A. PROJECT TITLE
Hospital Discharges and Deaths Associated with Cysticercosis in NC

B. PROJECT OFFICER(s)
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C. PROJECT DESCRIPTION
A. Specific Aims
1. To determine the hospital and admission/readmission rates for Cysticercosis in NC
2. To review death certificates for cysticercosis in NC from 1990-2003 and
3. To estimate the costs associated with hospitalization and treatment for neurocysticercosis in NC.
4. To determine the number/rates of emergency department admissions and hospital discharges for cysticercosis in North Carolina from 1990 to 2002;
5. To estimate number/rates due to cysticercosis in North Carolina from 1990 to 2002; and,
6. To estimate the costs associated with hospitalization and treatment for cysticercosis in North Carolina;

D. PROJECT START AND END DATES: Jan 1, 2005 – September 29, 2005

E. PROJECT ACCOMPLISHMENTS FOR PROGRAM CYCLE:

The discharge data for emergency hospital discharges were obtained from the Center for Health Statistics State Center for Health Statistics (SCHS) of the North Carolina Division of Public Health, Department of Health and Human Services. The information fields received contained no relevant patient identifiers and corresponded mainly to ICD9 and ICD10 codes associated with the diagnosis and treatment of Cysticercosis (code 123.1). Data were analyzed and results were summarized in tables and figures, including a map of NC indicating the location of the cases.

The review of the death certificates was not productive since the data contained in these documents relate to main cause of death that could be due to complications of cysticercosis but not cysticercosis per se. Therefore, we stopped at this point the analysis of the death certificate data based available in the Internet. Further analysis of death certificates would require paying for hard copies of the certificates and the cost is well over the budget of this project. We have estimated the death due to cysticercosis from our data base. It is also worth noting that foreign-born workers may go back home if sick to receive medical treatment in their own native countries and is so, a death of patient diagnosed here is not registered (a bias known as “the salmon effect”).
The overall cost of the disease was estimated and it is presented in section D of this document.

A second study was initiated by the Health Department to trace patients of what it seems to be of Hispanic/Latino origin. In the data base these patients are of unknown or missing race. The data collected at hospitals in NC does not have a provision for ethnicity.

Please note: This project lasted 9 months; the project was conducted between January 2005 and September 2005. Although the funding for the project ended September 30 2005, we continued working on the project with resources from the CVM and from the Health Department.

- Data based was obtained
- Data were analyzed
- Tables and figures were generated
- A report was submitted September 9, 2005 near completion of the project
- Funding for a continuation was not obtained (although an application was sent to a funding agency)
- A manuscript is being developed for publication

Drs. Maria T. Correa and Michael Levy delivered a talk at the Zoonosis Center from the University of Quito, Ecuador on July 3, 20 Summary of findings:

Cysticercosis is the parasitic aspect of the disease associated with the larval stage or cysticerci of the *Taenia solium*. Cysticercosis is acquired by ingestion of the tapeworm eggs which are shed in the feces of infected humans. When a person ingests cysticerci-infected pork, the adult worm develops in the intestine and the tapeworm cycle is completed often without any clinical disease. Humans carrying the adult tapeworm are the source of eggs that contaminate food, water, and lead to cysticercosis in humans and swine. Neurocysticercosis refers to the development of the cysticerci in the brain of a human and associated with hydrocephalus and space occupying lesions. Clinical signs associated with these conditions are seizures, headaches, and other central nervous system dysfunctions.

Recent reports from California and Oregon point to the importance of cysticercosis in the United States (US) as an emerging parasitic neurological disease, particularly among the H/L population. The disease is endemic in many countries in Latin America (LAM) reaching levels of 10-30% for the rural population in Mexico and other LAM countries. *Taenia solium* carriers usually account between 1 to 3% of the rural population in endemic areas in LAM; apparently is the case in California among H/L farm-workers. The prevalence of cysticercosis in swine in endemic areas could reach higher levels than in humans due to swine coprophagic behavior; and it is also associated with the lack of an appropriate sewage system and potable water, and the free access of swine to contaminated human feces.
North Carolina’s Hispanic/Latino (H/L) population has increased 400% in the 1990-2000 decade with most of our farm workforce coming from Mexico. Cysticercosis was described in the state in a 1990 study indicating that 10% of migrant farm workers and 13% of the Mexican-borne farm workers were cysticercosis seropositive. No *Taenia* eggs were found in the stool samples submitted by 66% of the farm workers. In 1992, three locally acquired cases of neurocysticercosis from NC, Massachusetts, and South Carolina were reported by the Centers for Disease Control and Prevention (CDC). The case from NC could not be associated with any of the known risk factors for the disease such as travel outside the US, a family history of tapeworm infection, or neurologic illness. A purely speculative explanation for the source of the infection was the hiring of seasonal farm labor from countries where cysticercosis is endemic. Dr. Tsang of the CDC has found that the seroprevalence for cysticercosis among H/L in different localities in Georgia varies between 10% and 14% (Personal communication).

In summary, *Bartonella* is associated to major diseases including endocarditis, arthritis, and debilitating conditions affecting mainly people with higher risk of exposure to animals and vectors such as ticks. *Taenia solium* Taeniasis seems to have followed the influx of the H/L into the US and has gone undetected—the possibility of food and water contamination by a carrier of the parasite exists and has to be considered. Thus, we propose a comprehensive five year population-based study to determine the prevalence of *Bartonella* and *Taenia solium* Taeniasis and Cysticercosis in our region, while developing prevention, educational, and intervention components for different levels of interest including our rural and special populations, academic and medical environments.

Our analyses of hospital-discharge data from the State Center for Health Statistics, North Carolina Division of Public Health encompassing eight years yielded very interesting information. In this study, we evaluated hospital discharges associated with the ICD9 and ICD10 codes for Cysticercosis or code 123.1. From 233 patients, 192 were first time discharges while several patients were discharged multiple times. First-time hospital discharges increased 45% from 15 in 1995 to 37 in 2001, and 33 in 2002. There were 129 males and 63 females with an overall median age of 26 years; the youngest patient was 3 years old and the oldest was 79.

Among the 192 first-time discharges, there were 64 (33%) patients classified as “Missing,” 76 (40%) patients classified as “Other Race,” 33 (17%) patients classified as “Asian/Pacific Islander,” and, “American Indian/Eskimo,” “Black,” and “White” were represented by 5 (2.6%), 6 (3.1%), and 8 (4.2%) patients, respectively. Ethnicity information is not provided in the hospital discharge forms. A total of 77 hospitals and 194 physicians in 42 counties were involved in the diagnosis and treatment of Cysticercosis; the condition was coded as the principal diagnosis for 62% of the patients, 18% as the second, and as the third diagnosis in 8% of the patients.

*There has been an obvious increase in the number of first-time discharges for Cysticercosis in North Carolina since 1995.* If all H/L patients had chosen “Missing” or “Other Race” as race, then the H/L patients would account for 70% of the first-time discharges from hospitals due to Cysticercosis. There were also 33 “Asian/Pacific Islander”
Islanders” between the ages of 21 and 38 discharged from regional hospitals. Interestingly, we have several cases identified as “White” that were older than the average study population. Currently, we are evaluating the medical records of the Cysticercosis patients to confirm their ethnicity, and to obtain information about the country of origin, and possibly travel history outside the US. Later, we will review in more detail the medical records of the children and other patients identified as American Indian/Eskimo, White, and Black diagnosed with Cysticercosis.

- A graduate student from UNC-Chapel Hill School of Public Health will continue the study reviewing records of patients across the state under the supervision of a Health Department Epidemiologist from the Communicable Disease group
- A request was made to the CDC for a EID Fellow to develop a project to diagnose and differentiate taeniasis in the Hispanic/Latino migrant population under supervision of Drs. Maria T. Correa and Julie Kase from the NCSLPH
- Educational materials in Spanish about the disease (e.g., fact sheets are under development)