengue Vectors**

Joon-Hak Lee, Ph.D.  
Matt Stahl, M.P.H.  
Scott Sawlis, M.S.  
Sumi Suzuki, Ph.D.  
Jib Ho Lee, M.S.

**Abstract**

In response to three imported dengue cases in north central Texas as well as increased case numbers in Texas and adjoining Mexican states in 2005, the authors assessed the potential risk of a dengue outbreak in north central Texas by investigating abundance and temporal variation of dengue vectors in 2006. Dengue vector abundance was monitored from 54 sites in Dallas County, Texas, from June to November 2006, using oviposition traps. Both dengue vectors—the yellow fever mosquito, *Aedes aegypti*, and the Asian tiger mosquito, *Aedes albopictus*—were present. Of the two, *Ae. albopictus* was more abundant and its abundance appeared to be positively affected by temperature and precipitation. Potential risk of a dengue outbreak was predicted based on the abundance and temporal variation of dengue vectors and a long-term trend of breeding season precipitation and warmer winter temperatures.

**A Potential Risk Assessment of a Dengue Outbreak in North Central Texas, USA  
(Part 2): Development of a Practical Prevention Strategy**

Joon-Hak Lee, Ph.D.  
Matt Stahl, M.P.H.  
Scott Sawlis, M.S.  
Sumi Suzuki, Ph.D.

**Abstract**

In response to three dengue cases in north central Texas in 2005, the authors assessed the potential risk of a dengue outbreak in Dallas County in 2006. As a part of the assessment, habitat factors for dengue vector mosquitoes were quantified and associated with their abundances. In addition, percent population originated from endemic countries (Hispanic origin in the Census data) was associated with vector abundances and habitat factors of the vectors. Percent population data were obtained from publicly accessible databases. The areas with higher Hispanic populations had more *Aedes aegypti* and container numbers and also appeared to have more shade, which is attractive to this species. The methodology of this study may help to devise a practical strategy to reduce

the risk of dengue outbreak in areas where dengue vector activity is present and a potential source of infection.

### **Growth and Evolution of a Municipal Pool Safety and Inspection Program**

Tom Vyles, M.A., R.E.H.S., R.S.

#### **Abstract**

The city of Plano Health Department swimming pool safety and inspection program has been growing and evolving since 1992. Currently, five environmental health specialists inspect 370 permitted commercial swimming pools. The environmental health specialists, who are all well trained and are Certified Pool Operators by the National Swimming Pool Foundation, inspect each facility twice during the summer season. The department considers quality training for both inspectors and operators a priority. Violation rates have been variable across the program, but improved operator training is proving successful in many areas. The program also plays a role in swimming pool construction by providing plan review services and construction inspections. Increased involvement in construction and design has significantly reduced problems and improved compliance with new pools. This has resulted in a higher level of service and swimmer safety. Additionally, a net drop in chemistry violations has been shown over the last three years. The department is constantly evaluating safety in public and semi-public pools in Plano in an effort to provide a maximum level of swimmer safety.

### **Determination of Groundwater Quality Index of a Highland Village of Kerala (India) Using Geographical Information System**

P.G. Rejith, M.Sc.

S.P. Jeeva, M.Sc.

H. Vijith, M.Sc.

M. Sowmya, M.Sc.

A.A. Mohamed Hatha, M.Sc., Ph.D.

#### **Abstract**

In this study, the authors' goal was to understand the groundwater quality of Nedumkandam panchayat by an integrated approach of traditional water quality analysis and Geographical Information Systems (GIS). Fourteen wells were identified from the study area and samples were collected and analyzed using standard protocols (American Public Health Association, 1998). Parameters analyzed include pH, hardness, nitrate, chloride, sulfate, phosphate, trace metals (cadmium, zinc, copper, and lead), and fecal coliforms. All parameters except pH, cadmium, and fecal coliforms were within the limit of drinking water quality standards prescribed by the Bureau of Indian Standards (BIS) (BIS, 1983). The spatial distribution of physico-chemical and biological parameters was analyzed using the Inverse Distance Weighted (IDW) approach and the maps thus obtained were integrated using the raster calculator option of spatial analyst in ArcGIS 8.3 software, and a water quality index (WQI) was calculated. Based on the WQI values, the study area was divided into poor, moderate, and good water quality zones.

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**July/August 2009**

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**Predictability of Swimming Prohibitions by Observational Parameters: A Proactive Public Health Policy, Stamford, Connecticut, 1989–2004**

Joseph Kuntz, R.S.  
Robert Murray, M.S.

**Abstract**

Using compiled bacterial analyses to predict water quality when certain conditions are observed provides a way to establish a proactive public health policy. In this study, the authors reviewed using the geometric mean various conditions including the amount of rain in previous days, wind direction and speed, tides and high tide height, water temperature, drought or flood conditions for the season, different materials coming into the swimming areas, and the location and amount of any sewage spills. Only three events showed statistical significance (Chi-squared  $p < .0001$ ): rain events of one inch or more in a 24-hour period under normal weather conditions; rain events over a half inch in a 24-hour period under drought conditions; and when “floatable” material from distant sewage spills (i.e., grease balls) are present at a beach. Such evaluations enable a public health policy to be easily developed that restricts swimming when certain adverse conditions are present without waiting for bacteriological examinations to prove that a problem exists.

**Mold Growth on Gypsum Wallboard—A Summary of Three Techniques**

M.Y. Menetrez, Ph.D.  
K.K. Foarde  
T.D. Webber  
T.R. Dean  
D.A. Betancourt

**Abstract**

Reducing occupant exposure to mold growing on damp gypsum wallboard and controlling mold contamination in the indoor environment was studied through 1) delineation of environmental conditions required to promote and avoid mold growth and 2) efficacy testing of antimicrobial products, specifically cleaners and paints, on gypsum wallboard (GWB) surfaces. The effects of moisture and relative humidity (RH) on mold growth and transport are important in avoiding and eliminating problems. These effects have been demonstrated on GWB and are discussed in this article for use as control guidance. The authors discuss the efficacy of antimicrobial cleaners and paints to remove, eliminate, or control mold growth on GWB. Research to control *Stachybotrys chartarum* growth using 13 separate antimicrobial cleaners and nine varieties of antimicrobial paint

on contaminated GWB was performed in laboratory testing. GWB surfaces were subjected to high RH. GWB control measures are summarized and combined, and the antimicrobial product results are explained.

### **Association of Self-Reported Leisure-Time Physical Inactivity with Particulate Matter 2.5 Air Pollution**

Xiao-Jun Wen, M.D.  
Lina S. Balluz, Sc.D., M.P.H.  
Jeffrey D. Shire, M.S.  
Ali H. Mokdad, Ph.D.  
Harold W. Kohl, III, Ph.D.

#### **Abstract**

This study examines the association between annual levels of particulate matter (PM<sub>2.5</sub>) and self-reported leisure-time physical inactivity (LTPI) in the Behavioral Risk Factor Surveillance System (BRFSS) among 63,290 survey respondents who participated in the 2001 BRFSS from 142 counties in the U.S. The average prevalence of self-reported LTPI was about 24.9% (*SE* = 0.3%). LTPI prevalence was positively associated with annual mean of PM<sub>2.5</sub> concentration ( $p < .0001$ ). The authors demonstrate that LTPI was associated with PM<sub>2.5</sub> pollution with statistical significance with and without adjustment for covariates (adjusted odds ratio [*OR*] = 1.16; 95% *CI*: [confidence interval] 1.06–1.27). This study suggests that ambient PM<sub>2.5</sub> air pollution is associated independently with LTPI. PM<sub>2.5</sub> pollution and physical inactivity are both risk factors of chronic diseases. Therefore, it is important for environmental officials to implement measures to reduce ambient air pollution while public health officials simultaneously promote regular physical activity by encouraging the general public to remain physically active.

### **The Health Impact of Nonhazardous Solid Waste Disposal in a Community: The Case of the Mare Chicose Landfill in Mauritius**

Smita Sulackshana Devi Goorah, M.B.B.C.H., D.F.F.P., M.R.C.P.  
Mary Libera Isabelle Esmyot, BSc  
Ravindra Boojhawon, Ph.D.

#### **Abstract**

The disposal of nonhazardous solid waste on the island of Mauritius is centered on the Mare Chicose landfill. Because of health concerns in the community, the authors conducted a health impact survey, took measurements of height and weight, and compared the results with a control locality. After adjusting for confounding factors, the authors observed that numerous complaints were significantly higher in the target population. After elimination of reporting bias, however, nausea and vomiting remained as the only significant self-reported outcomes. The mean body mass index (BMI) of target men was significantly lower when compared with the control. This result was not observed in the populations of women and children, and suggests a gender difference in the health impact of the landfill.

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**September 2009**

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**Survey of the Home Sewage Disposal Systems in Northeast Ohio**

Mark A. Tumeo, PhD, JD, PE  
Juliet Newland, MS, PE

**Abstract**

This article reports on failure rates in onsite sewage treatment systems (STS) that were found as part of a comprehensive seven-county survey that was performed under the auspices of the Northeast Ohio Areawide Coordinating Agency (NOACA) during the summer of 2000. The goal was to determine the percentage of onsite, individual home wastewater systems that were “failing.” A system was identified as “failing” if, upon inspection, it had observable surfacing of effluent from the treatment system. A certified soil scientist conducted each on-site investigation to ensure consistency in methodology and to provide verification of soil types for each installation. The survey revealed that between 12.7% and 19.7% of the onsite wastewater treatment systems are allowing wastewater to surface as opposed to infiltrate (at the 95% confidence interval). The rate of failure does not vary significantly between aerobic and septic systems or between systems with or without filters.

**University Students’ Hand Hygiene Practice During a Gastrointestinal Outbreak in Residence: What They Say They DO and What They Actually Do**

Brae V. Surgeoner, M.S.  
Benjamin J. Chapman, Ph.D.  
Douglas A. Powell, Ph.D.

**Abstract**

Published research on outbreaks of gastrointestinal illness has focused primarily on the results of epidemiological and clinical data collected postoutbreak; little research has been done on actual preventative practices during an outbreak. In this study, the authors observed student compliance with hand hygiene recommendations at the height of a suspected norovirus outbreak in a university residence in Ontario, Canada. Data on observed practices was compared to postoutbreak self-report surveys administered to students to examine their beliefs and perceptions about hand hygiene. Observed compliance with prescribed hand hygiene recommendations occurred 17.4% of the time. Despite knowledge of hand hygiene protocols and low compliance, 83.0% of students indicated that they practiced correct hand hygiene during the outbreak. To proactively prepare for future outbreaks, a current and thorough crisis communications and management strategy, targeted at a university student audience and supplemented with proper hand washing tools, should be enacted by residence administration.

## **Food Safety Education for Arabic Speakers in the Food Service Industry**

Angela M. Fraser, PhD  
Souod R. Alani, PhD

### **Abstract**

As the food service industry grows more dependent on immigrant workers, language and cultural differences could pose potential barriers to large and small operators alike. Therefore, food safety educators must be pragmatic and proactively address the needs of limited- and non-English speakers working in this important economic sector.

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**October 2009**

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## **Job Satisfaction and Issues Related to the Retention of Environmental Health Professionals in North Carolina**

Tracy L. Zontek, PhD, CIH, CSP  
Candice Cline DuVernois, MPH  
Burton R. Ogle, PhD, CIH, CSP

### **Abstract**

Issues related to job satisfaction of environmental health professionals in North Carolina health departments were evaluated using an online survey instrument. Respondents ( $N = 433$ ) indicated that the major issues regarding retention were inadequate or poor salary and limited opportunities for career advancement. Significant differences were found in satisfaction with salary and career advancement among regions, which may indicate the need for different intervention strategies. Salary inequities were identified for women with 6–10 and 11–15 years of experience. When overall satisfaction was correlated with salary, a positive significant association was found ( $r = 0.095$ ,  $p = .049$ ). Overall satisfaction was not significantly correlated with age, gender, or years of practice.

## **The Influence of Experience and Credential Status on Perceptions of Agency Competency in Delivery of the 10 Essential Environmental Public Health Services**

Daniel L. Partridge, MPH, RS  
Ruth Wetta-Hall, RN, PhD, MPH, MSN  
Angelia M. Paschal, PhD, MEd  
Jack A. Brown, MPA, MPH  
Carl Osaki, MSPH, RS

## Abstract

Contributions made by the environmental health (EH) workforce in reducing human disease are some of the most significant to public health. A shrinking workforce and increased work complexity have called for workforce training in the 10 essential public health services. The preliminary study discussed here assesses perceived competency of the Kansas EH workforce in the 10 essential public health services and evaluates credentialing influence on perceptions. State and local food service inspectors were anonymously surveyed using the Northwest Center for Public Health Practice Environmental Health Workforce Questionnaire. Credentialed respondents reported more years of experience and supervisory responsibilities. Noncredentialed respondents were more likely than credentialed respondents to answer that their work unit was capable of providing the 10 essential public health services. Kansas should establish an accredited EH program and national credentialing requirements established for EH practitioners would encourage and institutionalize ongoing workforce training programs.

## **Assessment of Shellfish Practices in Licensed Retail Food Establishments in Response to Increased *Vibrio* Illnesses in a Landlocked Area**

Laura DeGolier, MPH, REHS

Katya Ledin, MPH, PhD

George Vargulich, MA, REHS

Jennifer L. Patnaik, MHS

Bruce Wilson, MPA

Richard L. Vogt, MD

## Abstract

Cases of non-cholera *Vibrio* illness are typically associated with exposure to shellfish from marine coastal areas (U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition, 2009), not landlocked states such as Colorado. In 2004, a 2.8-fold increase in the incidence of non-cholera *Vibrio* cases in the Tri-County Health Department (TCHD) jurisdiction of Colorado prompted scrutiny of shellfish practices in local retail food establishments. Forty-three percent of establishments serving raw shellfish in the TCHD jurisdiction were in violation of one or more sections of the Colorado Retail Food Establishment Rules and Regulations (Colorado Department of Public Health and Environment, 2007a). The frequency of violations and the underutilization of safer, post-harvest processed shellfish may result in significant hazards to consumers if these practices continue.

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**November 2009**

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## **Evaluation of Respiratory Symptoms and Their Possible Association with Residential Indoor Bioaerosol Concentrations and Other Environmental Influences**

Carissa M. Flores, MPH  
Linda C. Mota, MPH  
Christopher F. Green, MS, PhD  
Kristina D. Mena, MSPH, PhD  
Hector Balcazar, MS, PhD  
Shawn G. Gibbs, MS, PhD

### **Abstract**

The study discussed here evaluated the presence of self-reported respiratory symptoms and their association with indoor bioaerosol concentrations over a year-long study in the El Paso, Texas, region. The authors collected air samples from homes to assess seasonal differences in bacterial and fungal bioaerosol concentrations. They distributed a health questionnaire to the participating homeowner during each seasonal air sampling. The authors used this questionnaire to assess whether the homeowners were suffering from specific symptoms prior to each sampling. Descriptive statistics and logistic regressions were conducted to model the relationship among “high” reporters of symptoms, bioaerosols, and environmental factors. The authors collected evidence to support an association between indoor respirable bacterial concentrations and homeowners that reported at least eight respiratory symptoms (odds ratio [*OR*] = 1.10, *p* = .045). Smoking status, indoor humidity, and season also displayed associations with homeowners that reported at least eight respiratory symptoms (current smokers *OR* = 3.3, *p* = .042; indoor humidity *OR* = 1.5, *p* = .030; spring season *OR* = 7.2, *p* = .001; fall season *OR* = 3.4, *p* = .008).

## **Recirculating Vertical Flow Constructed Wetland: Green Alternative to Treating Both Human and Animal Sewage**

Alfredo García-Pérez, PhD  
Mark Harrison, PE  
Bill Grant

### **Abstract**

Subsurface constructed wetlands using a recirculating vertical flow are a viable alternative technology to pretreating conventional residential septic systems effluents before underground discharge. The authors examined performance of a recirculating vertical flow constructed wetland (RVFCW) to treat both human and domestic animal sewage from the LaGrange County (Indiana) Animal Shelter. Effluent water samples were analyzed for the five-day biochemical oxygen demand (BOD<sub>5</sub>), total suspended solids (TSS), ammonia-nitrogen (AN), total Kjeldhal nitrogen (TKN), total nitrogen (TN), nitrate-nitrogen, total phosphorus (TP) and fecal coliform bacteria (FC). Treatment efficiencies (percentage removal) after a two-year operation were high for BOD<sub>5</sub> (99%), TSS (98%), AN (96%), TKN (94%), TN (83%), and FC (99%). Nitrate-nitrogen final

mean value was 6.8 mg/L, dissolved oxygen concentration increased from 1.8 to 4.3 mg/L, and removal efficiency for total phosphorus was low (33%). These results show that vertical flow constructed wetlands are a green alternative to remove pollutants generated for both human and domestic animals.

### **Achieving Compliance with Environmental Health–Related Land Use Planning Conditions in Hong Kong: Perspectives from Traditional Motivation Theories**

Rita Li Yi Man, ACI Arb, AHKI Arb

#### **Abstract**

Environmental health–related land use planning conditions can enhance the environment in Hong Kong. Previous research by others has shown, however, that a lack of compliance with planning conditions often occurs. And as no direct enforcement of planning conditions exists in Hong Kong, it is of interest to understand possible ways in which to increase the motivation of land developers and property owners to comply with planning conditions. The author looked at motivation from the perspective of three traditional motivation theories: Theory X, Theory Y, and incentive theory. While the majority of this article focuses on the enforcement and the legal tests in land use planning conditions, it also presents the results of the first study of the motivations behind Hong Kong land developers to comply with land use planning conditions.

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**December 2009**

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### **Assessing Consumer Awareness About Mercury in Fish**

Dhitinut Ratnapradipa, PhD, CHES  
Daniela Quilliam, MPH, REHS  
Lauren M. Wier, MPH  
Beverly Migliore  
William Dundulis, Jr., MS

#### **Abstract**

The study discussed in this article was conducted to determine if a retail-based educational campaign would be an effective tool to inform consumers about mercury in fish. In 2005, the Rhode Island (RI) Department of Health, in conjunction with the RI Food Dealers Association, conducted surveys in eight supermarkets to assess consumers' knowledge and awareness of mercury in fish. A presurvey was administered to 523 respondents as they prepared to exit the store June 17–19. During the week of July 11–17, a “Fish Week” educational program was conducted. An identical postsurvey to evaluate the effectiveness of “Fish Week” was administered to 556 customers exiting participating supermarkets on July 21–24. A significant ( $p < .05$ ) increase occurred in the

number of respondents who identified brochures as an information source about mercury in fish. Small, but significant, decreases in awareness and knowledge about mercury in fish issues, however, were unexpected findings that were likely due to factors discussed.

### **Predicting Saturated Hydraulic Conductivity from Percolation Test Results in Layered Silt Loam Soils**

Jay D. Jabro, PhD, CPSSc

#### Abstract

The objectives of the study discussed in this article were to develop an empirical relationship between the saturated hydraulic conductivity ( $K_s$ ) of layered soils and their percolation times (PT) in order to understand the influence of individual layers and compare this with the equations developed by Winneberger (1974) and Fritton, Ratvasky, and Petersen (1986). Field research was conducted on three silt loam soils. Six holes were spaced evenly in two parallel rows of three holes. The  $K_s$  was measured at three different layers for each soil using a constant head well permeameter. After completion of the second  $K_s$  measurement, the percolation test was conducted. Three linear equations for the upper, middle, and lower layers were developed between the  $K_s$  values of each individual layer in all three sites and the corresponding PT. Significant differences were found between the author's results and those predicted by Winneberger (1974) and Fritton and co-authors (1986).

### **Consumption of Groundwater as an Independent Risk Factor of *Salmonella* Choleraesuis Infection: A Case-Control Study in Taiwan**

Tsung-Hsien Li, MS  
Cheng-Hsun Chiu, MD, PhD  
Wan-Ching Chen, MS  
Chih-Ming Chen, MD  
Yuan-Man Hsu, PhD  
Shyan-Song Chiou, PhD  
Chien-Shun Chiou, PhD  
Chao-chin Chang, DVM, MS, PhD

#### Abstract

Infection with *Salmonella enterica* serovar Choleraesuis (*S. Choleraesuis*) in humans can be considered as an endemic disease in certain regions of Taiwan, and the number of cases has increased in recent years. The goal of the case-control study discussed in this article was to identify the possible demographic and environmental risk factors associated with *S. Choleraesuis* infection in Taiwan. During the period of December 2005 to March 2007, the case-control study was conducted in human patients with *Salmonella* infection from two medical centers. Structured questionnaires were applied to collect information of relevant risk factors after interviewing 13 culture-confirmed *S. Choleraesuis* cases and 84 controls with other *Salmonella* serotype infection. After evaluation by univariate and multivariate statistical models, the results

suggested that consumption of groundwater could be an independent risk factor associated with *S. Choleraesuis* in Taiwan. Therefore, appropriate health education needs to be conducted especially in areas where groundwater is used.