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Comparing the Effectiveness of Hantavirus Outreach in Northwestern New Mexico, Panama, and Chile

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COMPARING THE EFFECTIVENESS OF HANTAVIRUS OUTREACH IN NORTHWESTERN NEW MEXICO, PANAMA, AND CHILE

BY

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B.A., Journalism Film, University of Oklahoma, 1981
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DISSERTATION

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Doctor of Philosophy
Sociology

The University of New Mexico
Albuquerque, New Mexico

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DEDICATION

With great appreciation, I dedicate this manuscript to the 601 anonymous survey respondents in Northwestern New Mexico, Panama, and Chile. May they enjoy lives of good health and prosperity.

In addition, I dedicate my project to Terry L. Yates, Ph.D. (deceased), who embraced all disciplines toward the advancement of Hantavirus Pulmonary Syndrome knowledge. His passion for life, knowledge, and discovery shall continue to live through those who knew him.

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ABSTRACT

This research compared the effectiveness of Hantavirus Pulmonary Syndrome prevention outreach in northwestern New Mexico, the Los Santos region of Panama, and Region Araucania IX in Chile. Outreach effectiveness for hantavirus is not well understood, even though outreach in Chile appears to be more extensive than in northwestern New Mexico and Panama. Understanding the role of human demographics, disease ecology, and subsequent human behavior in the disease process is critical to the examination of community responses in terms of behavior changes.

Through the implementation of a self administered 28 question survey instrument (n=601), I measured attitudes towards, and across public health conditions with respect to hantavirus within three human populations of similar disease ecology and assessed whether knowledge and behavior change with respect to hantavirus is greater in high prevalence areas vs. low prevalence areas.

Respondents in the high risk, rural poor sites in northwestern New Mexico and Panama sweep and vacuum more than respondents in Chile. In addition, respondents in

Chile have a tendency engage more in proper cleaning methods such as disinfecting and mopping than those in northwestern New Mexico and Panama. However, levels of concern over contracting hantavirus were higher in New Mexico and Panama. This result indicates the public wants proper information on how to protect themselves and their families from exposure.

While public health messages appear to be more effective in Chile, public outreach messages continue to affect positive and negative behavior in all three populations. Messages that encourage disinfecting and mopping as positive behavior and target both high-risk and low-risk populations are needed to decrease risk of exposure to Hantavirus Pulmonary Syndrome.

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INTRODUCTION/LITERATURE REVIEW

Study Objective/Goal

This dissertation compares the effectiveness of Hantavirus Pulmonary Syndrome (HPS) prevention outreach in: 1) Northwestern New Mexico 2) the Los Santos region of Panama and 3) Region Araucanía IX in Chile. Hantavirus prevention outreach has been implemented on an ad-hoc basis in New Mexico and Panama, but in Chile, there has been extensive governmental investment in the prevention outreach programs geared toward minimizing exposure risk. It is believed that an understanding of the role of human demographics, disease ecology, and subsequent human behavior in the disease process is critical to the examination of community responses in terms of positive and negative behavior changes. The hypothesis to be tested is that even though Chile has extensive state intervention and outreach programs, there is no difference between the positive and negative behavior responses among high and low-risk human populations among countries. Although the hypotheses are designed as null, it would be reasonable to expect some differences between knowledge and positive/negative behavior changes in terms of standard socio-economic variables such as gender, occupation, education, age, race/ethnicity, and income. Ultimately, this study attempts to measure social responses by comparing similar populations' behavior toward HPS under the context of similar space and time, that is of three country sites during an endemic period.

Hantavirus is a global disease, but this analysis, specific to HPS, is confined to the Western Hemisphere. This research project measures social behavior via implementation of public surveys as well as personal interviews with key informants who implement public health policies and outreach programs in New Mexico, Panama, and Chile. This project is the first of its kind to assess attitudes of specific human populations toward hantavirus and to attempt to determine what impact public health warnings are having on human behavior in regard to preventive precautions against this disease. By comparing intervention strategies in terms of behavior change in New Mexico, Panama, and Chile, it is hoped that methods can be improved in each country for reducing human cases.

Introduction and Nature of the Research Question: New Mexico, Chile, Panama

New Mexico

In May 1993, an outbreak of a seemingly new, deadly disease hit the Four Corners region of Northwestern New Mexico. Just 19 days after the first case of HPS was observed in New Mexico, Centers for Disease Control (CDC) and University of New Mexico scientists identified the cause of the disease outbreak as a previously unknown hantavirus. Sin Nombre Virus (SNV) was identified as the primary agent, followed by the identification of P. maniculatus (deer mouse) as the rodent reservoir for this emerging disease (personal interview with Dr. Gary Simpson, M.D., Ph.D., MPH). Further investigation showed the pathogen, SNV, was found to be a previously unknown rodent-borne species of a New World hantavirus. New World hantaviruses such as SNV prove to be highly pathogenic, causing in humans a potentially fatal respiratory condition known as Hantavirus Pulmonary Syndrome (HPS) (Duchin 1994; Schmaljohn 1997).

New World hantaviruses are described clinically as producing an illness which at onset mimics the flu: fever, chills, myalgia, and headache which progresses in anywhere from 36 hours to five days into coughing and shortness of breath (Duchin, et al. 1994; Lee 1996; Nichol, Ksiazek, Rollin & Peters, 1996; Moolenaar, et al. 1995). Following the nonspecific symptoms during the initial onset of HPS, which usually lasts between 3 and 6 days, the patient's respiratory system quickly becomes compromised, requiring immediate and critical care (Nichol, Ksiazek, Rollin & Peters, 1996; Moolenaar, et al. 1995). There is no known medical intervention for HPS, nor is there a vaccine. The current case fatality rate in New Mexico hovers at 35% (CDC website 3/26/07). New World HPS is different than Old World hantaviruses such as Hantaan, Seoul, and Thailand, which cause Hemorrhagic Fever with Renal Syndrome (HFRS) and typically manifest to kidney failure, and which has a variable case fatality rate of 1% - 15% (Lee 1996).

Hantavirus infections actually occur throughout the world, with 37 viruses currently identified and approximately 200,000 annual cases of human infection of HFRS and HPS combined detected (Schmaljohn 1997, Lee 1996.). While many other viruses, such as West Nile Virus, which are associated with mosquito bites, are transmitted through *vectors*, hantaviruses tend to be grouped by mice and rat species-specific *reservoir* hosts. Distinct from reservoirs, vectors are any living creature (particularly arthropods such as mosquitoes, fleas, and ticks) that can become contaminated with an agent such as West Nile Virus or <u>Y. pestis</u> bacteria, and then transmit the infectious agent to humans through direct contact (CDC website, Glossary of Terms, 11/22/05). Reservoirs, on the other hand, are habitats of the infectious agent that exhibit an active immunity to the agent. Humans become infected indirectly through exposure via inhalation of virus particles in dust contaminated with rodent droppings and urine (Lee 1996).

Because exposure is associated largely with an indirect process, simple, inexpensive prevention measures can be used effectively. This is of benefit not only those in high-risk rural areas of northwestern New Mexico, but wherever hantaviruses pose a human health threat. Prevention measures include repairing screens and holes in walls (rodent-proofing), wearing rubber gloves to clean, trapping rodents, and disinfecting by mopping with common household detergents such as bleach or household disinfectant spray (Glass, G. et al. 1997; MMWR, July 2002). In peridomestic areas (areas near the home and include the yard and buildings), moving woodpiles away from the house, removing trash, and keeping lids on garbage cans are easy, effective, and inexpensive methods of keeping rodents away from the home (MMWR, July 2002).

To learn more about the public health outreach process during the initial North American hantavirus crises of 1993, I conducted interviews with Dr. Frederick Koster, M.D., Associate Scientist, Respiratory Immunology and Asthma Program, Lovelace Respiratory Research Institute, and Dr. Gary Simpson, MD, PhD, MPH. According to their accounts, the first step was to set up a "hantavirus hotline" to answer the public's questions, which at peak crisis amounted to approximately 1000 calls per hour. Second, educational activities were developed to train health officials in identifying potential cases, triaging the patient(s) and arranging transportation to the critical care facility at the University of New Mexico Hospital in Albuquerque, New Mexico. Educational materials were made available to the public upon request, and an Internet site was developed (PAHO 1999; personal interview with Dr. Koster, MD). Lastly, video and print materials were developed. Currently in the United States, information continues to be disseminated to the public on an ad-hoc and situational basis.

Following the 1993 outbreak, Dr. Terry Yates, PhD, and Dr. Robert Parmenter, PhD, evolutionary biologists and mammalogists at the University of New Mexico (UNM), predicted a second HPS outbreak following the 1997-1998 El Niño weather event (Hjelle and Glass, 2000). Drs. Yates and Parmenter predicted that unseasonably wet weather would increase vegetation, which would effectively swell the P. maniculatus population. Amplified mouse populations would then lead to increased risk of rodent-to-human contact as crowded mouse populations, seeking food and shelter, dispersed into human peridomestic areas. Public health awareness and outreach strategies were implemented as soon as the El Niño weather pattern was observed (Rodriguez-Moran, Kelly, Williams, and Hjelle 1998). By June 1998, the New Mexico State Health Department distributed Centers for Disease Control and Prevention (CDC) public service announcements to radio and television stations that detailed instructions on how to effectively clean potentially infested areas. The goal of the outreach strategy was to increase public awareness about SNV and HPS in northwestern New Mexico. Despite the public health outreach warnings, New Mexico counted 14 HPS cases during 1998 (Rodriguez-Moran, Kelly, Williams, and Hjelle 1998), which represents 22% of the total cases reported in New Mexico since 1993. As of March 26, 2007, of the 465 known United States HPS cases since 1993, New Mexico, with 72 cases, leads the nation (CDC website 3/26/07).

Chile

In 1995, two years following the North American outbreak of HPS another hantavirus emerged in Cochamo, in the Aysen (Region XI) of southern Chile. Similar to Sin Nombre Virus, this “new” virus named Andes (AND) also causes Hantavirus

Pulmonary Syndrome (Toro, J., et al. 1998). The primary rodent reservoir associated with Andes virus was identified as the long tailed pygmy rice rat (O. longicaudatus). Sporadic cases in Chile were reported until an official outbreak began in 1997, and continued through 1998 during the same El Niño event that disrupted normal mouse populations in New Mexico. Within a three-year time span (1995 – 1998) 33 cases were identified, with a case-fatality rate of 54% (Toro, J, et al., 1998; PAHO 1999).

Through March 2003, 287 cases were reported, with a case fatality ratio that exceeded 40% (Galeno, et al. 2002). As of March 2007, 533 cases have been identified in Chile with a case-fatality rate reduced to approximately 30% (Castillo, Nicklas, Mardones, Ossa, 2007). The current situation (April 16, 2008) described on the Chilean Ministry of Health Epidemiology Department website, shows 564 cases, with a case-fatality rate of 37%. Even though the number of identified cases has increased and the case-fatality rate has gone up a bit, awareness seems to have increased among the public and medical communities. Chilean public health officials hope that through increased awareness, patients will be able to understand and recognize the precursor activities of potential exposure and concomitant symptoms of hantavirus, get to the clinic in a reasonable amount of time, and receive critical care in a timelier manner – ultimately increasing survival chances.

Because Andes Virus transmission is rodent-borne, similar to that of the Sin Nombre Virus in New Mexico, effective prevention measures for Andes Virus in Chile are similarly simple, inexpensive, and easy to implement. Once the official outbreak of 1997-98 began in Aysen, public health officials implemented specific communication strategies to help calm a concerned population and provide prevention information

(PAHO 1999). A number of actions were taken at the community level with public health and media support: daily hantavirus reports were issued, information was disseminated through the schools, buses, and other public places; a scientific conference was held for journalists, and the media produced a “hantavirus radio day” which linked the health specialists to the population (PAHO 1999).

Finally a two stage general and summer “Hantavirus Prevention National Campaign” was designed and implemented (PAHO 1999). First, general prevention strategies promoted proper in-home cleaning habits while broadcast media support included rural broadcasting radio and television. Second, healthcare workers and hospital professionals distributed written media posters and notebooks to rural and semi-urban zones and schools. (PAHO 1999).

Summer HPS prevention activities disseminated information on how to remain safe during typical summer activities such as camping and cleaning summer cabins. Similar to the general prevention strategies, broadcast media support included radio and television messages that promoted proper cleaning methods for cabins and safe camping practices, posters, and prevention information for national park employees (PAHO 1999).

The Chilean Ministry of Health’s outreach plans for non-outbreak periods included keeping the population informed about new cases via an internet webpage, and cautioning the public to maintain proper domestic hygiene habits. The Health Ministry also continued to air television commercials geared toward making rural residents aware of risks of hantavirus and the benefits of easy prevention measures (PAHO 1999).

Panama

In December 1999, subsequent to the HPS outbreaks in New Mexico and Chile, Panama's first case presented in the community of Tonosi, Las Tablas District, Los Santos Region. The 36-year-old woman arrived at the local clinic with acute abdominal pain that rapidly developed into respiratory distress. She was quickly transported approximately 200 miles away to Panama City, Panama, where she was immediately placed on a mechanical breathing device. She died the next day. (Personal interview with Dr. Juan Pascale, MD.) Aware of HPS as an emerging disease, and aware of an unusual increase in the number of rodents in the Los Santos Region, Dr. Pascale telephoned Dr. C.J. Peters of the Centers for Disease Control in Atlanta, Georgia for advice and assistance, because Panama health professionals and scientists were not equipped to do specific HPS diagnoses in their laboratories. On February 21, 2000, the index sample was transmitted to the CDC; three days later, Dr. Pascale received confirmation of Central America and Panama's first known case of HPS (Personal interview with Dr. Juan Pascale, MD). Serum samples confirmed another novel hantavirus identified as Choclo, as the cause of the latest outbreak. The primary rodent reservoir associated with Choclo virus was eventually identified as the pygmy rice rat (<u>O. fulvescens</u>).

Similar to the other sites' outreach objectives, public health officials in Panama quickly sought to inform the public and monitor the progress of the disease in their communities. Similar to New Mexico and Chile, passive surveillance was established for suspected cases of HPS, a telephone hotline was established to address the situation and inform the public of prevention measures, educational materials were distributed to the general public, and medical providers were educated in prevention methods and clinical manifestations (Bayard, Kitsutani, Barria, Ruedas, et al. 2004). Although the case-fatality rate for HPS in Panama was 25% among the suspected and confirmed cases, HPS continued to be problematic in Panama with 30 confirmed cases since the initial case in 1999 (Bayard, Kitsutani, Barria, Ruedas, et al. 2004). As of April 2008, there are 93 confirmed cases of HPS, and a case-fatality rate of 19% (Dr. B. Armien, MD, personal correspondence). The similarities and differences among these three country sites in terms social knowledge and behavior responses will be the central focus of my analysis.

Need for This Type of Project

The incidence of reported cases shown below underscores the importance of the problem. While Panama and Chile are experiencing higher case rates and mortality rates per 100,000 than the United States, approximately one third of the patients who contract HPS in the United States and Chile do not survive.

Table 1.1: ***Incidence of identified cases in northwestern New Mexico, Panama, and Chile used to select survey sites.***

	USA	Panama	Chile
Cases	418[#] (1993-2006)[*]	101[##] (2000-2008)[**]	465[###] (2001-2009)[***]
Case Rate per 100,000	0.011	0.368	0.323
Mortality Rate per 100,000	0.004	0.077	0.104
Death/Case Rate per 100	34.45	20.19	32.04
Age (years)	10-83 (mean 38)[*]	26-58 (mean 42)[****]	<1-79 (mean 32)[***]

[*]CDC Website March 09; [**]B. Armien, personal correspondence; [***] www.minsal.cl March 09; [****]Bayard et al. 2004; [#]465 Cases 1993-2006; [##]104 Cases 1999-2000; [###]597 Cases 1995-2009

This work will expand our understanding of how the social context influences hantavirus transmission by evaluating the role of human behaviors in the Sin Nombre/ HPS, Andes/HPS, and Choclo/HPS processes in the United States, Chile, and Panama. This study follows the traditions of social epidemiology, a major concentration and substantial growth area of public health studies of many behavior-related diseases. Social epidemiology has been built through the centuries from the modest beginnings of Graunt and Malthus through the modern epidemiologic transitionists of Omran and Olshansky.

To date, no other formal evaluations on the effectiveness of hantavirus outreach have been conducted, although the need for such investigation is called for by public health officials in the United States and the Pan American Health Organization. Given the worldwide threat of hantaviruses and an estimated 200,000 new cases of both HFRS and HPS appearing each year, evaluating outreach efforts will help enable public health officials to design efficient and effective programs in the future. A careful analysis of the behavioral aspects and reported change of the disease process could be vitally important if not indispensable to designing effective prevention programs in North, Central, and South America.

Literature Review

Appropriate public health models

The nature of health advisory information is complex and public responses to information can vary greatly. For example, the Information Center and Advisory Services in Health (CISAS) in Nicaragua offers educational and social communication services adapted to target populations, especially women and children (http://www.comminit.com 2009). In an attempt to raise heath awareness issues, this organization distributes pamphlets, publications, and holds health workshops for communities in a variety of topical issues. However, given the multitude of health issues facing the communities ranging from acute to chronic diseases, responses may range from simple intake of information to action, but mainly depends upon access to available resources to implement action, which varies widely. Additionally, the complex nature of health includes many concepts such as holistic approaches, gender issues, generational differences, as well as local human activities.

Complex issues as stated in the above example leads then, to the observation that public health models may come in all shapes and forms to address critical issues in specific communities. In terms of this project however, it is expected that the most effective models for hantavirus prevention to be those that provide effective communication during both outbreak and non-outbreak situations. For example, during the outbreak periods in Chile, consistent messages via television, radio and print keep the risk of hantavirus in the public eye. Even during non-outbreak periods, long-term messages continue to be implemented. Posters and calendars are in health clinics and store windows (personal observation in Coyhaique, Region XI, Temuco, Region IX, and Concepcion, Region VIII). Additionally, hantavirus awareness events are staged with government and non-governmental agencies along with industry as seen in the city of Concepcion, in Bio-Bio Region VIII. The idea of consistent communication is in stages, that of immediate attention and rapid response to an outbreak followed by long term messages after the initial crisis, so the public remains aware.

It is hoped that increasing knowledge levels will lead to self-reported positive behavior changes to protect the public. Rosenstock (1966) formulated the Health Belief

Model to describe how patients perceive personal risk and act on personal risk assessment. Within the realm of hantavirus, a cue to preventive action and positive behavior may be knowing someone who has contracted HPS (a mediating variable question in the survey) or knowledge received from public health messages and community pressure.

Compounded with risk assessment are mediating variables such as socio-economic variables, geography and the environment in which those at high-risk live. For example, affordable housing for an agricultural worker may only be available in an area where forest has been clear-cut for pasture. This creates an environment, both economic and social, that is hazardous to a community without extra resources to prevent disease. Certainly the disease process is a complex one that has been examined extensively. To understand hantavirus and the modern disease process, an exploration through demographic and epidemiologic transitions is useful because identification of social patterns shall aid in the understanding of morbidity and mortality drivers, via changes through time.

Demographic transition

In pre-modern European societies, up to about 1650, pestilence and famine limited population growth primarily by high mortality rates in agrarian, subsistence and traditional pre-modern societies. Common community health problems during the 17th century were epidemics, famines, and under-nutrition aggravated by environmental problems brought on by poor housing, food, water, and an abundance of insects and rodents. To compensate for the high death rates from infectious diseases, high fertility kept the population mostly stable. Indeed, John Graunt quantified disease patterns in

Observations (1663), wherein he attributed 75% of deaths to infectious diseases in relation to social class and urban/rural locations (Glass 1964). Graunt analyzed data from the Bills of Mortality, which were tabulations of mortality based upon causes of death. More importantly, he set about to quantify the data in a useful manner while at the same time maintaining reliability (Kreager 1988). Graunt, considered by many to be the father of modern demography, was the first to study mortality in terms of regularities and norms of a community while attempting to measure case fatality differentiation between infectious disease death and "old age" death (Glass 1964; Kreager 1988, Weeks 1994).

Demography is the study or science of population (Weeks 1994). It attempts to explain the determinants and consequences of population trends (Yaukey 1985) by inventorying population size in relation to social processes, structures and characteristics (Barclay 1958). For example, at any given time, while people are born or dying and are migrating in or out of geographic areas, demographers record these population trends.

While Graunt was the first to study mortality as a scientific undertaking, the concept of demographic transition began as a description of demographic changes that take place over time, such as when societies shift from high fertility/mortality rates to those of low fertility/mortality rates (Kirk 1996). High mortality coupled with high fertility is often closely associated with low levels of economic development. That is, countries in transition from high to low fertility/mortality have a tendency to experience rapid population growth wherein a very high portion of the population is less than 15 years old because the decline in the birth rate generally lags behind the decline in death rate (Weeks 1994). Industrialized countries with advanced economic development, such as Japan, often experience low mortality/fertility rates and actually approach zero population growth (Weeks 1994). While these trends may appear innocuous, the impacts of demographic and health transitions become clear when thought of in terms of long term growth factors. Indeed as Malthus described in 1798, in his Essay on the Principles of Population, population size increases in a geometric progression relative to available resources, which increased arithmetically (Young 1998). This means that if left unchecked, populations would eventually outgrow their resource base.

Epidemiologic transition and population

Beyond the idea of demographic transition, the concept of epidemiologic transition attempts to explain long-term temporal changes in the pattern of health and disease in populations. Omran (1971) added the factor of disease into the demographic model and then postulated an epidemiology and population transition model based upon interactions between demographic, economic and sociological determinants. He suggested four societal ages:

1. Pestilence and famine in pre-modern society (high fertility/high mortality);
2. Receding pandemics in early industrial society (high fertility/lower mortality);
3. Receding pandemics in mature industrial society (lower fertility/lower mortality);
4. Man made diseases in post-industrial society, which could be described as modern chronic diseases of late-stage life (low fertility/low mortality).

Omran synthesized important observations about the effects of disease and long-term transitions. He associated the transitions as linear processes based upon cultural evolution, a framework that suggests that as the trend progresses, the next stage is more advanced and desirable than previous stages. However this model fails to acknowledge quality of life in later years, because the transitions focus on mortality rather than morbidity or positive health programs (Barrett 1998). For example, Dobson and Carper (1996) point out that smaller family size (which represents low fertility/low mortality) may also be a direct result of increased women's health and welfare coupled with the reduction of mortality within the family unit.

Farmer (1996) and Barrett (1998) point to another flaw in Omran's transitional framework, that of using whole nations as the units of analysis, for a macro-level focus can obscure the possible variation across different population categories including gender, race and class within the statistics by creating a false image of population homogeneity. Farmer (1996) also points out that illness and mortality are more closely linked to local inequalities than to national ones. Conversely, Cockerham (2005) points out that focusing on individual behavior in terms of health outcomes of structure or agency at the micro-level units of analysis does not allow for the analysis of general population trends in terms of human health and the construction of effective disease prevention models appropriate for reducing exposure risk. By embracing a dichotomous analysis at either the macro and micro levels, the mechanisms of disease outbreak are thus difficult to compare across populations and time.

Conversely to Omran, Carolina (2003) questioned the validity of the epidemiological transition model to interpret changes in the structure of mortality and morbidity. Carolina (2003) suggested that designing public health policy based on predetermined destiny distorts the perspective that would promote the construction of more appropriate population scenarios. Carolina (2003) asserted that truly preventive measures would imply radical transformations in both health production and health consumption. Responsible health policy would thus focus on "absolute prevention," since epidemiologic profiles are fundamentally dynamic, not static or linear. Health policy makers should undertake a detailed analysis linking events in the population profile to the specific causality for each illness that afflicts populations in that country (Carolina 2003).

Consequences of transition

The impacts of infectious disease on human population dynamics have been observable throughout history. Infectious disease was often a side effect of human population growth, as civilization emerged in the context of small communities and grew into larger cities (McNeill 1976). For example, as nomadic tribes became sedentary, with an increase in the number of permanent dwellings, water supplies soon became infected with toxic bacteria because waste disposal was contained within community living areas (Dobson and Carper 1996). Along with unprecedented contact with concentrated bacteria, it is also believed that viral diseases such as measles and smallpox developed among humans due to constant, close proximity to domestic animals such as cattle (McNeill 1976, Dobson and Carper 1996). Although infectious diseases were emerging, it is believed that prior to the agricultural revolution, host/human populations were not large enough to sustain epidemic levels. Evidence for this comes from early Greek records, which described instances of malaria, mumps, tuberculosis, and influenza, yet makes no mention of smallpox, measles or plague (Dobson and Carper 1996).

Barrett (1998) begins with the Paleolithic Age as a baseline for setting the parameters for what he considers to be the first of three stages in epidemiologic transition. He postulates that contrary to densely settled populations, bands of nomadic foragers were too small and dispersed to support acutely communicable pathogens (Barrett 1998). Thus, while parasitic diseases would have been endemic to the nomadic environments since hand-to-mouth foraging favors parasitic infections, diseases such as smallpox, measles and mumps are believed to be confined to the agricultural-based economies where the congregation of human populations in close, constant contact with animal promoted the conditions for infectious disease (Dobson and Carper 1996). Similar to the Paleolithic Age, in modern times, disease emergence from the environmental pool is manipulated by social organization, demographic and behavioral changes. Further, as climate shifts alter ecological niches and human/animal populations move in and out of the changed environment, it can be expected that “new emerging diseases” are inevitable.

As stated above, Barrett (1998) describes the first epidemiologic transition as the shift from nomadic patterns to sedentary, agricultural residence. Concomitant with the shift to permanent settlements came changes in human diets, demographics, and behavior (Dobson and Carper 1996; Barrett 1998). Increased interpersonal contact, accumulation of human waste, and domesticated animals provided ripe conditions for viruses and parasites, and for human exposure to more virulent strains of diseases such as tuberculosis and anthrax. As populations began to congregate in urban areas, crowded and unsanitary conditions promoted diseases, especially for those of lower social status such as women and children who suffered disproportionately regardless of social class (McNeill 1976; Barrett 1998). Diseases such as typhus and measles became increasingly common, and diseases became more common among adults instead of being confined to naïve or immuno-compromised populations such as children or the elderly (Barrett 1998). Various trends facilitated the spread of pathogens across geographic barriers, including migration and trade coupled with political conquest, all of which illustrates the effect of early globalization and the ability of diseases to cross nation-state boundaries (McNeill 1976; Barrett 1998).

Initially, even though mortality began to decline with the emergence of industrialized societies, fertility remained high (Omran 1971). This shift implies that while overall living standards and health status began to improve with industrialization, environmental problems also began to emerge as population settlement became denser. Barrett (1998) describes a second epidemiologic transition as coinciding with the industrial revolution in mid-19th century Europe. In developed countries, where there was a marked decline in infectious disease mortality, infectious diseases began to yield to chronic diseases (Omran 1971; Barrett 1996). It is commonly believed that the increase of technology and medical science were the leading factors causing the decline of infectious diseases in modern, urban society. Yet improved sanitation and nutrition appear to have been a more important cause of the decline (McKeown, Record, and Turner 1975; McNeil 1976; Dobson and Carper 1996; Barrett 1998). In line with Omran's model of the epidemiological transition (1971), the decline of infectious diseases and the resulting increased longevity and life expectancy brought about an increase in the impact of chronic diseases such as cancer, diabetes, and heart disease on overall population morbidity. Along with the industrial revolution came the increased risk of human contact with various detrimental environmental elements such as contaminated water, air pollution, and industrial chemicals (Barrett 1998). In industrialized societies, differences between morbidity and mortality are strongly associated with race, gender, and class for both chronic and infectious diseases (Barrett 1998). Le Riche and Milner (1971) point out that in relation to the social environment, illness tends not to be random and often comes in clusters. For example, in developing nations, rapid urbanization and social inequalities have led to an increase in communicable diseases such as tuberculosis among the densely populated urban poor, along with and an increase in chronic diseases in the emerging middle class with a longer life span (Dobson and Carper 1996; Barrett 1998).

Barrett (1998) identified a third epidemiologic transition, that of 1) an increase in the number of new diseases such as HIV/AIDS and, H5N1 influenza; 2) an increase in the incidence and prevalence of preexisting infectious diseases such as hantaviruses, TB, malaria, and 3) an increase in antimicrobial resistant strains of "superbugs" which cause conditions such as multi-drug resistant staph infections. In the context of modern globalization this transition can point directly to the convergence of human disease ecologies through trade and migration (Barrett 1998) but these trends are not mutually exclusive. For example, the increase in recognizing new diseases may also coincide with the increasing scientific ability to identify pre-existing diseases. Hantavirus has been in the medical literature for centuries, yet the technology necessary to identify specific viral strains was not available to the scientific community until the 1970s. In the famous Broad Street Pump investigation, John Snow recognized an infection within a certain community, yet the technology to identify the cholera bacteria was not readily available until many years later (Johnson 2006). The rapid spread of HIV and its unequal distribution across populations may be the result of several factors other than evolutionary changes, including neocolonialism, seasonal labor, sexual decision strategies and poverty (Barrett 1998). An increase in drug-resistant cases of tuberculosis can be demonstrated, along with the emergence of new strains of the disease itself (Personal conversation with Dr. Gary Simpson, MD, PhD, MPH; Barrett 1998).

Anthropogenic origins of ecological disruptions also account for an increase in infectious disease and mortality patterns throughout the world. In poorly developed environments, water pools have been shown to contribute to dengue fever and schistosomiasis; the practice of swine-duck agriculture in Asian nations is believed to increase genetic variations of influenza; and relaxed environmental conditions in nations outsourced by multi-national corporations has contributed to climate changes. These items coupled with unequal distribution of health resources have contributed to higher levels of preventable mortality (Barrett 1998).

While all of the above sounds as if mortality is increasingly knocking on the door, McKeown, Record & Turner (1975) point out that improved nutritional status and standard of living improvements have contributed to population stabilization. Indeed, in 1798, Malthus predicted that the overall population would eventually weigh in the favor of arable land. However, Malthus could not possibly have anticipated the vast agricultural improvements that were to be invented which would in turn increase the quantity and quality of food production in relation to arable land. Now that the global population exceeds 6 billion and arable land used for agricultural purposes is now approaching maximum capacity, the implications of shifting population health should be re-examined. There remains only so much land as an arithmetic potential, while the size of the population is increasing geometrically. Caldwell (1998) pointed to John Stuart

Mill who, in Principles of Political Economy (1848, 1st ed.), took Malthus' basic premises and added the concept of increased standard of living as a driver for certain population checks, but it was Omran (1971), who excelled in addressing the complex interactions and pathways of disease and transition throughout time, rather than the more typical scientific focus on specific economic, political, and historical approaches.

In post-modern society, the exponential growth in global population combines with the longevity of populations and the association of aging with chronic illness, and improved technology such as communications and transportation to set the stage for newly emerging as well as re-emerging infectious diseases. Comprehensive examinations of the social epidemiology of disease emergence and concomitant outreach efforts are even timelier. For example, disease that once disbursed relatively slowly now can be transmitted in a matter of hours or days via air transportation. SARS, a corona virus that emerged in Asia, was contained in Canada in a matter of days but not before 800 people had died amidst worldwide panic. West Nile Virus (WNV) is believed to have been transported by a goose used for a religious feast in Israel to New York. Scientists have discovered that the emerging WNV gene in the United States is genetically identical to WNV from a specific geographical site in Israel (Dr. Robert Parmenter, personal conversation). This information is critical to public health officials designing outreach programs for susceptible populations, not only in local communities, but also in larger states, nations and continents.

Consequences of transition: The 4th stage and a return to infectious disease

Olshansky and Ault (1986) noted that as nations progress through the epidemiologic transition, many people who would otherwise have died from infectious diseases survive into adulthood. Since the increased child survival rate temporarily increases the proportion of people 15 years of age or younger in the population structure, the human population grows at an explosive rates. This is demonstrated by the exponential growth rate of the world's population during the last 200 years. By 1800, the population had grown only to about 1 billion, yet from around 1800 onward, world population exploded from 1 billion to 6 billion (Olshansky 1986).

According to Durkheim's (1893) analysis of population growth and increasing divisions of labor vary in direct proportion to the volume and density of societies. That is, population growth leads to greater specialization because survival is more acute when differentiation and growth creates competition for resources to improve ones advantage. A medical sociologist would expect increased industrial health problems as a consequence of specialization. For example, workplace environmental problems may manifest in chronic disease patterns such a cancer from working with asbestos, asthma and bronchitis from poorly ventilated factories, and crippling disabilities from years of repetitive movements or stooping. One way to address these problems would be to look to industrial reorganization as a way to improve workers' health. Perhaps labor unions could take on a stronger collective voice to improve health benefits, improve safety training, and control the means of production as a way to help reduce the incidence and prevalence of chronic diseases.

Yet, environmental disturbances increasingly affect both urban and rural contexts. Urban disturbances include overcrowding, pollution, heavy metal particulate exposure, and the emergence of rational-purposive lifestyles. For example, human populations tend to be drawn toward consuming high-fat foods with the shift from producer to consumeroriented economies. Rural agricultural improvements have also brought about chemical fertilizers and pesticides that affect population via increased chronic diseases such as diabetes, heart disease, cancer and asthma, as well as increased cancer from pesticide exposure while the population shifted from extended families to migrant day laborers.

As unexposed human populations aggregated into larger settlements, initial human resistance to infectious disease was typically low, which translated into high mortality rates upon initial exposure to and manifestation of disease. Under the right circumstances, human resistance to pathogens gradually increased with the continual low-level exposure to pathogen(s) (Dobson and Carper 1996). For example, Roman epidemics such as smallpox were devastating to the general population, but not to the early Christian populations that tended to the sick (Dobson and Carper 1996). It is believed that the Christian caregivers were constantly exposed to low levels of the virus and may have built up a natural immunity to the pathogen, enabling them to move about the larger infected population without the same consequences as those who were not continually exposed at lower levels (Dobson and Carper 1996).

Typically, a pathogen's net impact on a human population is age-related with the greatest mortality falling on the very young (unexposed) or old (those with compromised immune systems), but there are a few exceptions. For example, the 1918 Spanish influenza epidemic killed many previously healthy, young adults (Potter 2001; Taubenberger and Morens 2006; Morens and Fouci 2007). An overview of the mortality curve reveals that nearly half the influenza-related deaths were in the 20-40-age range and the absolute risk of contracting influenza was consistently higher in the population less than 65 years of age (Taubenberger and Morens 2006; Morens and Fouci 2007).

Those in the younger age group of 5-14 year age group were actually more likely to contract influenza, but had a much lower death rate than those in the 20-40 year age group (Taubenberger and Morens 2006). Explanations for these unusual patterns have focused on host and environmental factors, exposure to risk co-factors, medications, and environmental agents (Taubenberger and Morens 2006). Perhaps the over 65 age group had previous "pre-cursor" exposure to influenza during the 19th century, thus providing a protective immunity that those in the 20-40 age group, born after1889, had not acquired (Taubenberger and Morens 2006).

Like cities, rural populations also have their own infectious disease dynamics. Today, measles is largely associated with large city dynamics, but as mentioned above measles likely emerged from cattle and associated livestock practices, which are linked to rural occupations (Dobson and Carper 1996). Hantavirus is also associated with rural populations and outdoor activities such as farming (land disturbances) and hunting (cabin disturbances after periods of non-use). Increasingly, today's scientists and public health officials realize that control and prevention of human disease increasingly relies understanding the ecology of pathogens and the transmission of disease. This is especially true for rodent populations and the risks of exposure to hantaviruses in rural populations and occupational activities that are associated with rural activities. Scientists now believe that there are many as-yet unidentified diseases that occur naturally in rural environments, so infectious disease is apt to persist even though proper sanitation has improved overall human health, contrary to the common assumption that infectious disease would be all but eradicated in the 21st century.

The above description of epidemiologic transition underscores the implication of new and re-emerging infectious diseases and a new frontier for social epidemiologists. In most cases, "new" diseases such as legionnaire's are really re-emerging diseases which are becoming treatment-resistant with increased frequency. With the exception of influenza, re-emerging diseases typically do not emerge through genetic shifts because viruses find new pathways to previously unexposed populations through changes in the ecological web. An important example of this disease pathway is the focus of this project: hantavirus. Emerging infections and parasitic diseases rarely or never before experienced by humans are having a profound influence on human health.

The early 1970s brought the notion that through modern medical technology via the invention and application of new antibiotics and vaccines, all infectious diseases would soon be wiped out; yet by the late 20th century, infectious diseases had exploded into world consciousness and the over-prescription of antibiotics had resulted in bacteria that are resistant to standard treatments. If we take into consideration a multidisciplinary perspective that incorporates socioeconomic, ecobiologic, and medical/public health determinants, and fast-forward from 1971 to 1993 in Northwest New Mexico, Omran's basic tenets of pre-modern infectious diseases can be applied, albeit to a modern society. In 2004, the majority of emerging infectious diseases were zoonoses (diseases that are transmitted from animals to humans as defined by the World Health Organization), which often follow ecological changes caused by human activity: agriculture, migration, urbanization, and deforestation, to name a few. Ecobiologic changes are reflected in the complex interactions among disease agents such as the level of environmental hostility and the resistance of the host. With the possible exceptions of smallpox and polio, argue

McKeown, Record, & Turner (1975), the recession of plague and many modern pandemics such as the 1918 influenza was more closely related to improved sanitation than to improvements in medical science. Adding to the debate, Fuchs (1974) highlighted rising female labor force participation, which increased their income and autonomy, rather than medical technology as the driver of mortality decline beginning in the middle of the 19th century. Socioeconomic standards of living, better hygiene and health habits, and improved nutrition are more a byproduct of social change than medical design. The great medical advances of the 20th century did not appear until after World War II, with the direct increase of federal funding for research. Medical and public health determinants are specific preventive and/or curative measures used to combat disease: that of immunization and the development of specific therapies such as dialysis and chemotherapy.

Farmer (1996) recommends that studies should not only ask what is an emerging infectious disease, but more importantly, why some persons are more at risk than others. As mentioned above, the present study investigates human populations in terms of positive and negative behavior changes reflecting infectious disease outreach efforts. Which outreach programs are effective for susceptible populations? What methods can public health officials use to supplement programs already in place, and how can a more comprehensive understanding of the complex dynamics between human behavior and the ecology of the disease be utilized to serve the needs of those at risk? Through an examination of public health models applied to infectious disease, and the sociological/ecological links that follows, I will further explore these issues and hopefully begin to answer some of the critical questions just mentioned.

Outreach model used and measures employed

As mentioned above, outreach methods implemented in the United States, Chile, and Panama vary, but in all three countries, the common denominator was an immediate rapid-response to an acute crisis. Television, newspapers, radio and eventually the internet in Panama and Chile all provided valuable resources for transmitting information to the general public. Government health officials then proceeded to inform the health community (physicians, nurses, emergency transport technicians, and so on) about the symptoms of hantavirus and how to detect whether a patient was exhibiting the signs of HPS. The difference between the United States, Panama and Chile is that the level of investment in Chile is much higher than in the latter. In Chile, since 2004, over 600 million pesos (approximately 1.5 million USD) have been invested directly into outreach and training programs designed specifically toward hantavirus prevention. This investment is reflected in the number of awareness programs in print format with widely distributed calendars, posters, and leaflets (personal observation), and hantavirus awareness events combined with continued medical community outreach and training. These additional measures are key to comparing the effectiveness of the Chilean outreach efforts to New Mexican and Panamanian outreach efforts.

Paradoxically, despite a higher level of outreach and funding for public health promotion, cases in Chile are higher than in the United States and Panama. Despite more funds and outreach programs implemented in Chile, which should either decrease cases or deaths of HPS, cases are more frequent than in Panama and the United States. This problem could be a function of population awareness as well as patient self-reporting of higher-risk activities to nurses and physicians. Nevertheless, while incidence is up in

Chile, it is also critical to identify who is implementing proper cleaning and prevention measures as well as who is engaging in improper cleaning methods. Measures of basic knowledge of HPS also indicates that the public knows what to look for (rodents and manifestation of disease) which in turn may translate into how to assess personal risk and when to seek help. Now, how do hantavirus, affected populations, and disease distribution work with the host/agent/environment system to manifest or prevent disease? This dissertation research will explore this paradox in the pages ahead.

CHAPTER II:

PUBLIC HEALTH MODEL APPLIED TO HANTAVIRUS

Public Health Model Applied to Hantavirus

Applying a public health model to hantavirus prevention promotes understanding the etiology of the disease in terms of human and mouse populations in order to design prevention models based upon the complex interactions between human behavior and rodent ecology. Pathways to both health and disease involve complex interactions. Epidemic disease emergence is complex because infectious diseases are dynamic, they change in distribution and severity, and most "new" infections reflect the re-emergence of "old" diseases such as hantavirus. Human activities are the most potent factors in the appearance and change of disease patterns, and interventions to control infections can paradoxically increase the burden of disease as illustrated by the Chilean experience in the previous chapter. To shed light on this complexity, a discussion of epidemics, webs of causation, patient behavior and the sick role, health belief model, affected populations and demography follows.

The word *epidemic* originates from the Greek language: *epi*, upon; and *demos*, people (Oxford University Press 2001). However the modern concept of an epidemic generally views it as an increase in disease incidence such that infection rates rise above endemic levels (Anderson and May 1979). In epidemiology, concepts of person, place and time have evolved into the populations both affected and not affected by disease, place in terms of the geographical extent of the problem, and the epidemic period which is the disease outbreak plotted over time (CDC 1992). An epidemic period normally shown as a histograph delineates disease rate changes over time. Disease rates show up with some regularity (influenza, for example), and through longitudinal data analysis, endemic/epidemic trends can be used to predict future outbreaks and clusters of disease and to evaluate disease prevention programs and policy decisions. Place describes the disease event in terms of geographical context, but the unit of analysis can vary. For example, through the concept of “place” one can get an idea of where a disease agent normally lives and multiplies, what may carry or transmit the disease, and how the disease is spread. This is especially true for hantavirus, since place infers factors that increase disease risks in the persons and environmental circumstances. The term “person” carries the inherent characteristics of age, sex, marital status, race, occupation, economic status, educational levels, and socio-economic status.

MacMahon and Pugh (1970) explored the concept of an epidemic not only in terms of person, place and time, but in terms of epidemic as a dynamic process: Is there an excess of disease prevalence and can the existence of an epidemic be demonstrated above an endemic level? Do we know high/low disease frequency in a population at a particular time? Can we compare the disease frequency in the same population to other populations within the same time frame? For example, within the hantavirus disease process, is a human population living and acting under environmental conditions that may make them either more or less susceptible to disease?

To answer some of these questions an understanding of the web of causation is necessary [see fig 1] (CDC 1992). First, there is a multi-factoral nature of hantavirus disease causation wherein the three factors of *agents* (SNV), *end-hosts* (humans), and *host-reservoirs* (rodents) need to converge under complex circumstances for a disease to emerge (CDC 1992). That is, agent, host and reservoir environmental factors interrelate in a variety of complex ways to produce disease in humans (CDC 1992). For hantavirus in northwest New Mexico, the agent is the Sin Nombre Virus (SNV), but in a general sense the agent could also be bacteria, parasite, or perhaps a chemical or physical cause (CDC 1992). The definition of reservoir can sometimes be loosely defined, but for the purposes of this project the reservoir of an infectious agent is "any animal, person, plant, soil or substance in which the infectious agent *normally* lives" (CDC website, Glossary of Terms, 11/22/05) rather than an arthropod vector such as a tick or mosquito. Another way to think about a vector is as transportation for the virus from one host to another. A resident host is where the virus lives normally, such as rodents, without affecting the host in terms of disease. Furthermore, the SNV agent must be able to survive and multiply within the reservoir (rodents in their environment) and to be transmitted to a defined population, in this case humans in high-risk areas of exposure to HPS or HFRS (Haydon, Cleaveland, Taylor, Laurenson 2002).

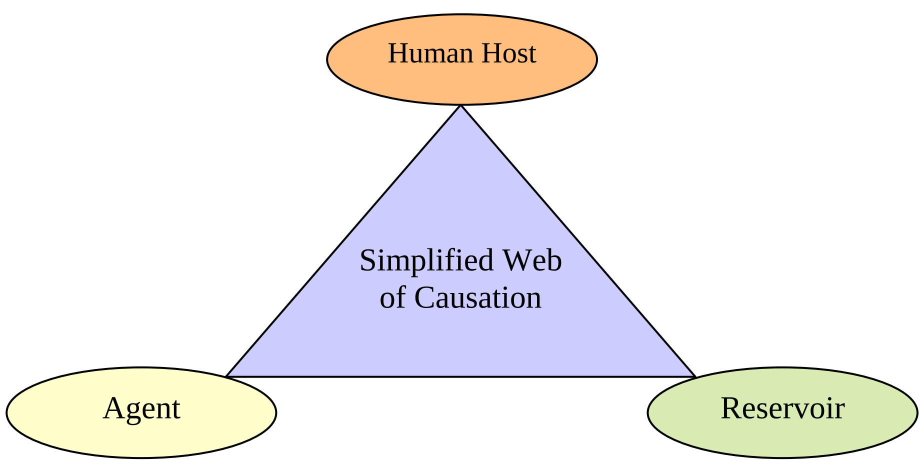


***Figure 2.1.* A simplified web of disease causation in relation to Hantavirus Pulmonary Syndrome**

Behavior: Do Outreach Plans Really Work?

Approaches to public health policy and to causality of emerging infectious diseases vary widely when examining human behavior change, education, and lifestyle. For example, it can be argued that in Panama, emerging agribusiness leads to large-scale deforestation for pasturelands and the planting of mono-species crops, such as teak trees. Teak, non-native to Panama, is pre-sold to foreign investors as a futures commodity (Mr. George Baca, finca owner, personal conversation). But in the process of creating economic futures for the small farmer, the degradation of the natural forest during the deforestation process increases the distribution patterns of rodent reservoirs carrying Choclo virus (Carroll et al. 2005; Suzan et al. 2006). Larger areas of rodent population distribution thus increase the human risk of coming into contact with rodents because susceptible humans are working and living in the cleared areas that may repopulate with different, infected rodents (Dr. Fred Koster, M.D., personal conversation).

Hantaviruses occur globally, and effective prevention strategies vary accordingly. In northwestern New Mexico, when a hantavirus case appears, messages are conveyed through public health alerts and news broadcasts. In Panama, public health officials are briefed in local clinics and rodent trapping crews are dispatched to outbreak areas upon hearing of a single case (Dr. Juan Pascal, M.D., and Dr. Blas Armien, M.D., personal conversations). Effective prevention programs often employ a complementary approach of broad based messages to the general public, clinician workshops for medical personnel, and one-on-one interventions that are culturally appropriate and adapted to local cultures. For example in Chile, the indigenous Mapuche are mostly agricultural workers. Teaching proper prevention methods through one-on-one contact with medical personal and local police would be an effective way to disperse valuable prevention information and perhaps effect positive behavior change to reduce the risk of exposure to the disease.

The New Mexico pilot study for this project, completed in July 2000, demonstrated that those in the highest risk groups (rural and poor) in northwestern New Mexico tended not to change behavior in a positive way to prevent contracting HPS even though they had knowledge of how to make those changes. The goal of this research is to assess what types of outreach efforts are effective or ineffective to develop procedures that might be effective for high-risk populations in a given context. The pilot study showed that increased knowledge does not necessarily lead to positive behavior changes among those at high-risk of exposure. This suggests that understanding the mediating environmental and social variables is necessary for designing programs that will encourage positive behavior. To underscore the complexity of this task, devising outreach prevention programs that are suitable for positive social behavior change in the disease process also means understanding the sick role, a person's perceived susceptibility to disease, cues to action to do something about the disease, and finally care seeking behavior (Rosenstock 1966).

From the structural-functionalist perspective, illness related behavior in terms of the sick role involves processes to restore the individual to an acceptable level of performance. Parsons (1951) defined four aspects of the sick role, a patterned set of expectations defining the norms and values appropriate to being sick, both for the sick person and for those who interact with him or her. Physicians are invested by society with the function of social control, while according to the expectations of the sick role, illness is a kind of deviance whose undesirable nature reinforces the motivation to be healthy. Those four aspects are:

- *Non-responsibility of the individual*: The person is not capable of healing simply through the desire to be well.
- *Exemption from normal obligations*: This stage of sickness is dependent upon the nature and severity of the illness.
- *Being sick is undesirable*: The illness is so bad, that the patient wants to get well, the patient is obligated to try to get well, and the patient must cooperate with others to do so.
- *Seeking out competent help*: The patient must make a concerted effort to restore health.

Criticism of the Parson's sick role paradigm encompasses four major issues: That of 1) the type of illness (acute vs chronic), 2) the variability among different patients (socio-economic status), 3) the patient/physician relationship (access to care) and 4) modern middle-class values (socio-economic status). For example, chronic conditions may prevent the patient from experiencing Parsons' four stages of illness to wellness. Chronic illnesses such as heart disease, cancer, or diabetes may delay the observable definition of sickness for a long time, and the patient may never be able return to pre-illness condition. The patient may be able to adjust to the permanent condition and retain the current level of ability, but may end up on a downward spiral in socioeconomic status since treating chronic illness is generally long term and expensive. Alternatively, the onset of acute hantavirus occurs so fast, that the patient may not have a choice about healthcare decisions.

Patient variability demonstrates the lack of uniformity of sick role behavior for various groups. It is now recognized that some socio-cultural groups perceive illness differently from what Parsons had in mind, and while some ill persons want to take on the role, others may object to it and wish to be granted exemption from the illness status. For example, with the onset of HIV/AIDS, social stigma may prevent a patient from seeking medical help in a community where HIV/AIDS is relatively rare and clinical facilities are not readily available.

Parsons also assumed a one-on-one relationship between the patient and a physician in private practice. But in the modern health care market, the solo practitioner has given way to group arrangements and collaborative practices and the ever-ominous health maintenance organizations (HMOs). Today marks an increase in hospitals, emergency rooms, clinics and mobile facilities, whereas during and immediately after World War II, when Parsons was writing, the physician-patient ratio was higher and house calls were common physician practice. Now the power differential is more balanced with the advent of consumer advocacy and through a patient's right to access his/her own record (Starr 1982). Thus the physician has less leverage over the patient, and the patient is no longer obligated to comply with "doctor's orders." That is, physician cultural authority is diminishing, along with a reduction in their authority to define and interpret the standards that govern medical practice (Starr 1982).

Following Parson's elucidation of the sick role, Szasz and Hollender (1956) recalibrated the sick role in terms of psychological models based on severity and manageability of illness. For example, a physician's responsibility for the desperately ill individual in the emergency room empowers the physician to make unilateral decisions on the patient's behalf. The patient's contributions are irrelevant. This would be the case when a severely acute hantavirus patient has been transported via emergency vehicles to the emergency room. In Szasz's guidance-cooperation model, the patient is cognizant and able to make judgments on the treatment process especially in treatment compliance. The physician guides the diagnosis and treatment while the patient cooperates. In mutual participation, which is effective in the management of chronic illness, the patient plays an active role in the disease process, with periodic consultations with the physician, and the doctor helps the patient "help himself" (Szasz and Hollender 1956). This latter model would be applicable to the prevention and/or care of heart disease, diabetes, and asthma.

Middle-class values now emphasize the individual's responsibility (agency) for health care and proactive wellness. The relevance of the sick role beyond the 1980s has shifted from expected to actual behavior in the sick process. Patients now go to the health delivery system, the system doesn't go to the people (no more house calls). It is believed that health care will remain highly centralized, and that it has become a seller's and buyer's market (Reeder 1972). In the seller's market, the customer is suspect by the provider in emergency/acute care needs situation, while the buyer's market presupposes the prevention of medical illness and the client has to be persuaded of the need for periodic medical checkups (Reeder 1972). Consequently, there is a greater sophistication of the general public and the development of consumerism: gone is the patient's dependency on the physician that Parsons detailed in the sick role. There is now a more equal footing on decision-making and responsibility for outcome while the patient/physician relationship to consumer/provider shifts, especially in well educated, upper middle class populations (Reeder 1972).

Anderson (1995) reiterated the health belief process to explain how social structure influences needs, resources and subsequent use of health services. Rosenstock (1966) first formulated a version of the Health Belief Model (HBM) to explain ways in which normally healthy people seek to avoid illness. The Health Belief Model attempts to predict behavior by a person's perceived risk of disease, susceptibility to illness, the benefits of change, the barriers to change, and the cues to action. A person's change in behavior, taken from the cue to action, is thus linked to the perception of perceived risk of disease coupled with susceptibility. But, even though a person may recognize that action is necessary to avoid a deadly disease such as hantavirus, the person still may not be motivated to do anything about it (Rosenstock 1966). The cue to action for someone to exhibit positive behavior change to prevent HPS may be as simple as knowing someone who has contracted HPS (internal cue) or as complex as reacting to the external cues of public health messages and community peer pressure (Rosenstock 1974).

Why would someone seek care? After exposure to and onset of hantavirus illness, patients need to seek medical care as soon as possible or risk certain death. Early detection and screening by aware nurses, physicians and hospital workers can help in the survival and recovery process. Although better suited to chronic diseases than the acute nature of hantavirus, HBM can help explain why someone would or would not take preventive measures and why someone would or would not seek medical care. First, a look at the four basic tenets of Health Belief Model as it relates to a patient seeking care after onset of illness (Rosenstock 1966):

- *Perceived susceptibility*: Hantavirus initially presents with flu-like symptoms and typically erupts in other than influenza producing seasons, such as early summer through early fall. Although off-season from the flu, feeling the onset of flu is not usually a reason to visit the doctor. Perceived susceptibility to hantavirus would be low.

- *Perceived threat that one may be vulnerable:* Someone of limited resources may not seek care in a timely manner, especially since hantavirus initially presents as something else. A physician/nurse who did not screen for hantavirus might simply say, “Go home, get some rest, and see me again soon.” In this case the patient would not perceive the threat as critical, and indeed this is what happened during the initial outbreak in New Mexico in 1993.
- *Perceived benefits*: That there is a positive outcome to seeking care with the perception of severity. After the initial presentation, New World hantavirus rapidly becomes critical when the patient develops difficulty with breathing. At this point, the benefits quickly outweigh any costs to seeking care because the severity is now life threatening.
- *Perceived barriers* to seeking care: The rural poor may not have appropriate transportation to get to the local clinic, nor the financial resources to pay for the visit or follow-up treatments.

Following the Health Belief Model, Greenberg (1989) applied Freire’s concepts of education to health promotion: that is, education through dialogue as the key to learning from one another, making good decisions, and effecting positive changes in community health. Greenberg (1989) pointed out that health related skills and knowledge are not always sufficient for positive behavior change. Wallerstein and Bernstein (1988) subsequently recognized Greenberg’s applications of Freire’s (1971)

"Theory of Freeing" as being a different approach to social action. That is, health promotion programs should be designed to enable a population to free itself from oppressive circumstances such as poor self-esteem, and to apply positive personal values to make health related decisions. Wallerstein and Bernstein (1988) then apply three active stages of listening, dialogue, and action to effect positive health behavior change in health education to promote change:

- The *listening stage* where the target populations identify problems and structural conditions within the community at risk and begin to set priorities [on-set of HPS cases];
- The *dialogue stage*, which revolves around a code of concrete physical representations of an identified community. Freire (1971) described dialogue as an encounter among men and an act of creation, not domination. Thus, group facilitators should lead the target population through critical discussions to help move from personal health analysis to social analysis in terms of the community and an action level [HPS hotlines and direct access to public health officials]; and
- The *action stage* which allows the target population to try out plans that came from the listening and dialogue stages and to modify those plans as needed for continuous health improvement in the community via collective attempts to change and become deeply involved in the process (McKenzie and Smeltzer 2001) [implementation of prevention measures].

Within the framework of the community, the *listening*, *dialogu*e and *action* stages that result from communication and media resources are likely to have an important influence on behavioral responses, provided the community has local government support for a healthy population and local customs do not prohibit changes toward new health behaviors.

To what extent do the media influence the public's response? While the role of the media is to convey the message, the primary problem with utilizing mass media stems from the public health goals to influence social change (Atkin 1990). Simply informing individuals of the risk factors is insufficient; public health campaigns need to convey high quality messages to target audiences that increase their receptivity to increasing awareness and changing attitudes and behavior (Atkin 1990). The message should be of clear purpose, long duration, and aimed at target populations. While the campaign should be aimed at changing fundamental behaviors of populations, the fine line between informing and overselling the benefits of behavior change cannot be underestimated or overlooked. Mistrust of the message must not be allowed to develop. Conditions for effective campaigns can and do exist through high quality messages, gaining and keeping the attention of the audience, encouraging favorable interpersonal communication about the issue at the individual and community levels, and finally by obtaining knowledge through an evaluation process (Atkin 1990).

In most cases, "new" diseases are really re-emerging, newly recognized, or treatment-resistant forms of diseases that are appearing with increased frequency. Infectious and parasitic diseases rarely or never before experienced by humans are having a profound influence on human health. In modern terms, diseases are typically re-emerging but we are just now at the point where we can recognize them. "New" disease typically does not emerge through mutations, but through new pathways to previously unexposed populations through changes in the ecological web. In 2004, the majority of re-emerging infectious diseases are zoonoses that often follow ecological changes caused by human activity: agriculture, migration, urbanization, deforestation, and dam building.

That said, a close interaction between human activities and the integrity of the natural environment appear to increase risk to exposure. In New Mexico when a reservoir such as P. maniculatus increases due to climactic changes such as ENSO, the distribution of the mouse population tends to expand as they seek to reduce competition for needed resources. The mouse dispersal (cascade effect) extends to human population and peridomestic areas, which may be appealing to the mouse, but not conducive to a safe environment for humans. P. maniculatus is an opportunistic species that will seek out food sources in many areas. Because of the spatial limitations of P. maniculatus, the poor populations of northwestern New Mexico are at higher risk of contracting hantavirus than those in a relatively more urban environment. The first cases of hantavirus in 1993, were family members living in the same rural mobile home, which was in a bad state of repair and was infested with mice.

The main sites of exposure of new-world hantaviruses are closed, poorly ventilated areas such as storage and feed sheds, woodpiles, and piles of trash and weeds accumulated near the home. Route of exposure is the disturbance of these areas by stirring up particulates (vehicles) and inhaling the contaminated dust. While the physical environment may pose a potential hazard to someone living in a high-risk area, human interaction does not always have to end in disaster, since a simple preventive step such as ventilating the shed for 30 minutes before entering may lead to a positive outcome.

Pathways to health and disease involve complex interactions in varying degrees, as mentioned above in the web of causation discussion. Disease emergence is complex, infectious diseases are dynamic and change in distribution, severity, and frequency, and most new infections are not caused by novel pathogens (Wilson 1995). Human activities are the most potent factors in the appearance and change in disease. Social, economic, climatic, and political forces all interact in ways that shape disease patterns, so models and pathways of health determinants associated with the development of health problems can be distinguished from the health problems themselves. Two pathways are *physical environment*, which encompasses all factors external to the body, and *lifestyles* as determined by social, cultural, and economic factors.

Physical environment and lifestyle interact intimately in the disease process, and within the context of hantavirus a well-balanced outlook utilizes these categories as complementary. Physical environment plays upon the close interrelationship between human activities and the integrity of the natural environment. How the two interact influences the health of populations and manifests in the nature of the hazard, the source, the site of exposure and the route of exposure. Lifestyle involves the complex human actions integrated culturally, socially, economically, and environmentally. Social, cultural, and economic factors can be viewed as gradients across socio-economic status (SES), but caution must be exercised when touting "socio-economic status" as a cause of disease. SES is often treated like a "black box" of causation, with little interest in the precise mechanisms of how social factors influence health.

Perhaps the perception that SES is associated with causality stems from the idea that poor health outcomes that are of a larger magnitude among poor populations and therefore on a larger "social radar screen." Social causation explanations attribute poor health to the adversity, deprivation, and stress that are presumably associated with low

SES, while health selection asserts that unhealthy persons fail to escape their low SES because diseases lock people in poverty. Because the rural poor are at greater risk of exposure to SNV/HPS, the site of emergence of the 1993 outbreak in rural New Mexico initially led HPS to be considered a stigmatizing disease, and it was prejoratively labeled as the "Navajo flu." Physical environment is closely linked with SES in that a person or group with limited resources in all likelihood will have difficulties securing safe housing, proper nutrition, and adequate resources to prevent hantavirus. Frequently, those at highest risk for hantavirus are the rural poor. This is true in northwestern New Mexico, Panama, and Chile, where prevalence is highest among the poorest populations. This is not to say that only the poor contract hantavirus, but instead that those who are poor typically have a higher exposure risk.   For example, in Panama activities such as deforestation in favor of agriculture, a rural environment, and lower socio-economic status converge, which may ultimately increase risk of poor human populations of exposure to hantavirus.

Human activities are the most potent factors in the appearance and changes of disease in an expanded example of the web of causation [see figure 2.2]. For example, physical environment as a pathway to health determinants involves a close interrelationship between human activities (deforestation and agribusiness, for example), the integrity of the natural environment (removal of natural barriers) and how the pathways interact to influence human population health. Environmental factors include the nature of the hazard (hantaviruses), the source (rodent reservoirs), where the hazard occurs (rural populations), the sites of exposure (land disturbances and peridomestic areas) and the route of exposure (contaminated dust disturbance). Lifestyles are equally complex actions that are culturally, socially, and economically driven. The characteristics of an individual or group may habituate over time, which may reduce exposure to endemic viruses or help build a natural immunity. But despite reductions in exposure and the build-up of community immunity, changes do occur. For example, when a fundamental economic shift occurs such as clear cutting old growth forests to create agribusiness, the result may be disease emergence. A good example of this is the emergence of hantavirus in Panama upon clear cutting old growth rain forest in favor of pastureland, rice patties and teak groves (Carroll et al. 2005, Suzan 2006).

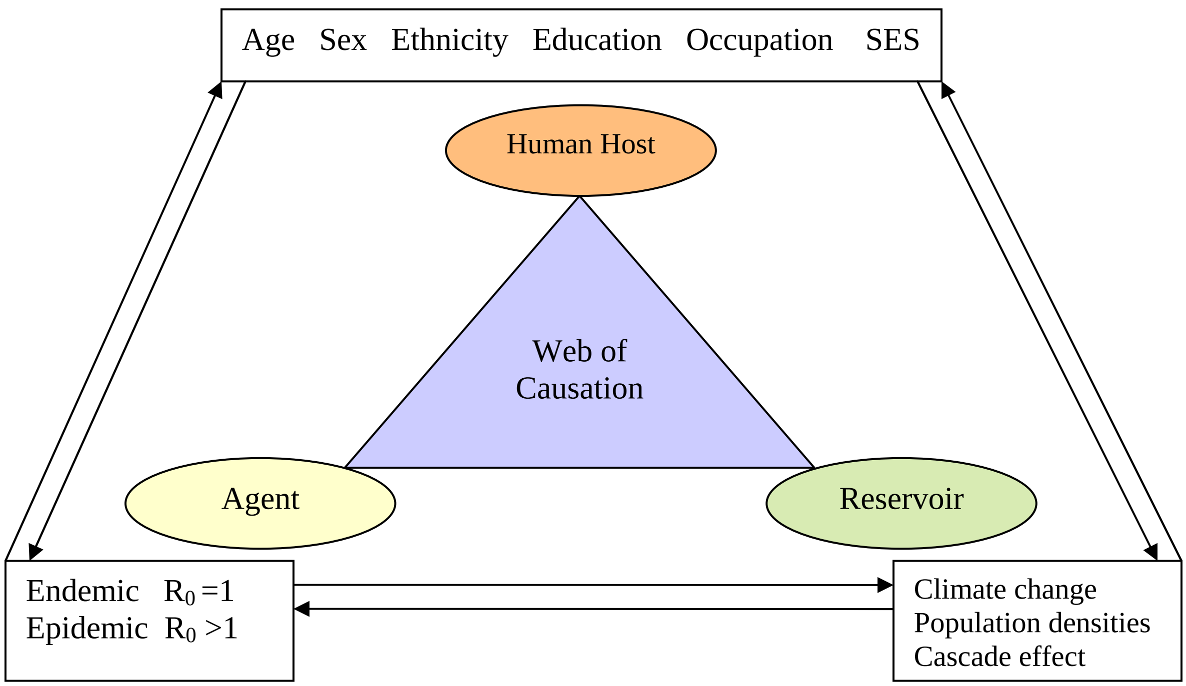


***Figure 2.2.* An expanded web of disease causation in relation to Hantavirus Pulmonary Syndrome**

Population: Affected Populations, Disease Distribution, and Demography

In this study, hantavirus distribution and disease determinants in humans are age, sex, ethnicity, education, occupation, geography and SES. In each area of northwest New

Mexico, Panama, and Chile, to know disease frequency and distribution, one must demonstrate mortality/morbidity during non-breakout periods, and it's necessary to know the frequency of the same condition in other populations and in the same population at other times. In acute hantavirus outbreaks this is not difficult because during short bursts of time more people will become ill, but low frequencies are just as significant, as the absence of disease in certain populations can help identify disease in others.

The purpose of distribution knowledge is to explore causal mechanisms, which test hypotheses of disease origin, and test the validity of the rationale on which control programs are based. Local characteristics of disease occurrence utilize disease commonalities elsewhere to explain local conditions and/or an outbreak. It is also used to formulate the preventive measures that are most suitable to the particular community (MacMahon and Pugh 1970). This is of particular importance to hantavirus prevention measures, since effective programs should consider the local environment and social customs. Finally, the importance of distributing knowledge is in the development of administrative guidelines for providing health services. This enables programs and studies to be directed toward population groups manifesting the greatest concentration of disease: the rural poor in northwestern New Mexico, Panama, and Chile.

Descriptive epidemiology traditionally considers person, place and time. Person considers age, sex, ethnicity, occupation, education, and socio-economic status. Place means country (Unites States, Panama, and Chile), districts (US: NW New Mexico; Panama: Los Santos Region; and Chile: Region IX), urban/rural, local community, housing, and related variables such as means of economic production. Time as a hantavirus ecological consideration investigates the year (in terms of ENSO), season (agricultural practices) and day (early morning disturbance of feed sheds). The association of disease in a particular place might be of relevance to persons interacting in that space. This is particularly true of hantavirus, since rodents live everywhere, but hantavirus occurs more often in certain areas than others. Through the method of analogy, hantavirus can be identified in geographic areas far away from other outbreaks. The distribution of disease may be sufficiently similar to others (index familial cases in Chile and northwestern New Mexico), because the disease has been successfully investigated elsewhere.

Health can also be viewed as a changing event. Formerly, health simply meant the absence of disease, but the World Health Organization has since added mental and social aspects: that of complete mental, physical, and social well being (WHO 1990). From a medical sociologist's point of view, exploring the social context of health can be seen as a method to explain human behavior as it relates to preventing illness or seeking health care to resolve illness. Therein also lies the distinction between disease and illness: disease according to a biomedical definition sees the presence or absence of disease as the indicator of health, while illness is an indicator of health status. Social construction is more centered on the illness experience than the biomedical diagnosis. The path to wellness can be made through care giving choices based on local medical cultures, race, class, gender, insurance status, and other social variables. Medical sociology counters the singular biomedical worldview of disease with a social view that emphasizes the interaction of biological and social factors.

Modern health can thus be viewed as an attainable goal through hard work, with the reward being a higher quality of life (Cockerham 2005). The epidemiological transition certainly illustrates the shift in disease patterns from acute to chronic diseases (Omran 1971). Modern medicine can help alleviate chronic health symptoms, yet the responsibility for good health has shifted to the individual to make lifestyle choices that ultimately promote good health.

Social identities have shifted from work or status or class position to consumption patterns. In the US this is particularly true in the post-World War II period when living standards and purchasing power greatly improved (Cockerham 2005). Social distinctions within in the working class reflect consumption patterns more than relationship to the means of production (Cockerham 2005). This is not to say that individualist health consumption is independent of social action as a bottom up approach, but rather the result of processes over time in concert with widespread beliefs that influence the behavior (agency) of individuals (Cockerham 2005).

The current tendency of socio-medical discourse is to investigate individualistic rather than collective behavior in the context of specific diseases or acute outbreaks. This is particularly true of standard public health analysis wherein health behavior is treated as an individual's choice that could be changed through education (Cockerham 2005). Rosenstock's (1966) Health Belief Model is also an illustration of individualistic behavior. Education is thought to increase effective agency, thereby increasing the chance that individuals will take appropriate action to reduce risk of exposure to disease.

While education is a major component of positive health outcomes, income and occupational status also act as structural variables with important influences (Cockerham 2005). While not mutually exclusive or totally overlapping, these three components are interconnected as indicators of socio-economic status (Cockerham 2005). In combination, these “components of class constitute a structural variable that produces top-down distinctions in quality of health lifestyles among individuals (agency) and provides a social context for the practice of these lifestyles (structure)” (Cockerham 2005).

What gives rise to customary patterns of behavior? Are they external constraints on the individual or an organized attitude of the whole community that is acting through social processes to shape the conduct of individual members? (Cockerham 2005). Assuming that people have the freedom to make positive choices also assumes that people have real options for conditions to change (Cockerham 2005). For example, where structural influences are so overwhelming, individual capabilities for positive change are ineffective (Cockerham 2005).

Positive health behavior tends to run along two tracks: promoting wellness and avoiding risk. Wilson (1995) outlined the social dimension of disease emergence in a way that is vaguely reminiscent of Rosenstock’s Health Belief Model: recognition of disease, perception of threat, and expected course of events, which may or may not result in cues to action. However, Wilson (1995) also recognized the relevance of the social factors, including the public understanding of risk, which influence how individuals, communities, and societies react to disease.

Multiple poor health practices are most common among people of lower socio-economic status (Cockerham 2005). Wilson (1995) points out that initial responses to epidemics can be framed in the context of an under-estimation of the severity of the problem, fear and anxiety when an agent is not yet identified, flight, denial and scapegoating of the ill, and the perception that business and civic coalitions control the shape of public health interventions. Communities can have conflicting ideas about causes and the most appropriate means to disease prevention, and therefore fail to comply with established programs to contain an epidemic or to promote positive health behaviors. Cockerham (2005) noted that health lifestyle behavior reflects individual routines that merge into groups and represent specific groups and classes. So it comes as no surprise that most positive health lifestyle practices are linked to higher social strata and women while most negative ones are connected to lower social strata, and that women were more apt than men to have healthy beliefs and behavior.

Therefore, public health interventions, especially health education, need to be based on group priorities, and risk perceptions should take into account local belief systems and practices in social/cultural/economic contexts. There is increasing interest in a more interdisciplinary triangulation among epidemiologists, virologists, and social scientists in infectious disease research. In terms of this research, social science can help elucidate what might motivate the affected population to change risky behavior and sustain behavioral patterns needed to contain an epidemic and improve the overall health of the population, regardless of socio-economic status.

CHAPTER III:

SOCIOLOGY AND BIOLOGY TO DESIGN EFFECTIVE PREVENTION MODELS

Effective etiological models geared toward hantavirus prevention should utilize knowledge of both human behavior and rodent biology in their respective environments. Prevention models using human knowledge and agency, such as Rosenstock's Health Belief Model and Parson's sick role, utilize behavior change theory and may be useful to construct effective interventions for human populations. Environmental elements that should be considered are: the history, nature, and role of the rodents in transmitting, and the nature of viruses. Combined with human demography, the above elements are of critical importance in this study, since the current prevention models in three human populations interacting with environmental disturbances are being compared and analyzed.

Historical Overview of Hantavirus

Observation and study of hantavirus are not new. While symptoms of hantavirus were discussed by Chinese doctors as early as 960 AD (Sinnott 1993; Johnson 2001), during the first half of the 20th century, war time "field nephritis" was recorded by field physicians tending to the wounded and ill brought in from the battlefield. Japanese physicians during the 1930s recorded instances of the disease while invading Manchuria (Sinnott 1993, Lee 1996). Unfortunately for the victims of field nephritis, these same Japanese physicians subsequently performed experiments on "volunteers" to determine whether the suspected possible zoonotic agent was the field mouse, <u>A. agrarius</u> (Sinnott

1993; Johnson 2001). During World War II, physicians recorded instances of affected German soldiers (Lee 1996, Johnson 2001, Maes 2004).

During the 1950s Korean conflict, soldiers fighting and camping in the trenches along the Hantaan River and 38th Parallel became affected with HFRS (hence the term "hantavirus" which stems from the Hantaan area). Between 1951 and 1954, more than 3000 United Nations soldiers were diagnosed with HFRS (Lee 1996). To isolate the suspected cases, patients were transported and quarantined to special field hospitals where the disease could be studied; case fatality among the quarantined population with this disease was about 7% (Johnson 2001). Meanwhile, field physicians who were aware of the Japanese/Manchurian efforts from the 1930s, scrambled to translate prior Japanese research on the disease (Schmaljohn 1997; Johnson 2001). Seasonality of the hantavirus cases had ruled out mites as the possible vector, since hantaviruses were transmitted when mites were seldom encountered, so following the Japanese/Manchurian lead, the Korean conflict physicians suspected the common denominator to be A. agrarius (Johnson 2001).

Hantavirus research shifted to more formal, structured techniques during the second half of 20th century with the advancement of scientific technology, combined with a little bit of serendipity. Along with the new, formal investigation strategies came a shift from studying the disease as a problem for soldiers during times of conflict to studying the disease in the context of public health. In 1963, Dr. Karl Johnson was sent to investigate an outbreak of a mysterious disease in the town of San Joaquin in eastern Bolivia. There Dr. Johnson and his team encountered a variation of acute Bolivian Hemorrhagic Fever (Machupo) and at the same time noticed an unusual number of rodents. Suspecting rodents as either the carrier (through arthropod vectors) or as the unknown cause of the disease, Dr. Johnson and his colleagues divided San Joaquin in half. One half of the town trapped and eradicated rodents, while the other half of the town did not. Within a short time, Machupo cases dropped significantly in the half of town that had eradicated the rodents (personal conversation with Dr. Johnson). From that observation, he and his team developed a rodent eradication campaign for the rest of San Joaquin, which brought about control of the disease (Johnson 2001). Pubic health prevention measures were effectively disseminated through theater troupes (personal conversations with Dr. Karl Johnson, MD, Dr. Terry Yates, PhD, Gary Simpson, MD, PhD, MPH).

Although rodents were suspected in San Joaquin, the exact agent remained elusive. Ectoparasites (possible arthropod vectors such as mites) were examined, but no conclusive evidence pointed toward a vector since there appeared to be a lag time between exposure and the onset of the disease and, similar to the Korean conflict cases of HFRS, there also appeared to be a seasonality linked to Machupo cases. During the crisis, National Institutes of Health (NIH) scientists who were working at the Gorgas Institute in Panama City, Panama, named the disease Machupo (personal conversation with Dr. Johnson). NIH scientists eventually identified C. callosus as the primary reservoir of Machupo virus because they had the facilities to study and determine the etiologic agent while simultaneously operating with Dr. Johnson's crisis team in Bolivia (Johnson 2001).

While the above example is quite dramatic, making the specific rodent reservoir and human disease link remained elusive. However, scientists rapidly closed in on possible associations. Following the outbreaks in Bolivia, the Soviet Union invited Dr. Johnson to Russia in 1966 and 1969 as part of a delegation to learn more about Soviet hemorrhagic fever cases (Johnson 2001). Even though the Bolivian cases were pulmonary (HPS) and the Soviet cases were renal (HFRS), the rodent-human health connection lingered in Dr. Johnson's memory (Johnson 2001). As with the Bolivian cases, the relatively long incubation period between possible exposure and disease onset indicated arthropods were an unlikely source of disease transmission. Rodents remained the key.

A major breakthrough occurred back in Latin America when Col. Bryce Walton, a parasitologist stationed with the NIH infectious disease scientists in the Panama Canal Zone was reassigned to Tokyo. While in Japan, Dr. Walton met with Dr. Ho Wang Lee, who was attempting to isolate the Korean hemorrhagic fever (Johnson 2001) because between 300 and 900 cases per year still occurred among the Korean troops stationed along the 38th Parallel and Hantaan River. In the spirit of reciprocity, Col. Walton arranged a trip for Dr. Lee to visit Panama to study the rodent-virus links (Johnson 2001). By late 1975, Dr. Lee had continued the work on hantaviruses, and through continuous specific tissue staining and advanced microscopy, he was finally able to positively identify the long suspected A. agrarius as the rodent reservoir of Korean hemorrhagic fever (Lee 1996, Johnson 2001). Dr. Lee named this new agent "Hantaan virus, after the small river passing near the village of Songnaeri, Korea, where the prototype strain of the virus was obtained." (Johnson 2001).

After the initial virus identification via the newer technology of more powerful microscopes, scientists in Scandinavia, Finland, and Russia, who had identified HFRS as endemic and periodically episodic, quickly recognized primary rodent reservoirs with their specific virus (Johnson 2001). By 1985, the concept of host-specific viruses took root as several new hantaviruses had been documented from around the world: Thottapalyam virus isolated from the shrew S. murinus in India; Thailand virus isolated from the rat B. indica in Thailand, and Dobrava virus isolated from the rat A. flavicollis in Yugoslavia (Johnson 2001).

Concomitant to the science of virus identification, came the ecologic studies to identify the reservoirs' life cycles and virus transmission among the rodent populations. In more formal, controlled confined cage experiments, scientists determined that mother-to-offspring vertical transmission of the virus was an unlikely source of virus etiology, while inter-cage horizontal transmission emerged as the likely source of virus transmission among the rodent populations (Schmaljohn 1997; Johnson 2001). Through this systematic analyses of virus transmission and controlled experiments, arthropods again seemed an unlikely vector while rodents' urine, feces, and saliva seemed more likely as the transmission route for hantavirus (Johnson 2001).

During the initial 1993 outbreak in the southwestern United States, Richard Malone, an investigator working for the New Mexico State Office of Medical Investigation, suspected similarities between the index cases in New Mexico and other hantavirus cases (Johnson 2001). Although perplexed by the initial cases, and after eliminating the possibilities of plague or environmental toxins as causes, investigators began to make the link between the index cases and other mysterious deaths that had occurred recently in New Mexico (Sinnott 1993). Within 19 days of the initial case, hantaviruses were identified as the cause of the outbreak. Soon after, P. maniculatus was identified as the primary rodent-reservoir host of Sin Nombre Virus (SNV). Within three weeks of the initial outbreak, 24 suspect case-patients had been identified (Sinnott 1993; personal conversations with Dr. Karl Johnson MD, Dr. Gary Simpson MD PhD MPH, Dr. Fred Koster MD, Dr. Terry Yates PhD, Dr. Robert Parmenter PhD).

Prevalence and Severity

While old world hantaviruses produce illnesses associated with renal failure, new world Hantavirus Pulmonary Syndrome cases incur capillary leakage localized exclusively in the lungs, not the kidneys (Lee 1996, Schmaljohn 1997). HPS death occurs from shock and cardiac complications (CDC website, Lee 1996, Schmaljohn 1997). Today, scientists and public health officials believe that globally between 150,000 and 200,000 cases of pulmonary and renal hantavirus are reported each year (Lee 1996; Schmaljohn 1997; Maes 2004). Depending upon the reservoir host and its ecology, case fatality for HFRS ranges from 0.1% for Puumala (PUU) to as much as 10% for HTN (Lee 1996, Schmaljohn 1997). Cases in the Americas are fewer, but more lethal, with HPS case fatality ranging from 19% in Panama to 85% upon initial outbreaks. Generally, when the disease first emerges geographically, case fatality is high until the reservoir is identified, preventive measures are disseminated to the public, and the medical community is educated about symptoms, risk factors, and how to proceed should a case present in a local clinic. This has shown to be true in all three research sites for this project: the United States, Panama, and Chile.

Risk Factors

Since the first part of the 20th century, field physicians and epidemiologic investigators have considered certain occupations and activities to be higher risk factors for exposure to "field nephritis" hantaviruses: military activities, heavy agricultural/farm work, and sleeping on the ground (Lee 1996). Indoor exposure was thought to occur when rodents invaded homes in search of warmth (fall/winter invasion) and in peridomestic areas in and near dwellings (wood piles and trash receptacles). In the 21st century, similar occupations and activities remain linked to exposure to hantavirus. Outdoor activities such as agriculture, camping and leisure activities (sleeping on the ground on hiking trips), indoor exposure in homes that are not rodent-proof, utility sheds, and peridomestic areas such as wood piles and trash receptacles remain areas of high-risk for exposure to hantaviruses.

Lower socio-economic status has also been associated with exposure to hantaviruses, since people living in poorer housing conditions or those engaging in low wage agricultural activities are more likely to come into contact with rodents (Lee 1996, Schmaljohn 1997). Middle and upper income exposure likely comes from outdoor activities such as camping and hiking and opening up summer cabins after a winter/spring of little air circulation (Schmaljohn 1997, PAHO 1999).

Hantaviruses Worldwide

An estimated 200,000 cases of hantavirus are identified each year (Lee 1996; Schmaljohn and Hjelle 1997). The following chart, compiled by the author, shows known and probable species of hantaviruses, reservoir, virus distribution, and disease (HFRS, HPS, or not yet determined). The list continually grows as scientists identify ecological niches of various species, long-term problems with climate change (El Nino), and socially engineered environmental problems such as clear cutting forests in Panama.

Table 3.1: ***Probable species of hantaviruses, reservoir, virus distribution, and disease.***

Virus	***Abbreviation***	***Rodent reservoir***	***Virus Distribution***	***HFRS/HPS***
Andes	AND	O. longicaudatus (long-tailed pygmy rice rat)*	Southern Argentina, Chile, Uruguay	HPS
Araraquara	ARA	B. lasiurus (forest rodent)	Brazil	HPS
Bayou	BAY	O. palustris (rice rat)	U.S.	HPS, HFRS
Bermejo	BRMV	O. chacoensis (Chacoan pygmy rice rat)	Northern Argentina, Bolivia	HPS
Black Creek Canal	BCC	S. hispidus (cotton rat)	U.S.	HPS, HFRS
Bloodland Lake	BLL	M. ochrogaster (prairie vole)*	U.S.	not determined
Blue River	BR	P. leucopus (white-footed mouse)	Central U.S.	not determined
Cano Delgadito	CD	S. alstoni (Alston's cotton rat)	Venezuela	HPS
Castelo dos Sonhos	CAS	unknown	Brazil	HPS
Choclo	CHOC	O. fulvescens (pygmy rice rat)	Panama	HPS
Dobrova-Aa	DOB-Aa	A. agrarius (striped field mouse)	Eastern, NE & Central Europe	HFRS
Dobrava-Af	DOB-Af	A. flavicollis (yellow-neck mouse)	Balkans, SE & Central Europe	HFRS
Dobraca-Ap	DOB-Ap	A. ponticus (caucasian wood mouse)	Southern Russia	HFRS
El Moro Canyon	ELMC	R. megalotis (Western harvest mouse)	U.S., Mexico	not determined
Hantaan	HTN	A. agrarius (striped field mouse)	China, Russia, Korea	HFRS
Hu39694	Hu39694	unknown	Central Argentina	HPS
Isla Vista	ISLA	M. californicus (California vole)*	U.S.	not determined
Juquitiba	JUQ	O. nigripes	Brazil	HPS
Khabarovsk	KHB	M. fortis (reed vole)	Russia	not determined

Table 3.1 Continued

Virus	***Abbreviation***	***Rodent reservoir***	***Virus Distribution***	***HFRS/HPS***
Laguna Negra	LNV	C. laucha (vesper mouse)*	Paraguay, Bolivia	HPS
Lechiguanas	LEC	O. flavescens (pygmy rice rat)	Central Argentina	HPS
Maciel	MAC	Necromys benefactus (dark field mouse)	Central Argentina	HPS
Monongahela	MON	P. maniculatus nubiterrae (Cloudland deer mouse)	Canada, Eastern U.S.	HPS
Muleshoe	MUL	S. hipidus (cotton rat)*	U.S.	not determined
New York	NY	P. leucopus (white-footed mouse)	U.S.	HPS
Oran	ORN	O. longicaudatus (long-tailed pygmy rice rat)*	Northwestern Argentina	HPS
Pergamino	PRG	Akodon azarae	Central Argentina	HPS
Prospect Hill	PH	M. pennsylvanicus (meadow vole)	U.S., Canada	not determined
Puumala	PUU	C. glareolus (red bank vole)	Europe, Russia, Scandinavia	HFRS
Rio Mamore	RIOM	O. microtis (small-eared pygmy rice rat)*	Bolivia, Peru	HPS
Rio Segundo	RIOS	R. mexicanus (Mexican harvest mouse)*	Costa Rica	not determined
Seoul	SEO	R. norvegicus (Norway rat) R. rattus (black rat)	Worldwide	HFRS
Sin Nombre	SNV	P. maniculatus (deer mouse)	U.S., Canada, Mexico	HPS
Thailand	THAI	B. indica (bandicoot rat)	Thailand	not determined
Thottapalaya	TPM	S. murinus (musk shrew)	India	not determined
Topografov	TOP	L. sibricus (Siberian lemming)*	Siberia	not determined
Tula	TUL	M. arvalis (European common vole)	Europe	HFRS
		* probable species		

(Compiled by author: Lee 1996; Schmaljohn and Hjelle 1997; Calderon 1999; Bohlman 2002; Maes et al. 2004; Chu et al. 2006; Puerta et al. 2006; CDC website 1/15/08, Klempa, B., et al. 2008).

Brief Overview of Viruses

In terms of this project, a basic knowledge of viruses is essential to understanding the link between the ecology of viruses and the subsequent disease prevention measures designed to improve human health. When viruses are identified quickly and understood in terms of environmental impacts, public health officials are better able to respond quickly during times of disease emergence. This helps allay public fear and assists the population in understanding what it takes to stay healthy during times of disease outbreak. A brief, yet essential explanation about the nature of viruses in terms of ecology and human health impact follows.

Technically, viruses are non-living, asexual entities that require host cells to reproduce; unlike bacteria, viruses cannot capture or store energy, (Regenmortel and Mahy 2004; Hurst & Lindquist 2000). Consequently, virus life cycles are dependent upon relationships with host cells and carriers (Regenmortel and Mahy 2004). To further complicate scientific identification, virus species classification follows the hierarchical concepts set forth in the traditional biological sciences: that of species, genus, family, etc. (Regenmortel and Mahy 2004).

The differences among virus species depend upon many properties, but particular differences are genome sequences, natural host range, mode of transmission, and pathogenicity (Regenmortel and Mahy 2004). While seemingly disparate, these properties actually make virus identification a comparative process whereby scientists use isolates of an already identified species to identify new or re-emerging ones. For example, the recent eruption of West Nile Virus (WNV) in North America was linked through a genetic match to a WNV species in Israel. Identifying WNV with an already established virus elsewhere in the world enabled public health officials in North America to plan and enact prevention measures to protect the public. In another more relevant example, scientists recently identified a third Dobrava Hantavirus lineage (DOB-Ap) by comparing genome sequences to already known DOB-Aa and DOB-Af. This novel hantavirus is carried by a different rodent species A. ponticus (Caucasian wood mouse) than DOB-Aa and DOB-Af, and occurs in a rural area of southern Russia (Klempa, B., E.Tkachenko, T. Dzagurova, Y. Yunicheva, et al. 2008).

For hantaviruses, identifying the genetic links and concomitant rodent reservoirs is valuable information for public health officials who design outreach programs for specific human populations. Research scientists already know what hantaviruses look like; quick identification of the virus and concomitant ecology means fast implementation of programs designed to reduce case fatality rates and improve the general quality of health within the geographic area of the rodent reservoir. For the purposes of this project, which encompasses the social epidemiology of hantavirus and incorporates the ecology of the rodent reservoirs, the definition of virus species follows the 1991 International Committee on Taxonomy of Viruses (ICTV): "A virus species is a polythetic class of viruses that constitute a replicating lineage and occupy a particular ecological niche." (Regenmortel and Mahy 2004). This definition underscores the co-evolution of host-reservoir rodent species within an ecological space dependent upon spatial and temporal scales. Therefore, understanding the basic co-evolution of rodents and hantaviruses is critical to understanding the determinants of HPS disease, its transmission, and ultimately transmission prevention measures.

Hantaviruses are highly pathogenic, cause Hantavirus Pulmonary Syndrome, are typically associated with a rodent host, and are determined by the location and distribution of the primary rodent host (Mills, Yates, Ksiazek, Peters & Childs 1999). For example, Sin Nombre Virus is classified as the virus species within the Bunyaviridae family wherein the primary rodent reservoir for SNV is P. maniculatus (deer mouse), a rodent that lives in almost all of North America. Although virus terminology appears redundant, with many hantaviruses identified throughout the world, new species identification becomes clear when similar hantaviruses are identified with another geographic location. As stated above, the newly identified HFRS Dobrava-Ap virus was determined from comparing isolates from two other Dobrava lineages and Hantaan virus is associated with A. agrarius in Korea and China (Lee 1996). Closer to home, HPS Choclo virus is associated with O. fulvescens in Panama, and Andes virus is associated with O. longicaudatus in Chile.

Hantaviruses are different because the virus is typically transmitted via rodents shedding the virus through urine, feces, or saliva. Human populations then inhale the virus through dust disturbance acting as a “vehicle” carrying the virus around in the air. In contrast to this method, “vectors” are the actual arthropod (mosquitoes or ticks) and act as transportation, that is, carriers of disease transmitting the infective virus from one host (a bird) directly to another (a human) (CDC website, Glossary of Terms). For example, West Nile Virus (WNV) is transmitted through mosquito bites after the mosquito bites an infected bird and then subsequently bites another animal such as a horse or human. Ticks act as the vector in the transmission of Lyme disease, wherein the virus is transmitted after the tick feeds on an infected deer and then bites a human (Ostfeld 1997).

As mentioned above, P. maniculatus is widespread throughout most of the United States, yet HPS is more likely to occur in certain biomes, making human risk more likely in certain geographic areas. This has led scientists to believe that unlike WNV or Lyme disease, hantaviruses probably co-evolved within specific rodent species and within specific environmental biomes, thus making specific hantaviruses highly pathogenic in certain ecologic niches and not in others (Suzan, G., et al. 2006). Additionally, sero-positive rodents appear to be unaffected by hantaviruses, which suggests a co-evolutionary rodent/virus sequence. Since human risk factors (rural and urban) appear to be closely linked to the environmental biome of potentially infected rodents, it is critical to consider the biome type of each rodent and concomitant virus. Biologists are linking co-evolution in environmental niches to methods of virus transmission such as the inhalation of a vehicle such as contaminated dust particles.

To emphasize the importance of rodent-virus biome relationships, scientists have studied the deer mouse extensively since the 1993 outbreak of SNV in northwest New Mexico (personal conversation with Drs. Parmenter, Yates, and Mills). While P. maniculatus is known throughout almost all of North America, when specific locations were studied for virus prevalence in the mice, (N=59) Great Basin piñon-juniper woodlands (33.9%), grasslands (28.8%), and desert scrub (23.7%) emerged as probable human exposure sites in relation to biome (Engelthaler, Mosley, Cheek, Levy, et. al. 1999). Although the distribution of the pathogen among the habitats is varied, with the lowest prevalence in the extreme desert and alpine tundra (Mills &

Childs 1998), highest pathogenicity occurs in spatial relation to elevation, with approximately 66% of the case-patients in the original 1993 outbreak being exposed at elevations of 1,800 m to 2500 m. (Engelthaler, Mosley, Cheek, Levy, et al. 1999). The highest prevalence occurs in the piñon-juniper woodlands, grasslands, and desert scrub within the above mentioned altitude parameters.

In northwest New Mexico, it is the rural poor who live in areas where hantavirus prevalence is high. Consequently, humans inhabiting rural areas in these biomes are at a higher risk of contracting hantavirus than those living in urban areas (CDC case information 1999). In New Mexico, these areas are remote, with sparse, poorly constructed housing, most often mobile homes. Because these areas are remote, access to urgent healthcare is difficult at best even through access to critical care in an acute moment can mean the difference between life saving practices and death.

Scientists also believe that North American temperature and precipitation patterns likely have an effect on seasonal and multi-year rodent patterns (Mills, Ksiazek, Peters & Childs 1999). Rodent sampling in the southwestern United States illustrates periodic population fluctuations in density, which is linked to rainfall. Dry climate conditions reduce the amount of available food for rodents, thus causing a population die-off in relation to available resources. Occasionally, climate change such as an El Nino Southern Oscillation (ENSO) event occurs when winter Pacific Ocean currents warm up by a few degrees. This effectively increases rainfall in southwestern United States, in turn increasing the amount of grasses and forbes available for rodents. The trophic cascade hypothesis links temporal events such as ENSO weather patterns to increased vegetation density, which in turn leads to increases in rodent populations (Parmenter, unpublished data). That is, wet weather leads to more vegetation, leading to increased rodent populations. In terms of human population risk, this is a significant problem, since those mice “cascade” from their normal territories in search of adequate food and shelter. This means human populated areas see an increase in mice infested homes, sheds, and woodpiles, and the risk of contracting hantavirus in these areas increase accordingly.

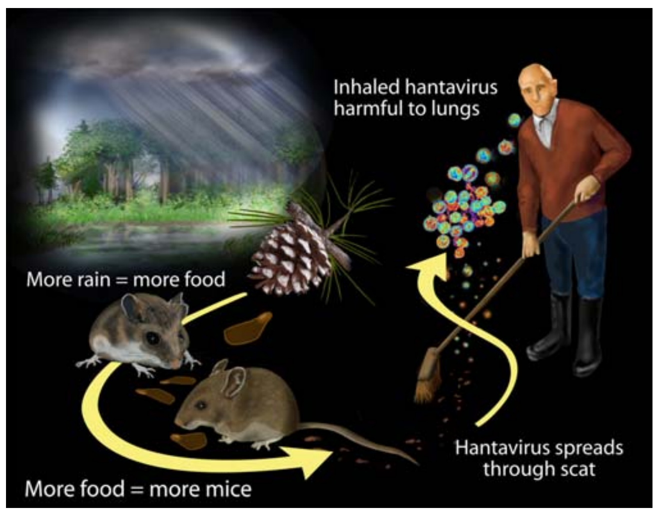
In the context of Hantavirus Pulmonary Syndrome, scientists such as Drs. Johnson, Parmenter, Yates, and Hjelle believe that the re-emergence of hantavirus in northwest New Mexico was the result of environmental disturbances rather than a dramatic change in human population distribution. As mentioned above, after a long period of drought, the ENSO event in1992 brought about large floral/fauna population growth in 1993, which exceeded normal distribution capacities. As a result, P. maniculatus populations cascaded into established human population areas (Parmenter, unpublished data). It is estimated that normal distribution of P. maniculatus is three to four per hectare. During the hantavirus outbreak in 1993, deer mouse populations swelled to approximately 30/hectare, a ten-fold increase. Similar to human population dynamics, the crowded mice looked elsewhere for resources to ensure reproductive success, seeking food and shelter which were more accessible in human peridomestic areas, including feed sheds, wood piles, and unkempt homes.

Increased mouse populations shift virus levels from endemic to epidemic in the rodent reservoir where $R_0>1$. R_0 represents the basic reproductive ratio: the required number of individuals which infect other individuals at the beginning of an epidemic (May and Anderson 1979; Dobson and Carper 1996). In other words, for a virus to persist in a mouse population, one individual must transmit the virus to at least one other individual (R_0=1). Otherwise, the virus dies out and disappears from the population (R_0<1). When (R_0>1), more rodents carrying hantavirus means a higher human risk of contracting HPS because there is an increased chance an infected mouse will inhabit a human peri-domestic area such as a shed or woodpile (Glass, Cheek, Patz, Shields, et. al. 2000).

During the 1993 outbreak in the southwestern United States, infected households were shown to have rodent populations higher than those in non-infected households (Glass, Cheek, Patz, Shields, et al. 2000). Follow-up studies demonstrated a distribution of hantavirus cases in 1999 that reflected a spring-summer seasonality (CDC website 1999). Given the dynamics of rodent populations, understanding seasonal population patterns and topographical elements of rodent reservoirs is critical for effective public health outreach no matter where HPS or HFRS is present (Mills & Childs 1998). The most vulnerable human populations are the rural poor who do not have adequate housing or resources to lower or limit exposure to hantaviruses. This does not preclude urban or wealthier populations from exposure, since camping, hiking and related outdoor leisure activities also increase the risk of hantavirus exposure. It does however, point to the problem that those with the more vulnerable socio-economic status are more likely to be exposed and contract HPS or HFRS. Scientists are currently researching whether these groups of people are more susceptible due to less adequate nutrition, and whether certain populations exhibit a genetic resistance to the virus.

Rodent populations typically experience what is termed normal temporal conditions. This is simply when rodent populations are normally highest/lowest throughout the year. As Mills, Ksiazek, Peters & Childs (1999) state, “all factors being equal, the highest risk for human contact with infected rodents is during the period of highest rodent densities." This statement may appear obvious, but it underscores the importance both of rodent density factors, such as when rodents shed active viruses; and rodent behavior, particularly when they invade human peridomestic areas in search of food and shelter. High-risk exposure events typically occur in concert with periodic and seasonal agricultural practices such as planting in spring, maintaining fields during the summer, and harvesting in the fall, and with culturally specific behavioral practices such as cleaning out rodent infected work sheds in the spring.

Here is an appropriate illustration of the climate, rodent and human dynamics that increases the risk of human exposure to hantavirus:



Zina Deretsky, National Science Foundation

***Figure 3.1.* An illustration of the climate, rodent, and human interactions that increases the risk of human exposure to hantavirus.**

Because other factors such as rodent reservoir temporal and spatial patterns are of equal importance, one must be cautious about employing only normal temporal conditions in disease models. Public health officials designing disease prevention models should consider spatial and topographical elements such as altitude and biome in rodent population predictions as a measure of disease risk (Mills, Ksiazek, Peters & Childs 1999). With increased technology, research scientists have begun to employ remote sensing to develop predictive models (Mills & Childs 1998). Using GIS data, they can begin to construct a set of overlapping steps for detecting risk levels (Mills & Childs 1998). This modeling attempts to predict relative risk for contracting hantavirus based upon increased vegetation (grasses, forbes, insects) and interactions in the ecological system within disease-endemic areas (altitude parameters included) for rodent-borne zoonotic disease (Mills & Childs 1998).

Virus transmission among rodent populations varies in frequency, but scientists have identified some similarities among populations (Mills & Childs 1998). Infection patterns vary among rodent species, which Mills and Childs (1998) speculate may reflect behavior differences; but for P. maniculatus which presented with SNV, the ratio of infected males to females was 2:1, suggesting horizontal transmission patterns of the virus when adult males rodents fight for territory (Mills & Childs 1998). Vertical transmission (mother to offspring) also occurs since juveniles can test positive for antibodies, but this eventually wanes, leaving juveniles and older rodents vulnerable to infection.

The geographic distribution of the host reservoir defines the maximum area that the disease is endemic (Mills & Childs 1998). Determining endemic levels of the virus in the host reservoir thus indicates the area in terms of increased human risk when $R_0>1$ (Mills & Childs 1998). But not all rodents are going to be infected with the virus, so the area of disease is only a portion of the total host reservoir population. This concept is critical, because although one should take precautions when observing and trapping rodents in a peridomestic area, not all rodents are disease carriers. This suggests that within geographic locations, the pathogen is dynamic and adaptable to environmental conditions (Mills & Childs 1998). Consequently, prevention models that include rodent-proofing homes, cleaning peridomestic areas and trapping/poisoning rodents properly are critical to disease prevention regardless of estimated seroprevalence levels (Glass et al., 1997). This is good practice in terms of positive human behavior in both high and low-risk areas for hantavirus exposure.

HPS Exposure and Population Risk Reduction

The Centers for Disease Control have published recommendations and reports for hantavirus risk reduction (1993 & 2002). Based upon virus taxonomy, rodent population ecology, and the trophic cascade hypothesis, the CDC made recommendations for general household cleaning, eliminating rodents, clean-up of infested areas, precautions for workers in affected areas who are regularly exposed to rodents, occupational hazards, and recreational activities such as camping or hiking, that may risk exposure.

Thoroughly wetting dead rodents with household disinfectants or spraying where they have defecated or urinated is one of the most effective ways of preventing hantavirus. Other prevention measures include avoiding rodent contact as well as preventing rodents from entering and occupying peridomestic areas. Simple trash clean up, removing weeds and grasses from the perimeter of the house and moving wood piles away from the house are also simple prevention measures. Prolonged exposure to sunlight also destroys hantavirus, which makes the airing out of sheds for 30 minutes before entering critical to reducing risk of hantavirus exposure. It is the understanding of pathogen ecology that will determine the control and prevention strategies of emerging and re-emerging diseases such as hantavirus. Effectiveness of those strategies will be determined by human population and behavior responses.

While the overall ecology of hantaviruses has become better understood with ongoing ecologic investigation, the roles and responses of humans to the disease remains murky. To date, no one has undertaken an investigation of how human populations respond to hantaviruses or how and why people may or may not engage in the simple, inexpensive measures needed to prevent the disease (Yates, Mills, Parmenter, Ksiazek, et al. 2002; Mills & Childs, 1998). By utilizing the on-going and extensive rodent reservoir studies as discussed above, and identifying and surveying high-risk human populations, it is believed that this project will help identify effective outreach measures. Public health officials can then modify outreach plans and intervention strategies for specific population needs during an epidemic and as well as seasonal endemic periods.

Because of the deer mouse's natural habitat, the poor, rural human populations of northwestern New Mexico are at higher risk of exposure to hantavirus than those in a relatively urbanized environment. The New Mexico hantavirus index cases were family members from the same mobile home in a poor state of repair and infested with mice. Simple, inexpensive prevention measures offer the real possibility to transcend the disadvantage of socio-economic status: moving woodpiles away from the home, aerating feed sheds prior to entering, and using inexpensive, normal household disinfectants such as bleach.

Preventive measures such as vaccines are still being researched, yet if a patient arrives for medical treatment in the early stages of HPS, survival rates are high. Medical therapies are improving steadily, with the experimentation of broad-spectrum viral concoctions, but this also raises another sociological challenge: well understood health education as the driver for better health outcomes and behavior in susceptible human populations. However, as with the main motivation of reducing infectious diseases in the United States in the early 20th century, reduction of the incidence of hantavirus will be through early case detection by informed physicians, nurses, and technicians, along with improved sanitation, living conditions, and cleaning methods. The combination of these simple procedures is reflected in the reduction of the United States case-fatality rate from approximately 80% in 1993 to approximately 38% in 2006.

While medical ecology studies diseases in terms of people in relation to the environment and associated factors, social medicine is concerned with all diseases that have their epidemiologies and correlations with social and occupational conditions and must to some degree be considered preventable (Le Riche and Milner 1971). Logically then, causation of disease is often of a multiple rather than single etiology. Early Chinese physicians often took a holistic approach to dealing with disease and considered as critical the imbalance between host and environmental factors. Social environment studies consider illness not to be random as is commonly thought, since disease frequently emerges in clusters. In northwestern New Mexico and Chile, hantavirus index cases bear this out, as family clusters. That said, public health official reactions to disease viewed in terms of total environment should consider not only the social and cultural environment, but the ecology as well (Le Riche and Milner, 1971).

CHAPTER IV:

METHODS AND PROPOSED STATISTICAL ANALYSIS

Summary Statement and Hypotheses

Specific Aims

This research compares the effectiveness of Hantavirus Pulmonary Syndrome (HPS) prevention outreach in: 1) northwestern New Mexico, 2) the Los Santos region of Panama, and 3) Region Araucania IX in Chile. Outreach effectiveness for HPS is not well understood, even though outreach appears to be more extensive in Chile than in northwestern New Mexico and Panama. Therefore, understanding the role of human demographics, disease ecology, and subsequent human behavior in the disease process is critical to assessing community responses in terms of behavior changes.

Through the implementation of a self-administered 28-question survey instrument, I propose to:

1.) Assess attitudes towards and across public health conditions with respect to hantavirus within three human populations:
   a. Northwestern New Mexico
   b. Los Santos region of Panama
   c. Region Araucania IX in Chile

2.) Assess whether the exposure to public health information makes a difference in knowledge and behavior responses. This is measured to any health information by exposure (yes/no), type of exposure and by the responses to the exposure.

3.) Assess how much change in preventive practices has occurred and what types of changes have occurred.

4.) Assess whether knowledge of hantavirus is greater in high prevalence areas vs. low prevalence areas.

Hypotheses

1.) There is no difference between sites in terms of attitudes and conditions regarding hantavirus, although it is expected that most respondents will demonstrate a basic knowledge of hantavirus, its causes, and practical prevention measures from each country population with similar conditions.

2.) There is no difference in terms of exposure (yes/no) to types of exposure, and responses to public health information.

3.) In terms of positive behavior changes to reduce risk of exposure to hantavirus, there is no difference between the mostly urban control sites and the rural poor, who represent the highest risk groups.

4.) There is no difference in terms of hantavirus knowledge between high and low prevalence areas.

Although the hypotheses are designed as null, it would be reasonable to expect some differences between knowledge and positive/negative behavior changes in terms of gender, education, race/ethnicity, and income. Additionally, outcomes are expected to be better in Chile in terms of knowledge and positive behavior changes because there is more extensive outreach conducted in Chile than in Panama or northwestern New Mexico. This study attempts to measure responses by comparing similar populations' behavior toward HPS under the context of similar space and time, that is of the nine sites during an endemic, rather than and outbreak or epidemic period.

Results from Previous Phases of Investigation in Northwestern New Mexico

Pilot survey research implemented in Grants, Farmington, and Gallup, New Mexico (n=235) during July 2000 indicated that the general public is informed about hantavirus and has a basic knowledge of what environmental and behavioral changes to make to reduce their risk of contracting HPS. Data analysis showed that while individuals in the lowest risk group (urban, middle class) make the most behavioral changes, those in high-risk groups (rural, poor) make the fewest changes.

With a target sample of 100 completed surveys from adults 18 years of age or older at each site, Grants yielded 83 surveys, Farmington 100 surveys, and Gallup 52 surveys (n=235). Over a period of two Saturdays (Grants and Farmington) and one Sunday (Gallup), surveys were collected from the general public in front of Walmart in Grants and Farmington, and in front of the Coast-to-Coast Hardware store in Gallup. Gallup did not yield as many completed surveys as hoped, but lower numbers could be due to implementing the surveys on Sunday rather than Saturday, and Coast to Coast Hardware had less foot traffic than a big box store such as Walmart. Site selection of Coast-to-Coast Hardware in Gallup was due to the non-response from the Walmart manager after several requests to implement surveys, but the store manager at Coast-to-Coast Hardware was amenable to survey collection on a Sunday morning. Survey collection in Grants and Farmington began by 9:30 each morning and continued until either all-100 surveys were completed or 12:00 p.m. which ever came first. Survey collection in Gallup began at 10:00 a.m. when the store opened and continued until 1:00

p.m. At each site, after completion of the survey, each respondent was handed a piece of candy and a hantavirus prevention handout.

Data collected during the 2000 pilot field survey reflected attitudes, knowledge, living conditions, behavior, and standard socio-economic (SES) questions. Findings are summarized below.

1) In response to public service announcements, urban residents set more traps than those living in rural areas, but there were no significant differences or changes in behavior among people living in grassland, rural-desert, rural-piñon/juniper, and rural-ponderosa pine conditions.
2) Education (measured by years completed) was not significantly associated with cleaning habits or response to public service announcements.
3) Men and women did not differ significantly in their desire to learn more about hantavirus or in their level of concern about catching hantavirus.
4) There were no significant behavioral differences among occupations, except that all farmers purchased ventilator masks. This was probably a function of occupational safety due to work in grain fields, rather than response to HPS public service announcements, since only farmers purchased masks.
5) Since the respondents demonstrated a basic knowledge of hantavirus, its causes, and its prevention measures, public service announcements about hantavirus appear to have been useful as a method of community outreach; yet those in the highest risk groups made the fewest positive changes to reduce the risk of contracting hantavirus.

Methodology

Based upon the 2000 pilot study, this project uses quantitative survey research methods and qualitative interviews with public health officials to assess the effectiveness of hantavirus outreach in three different populations where hantaviruses are prevalent and a direct threat to the health of three populations: northwestern New Mexico, Panama, and Chile.

It is expected that compared to northwestern New Mexico and Panama, the Chilean responses will reflect better cleaning habits, purchase of proper cleaning materials, and better improvements in peridomestic areas. It is also expected that since both the medical community and the general population have knowledge of hantavirus, the actual numbers of cases may reflect high numbers, even though the case-fatality rate is low. This may be because of increased awareness on the part of the general community resulting in better cleaning habits. The general community may also be connecting the relationship between certain human activities and exposure risk. Increased knowledge in the medical community also demonstrates the ability to triage patients correctly by screening for risk behavior activities.

The Questionnaire Variables

Project measures: Both quantitative and qualitative measures are implemented in this project. First, social behavior changes (positive/negative) are measured via the implementation of a simple, self-administered, 28 question survey (quantitative measures); Second, interviews were conducted with key public heath officials who implement public health policies (qualitative measures).

Detailed research design and variables

Overall design: A total of 600 surveys were ultimately collected: 200 from northwestern New Mexico, 200 from Panama, and 201 from Chile to be used for statistical analyses and comparison of attitudes, beliefs, and cues to action through survey analyses and interviews with key collaborators.

Antecedent Survey sites: After consulting with public health officials in New Mexico, Panama, and Chile, each in-country site was chosen based upon HPS reported incidence and geographic locations relative to high- and low-risk sites. Therefore, each country has three sub-sites that best represent two high-risk areas of contracting HPS and one lower relative risk area that will act as a control site. In northwestern New Mexico, Gallup and Farmington represent high-risk areas, while Grants will act as the low-risk control. In Panama, higher risk areas are Tonosi and Pocri, while Jaguito/El Roble acts as the low-risk control. In Chile's Region IX, Melipeuco and Curacautin are the higher risk areas while the relatively urban area of Temuco is the low-risk control site. These sites were determined by reviewing outbreak rates and geographical locations that are similar along with discussions with appropriate public health officials in each country.

Table 4.1: *Country site selection matrix according to high-risk and low-risk incidence*

Country site	High-risk	Lower risk
New Mexico (n=200)	Gallup, Farmington (n=133)	Grants (n=67)
Panama (n=200)	Tonosi, Pocri (n=133)	Jaguito/El Roble (n=67)
Chile (n=201)	Melipeuco, Curacautin (n=134)	Temuco (n=67)

Variables (Appendix A: Chart related to survey questions)

<u>Independent</u>:

Age, sex, ethnicity, occupation, income, education

<u>Mediating environmental variables</u>:

What is the respondent's length of time living in area, what type of home does he/she live in, what is the age of the home, do they own or rent their home and in what type of biome do they live?

<u>Dependent</u>:

Knowledge responses: Does the knowledge of how HPS is contracted, what the carriers of HPS are, what the symptoms of HPS are, observation of rodents in the home, and knowledge of proper cleaning and prevention methods lead to positive behavior responses?

Behavior responses: These variables include, if, when, and how a person has reacted upon learning about HPS and hearing public service announcements, concern for self and others, changes in cleaning habits and environment.

Common epidemiologic strategies search for causal associations between diseases, distribution, and environmental exposures. For this project, associations among disease, distribution, and exposures were incorporated into the survey for both the 2000 pilot study and the main project as described in detail below. Relative site surveys are attached as an appendix, and the following section describes in more detail the social, living, hantavirus knowledge and cleaning variables that the survey encompasses along with socio-economic status variables.

Initial responses to hantavirus are measured by asking when and how the respondent first heard about hantavirus, whether through media, family/friends or through some other method. Responses to public service announcements are measured through what would be deemed an appropriate response, such as "check for mice", or a misinformed response, such as "get a flu shot" or no action by the respondent at all. Respondents can circle all responses that apply to their situation, so some measure of behavioral response in terms of understanding the public service message can be obtained when related to demographics.

Mediating variables are the direct measures that ask how long the respondent has lived in the area, the type and age of the home they live in, and whether or not they own the property in which they reside. A valuable question to investigate is whether or not there is a difference in proper indoor cleaning and peridomestic area clean up in relation to home ownership. A description of the environmental biome is also requested, since ecological studies have shown that sero-prevalence of the agent in the reservoir is higher in certain biomes than others where risk of exposure is lower.

Concern for contracting HPS is measured for self and family members by asking if the respondent "panicked," avoided contact with animals or simply wondered who the victim was. Embedded in this section is whether the respondent knows someone who has contracted HPS. This is critical, because the question is a direct path to cue action and behavior changes based upon knowledge.

Disease knowledge questions ask directly about information that may be linked to actually knowing someone who has had hantavirus and/or information gained through public service or the medical community. Knowledge is measured by asking how HPS is contracted, what kinds of animals/insects carry hantavirus, and symptoms. As in the previous survey section, appropriate and inappropriate answers are embedded in the selections that the respondent may circle according to knowledge level. If the respondent knows someone who has contracted HPS, then logically he or she should know how the disease is contracted, those rodents carry the agent, and the symptoms, even though initial stages of HPS mimic the flu. However, the respondent may not know about hantavirus, and if so, then this information can be investigated for significance by sex, age, income, and occupation.

Behavior changes, both positive and negative, are then measured by directly asking the respondent if a rodent has been observed within the home or garage, and then whether cleaning habits have changed at all. If habits have not changed at all, the respondent is asked to skip the next section and proceed directly to socio-economic variables. In this way, the analyses will determine if there are any significant differences between those whose habits have changed or not changed by gender, age, ethnicity, income, occupation, and years of education.

Positive and negative behavior changes are measured by asking respondents whose habits have changed, how those habits have changed, and what specific activities they engage in for disease prevention and risk reduction. As in the previous sections, both appropriate and inappropriate knowledge responses are included, and the respondent can circle all that apply. For example, inside the home, they are asked: if they mop (appropriate) or sweep/vacuum (inappropriate) more frequently, whether they set more traps, and if they wear a mask, whether it is a dust mask (ineffective and inexpensive), or ventilator mask (effective, but expensive). The respondent is then asked, when purchasing cleaning supplies, what types of supplies are purchased. In the context of the Health Belief Model, and taking cues to action, the reaction may be positive; but if the incorrect message is received, then the respondent may take inappropriate action toward disease prevention. These questions were designed to determine whether the message was received, and then if the appropriate action was being taken.

For the final questions regarding the peridomestic area, respondents are queried whether proper cleaning procedures are being implemented. Are they removing trash from the home, cleaning up woodpiles, and cutting down grass and weeds? If someone is performing these positive behavior changes, is he or she the homeowner?

Lastly, the following independent socio-economic variables are measured: County/area of residence, gender, age range, number of children under 18 living with the respondent, ethnicity, average income range, occupation/activity, and years of formal education achieved. County and area of residence identifies the proximity of the respondent’s home to high/low-risk biomes.

Behavior Changes: An Analysis Plan

To investigate disease distribution successfully, a closer look at each “person” is necessary, including his or her age, sex, ethnicity, occupation, area of residence, and income.

Age is the most important single variable in descriptive studies because age variation may be linked to factors in the development of disease (MacMahon and Pugh 1970; Young 1998). For example, the average age of hantavirus patients in NW New Mexico, Panama and Chile is 38 (range 10-83), 42 (range 18-84), and 32 (range 1-76) respectively which suggests the question, what would people in these average age ranges be doing that would increase exposure risk? Associations between age and disease are so strong that indirect effects need to be eliminated in examination of differences in disease rates in association with other variables. Comparisons between two populations are generally meaningless unless account has been taken of possible age differences between them. Association is usually measured by relating the number of cases of the disease by age group to the population of the same age group and deriving a succession of age-specific incidence or prevalence rates (McMahon and Pugh 1970). Age range associations (across age groups) are valuable, because they will be compared to knowledge and behavior responses in relation to the demographics of those who contracted HPS in their particular region as well as to those in the control clinics at each site data were collected.

Second to the importance of age is the gender distribution of disease: that of morbidity/mortality factors and the causes of illness. For example, in chronic diseases, women present with higher morbidity instead of mortality, which is linked to their longer life expectancy than men. Gender will be compared for significant differences between men and women in concern for family health and learning more about hantavirus in addition to positive and negative behavior changes in cleaning habits in rural and urban environments. Even though the northwest New Mexico pilot study in 2000 showed that there was no significant difference between men and women in perceived risk of contracting hantavirus, there might be a gender effect in the larger study, or in Chile or Panama.

Number of children under 18 living in the respondent's household not only gives an indication of household size and SES but also index cases for HPS are frequently familial. In South America, children are more likely to contract HPS, whereas in North America, children are less likely to contract HPS after exposure. The reason for this is not well understood, and while scientists are studying genetics and nutrition as a possible explanation, the relationship between exposure and disease onset may also be due to household structure.

While race extends to permanent biologic inheritance, ethnicity may be linked with a particular location that is inhabited by a group of people through nativity (born at that location) or migration (movement in and out). Ethnicity can influence how well the messages of the outreach programs are received by different populations within the sites in terms of positive and negative behavior changes as well as living conditions, as indicated the direct measures mentioned above.

Average income is site specific and can be compared to demographic data obtained from public access statistic sites. For example, in New Mexico, average incomes for each site are available through public access to the Bureau of Research and Economic Development at the University of New Mexico. The sites lists areas by county and then are further broken down by city, so average income can be obtained for Grants, Gallup, and Farmington. The U.S. State Department has similar detail for the other two sites, Panama and Chile, and colleagues in those sites provided average income information for the regions surveyed.

Associative interpretation considers the differences between groups with respect to demographic variables and environmental differences. For example, occupation is associated with specific exposure risks connected to certain kinds of work such as agricultural pursuits. Occupation also identifies respondents in specific risk groups associated with exposure to HPS since it signifies general conditions under which a particular group works and lives as a community, apart from exposure to specific physical agents that may play a part in determining a disease experience. Additionally, those in agricultural occupations tend to earn low wages. Low income and low SES typically entail poor or substandard housing conditions and poor nutrition that are concomitant to poor health outcomes.

Since hantavirus is typically associated with rural activities such as agriculture, and forestry, each site survey has the appropriate occupations that are common to the area. For example, the New Mexico survey lists occupational categories including professional, skilled labor, farmer, rancher, clerical, and so on, while the Chilean survey deleted rancher and added fisherman and forestry, since these are common rural occupations in Chile.

Along with the above-mentioned variables, area of residence (rural/urban, montane, forested, or streams) is important to examine. Characteristics of geographic association may suggest the following: that high frequency rates are observed in all ethnic groups in the area; that high frequency rates are not observed in persons of similar ethnic groups inhabiting other areas; and otherwise healthy persons may become ill upon entering the area. The more of the above criteria that a disease meets, the higher the probability that frequency is determined by characteristics related to place.

Embedded in the concept of socio-economic status is the concept that a single variable that can be objectively defined. Since each variable may measure a different component of socio-economic complexity, it is not surprising that associations may differ according to which measure is used, such as income, education, housing, and occupation.

For example, income may be thought of as a more direct measure of socio-economic status than occupation. Nevertheless, the above measurable data points of the respondents are integrated with place and time in the survey instrument to be used in this project.

Finally, years of education are listed and are site specific. For example, in Chile and Panama, technical school was added because post-high school equivalent education does not necessarily mean a university education.

An integrated set of prevention activities implies preplanning and organization, yet optimum organization cannot always be carried out as desired during an emerging disease crisis. Through comparative analyses of public health campaigns by implementing a survey instrument in New Mexico, Panama and Chile, it is hoped that outreach plans can be designed and implemented quickly to effect positive behavior change. The interviews provided specific examples of outreach activities in each country, while the surveys will provide complementary analyses of public knowledge and behavior changes the public might be acting upon from the outreach activities.

The common factor underlying the varying circumstances associated with the three populations in northwestern New Mexico, Panama, and Chile in terms of the prevalence of Hantavirus Pulmonary Syndrome is infected rodents in either anthropogenic or naturally disturbed rural environments. The social arrangements particular to specific places are major determinants of the biologic and physical environments to which the inhabitants are exposed. These arrangements appear to be the main forces in control of the quantity of flora/fauna sharing the environment, and the presence of reservoirs for the spread of infection (Dr. Fred Koster, personal conversation). For example, a hantavirus patient in Panama who subsequently died was exposed to Choclo virus when she swept the sidewalk next to her newly constructed home. The sidewalk was adjacent to a rice patty recently cultivated after clear-cutting land, which effectively removed the natural barriers to O. fulvescens (Dr. Fred Koster, personal conversation).

Disturbances aside, surveys of both animals and humans are frequently undertaken to develop an understanding of the distribution of infectious diseases. Typically, epidemiological human surveys search for existing cases of the disease, while animal surveys search for seroprevalence, distributions, and habitat. Fortunately, a consistency in animal and ecological data collection exists among the northwestern New Mexico, Panama and Chile sites. This is because the multi-disciplinary team assembled by the International Center for Infectious Disease Research (ICIDR) was able to effectively plan a collaborative investigation on the ecology and methods as the outbreaks began at each site. Currently, the ICIDR team in Chile is utilizing Geographic Imaging Systems and Remote Sensing to map out rodent densities, seroprevalences and human cases of hantavirus (personal observation in Region IX, Chile).

Institutional Review Board approvals were obtained in each country prior to the surveys being implemented. In the United States, the University of New Mexico IRB has approved the project continuously since the initial pilot project in 2000. In Panama, IRB approval was obtained through colleagues in the Gorgas Institute in conjunction with the Panamanian Minister of Health. In Chile, the Ministry of Health, through the Center for Infectious Diseases, approved the implementation of the surveys. In each case, the surveys were translated into local dialect without changing the meaning or intent of the question to ensure reliability of measurement across the three sites. Other changes were made to reflect local variations. For example, in Panama, estimated monthly income was used instead of yearly income since Panamanians measure income by the month rather than by year. These numbers can then be standardized to local average incomes and then compared to other collection sites within Panama.

Samples

As mentioned above, surveys (n=601) were collected from northwestern New Mexico, Los Santos Panama, and Region IX Chile to be used for statistical analyses and comparison of attitudes, beliefs and cues to action through historical analyses and interviews with key collaborators. Each country's sub-sites were determined by reviewing incidence and similar geographical locations in specific time periods.

Surveys in Chile (n=201) were obtained in January 2004. While a random collection was indented for each site, the tumultuous clinic activities in the control site of Temuco prohibited such collection. The waiting room was a crowded central area where patients and their families waited for their appointments or walk-in urgent care, only to be whisked away from the central area to one of nine intake desks that led to corridors of examination rooms. Due to the limited time available for health officials to obtain survey data and the general activities at the Temuco Hospital control site, it was determined to approach families waiting to be called the to examination rooms. The lead survey team of Dr. Constanza Castillo and I first checked in with appropriate hospital administrative officials for approval to proceed with data collection in the central waiting room. After approval, Dr. Castillo, her assistant, and I proceeded to the central waiting room. Chilean State Health Ministry identification tags were worn by the local team. I wore appropriate

University of New Mexico identification while working with the local health officials. Respondents were chosen at random, in no particular order, and asked whether they wished to participate in the survey. Respondents were generally positive and willing to take the survey.

Surveys collected in Melipeuco and Curacautín were collected in a similar manner. As in the Temuco collection site, the survey team first checked in with the clinic administrator for approval to administer the surveys. Teams wore proper Chilean Health Ministry identification in addition to standard issue “hantavirus team t-shirts”. The rural waiting rooms were not as chaotic as the urban Temuco site. In this more relaxed atmosphere the team was able to engage the respondents in a quiet conversation. Surveys were handed over to the respondents with pens. Once completed, the candidate collected the surveys. There were no incentives other than a respondent’s willingness to complete the survey. In addition to collecting from the clinic, random surveys were completed in nearby neighborhoods by selecting every other household and asking if the adult member at home would complete the survey. If no one was home or the respondent was unwilling to complete the survey [rejected household n=1 in Melipeuco] the next available house was selected.

Panamanian survey collection (n=200) was obtained during May and June 2004. Unlike the Chilean collection, Panama administrators had more time to invest in implementing the survey and had the infrastructure in place to support the implementation at the three sub-sites. After each copy of the survey was stamped with the local Ministry of Health seal of approval, surveys were administered to every third adult in local clinic waiting rooms who was willing to participate. Nurses, instructed by

Dr. Juan Pascale on the proper implementation of the survey, administered the surveys over time. As in Chile, there were no incentives offered to the respondents; they completed the surveys with no compensation outside the inherent rewards of doing so. Once the surveys were completed for each site, I returned to Panama to visit each site, met the nurses and asked if there were any complications or notations of adverse events. None were reported.

Northwestern New Mexico (n=200) data collection occurred over a longer period of time in relation to data collection in Chile and Panama. While the doctors, nurses, and clinicians in Panama and Chile were eager to contribute to the project, locating an appropriate and consenting survey site proved a little more difficult in New Mexico. Eventually, three suitable and amenable sites were located: Rehoboth Medical in Gallup (67 completed surveys), San Juan Regional in Farmington (66 completed surveys), and Pitts Medical in Grants (67 surveys). Once the surveys were completed, they were either mailed directly to me or I picked them up from the site.

As mentioned above, the survey measures public knowledge and responses to hantavirus outreach and standard socio-economic and demographic information. To help assure each respondent the necessary human subject protections, each survey begins with the voluntary disclaimer,

> Your participation is voluntary and anonymous. You can choose not to participate or not complete the survey and the decision will not affect your medical attention.

The survey incorporates measurable data points as described in detail above. In general, the survey asks the following: if, when, and how the respondent has heard about hantavirus followed up with response scenarios measuring the level of concern for self and family members. Questions then measure the respondent's general knowledge of how hantavirus is contracted, its symptoms, and length of time the respondent has lived in the area. General descriptions of housing and landscape environment are then asked, followed by information on potential changes in cleaning habits, cleaning supply purchases and how those purchases are utilized for home improvement and modified behavior changes. Finally, standard demographic questions are asked, such as gender, age range, number of minors in the household, ethnicity, average income, occupation, and years of education. It was estimated that time to fill out the survey was approximately 5-10 minutes for each site, utilizing a quick, efficient way to capture critical information from each site and sub-site. Incentives were not offered to the respondents for their participation in the study.

Interviews with Experts

Personal interviews were conducted with Dr. Roberto Belmar, MD, former Director of Environmental Health of the Chilean Ministry of Health, professor of public health at the University of Santiago, and Professor of Social Epidemiology of Albert Einstein College of Medicine in New York City and with Dr. Constanza Castillo, MD Department of Internal Medicine, Universidad de La Frontera, Temuco, Chile. Dr. Belmar, MD and Dr. Castillo, MD outlined the public health outreach programs implemented by the Chilean government from initial case recognition in 1995 through the first official outbreak in 1997 and current efforts.

In Panama, interviews were conducted with Dr. Juan Pascale, MD of the Gorgas Institute of Health, Panama City, Panama. As in the interview with Dr. Belmar MD and Dr. Castillo MD, details of the index case in 1999/2000 and outreach programs were documented. Such history and detail shall then be compared to the activities in New Mexico during the 1993 and 1998 outbreaks as described by Dr. Fred Koster, MD and Dr. Gary Simpson, MD, PhD, MPH.

Samples and the Proposed Statistical Methods

The extensive discussions in the previous chapters on epidemiological transition (movement from emergence of chronic diseases to the reemergence of infectious diseases), Health Belief Model (perception of exposure risk and cues to action), and the sick role (patient/physician responsibilities) set the stage for exploring hantavirus pathways in the human populations surveyed. Analyses models are based upon knowledge of the literature, as well as the antecedent chart (Appendix A) that uses the actual questions on the survey to outline basic pathways: Antecedent (United States, Panama, and Chile), independent variables (sex and age groups, socioeconomic, and ethnicity), mediating variables (environmental and predicating), and dependent variables (knowledge responses leading to behavior changes).

Demographic literature shows the strongest predictors of behavior change are the categories of gender and age. Additionally, there may be a reasonable expectation of reliability and analyses power because the minimum number of collected surveys (n=600) was appropriate for the number of mediating and dependent variables in the model. (20 dependent variables X 10 surveys for each variable X 3 countries) Other variables to be utilized in the analyses are education, income, and occupation, because those are valid indicators of socio-economic status which influences the likelihood that a specific sector of the population will live in an area posing increased risk of hantavirus exposure.

Initial analysis will consist of chi-square test for independence for each variable by individual country and high/low-risk sites (Chapter 5), followed by cross-country site comparisons by high-risk, low-risk, and all risk combined (Chapter 6). Analysis will include t-tests and F-tests where applicable. Once patterns emerge and significant differences are apparent, correlation analyses (Chapter 7) will further define knowledge and behavior relationships across sites. Finally, regression analysis (Chapter 8) will be utilized to answer targeted aims and questions as noted above.

Chi-square tests for independence are typically used to explore relationships among variables (Pallant 2007). Because the survey instrument was designed to parallel each country site, this method would be most appropriate for exploring the basic descriptive measurements within each site and among sites. For example, respondents in each country site were asked whether rodents had been observed within the home. If more respondents in Panama are more likely to have observed rodents in their home than respondents in New Mexico or Chile, are those same respondents changing their cleaning habits? If so, are they doing so in an appropriate manner in comparison to the other countries? By making initial comparisons via chi-square tests, I can begin to assess whether the public service messages are effective.

Similarly, independent sample t-tests will be used where appropriate to confirm significance of chi-square tests for independence in the individual site results. This test is used to compare the means on some continuous variables for two different groups (high/low-risk), in age, income, and number of minor children in the home categories (Pallant 2007). F-tests for the same variables will be used in the cross-country site comparisons for the same reasons, except that F-tests are utilized when there are more than two groups being compared. In this case, F-tests will measure whether the means among the cross-country sites, New Mexico, Panama, and Chile are normally distributed and the null hypothesis is true.

To address the hypotheses, logistic stepwise regression models will be constructed upon examination of the descriptive results. These results will have already confirmed if the sample population was representative of the general population in each site. Thus, specific dependent behavioral variables will be chosen to address the hypotheses and will be analyzed based upon the aims of the study. It is hoped that these factors will predict the likelihood that respondents will perform a specific positive or negative behavior pattern.

Finally, based upon the likelihood of the respondents' specific positive or negative behavior patterns, an additive index will be created. This index includes various combinations of interesting positive and negative cleaning behaviors that emerge from the first one-way step-wise regression analysis. Because groups are now being compared with specific positive and negative behavior patterns, multivariate analysis of variance will be used for the statistical analysis. This method should be able to explain differences between the groups of independent variables and the composite dependent indices.

CHAPTER V:

INDIVIDUAL SITE COMPARISONS BY HIGH AND LOW-RISK

This chapter describes the individual sites in accordance with the 28 variables collected. It is organized by the following sections for each site: Sociodemographic characteristics, mediating variables, knowledge responses, and behavior responses. Each site will be examined separately by high and low-risk sites. New Mexico high-risk sites are Gallup and Farmington; low-risk site is Grants. Panama high-risk sites are Tonosi and Pocri; low-risk site is Jagito/El Roble. Chile high-risk sites are Melipeuco and Curacautin; low-risk site is Temuco.

New Mexico

Section I – Sociodemographic Characteristics: 5.1 – 5.8
Section II – Mediating Variables: 5.9 – 5.11
Section III – Knowledge Responses: 5.12
Section IV – Behavior Responses: 5.13 – 5.19

Panama

Section V – Sociodemographic Characteristics: 5.20 – 5.27
Section VI – Mediating Variables: 5.28 – 5.30
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Chile

Section IX – Sociodemographic Characteristics: 5.39 – 5.46
Section X – Mediating Variables: 5.47 – 5.49
Section XI – Knowledge Responses: 5.50
Section XII – Behavior Responses: 5.51 – 5.57

NEW MEXICO

Section I – Sociodemographic Characteristics

Table 5.1: ***Sample characteristics by site in New Mexico***

	Gallup, Farmington (n = 133)	Grants (n = 67)
Residence (County), No. (%)		
McKinley	48 (36.1)	4 (6.0)
San Juan	60 (45.1)	0 (0.0)
Cibola	2 (1.5)	54 (80.6)
Sandoval	0 (0.0)	1 (1.5)
Bernalillo	1 (0.8)	0 (0.0)
Catron	0 (0.0)	1 (1.5)
Torrance	0 (0.0)	1 (1.5)
Out of state (AZ, CO, TX)	3 (2.3)	1 (1.5)
Not identified	18 (13.5)	5 (7.5)

All sites demonstrated appropriate response numbers indicating that most respondents were from the intended counties. High-risk sites are Gallup in McKinley County and Farmington in San Juan County while the low-risk site is Grants in Cibola County.

Table 5.2: ***Frequency and Percentage of Women in the New Mexico Sample***

	Gallup, Farmington (n = 133)	Grants (n = 67)	Chi-sq (df)	p
Women, No. (%)	95 (71.4)	45 (68.2)	.956 (1)	.328

There was no significant difference in the gender composition between the Gallup/Farmington and Grants sites in either frequency or percentage. Therefore, it was expected that since the percentages were so close, the chi-square result (p = .328) would not indicate significant differences between the sites. Sixty eight to 71% of respondents are women.

Table 5.3: ***Frequency and Percentage of Age Distributions in the New Mexico Sample***

	Gallup, Farmington (n = 133)	Grants (n = 67)	Chi-sq (df)	p
Age, No. (%)		Overall chi-sq (df):	2.387 (5)	.793
18-25	15 (11.3)	6 (9.0)	.256 (1)	.613
26-34	23 (17.3)	12 (17.9)	.012 (1)	.914
35-44	34 (25.6)	14 (20.9)	.532 (1)	.466
45-54	30 (22.6)	17 (25.4)	.197 (1)	.657
55-64	19 (14.3)	8 (11.9)	.210 (1)	.647
>64	6 (4.5)	8 (11.9)	3.777 (1)	.052
Average age	44.06	46.00	t = -.900	p = .369

Overall, chi-square results showed no significant difference (p=.793) among age groups and the sites, indicating a similar age composition in the two New Mexico site samples. Difference of means test calculated for average age across categories (Gallup/Farmington = 44.06 years, Grants = 46 years) for this variable confirmed that overall, age should not have a confounding effect on continued analysis. It should be noted in the chi-square detail that age group of >64 did approach significance (p = .052).

Table 5.4: ***Frequency and Percentage of Number of Minor Children in the Household in the New Mexico Sample***

	Gallup, Farmington (n = 133)	Grants (n = 67)	Chi-sq (df)	p
Number of minor children in household (as categories)		Overall chi-sq (df):	1.037 (4)	.904
No children	58 (43.6)	31 (46.3)	.128 (1)	.721
1 child	19 (14.3)	12 (17.9)	.447 (1)	.504
2 children	26 (19.5)	10 (14.9)	.645 (1)	.422
3 children	11 (8.3)	5 (7.5)	.040 (1)	.842
4 or more children	19 (14.3)	9 (13.4)	.027 (1)	.870
Average children/home	1.42	1.31	t = .498	.619

Overall, the chi-square results indicated no significant difference (p = .904) in number of minor children in the household as categories. Average number of children in the high-risk sites was higher than low-risk site (1.42:1.31). T-test analysis confirmed no significance.

Table 5.5: *Frequency and Percentage of Race/Ethnicity in the New Mexico Sample*

	Gallup, Farmington (n = 133)	Grants (n = 67)	Chi-sq (df)	p
Ethnicity, No. (%)		Overall chi-sq (df):	20.143 (3)	.000
American Indian	45 (33.8)	9 (13.4)	9.409 (1)	.002
African-American	0 (0)	0 (0.0)	---	---
Anglo, non-Hispanic	54 (40.6)	24 (35.8)	.428 (1)	.513
Hispanic or Latino	24 (18.0)	30 (44.8)	16.153 (1)	.000
Other	7 (5.3)	4 (6)	.043 (1)	.836

Overall, the chi-square results showed a significant difference between high and low-risk sites (p = .000). In particular, American Indian (p = .002) and Hispanic or Latino (p = .000) showed the most significance. This was to be expected because in relation to Grants, the American Indian population in Gallup/Farmington is greater. Logically, the Hispanic or Latino population is relationally greater (and American Indian population lower) in Grants than Gallup/Farmington, and one would expect a significant difference. This table also indicates that in the high-risk areas, American Indians represent 33.8% of the respondents. In the Four Corners area of northwestern New Mexico, ethnicity is an indicator for populations at risk.

Table 5.6: *Frequency and Percentage Income Brackets in the New Mexico Sample*

	Gallup, Farmington (n = 133)	Grants (n = 67)	Chi-sq (df)	p
Income (USD), No. (%)		Overall chi-sq (df):	10.317 (5)	.067
0-10K	11 (8.3)	8 (11.9)	.698 (1)	.404
10,001-20K	16 (12.0)	18 (26.9)	6.950 (1)	.008
20,001-30K	27 (20.3)	13 (19.4)	.022 (1)	.881
30,001-40K	14 (10.5)	8 (11.9)	.091 (1)	.763
40,001-50K	15 (11.3)	5 (7.5)	.721 (1)	.396
>50K	33 (24.8)	10 (14.9)	2.580 (1)	.108
Average income	$40,488	$31,567	t = 2.787	p = .006

Overall, the chi-square results on income approached significance (p = .067) between the high and low-risk sites. A difference of means test (average income: Gallup/Farmington $40,488; Grants $31,567) confirmed significance in average income (p = .006) with Gallup and Farmington having a higher mean income than Grants. While most categories did not show individual significance, the income range of between $10,001 - $20,000 results (p = .008) indicated that the Grants site earns less in this category and may confound additional analysis. This may be because the Gallup/Farmington site (n = 16) frequency (12.0%) percentage in this category was a little less than half of Grants (n = 18, 26.9%). The higher risk sites show a higher average income than the low-risk site. Since lower income and SES are indicators of a higher risk population, those at risk may be hidden within the lower income categories. Table 5.7 indicates higher professional occupations and table 5.8 indicates higher education levels for the higher risk areas. Therefore, the lower income and SES categories may be an indicator of access to health care facilities because the surveys were distributed at health care clinics. In New Mexico, those with higher incomes have better access to health care than those with lower incomes.

Table 5.7: *Frequency and Percentage by Occupation Category in the New Mexico Sample*

	Gallup, Farmington (n = 133)	Grants (n = 67)	Chi-sq (df)	p
Occupation, No. (%)		Overall chi-sq (df):	3.030 (5)	.695
Professional	49 (36.8)	18 (26.9)	1.991 (1)	.158
Skilled labor	13 (9.8)	8 (11.9)	.222 (1)	.637
Farmer	3 (2.3)	3 (4.5)	.756 (1)	.385
Clerical	21 (15.8)	11 (16.4)	.013 (1)	.909
Sales	6 (4.5)	5 (7.5)	.747 (1)	.388

Overall, the chi-square results for occupation did not show significance (p=.695) in occupation as categories. More respondents from Gallup/Farmington identified their occupation as professional, while more respondents from Grants identified their occupation as skilled labor, farmer, clerical, or sales. This could be because Gallup/Farmington respondents had higher average years of education than Grants respondents. (See next table.)

Table 5.8: *Frequency and Percentage by Education Levels in the New Mexico Sample*

	Gallup, Farmington (n = 133)	Grants (n = 67)	Chi-sq (df)	p
Education, No. (%)		Overall chi-sq (df):	.4125 (4)	.389
0-8	5 (3.8)	5 (7.5)	1.286 (1)	.257
9-12	45 (33.8)	24 (35.8)	.078 (1)	.780
13-16	56 (42.1)	30 (44.8)	.130 (1)	.719
>16	22 (16.5)	5 (7.5)	3.145 (1)	.076
Average years of education	12.805	11.933	t = 1.427	p = .155

Overall chi-square results did not indicate a significant difference (p = .389) between the high and low-risk sites with respect to education levels. A difference of means test (average years of education 12.8 Gallup/Farmington; 11.9 Grants) confirmed that education (p = .155) also indicates that respondents in Gallup/Farmington are slightly higher educated than those Grants respondents. While Grants reported slightly higher percentages in the 0-8, 9-12, and 13-16 years of education categories, Gallup/Farmington reported more than twice percentage of respondents in the >16 years category.

Section II – Mediating Variables

Table 5.9: ***Frequency and Percentage of Length of Time in Area in the New Mexico Sample***

	Gallup, Farmington (n = 133)	Grants (n = 67)	t-test	p
Length of time in area (average years)	26.84	25.00	t = .610	p = .542

There was little difference in the average length of time in years that respondents lived in the area. Therefore, it was expected that there would be no significant difference, and t-test analysis confirmed that length of time in the area did not emerge as a confounding factor to consider in further analysis. Compared to Section 1, Table 4.3, Age Groups, the Gallup/Farmington sample represents the lower end of the 26-34 age group and in the Grants sample, the high end of the 18-25 age group and the sample indicates respondents that have been living in the area at least half of their lives.

Overall, the chi-square results for housing type (p = .159) did not emerge as significant, but upon further detailed analysis, mobile home (p = .049) did show significance between high and low-risk sites. Compared to Grants (22.4%) Most respondents in Gallup/Farmington live in a mobile home (36.1%), which is an affordable alternative to site construction homes, and is easier to locate in rural areas. Most respondents in Grants live in traditional wood frame homes, with a smaller percentage living in mobile homes followed by brick and adobe home construction. In terms of increased risk for exposure to HPS, because mobile homes are of cheaper construction, rodent populations may be able to invade easier and in greater numbers. (Personal observation.)

Table 5.10: ***Frequency and Percentage in Type of Home, Average Age of Home, and Home Ownership for the New Mexico Sample***

	Gallup, Farmington (n = 133)	Grants (n = 67)	Chi-sq (df)	p
Type of Home No. (%)		Overall chi-sq (df):	.7956 (5)	.159
Mobile home	48 (36.1)	15 (22.4)	3.877 (1)	.049
Cabin	2 (1.5)	2 (3.0)	.499 (1)	.480
Wood frame	31 (23.3)	22 (32.8)	2.076 (1)	.150
Brick	15 (11.3)	8 (11.9)	.019 (1)	.890
Adobe/stucco	24 (18.0)	8 (11.9)	1.235 (1)	.266
Other	9 (6.8)	1 (1.5)	3.827 (3)	.281
Average age of home	17.52	15.90	t = .665	p = .507
Own home, No. (%)	100 (75.2)	52 (77.6)	1.44 (1)	.705

There was no significant difference in the average age of homes between high and low-risk sites of respondents lived in the area. Therefore, it was expected that no significant difference would emerge. T-test analysis confirmed that average age of homes did not emerge as a confounding factor to consider in further analysis.

There was little difference in the percentage of homeowners. Therefore, it was expected that no significant difference would emerge. Chi-square analysis confirmed that those who own homes do not present a disparate risk between sites.

Table 5.11: ***Frequency and Percentage of Biome and Observation of Rodents in the Home for the New Mexico Sample***

	Gallup, Farmington (n = 133)	Grants (n = 67)	Chi-sq (df)	p
Biome, No. (%)		Overall chi-sq (df):	12.434 (4)	.014
City/town	63 (47.4)	38 (56.7)	1.558 (1)	.212
Rural pasture	34 (25.6)	6 (9.0)	7.682 (1)	.006
Rural desert	14 (10.5)	7 (10.4)	.000 (1)	.986
Rural PJ	11 (8.3)	3 (4.5)	.985 (1)	.321
Rural, Ponderosa	1 (0.8)	1 (1.5)	.247 (1)	.619
Observed rodents in home? No. (%)	68 (51.1)	30 (44.8)	.719 (1)	.396

Overall, the chi-square results for type of biome in which respondents lived (p = .014) did emerge as significant, and upon further detail analysis, those living in rural pasture areas (p = .006) did show significance between the high and low-risk sites. Most respondents in high-risk site of Gallup/Farmington live in the city, with smaller percentages living in rural pasture, desert, pinon-juniper, and ponderosa biomes. Most respondents in low-risk Grants also live in urban areas, with smaller percentages in pasture, desert, pinon-juniper, and ponderosa.

There was little difference in the percentage of respondents that have observed rodents in their homes between high and low-risk sites. Therefore, it was expected that no significant difference would emerge. Those who have observed rodents in their homes would indicate a higher risk of exposure to HPS. It should be noted that more than one half of the respondents in Gallup/Farmington and close to 45% of the respondents in Grants have observed rodents in the home, indicating risk of exposure to HPS. While those at highest risk live within specific altitudes and biomes, no one is completely risk free from exposure. Therefore, those living in rural pasture environment indicates environmental disturbance, feed sheds, and occupational exposure to HPS.

Section III – Knowledge Responses

Table 5.12: ***Frequency and Percentages of Knowledge Responses for the New Mexico Sample***

	Gallup, Farmington (n=133)	Grants (n=67)	Chi-sq (df)	p
Heard of HPS? Yes, (%)	128 (96.2)	56 (83.6)	9.700 (1)	.002
When? No. (%)	Overall chi-sq (df)		12.710 (6)	.048
Prior to 1970	0 (0)	1 (1.5)	1.995 (1)	.158
1971-1980	5 (3.8)	0 (0.0)	2.583 (1)	.108
1981-1990	9 (6.8)	6 (9.0)	.308 (1)	.579
1991-1993	8 (5.3)	4 (6.0)	.000 (1)	.990
1994-1999	41 (31.1)	9 (14.9)	7.190 (1)	.007
2000-2007	30 (20.7)	22 (31.3)	2.447 (1)	.118
No response	40 (30.3)	25 (37.3)	1.064 (1)	.302
How heard of HPS, no. (%)				
Newspaper	80 (60.2)	28 (41.8)	6.406 (1)	.014
Television	95 (71.4)	42 (62.7)	1.578 (1)	.209
Radio	45 (33.8)	15 (22.4)	2.780 (1)	.095
Family friends	59 (44.4)	20 (29.9)	3.925 (1)	.048
Other	18 (13.5)	5 (7.5)	7.582 (14)	.910
Know someone that has had HPS? No. (%)	23 (17.3)	5 (7.5)	3.576 (1)	.059
How do people catch HPS? No. (%)				
Animal bites	10 (7.5)	4 (6.0)	.164 (1)	.685
Other sick people	4 (3.0)	0 (0.0)	2.056 (1)	.152
Breathing contaminated air	125 (94.0)	51 (76.1)	13.467 (1)	.000
Petting dog or cat	4 (3.0)	1 (1.5)	.420 (1)	.517
Working with livestock	6 (4.5)	3 (4.5)	.000 (1)	.991
Kinds of animals/insects carry HPS? No. (%)				
Mosquitoes	13 (9.8)	10 (14.9)	1.162 (1)	.281
Ticks	8 (6.0)	6 (9.0)	.592 (1)	.442
Dogs	3 (2.3)	1 (1.5)	.132 (1)	.716
Mice	126 (94.7)	50 (74.6)	17.063 (1)	.000
Sheep	3 (2.3)	0 (0.0)	1.534 (1)	.215
Cats	4 (3.0)	1 (1.5)	.420 (1)	.517
Fleas	13 (9.8)	7 (10.4)	.022 (1)	.881

Table 5.12 Continued

	Gallup, Farmington (n=133)	Grants (n=67)	Chi-sq (df)	p
Symptoms of HPS No. (%)				
Aches	88 (66.2)	26 (38.8)	13.607 (1)	.000
Sore throat	40 (30.1)	12 (17.9)	3.427 (1)	.064
Rash	18 (13.5)	3 (4.5)	3.888 (1)	.049
Fever	100 (75.2)	44 (65.7)	2.001 (1)	.157
Headache	61 (45.9)	13 (19.4)	13.384 (1)	.000
Cough	58 (43.6)	13 (19.4)	11.401 (1)	.001

In terms of if the respondent has heard of HPS, chi-square analysis indicated a significant difference (p = .002) between high and low-risk sites. This result should have been expected since the percentage difference between the sites was a margin of 12.6% and because HPS is more prevalent in the Gallup/Farmington area than Grants. Additionally, the original outbreak occurred in the Gallup/Farmington Four Corners area, so it was also expected that more respondents would have heard of HPS.

With respect to when the respondent heard of HPS, overall, the chi-square results showed a significant difference between high and low-risk sites (p = .048). In particular, those respondents who had heard of HPS between 1994 and 1999 showed the most significance, while other categories, including 2000-2007 did not result in significance. Those who heard of HPS prior to 1994 were included as categories because of cultural influences on collective memory. No response, which occurred more than 30% in each population, was also included because the time lapse between the initial outbreak and data collection was 13 years. However, after 1999, a greater percentage of respondents in Grants have heard about HPS than in Gallup/Farmington.

For those respondents who did hear about HPS, detailed chi-square results showed a significant difference between high and low-risk sites from those who had heard about HPS through newspapers (p = .014) and family/friends (p = .048). While the variable choices and answers are not discrete, the table does show high percentages of respondents who heard about HPS via newspaper, television, and family/friends. Just over one third of the respondents from Gallup/Farmington learned about HPS from radio information, while a little more than one fifth of the respondents from Grants learned about HPS from the radio. "Other" responses included clinic and emergency room information, school, work, and family/friends that contracted HPS.

More than twice the percentage of respondents between high and low-risk sites know someone who has had HPS, and it was expected that a significant difference would emerge. Chi-square analysis demonstrated that there was not a significant difference, yet since p does approach significance, it would seem reasonable to consider this variable in further exploratory analysis.

In terms of how people contract HPS, detailed chi-square results predicted a significant difference between high and low-risk sites with respect to breathing contaminated air (p = .000). The variable choices and answers are not discrete, and the table does show small percentages of respondents who believe that HPS may be caught from animal bites (rare), other sick people (not confirmed with SNV/HPS), petting a dog or cat (not likely) or working with livestock (not likely).

Detailed chi-square results showed a significant difference in knowledge between high and low-risk sites with respect to mice as the animal that carries HPS (p = .000) This is not surprising since the original outbreak was in northwestern New Mexico and the respondents from Gallup/Farmington were in the center of outbreak controversy in 1993. The knowledge variable choices and answers are not discrete and the table does show small percentages of respondents who believe that HPS is carried by arthropods (mosquitoes, ticks, fleas), as well as animals that are not mice, such as dogs, sheep, and cats.

In terms of symptoms of HPS, detailed chi-square results showed a significant difference between high and low-risk sites with respect to aches, rash, headache, and cough. Percentages of respondents differ greatly for these choices, and since the original outbreak occurred in the Four Corners area of New Mexico, it was not unexpected that those respondents would recognize HPS symptoms. Although the percentages are low of those who believe rash is a symptom, the result remains significant, but is an incorrect response to HPS symptoms and indicates that misinformation has been received by a small percentage of respondents at each site.

Overall, knowledge responses indicate that, compared to respondents in low-risk areas, most respondents in high-risk areas have heard about HPS, they heard about it primarily through television and radio and family, and they know that people catch HPS by breathing contaminated air. They also know that mice carry the virus, and are aware of the symptoms of HPS. This is critical because although the knowledge may be accurate, behavior responses must be considered to assess whether the knowledge is translating into the proper activities designed to reduce exposure risk.

Section IV – Behavior Responses

Table 5.13: ***Frequency and Percentage in Cleaning Level Change for the New Mexico Sample***

	Gallup, Farmington (n=133)	Grants (n=67)	Chi-sq (df)	p
Level of cleaning change No. (%)		Overall chi-sq (df):	8.035 (4)	.090
Changed extremely	20 (15.0)	4 (6.0)	3.469 (1)	.063
Changed very much	27 (20.3)	9 (13.4)	1.424 (1)	.233
Changed a little bit	42 (31.6)	20 (29.9)	.063 (1)	.803
Not changed much	16 (12.0)	14 (20.9)	2.747 (1)	.097
No change	17 (12.8)	8 (11.9)	.029 (1)	.865

Overall chi-square results showed no significant difference (p=.090) in levels of cleaning changes between high and low-risk sites. Detailed analysis showed that most respondents from each site reported changing a little bit. More respondents from Gallup/Farmington than those from Grants changed habits extremely or very much. More respondents from Grants had not changed habits much at all, while similar percentages of respondents from each site reported no changes in cleaning habits. With the exception of not changed much, more respondents in the higher risk sites exhibit more change in cleaning levels than those in the low-risk site. Thus most respondents in the high-risk area reported changing cleaning levels a little bit or very much, suggesting a closer look is needed to assess what they are actually doing.

Table 5.14: ***Frequency and Percentage of How Habits Have Changed for the New Mexico Sample***

	Gallup, Farmington (n=133)	Grants (n=67)	Chi-sq (df)	p
How have habits changed, No. (%)				
Mop more	40 (30.1)	14 (20.9)	1.905 (1)	.168
Sweep and/or vacuum more	42 (31.6)	15 (22.4)	1.847 (1)	.174
Disinfect more	63 (47.4)	24 (35.8)	2.417 (1)	.120
Set more traps	45 (33.8)	15 (22.4)	2.780 (1)	.095
Wear rubber gloves	43 (32.3)	15 (22.4)	2.139 (1)	.144
Wear dust mask	42 (31.6)	7 (10.4)	10.756 (1)	.001
Wear ventilator mask	2 (1.5)	2 (3.0)	.499 (1)	.480
Other	4 (3.0)	3 (4.5)	7.980 (7)	.334

Detailed chi-square results showed no significant difference in most categories of how cleaning habits had changed between high and low-risk sites. Detailed analysis did show a significant difference between sites in those who wore dust masks (p = .001), which is an ineffective method of cleaning. Use of sweeping and vacuuming, which is also ineffective ways to clean, did not show significant difference between sites. The remaining variables, which are generally recognized as proper cleaning methods did not show significant differences between the sites. Results demonstrate that respondents from each site performed not only improper cleaning habits such as sweeping and wearing a dust mask, but also the proper methods such as mopping, disinfecting, setting traps, wearing rubber gloves, and using a ventilator mask. This suggests that although knowledge is sufficient (as indicated in Table 5.12), the messages received may not be as clear as they should be in terms of translating into proper cleaning methods.

Table 5.15: Frequency and Percentage of Purchase Changes for the New Mexico Sample

	Gallup, Farmington (n=133)	Control site: Grants (n=67)	Chi-sq (df)	p
Purchases, No. (%)				
Mouse rat traps	47 (35.3)	14 (20.9)	4.384 (1)	.036
Rat poison	23 (17.3)	13 (19.4)	.134 (1)	.714
Bleach	54 (40.6)	23 (34.3)	.741 (1)	.389
Dust masks	23 (17.3)	6 (9.0)	2.499 (1)	.114
Disinfectants	52 (39.1)	21 (31.3)	1.156 (1)	.282
Ventilator masks	6 (4.5)	2 (3.0)	.270 (1)	.603
Other	3 (2.3)	1 (1.5)	3.499 (4)	.478

Detailed analysis shows a significant difference between sites in terms of those who purchase mousetraps (p = .036), which is an effective method of rodent control when implemented properly. Except for purchasing dust masks, the remaining variables are generally recognized as proper purchases methods and did not show significant differences between the sites. This demonstrates that respondents sometimes make improper cleaning purchases such as buying dust masks, but most buy the proper items such as traps, poison, bleach, disinfectants and ventilator masks. Public health approaches should include the message to continue proper cleaning methods and that dust masks are ineffective.

Table 5.16: ***Frequency and Percentage of Peridomestic Improvements for the New Mexico Sample***

	Gallup, Farmington (n=133)	Control site: Grants (n=67)	Chi-sq (df)	p
Peridomestic improvements No. (%)				
Mouse rat proof home	53 (39.8)	18 (26.9)	3.280 (1)	.070
Remove trash from home	64 (48.1)	30 (44.8)	.200 (1)	.655
Clean up wood piles	39 (29.3)	14 (20.9)	1.625 (1)	.202
Cut grass weeds	50 (37.6)	21 (31.3)	.760 (1)	.383
Other	5 (3.8)	4 (6.0)	6.891 (4)	.142

Detailed analysis showed no significant differences between high and low-risk groups with respect to peridomestic improvements, although differences in the rat proofing of homes approach significance. More respondents from Gallup/Farmington than Grants were performing the proper tasks but overall respondents from both sites demonstrated proper improvements such as mouse/rat proofing the home, removing trash, cleaning wood piles, and cutting grass and weeds away from the home. These tasks are not only proper for HPS prevention, but also good activities for peridomestic sanitation and general environmental conditions.

Table 5.17: ***Frequency and Percentage in Response Upon Hearing about HPS for the New Mexico Sample***

	Gallup, Farmington (n=133)	Control site: Grants (n=67)	Chi-sq (df)	p
Response upon hearing about HPS, No. (%)				
Check for mice	89 (66.9)	30 (44.8)	9.063 (1)	.003
Clean the house	69 (51.9)	20 (29.9)	8.754 (1)	.003
Took vitamins	12 (9.0)	3 (4.5)	1.327 (1)	.249
Got a flu shot	20 (15.0)	4 (6.0)	3.469 (1)	.063
Nothing	20 (15 .0)	17 (25.4)	3.157 (1)	.076
Other	12 (9.0)	4 (6.0)	6.549 (11)	8.34

Detailed analysis indicated a significant difference between high and low-risk sites in those who checked for mice (p = .003) and then cleaned the house (p = .003) upon learning about HPS. More respondents in Gallup/Farmington than Grants took vitamins and got an influenza shot, while respondents in Grants were more apt to do nothing upon hearing about HPS. More respondents from Gallup/Farmington than Grants also performed “other” responses, such as telling neighbors and family about HPS. This result indicates respondents in the high-risk areas intend to practice better health protective and prevention behavior in the high-risk areas of Gallup and Farmington. However, upon examination of Table 4.14 above, it appears that respondents are performing not only proper but improper cleaning practices such as sweeping/vacuuming and wearing a dust mask. This indicates that a portion of the population is not receiving the correct information on how to properly clean to reduce risk. Additionally, Table 4.15 indicates that while many respondents are purchasing rattraps, they are also purchasing dust masks, another indication that misinformation or no information is being received by those at high-risk.

Table 5.18: *Frequency and Percentage of Responses to PSAs for the New Mexico Sample*

	Gallup, Farmington (n=133)	Control site: Grants (n=67)	Chi-sq (df)	p
Response to PSAs, No. (%)				
Panic	12 (9.0)	1 (1.5)	4.157 (1)	.041
Stayed home	10 (7.5)	1 (1.5)	3.113 (1)	.078
Avoid contact with animals	30 (22.6)	11 (16.4)	1.030 (1)	.310
Learned more about HPS	80 (60.2)	26 (38.8)	8.149 (1)	.004
Wonder about victim	31 (23.3)	15 (22.4)	.021 (1)	.884

Detailed analysis predicted a significant difference between high and low-risk sites in those who panicked ($p = .041$) and then proceeded to learn more about HPS ($p = .004$). More respondents in Gallup/Farmington than Grants proceeded to stay home, avoided contact with animals, and wondered about the victims of HPS, although the percentage of respondents who wondered about the victims was only 1.1% different between the sites. The high-risk respondents were more attuned to the events surrounding HPS and exhibited varied responses including wondering about the victim(s), but this was to be expected since the initial North American outbreak occurred in the Four Corners area.

Table 5.19: ***Frequency and Percentage of Concern About Catching HPS for the New Mexico Sample***

	Gallup, Farmington (n=133)	Control site: Grants (n=67)	Chi-sq (df)	p
Concern about catching HPS, No. (%)		Overall chi-sq (df):	6.616 (4)	.158
Very concerned	29 (21.8)	7 (10.4)	3.893 (1)	.048
Concerned	20 (15.0)	12 (17.9)	.274 (1)	.601
Little bit of concern	24 (18.0)	8 (11.9)	1.235 (1)	.266
Not much concern	33 (24.8)	20 (29.9)	.581 (1)	.446
Not concerned at all	21 (15.8)	9 (13.4)	.194 (1)	.660

Overall chi-square results showed no significant difference (p=.158) between high and low-risk sites with respect to concern for self and family about catching HPS. Detailed analysis, however, shows a significant difference between high and low-risk sites in those who are concerned about catching HPS (p = .048) More respondents in Gallup/Farmington than Grants show only a little concern or no concern at all, while those from Grants were either concerned or had not much concern about catching HPS. This indicates the respondents from the high-risk areas remain aware of HPS. For those respondents that are not concerned, they could already be practicing proper cleaning habits through accurate knowledge, or it could mean that since HPS risk rises and lowers over time and public health messages are not consistent in either amount of information or access to information.

PANAMA

Section V – Sociodemographic Characteristics

Table 5.20: ***Sample Characteristics by Site in Panama***

Residence (Community)	Tonosi, Pocri (n = 133); No. (%)	Jaguito – El Roble (n=67); No. (%)
Pocri	33 (24.8)	0 (0.0)
Tonosi	42 (31.6)	0 (0.0)
Jaguito	0 (0.0)	9 (13.4)
El Roble	0 (0.0)	53 (79.1)
Bucaro	2 (1.5)	0 (0.0)
Cadezera	1 (0.8)	0 (0.0)
Cambutal	2 (1.5)	0 (0.0)
Canafistulo	3 (2.3)	0 (0.0)
Cartego	1 (0.8)	0 (0.0)
Cubucara	1 (0.8)	0 (0.0)
El Bebedero	4 (3.0)	0 (0.0)
El Cacao	3 (2.3)	0 (0.0)
Flores	3 (2.3)	0 (0.0)
Guanico	6 (4.5)	0 (0.0)
La Concapcia	1 (0.8)	0 (0.0)
La Laguna	1 (0.8)	0 (0.0)
La Zaganini	1 (0.8)	0 (0.0)
Lajamina	12 (9.0)	0 (0.0)
Las Tablas	1 (0.8)	0 (0.0)
Loto	1 (0.8)	0 (0.0)
Manato	1 (0.8)	0 (0.0)
Paraiso	2 (1.5)	0 (0.0)
Paratilla	2 (1.5)	0 (0.0)
Pueblo Nuevo	1 (0.8)	0 (0.0)
Purio	3 (2.3)	0 (0.0)
Santo Domingo	2 (1.5)	0 (0.0)
Not identified	4 (3.0)	5 (7.5)

All sites demonstrated appropriate response numbers, indicating that most respondents were from the intended communities that were the high-risk sites Tonosi and Pocri, and low-risk site Jaguito – El Roble. More respondents in the high-risk areas noted smaller communities where they live surrounding the areas of Tonosi and Pocri. Most were from Pocri, Tonosi, and Lajamina, a regional community. Four did not identify their residence community. In the lower risk site of Jaguito – El Roble respondents were from the actual community. Five did not identify their community.

Table 5.21: ***Frequency and Percentage of Women in the Panama Sample***

	Tonosi, Pocri (n = 133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Women, No. (%)	64 (49.2)	50 (76.9)	13.684 (1)	.000

There was a difference in the female gender structure between Tonosi/Pocri (49.2%) and the Jagito – El Roble (76.9%) sites in overall percentages. Therefore, it was reasonable to expect a significant difference between the sites. Chi-square analysis confirms the expectation, as p = .000.

Table 5.22: ***Frequency and Percentage of Age Distributions in the Panama Sample***

	Tonosi, Pocri (n = 133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Age, No. (%)	Overall chi-sq (df):		.571 (5)	.989
18-25	15 (11.3)	10 (14.9)	.542 (1)	.462
26-34	28 (21.1)	14 (20.9)	.001 (1)	.979
35-44	40 (30.1)	19 (28.4)	.063 (1)	.802
45-54	23 (17.3)	11 (16.4)	.024 (1)	.876
55-64	13 (9.8)	6 (9.0)	.035 (1)	.852
>64	11 (8.3)	6 (9.0)	.027 (1)	.870
Average age	42.71	41.79	t = .425	p = .672

Overall, the chi-square results indicated no significant difference (p=.989) among age groups and the sites indicating similar age composition in the two Panama site samples. Difference of means test calculated for average age across categories (Tonosi/Pocri = 42.71 years, Jaguito – El Roble = 41.79 years) for this variable. In terms of frequencies, most respondents from both high and low-risk sites were between the ages of 26-34, 35-44, and 45-54.

Table 5.23: ***Frequency and Percentage of Number of Minor Children in the Household in the Panama Sample***

	Tonosi, Pocri (n = 133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Number of minor children in household, No. (%)		Overall chi-sq (df):	4.978 (4)	.290
No children	46 (34.6)	17 (25.4)	1.753 (1)	.186
1 child	34 (25.6)	19 (28.4)	.179 (1)	.673
2 children	24 (18.0)	20 (29.9)	3.619 (1)	.057
3 children	23 (17.3)	8 (11.9)	.975 (1)	.323
4 or more children	6 (4.5)	3 (4.5)	.000 (1)	.991
Average children/home	1.52	1.74	t = -1.032	p = .303

Overall, the chi-square results provided no significant difference (p = .290) in the relative number of minor children in the household. High frequencies and percentages show that in both high and low-risk sites, households had 2 or fewer minor children living in the household. It should be noted that in households with 2 minor children, Jaguito – El Roble (29.9%) Tonosi/Pocri (18%), the p value did approach significance (p = .057).

Table 5.24: ***Frequency and Percentage of Race/Ethnicity in the Panama Sample***

	Tonosi, Pocri (n = 133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Ethnicity, No. (%)		Overall chi-sq (df):	14.032 (5)	.015
Indigenous	0 (0.0)	0 (0.0)	---	---
White	42 (31.6)	22 (32.8)	.032 (1)	.857
Mestizo	70 (52.6)	35 (52.2)	.003 (1)	.958
Asian	2 (1.5)	0 (0.0)	1.018 (1)	.313
Black	4 (3.0)	9 (13.4)	7.968 (1)	.005
Mulato	7 (5.3)	0 (0.0)	3.654 (1)	.056
other	8 (6.0)	1 (1.5)	.506 (2)	.477

Overall, the chi-square results showed a significant difference between high and low-risk sites (p = .015). In particular, the Black (p = .005) respondents showed the most significance between the high and low-risk sites, while Anglo, non-Hispanic and Other did not result in significance. It should be noted that Mulato (p = .056) approached significance but actual numbers were low (7 in Tonosi/Pocri; 0 in Jaguito – El Roble). Most respondents identified as either Mestizo or White.

Table 5.25: *Frequency and Percentage Income Brackets in the Panama Sample*

	Tonosi, Pocri (n = 133)	Jaguito – El Roble (n=67)	Chi-sq (df) t-test	p
Income, (Balboas) No. (%)		Overall chi-sq (df):	38.433 (6)	.000
0-100	32 (24.1)	5 (7.5)	8.140 (1)	.004
101-200	32 (24.1)	8 (11.9)	4.090 (1)	.043
201-300	15 (15.8)	2 (3.0)	7.178 (1)	.007
301-400	8 (2.3)	9 (13.4)	9.869 (1)	.002
401-500	2 (1.5)	2 (3.0)	.499 (1)	.480
>500	9 (6.8)	7 (10.4)	.820 (1)	.365
Not identified	29 (21.8)	33 (49.3)	15.694 (1)	.000
Average Income	196.63	310.29	t = -3.137	p = .001

Overall, the chi-square results indicated a significant difference (p = .000) between income ranges in the high and low-risk sites. A difference of means test (average income: Tonosi/Pocri $196.63/month; Jaguito – El Roble $310.29) confirmed significant differences in average income (p = .001). Most categories did show individual significance, with the exception of the 401-500 and >550 Bbl/month income ranges, the only categories that did not show significance between high and low-risk sites. These results are not surprising since Jaguito – El Roble is more urbanized in comparison to the more rural areas of Tonosi/Pocri. Therefore Jaguito – El Roble is more likely to have a higher income base than Tonosi/Pocri. Almost half of the respondents in Jaguito – El Roble did not report monthly household income, while a little more than one-fifth of the respondents in Tonosi/Pocri did not divulge their household income.

Unlike New Mexico, in this sample, the high-risk areas are generally low income, indicating low SES. This table also indicates that there is less stratification in Panama since most respondents earned 400 Bbl per month or less.

Table 5.26: ***Frequency and Percentage by Occupation Category in the Panama Sample***

	Tonosi, Pocri (n = 133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Occupation, No. (%)	Overall chi-sq (df):		46.915 (7)	.000
Professional	15 (11.3)	11 (16.4)	1.041 (1)	.308
Skilled labor	9 (6.8)	1 (1.5)	2.609 (1)	.106
Agricultural	33 (24.8)	0 (0.0)	19.909 (1)	.000
Construction	1 (0.8)	4 (6.0)	4.977 (1)	.026
Secretary/Office	21 (15.8)	1 (1.5)	9.303 (1)	.002
Sales	6 (4.5)	1 (1.5)	1.202 (1)	.273
Ama de casa (housewife)	29 (21.8)	30 (44.8)	11.305 (1)	.001
Other	18 (13.5)	17 (25.4)	40.57 (29)	.075

Overall, the chi-square results for occupation did indicate significance (p = .000) in occupation as categories. More respondents from Tonosi/Pocri work in the agricultural or housewife occupations while respondents from Jaguito – El Roble work in construction or are housewives. Other occupations were listed as students, retirees, and clergy.   In terms of high-risk exposure, respondents that indicate agricultural occupations should be cognizant of risk reduction procedures.

Table 5.27: ***Frequency and Percentage by Education Levels in the Panama Sample***

	Tonosi, Pocri (n = 133)	Jaguito – El Roble (n=67)	Chi-sq (df) t-test	p
Education, No. (%)	Overall chi-sq (df):		20.886 (4)	.000
None	7 (5.3)	1 (1.5)	1.650 (15)	.199
Primary	62 (46.4)	13 (19.4)	14.790 (1)	.000
Secondary	41 (30.8)	37 (55.2)	11.147 (1)	.001
University	17 (12.8)	15 (22.4)	3.059 (1)	.080
Technical	4 (3.0)	1 (1.5)	.420 (1)	.517
Average years of education	8.19	10.02	t = -3.1900	p = .000

Overall, the chi-square results did provide a significant difference (p = .000) between the high and low-risk sites with respect to education. A difference of means test (average years of education 8.19 Tonosi/Pocri; 10.2 Jaguito – El Roble) confirmed that education (p = .000) should be considered carefully during further site analysis. Results also indicate that respondents in Jagito – El Roble have a slightly higher level of education than respondents in Tonosi/Pocri. Furthermore, respondents in Tonosi/Pocri have completed at least a primary level of education, while those in Jaguito – El Roble are more likely to have completed at least a secondary (US high school) equivalent level of education. Although not significant, almost twice the number of respondents in Jaguito – El Roble has attended University, indicating that the likelihood of higher income and better occupation, and better living conditions for the control site.

Overall, the high-risk areas in Panama are more consistently low SES (lower income levels, rural occupations/housewives, and lower overall education levels), which indicates higher levels of populations at risk. This also means the high-risk areas are not as hidden in the communities as in the United States.

Section VI – Mediating Variables

Table 5.28: *Frequency and Percentage of Length of Time in Area in the Panama Sample*

	Tonosi, Pocri (n = 133)	Jagito – El Roble (n = 67)	t-test	p
Length of time in area (average years)	29.60	35.00	t = -1.829	p = .069

There was a relatively small difference in the average length of time in years that respondents lived in both high and low-risk areas. Therefore, it was reasonable to expect no significant difference between the sites. T-test analysis confirmed that length of time in the area did not emerge as a confounding factor to consider in further analysis. Compared to Section 1, Table 3, Age Groups, the Tonosi/Pocri sample represents the middle range of the 26-34 age group and in the Jaguito – El Roble sample, the low end of the 35-44 age group. Therefore, the sample indicates respondents that have been living in the area at least half of their lives.

Table 5.29: *Frequency and Percentage in Type of Home, Average Age of Home, and Home Ownership for the Panama Sample*

	Tonosi, Pocri (n = 133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Type of Home No. (%)	Overall chi-sq (df):		30.950 (5)	.000
Cement	86 (64.7)	67 (100.0)	30.950 (1)	.000
Madera (wood)	20 (15.0)	0 (0.0)	11.195 (1)	.001
Pencas (thatch)	3 (2.3)	0 (0.0)	1.534 (1)	.215
Ladril (brick)	6 (4.5)	0 (0.0)	3.116 (1)	.078
Quinch (mud and fabric)	11 (8.3)	0 (0.0)	5.864 (1)	.015
Other (plastic)	1 (0.8)	0 (0.0)	.506 (1)	.477
Age of home t-test (average age in years)	20.54	22.38	t = -.731	p = .466
Own home No. (%)	107 (80.5)	64 (95.5)	8.163 (1)	.004

Overall, the chi-square results for housing type (p = .000) did emerge as significant between high and low-risk sites, and upon further analysis the following home categories indicated significance: Cement, madera, and quinch. Most respondents in Panama live in cement homes, as compared to those who live in wood frame, thatch, brick, and quinch. Cement homes are common in Panama because of the warm, humid climate, sturdy construction required in case of hurricanes, as well as accessibility to building materials. All respondents in Jaguito – El Roble live in cement homes, which is an indication of higher affluence than those in Tonosi/Pocri who also live in the rest of the categories, while one respondent lives in a plastic home.

There was little difference in the average age of homes between high and low-risk sites of respondents lived in the area. This indicates that cement homes are generally constructed well and last in the humid climate as noted above. Therefore, it was expected that no significant difference would emerge between the sites. T-test analysis (p = .466) confirmed that average age of homes did not emerge as a confounding factor to consider in further analysis.

There was a difference in the percentage of homeowners between high and low-risk sites. Respondents in the low-risk, more affluent site of Jaguito – El Roble are more likely to own their own home while respondents in the rural, poor high-risk site are less likely to own their own home. Therefore, it was expected that a significant difference would emerge.

Table 5.30: ***Frequency and Percentage of Biome and Observation of Rodents in the Home for the Panama Sample***

	Tonosi, Pocri (n = 133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Biome, No. (%)		Overall chi-sq (df):	14.895 (4)	.005
City	82 (61.7)	25 (37.3)	10.611 (1)	.001
Rural pasture	38 (28.6)	34 (50.7)	9.509 (1)	.002
Rural desert	0 (0.0)	1 (1.5)	1.995 (1)	.158
Rural maisal (corn field)	2 (1.5)	3 (4.5)	1.617 (1)	.204
Rural, arroz (rice patty)	3 (2.3)	2 (3.0)	.097 (1)	.755
Observed rodents in home? No. (%)	104 (78.2)	47 (70.1)	1.559 (1)	.212

Overall, the chi-square results for the type of biome in which respondents lived (p = .005) did emerge as significant, and upon further detailed analysis, those living in both the city (p = .001) and rural pasture areas (p = .002) did show significant differences between the high and low-risk sites. Although the high-risk site is more rural, most respondents in Tonosi/Pocri consider themselves to live in a more urban environment than those in Jaguito – El Roble. Conversely, more respondents who live in Jaguito – El Roble consider themselves to live in a more rural environment compared to Tonosi/Pocri, even though Jaguito – El Roble is a more urban biome. Relatively few respondents from either site live in rural desert, cornfields or rice patties.

There was little difference between high and low-risk sites in the percentage of respondents that had observed rodents in their homes; more than 70% of respondents in Jaguito – El Roble and close to 80% of respondents in Tonosi/Pocri had observed rodents in the home. Therefore, it was expected that no significant difference would emerge.

Section VII – Knowledge Responses

Table 5.31: ***Frequency and Percentages of Knowledge Responses for the Panama Sample***

	Tonosi, Pocri (n=133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Heard of HPS Yes, No. (%)	124 (93.2)	67 (100.0)	4.74 (1)	.029
When?		Overall chi-sq (df)	6.657 (4)	.155
Prior to 1970	0 (0.0)	0 (0.0)	---	---
1971-1980	1 (0.8)	1 (1.5)	0.247 (1)	.619
1981-1990	0 (0.0)	2 (3.0)	4.010 (1)	.045
1990-1993	0 (0.0)	0 (0.0)	---	---
1994-1999	27 (20.3)	19 (28.4)	1.633 (1)	.201
2000-2007	92 (69.2)	41 (61.2)	1.273 (1)	.259
No response	13 (9.8)	4 (6.0)	0.829 (1)	.363
How heard of HPS No. (%)				
Newspaper	25 (18.8)	29 (43.3)	13.554 (1)	.000
Television	95 (71.4)	54 (80.6)	1.971 (1)	.160
Radio No.	49 (36.8)	21 (31.3)	.592 (1)	.442
Family friends	16 (12.0)	7 (10.4)	.110 (1)	.741
Other	11 (8.3)	20 (29.9)	41.455 (7)	.000
Know someone that has had HPS? No. (%)	54 (40.6)	47 (70.1)	15.561 (1)	.000
How do people catch HPS? No. (%)				
Animal bites	7 (5.3)	1 (1.5)	1.650 (1)	.199
Other sick people	8 (6.0)	4 (6.0)	.000 (1)	.990
Breathing contaminated air	110 (82.7)	63 (94.0)	4.892 (1)	.027
Petting dog or cat	1 (0.8)	0 (0.0)	.506 (1)	.477
Working with livestock	3 (2.3)	0 (0.0)	1.534 (1)	.215
Kinds of animals/insects carry HPS? No. (%)				
Mosquitoes	6 (4.5)	2 (3.0)	.270 (1)	.603
Ticks	0 (0.0)	0 (0.0)	---	---
Dogs	2 (1.5)	0 (0.0)	1.018 (1)	.313
Mice	122 (91.7)	65 (97.0)	2.048 (1)	.152
Sheep	0 (0.0)	1 (1.5)	1.995 (1)	.158
Cats	1 (0.8)	1 (1.5)	.247 (1)	.619
Fleas	1 (0.8)	0 (0.0)	.506 (1)	.477

Table 5.31 Continued

	Tonosi, Pocri (n=133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Symptoms of HPS No. (%)				
Aches	33 (24.8)	6 (9.0)	7.137 (1)	.008
Sore throat	23 (17.3)	6 (9.0)	2.499 (1)	.114
Rash	10 (7.5)	0 (0.0)	5.303 (1)	.021
Fever	54 (40.6)	28 (41.8)	.026 (1)	.872
Headache	40 (30.1)	27 (40.3)	2.090 (1)	.148
Cough	91 (68.4)	59 (88.1)	9.165 (1)	.002

In terms of whether the respondent has heard of HPS, chi-square analysis demonstrated a significant difference (p = .029) between high and low-risk sites. This result should have been expected since 100% of the respondents in the low-risk site of Jaguito – El Roble had heard of HPS while 93.2 of the respondents in Tonosi/Pocri, a high-risk site had heard of HPS. This is interesting because the index case of 2000 was from the Tonosi area.

With respect to when the respondent had heard of HPS, overall the chi-square results did not indicate a significant difference between high and low-risk sites (p = .155). In particular, most respondents had heard of HPS between 2000 and 2007 while some had heard of HPS prior to 2000. That most respondents heard of HPS between 2000 and 2007 is not surprising because Carnival, an important cultural event leading up to the religious event of Lent was cancelled in 2000 due to the outbreak. This finding suggests that the population sampled indicates that the disruption of cultural and religious events that was due to the emergence of HPS remains a part of the collective memory of the community.

For those respondents who did hear about HPS, detailed chi-square results showed a significant difference between high and low-risk sites from respondents who heard about HPS through newspapers (p = .000) and other sources (p = .000). While the variable choices and answers are not discrete, the table does show high percentages of respondents who heard about HPS via all categories. Most respondents from each site heard about HPS from the television. "Other" responses included direct clinic information such as "Charlas de Salud" and medical personnel in the communities.

Almost twice the percentage of respondents between low and high-risk sites knows someone who has had HPS, and it was expected that a significant difference would emerge. Chi-square analysis confirmed a significant difference, and it would seem reasonable to consider this mediating variable in further exploratory analysis.

With respect to how HPS is transmitted, detailed chi-square results indicated a significant difference between high and low-risk sites with respect to breathing contaminated air (P = .000). Although both site show a very high percentage of respondents that know how HPS is transmitted (Tonosi/Pocri 82.7%; Jaguito – El Roble 94%), more respondents in the low-risk area know that the greatest risk comes from breathing contaminated air. This indicates that those in the higher risk areas are either not receiving correct information or do not understand the information being transmitted to the community. The table does show small percentages of respondents who believe that HPS may be transmitted through animal bites (rare), other sick people (not confirmed with HPS), petting a dog or cat (not likely) or working with livestock (not likely).

Although there is a significant difference between sites in how HPS is transmitted, detailed chi-square results showed no differences among categories between high and low-risk sites with respect to the kinds of animals/insects that carry HPS. However, the table does show small percentages of respondents who thought that HPS is carried by arthropods (mosquitoes, fleas), and mammals other than rodents (dogs, sheep, and cats).

In terms of symptoms of HPS, detailed chi-square results provided a significant difference between high and low-risk sites with respect to recognition of HPS symptoms. Since HPS initially mimics influenza, it was not unexpected that respondents would recognize the prodromal stages of HPS symptoms. Although the percentages are low of those who believe rash is a symptom, and no respondents in Jaguito – El Roble believe rash is a symptom, the result was significant, and indicates misinformation has been received by a small percentage of respondents in the high-risk Tonosi/Pocri site.

Overall, respondents in Panama have heard of HPS, have learned about it from television, newspaper and radio, and most have known someone with HPS. The latter could be a result from living in smaller communities and extended families. Most know that breathing contaminated air is how HPS is transmitted, but fewer respondents in the high-risk area than the low-risk area know that breathing contaminated air is how HPS is transmitted and that rodents are the carriers. Lastly, those in high-risk areas generally consider rash to be a symptom of HPS. These three areas of HPS knowledge are critical to understanding behavior changes. Since fewer respondents in the high-risk areas know this information, it is expected that the behavioral responses will be either negative, or a mixture of negative with positive behavior.

Section VIII – Behavior Responses

Table 5.32: ***Frequency and Percentage in Cleaning Level Change for the Panama Sample***

	Tonosi, Pocri (n=133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Level of change, No. (%)		Overall chi-sq (df):	7.810 (4)	.099
Changed extremely	73 (54.9)	46 (68.7)	3.506 (1)	.061
Changed very much	25 (18.8)	13 (19.4)	.011 (1)	.918
Changed a little bit	20 (15.0)	6 (9.0)	1.457 (1)	.227
Not changed much	5 (3.8)	2 (3.0)	.079 (1)	.779
No change	1 (0.8)	0 (0.0)	.506 (1)	.477

Cleaning changes did not differ significantly (p=.099) between high and low-risk sites. Detailed analysis showed that most respondents from each site reported changing anywhere from extremely to a little bit. More respondents from low-risk Jaguito – El Roble than respondents from Tonosi/Pocri changed habits extremely and changed very much. More respondents from the high-risk site of Tonosi/Pocri have only changed a little bit, not changed much or not at all. Concern about catching HPS and level of cleaning change show that respondents want to perform proper cleaning methods, but may not necessarily know what to do.

Table 5.33: ***Frequency and Percentage of How Habits Have Changed for the New Mexico Sample***

	Tonosi, Pocri (n=133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
How have habits changed, No. (%)				
Mop more	63 (47.4)	16 (23.9)	10.286 (1)	.001
Sweep and/or vacuum more	63 (47.4)	37 (55.2)	1.100 (1)	.294
Disinfect more	53 (39.8)	36 (53.7)	3.476 (1)	.062
Set more traps	35 (26.3)	23 (34.3)	1.389 (1)	.239
Wear rubber gloves	14 (10.5)	0 (0.0)	7.583 (1)	.006
Wear dust mask	20 (15.0)	4 (6.0)	3.469 (1)	.063
Wear ventilator mask	3 (2.3)	0 (0.0)	1.534 (1)	.215
Other	6 (4.5)	4 (6.0)	5.362 (5)	.373

With respect to how cleaning habits have changed, detailed analysis indicates a significant difference between high and low-risk sites in those who mop more (p = .001) and for those who wear rubber gloves (p = .006) which are effective cleaning methods. Sweeping and vacuuming, which is also an ineffective way to clean did not show significant difference between sites, yet a high percentage of respondents at both high and low-risk sites are performing these chores. This indicates either misinformation being transmitted or respondents not understanding that sweeping and vacuuming are incorrect cleaning methods to reduce risk to exposure and may in fact increase risk. The rest of the variables, which are generally recognized as proper cleaning methods did not show significant differences between the sites. This shows that respondents from each site perform not only improper cleaning habits, but also the proper methods such as mopping, disinfecting, setting traps, wearing rubber gloves, and in Tonosi/Pocri by using a ventilator mask.

Table 5.34: ***Frequency and Percentage of Purchase Changes for the Panama Sample***

	Tonosi, Pocri (n=133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Purchases, No. (%)				
Mouse rat traps	56 (42.1)	19 (28.4)	3.593 (1)	.058
Rat poison	60 (45.1)	30 (44.8)	.001 (1)	.964
Bleach	29 (21.8)	15 (22.4)	.009 (1)	.925
Dust masks	13 (9.8)	3 (4.5)	1.698 (1)	.192
Disinfectants	49 (36.8)	32 (47.8)	2.204 (1)	.138
Ventilator masks	4 (3.0)	0 (0.0)	2.056 (1)	.152
Other	2 (1.5)	4 (6.0)	6.047 (4)	.196

Detailed analysis did not indicate a significant difference between sites with respect to purchases, although those who purchased traps neared significance from high to low-risk sites. The remaining variables, which are generally recognized as proper purchases did not show significant differences between the sites. This demonstrates that respondents from both high and low-risk sites are performing not only improper cleaning purchases, but also the proper methods such as traps, poison, bleach, disinfectants, and ventilator masks. This indicates that the public health approaches are effective, but need to include the information that dust masks are ineffective in reducing exposure.

Table 5.35: ***Frequency and Percentage of Peridomestic Improvements for the Panama Sample***

	Tonosi, Pocri (n=133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Peridomestic improvements No. (%)				
Mouse rat proof home	81 (60.9)	46 (68.7)	1.156 (1)	.282
Remove trash from home	63 (47.4)	41 (61.2)	3.412 (1)	.065
Clean up wood piles	31 (23.3)	10 (14.9)	1.921 (1)	.166
Cut grass weeds	47 (35.3)	35 (52.2)	5.261 (1)	.022
Remove grains from home	39 (29.3)	17 (25.4)	.345 (1)	.557
Other (got cats)	0 (0.0)	2 (3.0)	4.040 (1)	.045

Detailed analysis shows significant differences between high and low-risk areas with respect to peridomestic improvements such as cutting grass and weeds away from the home and other responses such as getting cats. More respondents from Tonosi/Pocri than Jaguito – El Roble are performing the proper tasks such as cleaning up woodpiles and removing grains from the home. More respondents from Jagito – El Roble than those in Tonosi/Pocri are rat proofing the home, removing trash and cutting the grass/weeds. But overall, respondents from both sites demonstrate proper improvements such as mouse/rat proofing the home, removing trash, cleaning wood piles, and cutting grass and weeds away from the home.

Table 5.36: ***Frequency and Percentage in Response upon Hearing about HPS for the Panama Sample***

	Tonosi, Pocri (n=133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Response upon hearing about HPS, No. (%)				
Check for mice	75 (56.4)	45 (67.2)	2.155 (1)	.142
Clean the house	90 (67.7)	54 (80.6)	3.694 (1)	.055
Took vitamins	6 (4.5)	2 (3.0)	.270 (1)	.603
Got a flu shot	9 (6.8)	7 (10.4)	.820 (1)	.365
Nothing	3 (2.3)	0 (0.0)	1.534 (1)	.215
Other	4 (3.0)	1 (1.5)	1.766 (4)	.779

While detailed analysis predicted no significant difference between high and low-risk sites in response to hearing about HPS, respondents in Jaguito – El Roble cleaned the house (p = .055) more than respondents in Tonosi/Pocri. More respondents in Jaguito – El Roble checked for mice, cleaned the house, and got an influenza shot. More respondents from Tonosi/Pocri took vitamins did nothing or got a cat (other). Respondents checked for mice and cleaned the house, but behavior indicators have shown that in addition to proper methods, respondents are sweeping/vacuuming, which is an incorrect prevention method.

Table 5.37: ***Frequency and Percentage of Responses to PSAs for the Panama Sample***

	Tonosi, Pocri (n=133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Response to PSAs, No. (%)				
Panic	38 (28.6)	30 (44.8)	5.214 (1)	.022
Stayed home	19 (14.3)	1 (1.5)	8.102 (1)	.004
Avoid contact with animals	33 (24.8)	11 (16.4)	1.829 (1)	.176
Learned more about HPS	54 (40.6)	40 (59.7)	6.525 (1)	.011
Wonder about victim	14 (10.5)	6 (9.0)	.122 (1)	.727

Detailed analysis indicates a significant difference between high and low-risk sites in those who panicked (p = .022), stayed home (p = .004), and then proceeded to learn more about HPS (p = .011). More respondents in Jaguito – El Roble panicked, and learned more about HPS, while more respondents in Tonosi/Pocri stayed home, avoided contact with animals and wondered about the victim. Those in the higher risk group did not panic in comparison to the control site, yet were also more inclined to stay home and avoid contact with animals until more information could be learned about HPS. Those in the lower risk site actually learned more about HPS and this is reflected in the changes, purchases, and cleaning habits mentioned above.

Table 5.38: ***Frequency and Percentage of Concern about Catching HPS for the Panama Sample***

	Tonosi, Pocri (n=133)	Jaguito – El Roble (n=67)	Chi-sq (df)	p
Concern about catching HPS, No. (%)		Overall chi-sq (df):	10.525 (4)	.032
Very concerned	53 (39.8)	32 (47.8)	1.141 (1)	.285
Concerned	38 (28.6)	24 (35.8)	1.095 (1)	.295
Little bit of concern	20 (15.0)	8 (11.9)	.355 (1)	.551
Not much concern	0 (0.0)	1 (1.5)	1.995 (1)	.158
Not concerned at all	14 (10.5)	2 (3.0)	3.443 (1)	.064

Overall, the chi-square results showed a significant difference (p=.032) between Jagito – El Roble and Tonosi/Pocri with respect to concern for self and family about catching HPS. Detailed analysis, however, shows no significant difference between high and low-risk sites for the variables. Nevertheless, more respondents in Tonosi/Pocri have a little bit of concern or not concerned at all, while respondents in low-risk Jaguito – El Roble are very concerned, concerned, or show not much concern at all about contracting HPS. This is reflected in the knowledge, cleaning purchases, and habits of the tables above. The public health messages are being received by both sites, but the more affluent area of Jaguito – El Roble is performing more of the proper changes in comparison to Tonosi/Pocri. Both sites, however also exhibit a few improper cleaning procedures, which indicates that the public health messages need to be clearly defined and targeted to specific populations.

CHILE

Section IX – Sociodemographic Characteristics

Table 5.39: ***Sample characteristics by site in Chile***

	Melipeuco, Curacautin (n = 134)	Temuco (n=67)
Residence (Community), No. (%)		
Melipeuco	65 (48.5)	0 (0.0)
Curacautin	57 (42.5)	1 (1.5)
Temuco	0 (0.0)	44 (65.7)
Freire	1 (0.7)	0 (0.0)
Malacahuello	4 (2.2)	0 (0.0)
Angol	0 (0.0)	1 (1.5)
Galvarino	0 (0.0)	1 (1.5)
Gorbea	0 (0.0)	1 (1.5)
Laurtaro	0 (0.0)	4 (6.0)
P las Casas	0 (0.0)	5 (7.5)
Perpuenco	0 (0.0)	1 (1.5)
Petrufuqen	0 (0.0)	1 (1.5)
Victoria	0 (0.0)	3 (4.5)
Not identified	8 (6.0)	5 (7.5)

All sites demonstrated appropriate response numbers indicating that most respondents were from the intended communities, which were the high-risk sites of Melipeuco and Curacautin (MelCur), and low-risk, urban site of Temuco. More respondents in the low-risk area of Temuco noted smaller communities where they live. Most were from Temuco, Laurataro, P las Casas, and Victoria, all regional communities. In the higher risk sites of Melipeuco and Curacatin, which are more rural, most respondents were from the actual site community with one from Freire, four from Malacahuello and eight that did not identify their community.

Table 5.40: ***Frequency and Percentage of Women in the Chile Sample***

	Melipeuco Curacautin (n = 134)	Temuco (n=67)	Chi-sq (df)	p
Women, No. (%)	77 (59.7)	35 (55.7)	.440 (1)	.507

There was no significant difference in the gender composition between MelCur (59.7%) and the Temuco (55.7%) sites in overall percentages. Therefore, it was reasonable to expect no significant difference between the sites. Chi-square analysis confirms the expectation, as p = .507.

Table 5.41: ***Frequency and Percentage of Age Distributions in the Chile Sample***

	Melipeuco Curacautin (n = 134)	Temuco (n=67)	Chi-sq (df)	p
Age, No. (%)	Overall chi-sq (df):		7.793 (1)	.254
18-25	29 (21.6)	7 (10.4)	3.807 (1)	.051
26-34	30 (22.4)	12 (17.9)	.542 (1)	.462
35-44	37 (27.6)	19 (28.4)	.012 (1)	.911
45-54	17 (12.7)	16 (23.9)	4.079 (1)	.043
55-64	9 (6.7)	5 (7.5)	.038 (1)	.845
>64	9 (6.7)	5 (7.5)	.038 (1)	.845
Average age	38.46	42.56	t = -1.954	p = .052

Overall, the chi-square results provided a significant difference (p=.043) in the 45-54 age group between low and high-risk sites. Among the other categories, there was no significant difference, indicating a similar age composition in the two Chile site samples. Difference of means test calculated for average age across categories (MelCur = 38.46 years, Temuco = 42.56 years) for this variable confirmed no significant difference overall, but did approach significance (p = .052). The 18-25 years age group (p = .051) also approached significance. Overall, most age groups from both high and low-risk sites were in the 18-24, 26-34, 35-44 and 45-54 age groups.

Table 5.42: ***Frequency and Percentage of Number of Minor Children in the Household in the Chile Sample***

	Melipeuco Curacautin (n = 134)	Temuco (n=67)	Chi-sq (df)	P
Number of minor children in household, No. (%)		Overall chi-sq (df):	4.819 (5)	.438
0 children	36 (26.9)	26 (38.0)	2.985 (1)	.084
1 child	38 (28.4)	17 (25.4)	.200 (1)	.655
2 children	35 (26.1)	13 (19.4)	1.108 (1)	.292
3 children	19 (14.2)	6 (9.0)	1.119 (1)	.290
4 or more children	6 (4.5)	5 (7.5)	.769 (1)	.380
Average children/home	1.433	1.246	t = .990	.323

Overall, the chi-square results showed no significant difference (p = .438) in number of minor children in the household as categories. High frequencies and percentages show that in both high and low-risk sites, households that had 2 or fewer minor children living in the household. Also, 14.2% of the households in MelCur, a high-risk site had 3 children in the household while only 9% of the households in Temuco had 3 children.

Table 5.43: ***Frequency and Percentage of Race/Ethnicity in the Chile Sample***

	Melipeuco Curacautin (n = 134)	Temuco (n=67)	Chi-sq (df)	p
Ethnicity, No. (%)		Overall chi-sq (df):	2.994 (4)	.559
Mapucho	13 (9.7)	9 (13.4)	.638 (1)	.424
White	36 (26.9)	16 (23.9)	.208 (1)	.649
Hispanic	61 (45.5)	35 (52.2)	.808 (1)	.369
Asian	1 (0.7)	0 (0.0)	.503 (1)	.478
Other (Mestizo)	2 (1.5)	2 (1.5)	.943 (2)	.624

Overall, the chi-square results did not emerge as a significant difference between high and low-risk sites (p = .559). In particular, similar frequencies and composition of Mapucho, White and Mestizo respondents were in high and low-risk sites. The majority of the respondents identified as Hispanic with 45.5% in MelCur and 52.2 in Temuco. While SES is lower in these communities, Mapucho represents a portion of the population at highest risk. Like Panama, these are indicators that the highest risk populations are not hidden within the larger sample.

Table 5.44: ***Frequency and Percentage Income Brackets in the Chile Sample***

	Melipeuco Curacautin (n = 134)	Temuco (n=67)	Chi-sq (df)	p
Income (in pesos/month), No. (%)	Overall chi-sq (df):		10.081 (4)	.039
0-50K	30 (22.4)	11 (16.4)	.980 (1)	.322
50K-150K	46 (34.3)	12 (17.9)	5.865 (1)	.015
150K-250K	17 (12.7)	16 (23.9)	4.079 (1)	.043
250K-350K	10 (7.5)	6 (9.0)	.136 (1)	.712
>350K	19 (14.2)	16 (23.9)	2.923 (1)	.087
Average income	203.36	260.52	t = 2.122	p = .035

Overall, the chi-square results in income indicated a significance difference (p = .039) between the high and low-risk sites income ranges. A difference of means test (average income: MelCur $203.26 pesos/month; Temuco $260.52 pesos/month) confirmed significance in average income (p = .035). Most categories did show individual significance, with the exception of the poorest (0-50K) middle income (250k-350K), and higher income (>350K) pesos/month income ranges. These results are not surprising since Temuco is of a more urban area in comparison to the more rural areas of MelCur. Therefore Temuco is more likely to have a higher income base than MelCur. Since most of the income level fall under the 250K-peso/month mark, Chile has less stratification than the United States sample.

Table 5.45: *Frequency and Percentage by Occupation Category in the Chile Sample*

	Melipeuco Curacautin (n = 134)	Temuco (n=67)	Chi-sq (df)	p
Occupation, No. (%)	Overall chi-sq (df):		8.892 (7)	.260
Professional	20 (14.9)	12 (17.9)	.297 (1)	.586
Skilled labor	13 (9.7)	12 (17.9)	2.764 (1)	.096
Agricultural	16 (11.9)	6 (9.0)	.408 (1)	.523
Forestry	5 (3.7)	2 (3.0)	.074 (1)	.786
Secretary/clerical	8 (6.0)	1 (1.5)	2.094 (1)	.148
Sales	19 (14.2)	7 (10.4)	.552 (1)	.457
Ama de Casa	24 (17.9)	18 (26.9)	2.167 (1)	.141
Other	13 (9.7)	5 (7.5)	10.086 (14)	.756

Overall, the chi-square results for occupation did not indicate a significance (p = .260) in occupation as categories. More respondents from the rural high-risk sites of MelCur were in the agriculture, forestry, secretarial, and sales positions, while respondents from Temuco garnered more professional, skilled labor, and housewife positions. Other occupational categories included students, retirees, and two church missionaries. High-risk occupations include agricultural and housewife and are good indicators that populations in MelCur are at risk and should be targets of public health messages.

Table 5.46: *Frequency and Percentage by Education Levels in the Chile Sample*

	Melipeuco Curacautin (n = 134)	Temuco (n=67)	Chi-sq (df)	p
Education, No. (%)	Overall chi-sq (df):		6.365 (4)	.173
None	1 (1.5)	3 (4.5)	1.641 (1)	.200
Basic	42 (31.3)	12 (17.9)	4.102 (1)	.043
Middle	56 (41.8)	28 (41.8)	.000 (1)	1.000
University	21 (15.7)	14 (20.9)	.848 (1)	.357
Technical	12 (9.0)	8 (11.9)	.444 (1)	.505
Average years of education	9.61	10.27	t = -1.300	p = .195

Overall chi-square results did not show a significance difference (p = .173) between the high and low-risk sites. A difference of means test (average years of education MelCur 9.61 years; Temuco 10.27 years) confirmed that education (p = .195) levels in high and low-risk sites were not significantly different. Detailed results did show that in basic education years (p = .043), more respondents from MelCur (31.3%) than Temuco (17.9%) only attained the equivalent of an 8^{th} grade US education. Results also indicate that respondents in Temuco have a slightly higher level of education than respondents in MelCur at the University and Technical school levels. Furthermore, most respondents in MelCur and Temuco are likely to have completed at least a middle (US high school) equivalent level of education.

Section X – Mediating Variables

Table 5.47: *Frequency and Percentage of Length of Time in Area in the Chile Sample*

	Melipeuco Curacautin (n = 134)	Temuco (n = 67)	t - test	p
Length of time in area	28.36	27.55	t = .268	p = .789

There was a relatively small difference in the average length of time in years that respondents lived in both high and low-risk areas. Therefore, it was reasonable to expect no significant difference between the sites. T-test analysis confirmed that length of time in the area did not emerge as a confounding factor to consider in further analysis. Compared to Section 1, Age Groups, both samples represent the lower end of the 26-34 age group, which indicates respondents that have been living in the area at least half of their lives.

Table 5.48: ***Frequency and Percentage in Type of Home, Average Age of Home, and Home Ownership for the Chile Sample***

	Melipeuco Curacautin (n = 134)	Temuco (n=67)	Chi-sq (df)	p
Type of Home No. (%)	Overall chi-sq (df):		22.977 (4)	.000
Auracana	1 (0.7)	0 (0.0)	.503 (1)	.478
Cabin	2 (1.5)	0 (0.0)	1.010 (1)	.315
Wood frame	119 (88.8)	43 (63.2)	17.323 (1)	.000
Ladril	11 (8.2)	21 (31.3)	17.859 (1)	.000
Adobe	0 (0.0)	0 (0.0)	---	---
Other	0 (0.0)	0 (0.0)	---	---
Age of home (average age)	21.47	21.10	t = .139	p = .890
Own home, No. (%)	103 (76.9)	55 (82.1)	.725	.395

Overall, the chi-square results for type of home (p = .000) did emerge as significant between high and low-risk sites for those living in wood frame and ladril. Most respondents in Region IX live in wood frame homes, as compared to those who live in auracana, ladril, and cabin. No respondents in Region IX reported living in adobe or other type of construction.

There was a little percentage difference in the average age of homes between high and low-risk sites of respondents lived in the area. Therefore, it was expected that no significant difference would emerge between the sites which t-test analysis confirmed.

More respondents in Temuco than MelCur are homeowners, although the percent difference only 5.2%. Therefore, it was expected that no significant difference would emerge, and chi-square analysis confirmed this (p = .395).

Table 5.49: ***Frequency and Percentage of Biome and Observation of Rodents in the Home for the Chile Sample***

	Melipeuco Curacautin (n = 134)	Temuco (n=67)	Chi-sq (df)	p
Biome, No. (%)		Overall chi-sq (df):	3.426 (1)	.331
City/town	97 (72.4)	54 (80.6)	1.611 (1)	.204
Rural, centralized	24 (17.9)	6 (9.0)	2.821 (1)	.093
Rural, agriculture	7 (5.2)	5 (7.5)	.399 (1)	.528
Rural, pine	0 (0.0)	0 (0.0)	---	---
Rural, bosque	3 (2.2)	0 (0.0)	1.523 (1)	.217
Observed rodents in home? No. (%)	45 (33.6)	22 (32.8)	.011 (1)	.916

Overall, the chi-square results for type of biome where respondents lived (p = .331) did not emerge as significant, and upon further detailed analysis, those living in the various biomes did not show significance between the high and low-risk sites. Most respondents in Temuco considered themselves to live in a more urban environment than those in MelCur, although the difference was only 8.2%. Conversely, more respondents who live in MelCur considered themselves to live in a more centralized-rural environment compared to Temuco. Relatively few respondents from either site lived in rural agriculture or bosque. No respondents considered their biome as rural, pine.

Roughly one-third of respondents in each site had observed rodents in their home and there was little difference in the percentage of respondents that have observed rodents in their homes between high and low-risk sites. Therefore, it was expected that no significant difference would emerge and chi-square analysis confirmed this expectation (p = .916).

Section XI – Knowledge Responses

Table 5.50: ***Frequency and Percentages of Knowledge Responses for the Chile Sample***

	Melipeuco Curacautin (n=134)	Temuco (n=67)	Chi-sq (df)	p
Heard of HPS? Yes, (%)	133 (99.3)	66 (98.5)	.253 (1)	.615
When heard of HPS?	Overall chi-sq (df)		3.124 (4)	.547
Prior to 1970	0 (0.0)	0 (0.0)	---	---
1971-1980	0 (0.0)	0 (0.0)	---	---
1981-1990	5 (3.7)	3 (4.5)	.065 (1)	.799
1991-1993	2 (1.5)	0 (0.0)	1.010 (1)	.315
1994-1999	55 (41.0)	23 (34.3)	.848 (1)	.357
2000-2007	44 (32.8)	29 (43.3)	2.108 (1)	.147
No response	28 (20.9)	12 (17.9)	.250 (1)	.617
How heard of HPS, No. (%)				
Newspaper	22 (16.4)	14 (20.9)	.609 (1)	.435
Television	104 (76.0)	55 (82.1)	.542 (1)	.462
Radio	31 (23.1)	6 (9.0)	5.979 (1)	.014
Family friends	18 (13.4)	6 (9.0)	.852 (1)	.356
Other	12 (9.0)	4 (6.0)	8.793 (9)	.457
Know someone that has had HPS? No. (%)	66 (49.3)	9 (13.4)	24.503 (1)	.000
How do people catch HPS? No. (%)				
Animal bites	6 (4.5)	5 (7.5)	.769 (1)	.380
Other sick people	1 (0.7)	2 (3.0)	1.523 (1)	.217
Breathing contaminated air	129 (96.3)	60 (89.6)	3.589 (1)	.217
Petting dog or cat	2 (1.5)	4 (6.0)	3.092 (1)	.079
Working with livestock	0 (0.0)	1 (1.5)	2.010 (1)	.156
Kinds of animals/insects carry HPS? No. (%)				
Mosquitoes	1 (0.7)	0 (0.0)	.503 (1)	.478
Ticks	0 (0.0)	0 (0.0)	---	---
Dogs	1 (0.7)	2 (3.0)	1.523 (1)	.217
Mice	128 (95.5)	65 (97.0)	.260 (1)	.610
Sheep	1 (0.7)	0 (0.0)	.503 (1)	.478
Cats	2 (1.5)	0 (0.0)	1.010 (1)	.315
Fleas	0 (0.0)	0 (0.0)	---	---

Table 5.50 Continued

	Melipeuco Curacautin (n=134)	Temuco (n=67)	Chi-sq (df)	p
Symptoms of HPS No. (%)				
Aches	30 (22.4)	14 (20.9)	.058 (1)	.809
Sore throat	12 (9.0)	6 (9.0)	.000 (1)	1.000
Rash	4 (3.0)	0 (0.0)	2.041 (1)	.153
Fever	117 (87.3)	51 (76.1)	4.079 (1)	.043
Headache	49 (36.6)	17 (25.4)	2.538 (1)	.111
Cough	21 (15.7)	20 (29.9)	5.531 (1)	.019

Chi-square analysis showed no significant difference (p = .615) between high and low-risk sites in terms of if the respondent had heard of HPS. This result should have been expected since nearly 100% of the respondents in both high and low-risk sites have heard of HPS.

Overall chi-square results for when respondents first heard about HPS did not show a significant difference between high and low-risk sites (p = .537). In particular, most respondents heard of HPS between 1994 and 2007. Most heard about HPS between 1994-1999, which is not surprising since that is the time frame when HPS emerged in southern Chile.

Detailed chi-square results on how the respondents heard about HPS showed a significant difference between high and low-risk sites from respondents who heard about HPS through radio communication (p = .014). Initial outbreak messages were transmitted by radio in rural areas of southern Chile in an attempt to reach those rural poor who did not have televisions. While the variable choices and answers are not discrete, the table does show high percentages of respondents from Temuco who heard about HPS via television, which is reasonable, since Temuco is an urban, more affluent area than MelCur. However, most respondents from each site did hear about HPS from the television. “Other” responses included direct clinic information such as the police and medical personnel in the communities.

More than three times the percentage of respondents between high and low-risk sites know someone who has had HPS, and it was expected that a significant difference would emerge. Chi-square analysis confirmed a significant difference ($p = .000$).

With respect to knowledge of how people catch HPS, detailed chi-square results showed no significant difference between high and low-risk sites although the table does show small percentages of respondents who believed that HPS could be caught from animal bites (rare), other sick people (reported within a family cluster in Argentina), petting a dog or cat (not likely) or working with livestock (not likely). Most respondents, however, knew that breathing contaminated air is the most likely way to contract HPS.

Detailed chi-square results for the kinds of animals/insects that carry HPS, showed no differences among categories between high and low-risk sites although the table does show very small percentages of respondents who believe incorrectly that HPS is carried by arthropods (mosquitoes), and mammals other than rodents (dogs, sheep, and cats).

In terms of symptoms of HPS, detailed chi-square results showed a significant difference between high and low-risk sites with respect to recognizing fevers and coughs as HPS symptoms. Although the percentage is low of MelCur respondents who believe rash is a symptom, no respondents in Temuco believe rash is a symptom. Overall, respondents recognized the typical flu symptoms that appear upon HPS onset.

Overall, Chilean respondents have heard about HPS through television, newspaper, and radio. More than their counterparts in New Mexico or Panama, Chileans also know that HPS is transmitted by breathing contaminated air and that rodents carry the virus. They also recognize proper symptoms of HPS, particularly fever, aches, and coughs. These responses indicate that outreach messages are effective in Chile and probably indicate that behavior changes are going to be more positive than negative.

Section XII – Behavior Responses

Table 5.51: ***Frequency and Percentage in Cleaning Level Change for the Chile Sample***

	Melipeuco Curacautin (n=134)	Temuco (n=67)	Chi-sq (df)	p
Level of change No. (%)		Overall chi-sq (df):	5.202 (4)	.267
Changed extremely	54 (40.3)	25 (37.3)	.167 (1)	.683
Changed very much	35 (26.1)	19 (28.4)	.114 91)	.736
Changed a little bit	25 (18.7)	10 (14.9)	.432 (1)	.511
Not changed much	6 (4.5)	0 (0.0)	3.092 (1)	.079
No change	10 (7.5)	10 (14.9)	2.776 (1)	.096

Overall, the chi-square results indicated no significant difference (p=.267) in levels of cleaning changes between high and low-risk sites. Detailed analysis showed that most respondents from each site reported changing anywhere from extremely to a little bit. More respondents from low-risk Temuco than those from high-risk MelCur have changed habits very much or not at all. More respondents from the high-risk site of MelCur have only changed extremely, a little bit, or not much.

Table 5.52: ***Frequency and Percentage of How Habits Have Changed for the Chile Sample***

	Melipeuco Curacautin (n=134)	Temuco (n=67)	Chi-sq (df)	p
How have habits changed, No. (%)				
Mop more	37 (27.6)	16 (23.9)	.320 (1)	.571
Sweep and/or vacuum more	24 (17.9)	14 (20.9)	.260 (1)	.610
Disinfect more	77 (57.5)	37 (55.2)	.091 (1)	.763
Set more traps	19 (14.2)	8 (11.9)	.193 (1)	.661
Wear rubber gloves	14 (10.4)	12 (17.9)	2.209 (1)	.137
Wear dust mask	15 (11.2)	7 (10.4)	.026 (1)	.873
Wear ventilator mask	0 (0.0)	1 (1.5)	2.010 (1)	.156
Other	6 (4.5)	3 (4.5)	9.000 (1)	.342

With respect to how cleaning habits had changed, detailed analysis showed no significant difference between high and low-risk sites. Sweeping and vacuuming, which is also an ineffective way to clean did not show significant difference between sites, yet some respondents at both high and low-risk sites are performing these chores while wearing a dust mask. The rest of the variables, which are generally recognized as proper cleaning methods, did not show significant differences between the sites. This shows that respondents from each site perform not only improper cleaning habits, but also the proper methods such as mopping, disinfecting, setting traps, wearing rubber gloves, and in Temuco by using a ventilator mask. Compared to the other country sites, respondents in Chile are more apt to perform proper cleaning methods, although some continue to sweep/vacuum. This indicates not only that public health messages are effective, but also that messages could be improved toward target populations.

Table 5.53: ***Frequency and Percentage of Purchase Changes for the Chile Sample***

	Melipeuco Curacautin (n=134)	Temuco (n=67)	Chi-sq (df)	p
Purchases, No. (%)				
Mouse rat traps	7 (5.2)	8 (11.9)	2.918 (1)	.088
Rat poison	42 (31.3)	16 (23.9)	1.212 (1)	.271
Bleach	92 (68.7)	42 (62.7)	.716 (1)	.397
Dust masks	5 (3.7)	0 (0.0)	2.564 (1)	.109
Disinfectants	24 (17.9)	12 (17.9)	0.00 (1)	1.000
Ventilator masks	2 (1.5)	2 (3.0)	.510 (1)	.475
Other	0 (0.0)	0 (0.0)	---	---

Detailed analysis did not produce a significant difference between sites with respect to purchases. More respondents in MelCur than Temuco are purchasing poison and bleach. More respondents in Temuco are purchasing traps, and a few ventilator masks. The same number of respondents at both sites reports an increase in purchasing disinfectants, which is a proper purchase. Respondents in MelCur are purchasing dust masks, which are ineffective in preventing HPS. This demonstrates that respondents from both high and low-risk sites are performing not only improper cleaning purchases, but are mostly making proper purchases such as traps, poison, bleach, disinfectants, and ventilator masks.

Table 5.54: ***Frequency and Percentage of Peridomestic Improvements for the Chile Sample***

	Melipeuco Curacautin (n=134)	Temuco (n=67)	Chi-sq (df)	p
Peridomestic improvements No. (%)				
Mouse rat proof home	65 (48.5)	20 (29.9)	6.370 (1)	.012
Remove trash from home	45 (33.6)	32 (47.8)	3.800 (1)	.051
Clean up wood piles	47 (35.1)	19 (28.4)	.914 (1)	.339
Cut grass weeds	88 (65.7)	36 (53.7)	2.695 (1)	.101
Other	2 (1.5)	1 (1.5)	.750 (1)	.687

Detailed analysis shows significant differences between high and low-risk sites with respect to peridomestic improvements such as rat proofing the home. More respondents from MelCur are performing the proper tasks such as rat proofing, cleaning up woodpiles, and cutting grass/weeds away from the home. More respondents from Temuco are removing trash from the home. But overall, respondents from both sites demonstrate proper improvements.

Table 5.55: ***Frequency and Percentage in Response upon Hearing about HPS for the Chile Sample***

	Melipeuco Curacautin (n=134)	Temuco (n=67)	Chi-sq (df)	p
Response upon hearing about HPS, No. (%)				
Check for mice	71 (53.0)	38 (56.7)	.251 (1)	.617
Clean the house	83 (61.9)	30 (44.8)	5.346 (1)	.021
Took vitamins	3 (2.2)	1 (1.5)	.128 (1)	.721
Got a flu shot	3 (2.2)	1 (1.5)	.128 (1)	.721
Nothing	10 (7.5)	6 (9.0)	.136 (1)	.712
Other	5 (3.7)	3 (4.5)	8.503 (1)	.386

With respect to responses upon hearing about HPS, detailed analysis shows a significant difference in cleaning the house between high and low-risk sites (p = .021). More respondents in MelCur cleaned the house, took vitamins, checked for mice, cleaned the house, and got a flu shot. More respondents from Temuco checked for mice, did nothing at all, and/or got a cat. Unlike Panama and New Mexico who also responded that they cleaned the house, respondents in Chile are performing more proper cleaning methods than improper methods.

Table 5.56: ***Frequency and Percentage of Responses to PSAs for the Chile Sample***

	Melipeuco Curacautin (n=134)	Temuco (n=67)	Chi-sq (df)	p
Response to PSAs, No. (%)				
Panic	21 (15.7)	7 (10.4)	1.017 (1)	.313
Stayed home	5 (3.7)	1 (1.5)	.773 (1)	.379
Avoid contact with animals	14 (10.4)	7 (10.4)	.000 (1)	1.000
Learned more about HPS	87 (64.9)	48 (71.6)	.914 (1)	.339
Wonder about victim	15 (11.2)	3 (4.5)	2.471 (1)	.116

Detailed analysis shows no significant difference between high and low-risk sites with respect to responding to public service announcements. More respondents in MelCur panicked, stayed home or wondered about the victim. More respondents in Temuco learned more about HPS, while the same percentage of respondents from both high and low-risk sites avoided contact with animals.

Table 5.57: ***Frequency and Percentage of Concern About Catching HPS for the Chile Sample***

	Melipeuco Curacautin (n=134)	Temuco (n=67)	Chi-sq (df)	p
Concern about catching HPS, No. (%)		Overall chi-sq (df):	6.807 (4)	.146
Very concerned	59 (44.0)	22 (32.8)	2.326 (1)	.127
Concerned	40 (29.9)	28 (41.8)	2.845 (1)	.092
Little bit of concern	11 (8.2)	8 (11.9)	.727 (1)	.394
Not much concern	3 (2.2)	4 (6.0)	1.850 (1)	.174
Not concerned at all	17 (12.7)	5 (7.5)	1.251 (1)	.263

Overall chi-square results provided no significant difference (p=.146) between high and low-risk sites with respect to concern for self and family about catching HPS. More respondents in MelCur are very concerned about contracting HPS, while more respondents in Temuco are only concerned, have a little bit of concern, not much concern, or are not concerned at all about contracting HPS.

The above tables provided individual site descriptive analysis of the New Mexico, Panama, and Chile data collection sites, which included sociodemographic characteristics, mediating variables, knowledge responses and behavior responses. Summary statements for each site are as follows:

> In New Mexico, not only did respondents believe that mice carry HPS, but also that mosquitoes, ticks and fleas carry HPS. This could warrant further investigation because of the local prevalence of plague, West Nile Virus, and Rocky Mountain Spotted Fever, which are viruses transmitted through arthropod vectors, rather than rodent reservoirs. Also, a higher percentage of respondents in the high-risk site of Gallup had obtained a higher level of education. This may be due to the proximity of The University of New Mexico branch campus in Gallup. Respondents in New Mexico were also performing both positive and negative behavior changes with respect to cleaning procedures. While respondents reported positive behavior activities such as disinfecting, and mopping, they also reported negative cleaning activities such as sweeping and wearing a dust mask.
>
> In Panama, most respondents reported that breathing contaminated air was how people caught HPS, and high percentages in each high and low-risk site knew that mice carry HPS. A few respondents reported mosquitoes and fleas as carriers of HPS, but not as many as in New Mexico. In terms of behavior responses, Panamanians believed their cleaning has changed extremely, they are checking for rodents, and they are cleaning. However, while respondents reported mopping and disinfecting more, they were also sweeping at higher percentages in both high and low-risk sites.

As in New Mexico and Panama, Chilean respondents knew that mice carry hantavirus, and that the most common way to catch HPS was by breathing contaminated air. Chilean respondents also believed that their cleaning activities had changed extremely and they were disinfecting, mopping and setting traps. However, they were also sweeping.

These results indicated that across sites, respondents had a basic knowledge of hantavirus, its transmission and illness symptoms. Results also indicated that while respondents were changing cleaning habits they were doing so in both positive and negative ways. The next analysis will examine the three countries across high-risk, low-risk, and all-risk sites.

CHAPTER VI:

COMBINED SITE COMPARISON BY HIGH-RISK, LOW-RISK, AND ALL-RISK

This chapter describes the combined sites in accordance with the variables collected and organized by the following sections for each site: Sociodemographic characteristics, mediating variables, knowledge responses, and behavior responses. Sites will be examined by high-risk, low-risk, and all-risk. High-risk sites are: Gallup/Farmington (New Mexico), Tonosi/Pocri (Panama), and Melipeuco/Curacautin (Chile). Low-risk sites are: Grants (NWNM), Jaguito-El Roble (Panama), and Temuco (Chile). All-risk sites are combined high and low-risk.

High-risk Sites Combined
- Section I – Sociodemographic Characteristics: 6.1 – 6.7
- Section II – Mediating Variables: 6.8 – 6.10
- Section III – Knowledge Responses: 6.11
- Section IV – Behavior Responses: 6.12 – 6.18

Low-risk Sites Combined
- Section V – Sociodemographic Characteristics: 6.19 – 6.25
- Section VI – Mediating Variables: 6.26 – 6.28
- Section VII – Knowledge Responses: 6.29
- Section VIII – Behavior Responses: 6.30 – 6.36

All-risk Sites Combined
- Section IX – Sociodemographic Characteristics: 6.37 – 6.43
- Section X – Mediating Variables: 6.44 – 6.46
- Section XI – Knowledge Responses: 6.47
- Section XII – Behavior Responses: 6.48 – 6.54

Summary table of significant results: 6.55

HIGH-RISK SITES COMBINED

Section I – Sociodemographic Characteristics

Table 6.1: ***Frequency and Percentage of Women in the High-risk Sites***

	NWNM (n = 127)	Panama (n = 130)	Chile (n = 129)	χ^2 (df)	p
Women, No. (%)	95 (74.8)	64 (49.2)	77 (59.7)	17.853 (2)	.000

There was a significant difference in the gender composition between NWNM and Panama/Chile in frequency and percentage. This is not unexpected since a greater proportion of the northwestern New Mexico respondents were women in comparison to Panama and Chile. Overall, 49.2% (Panama) to 74.8% (NWNM) of respondents were women in the high-risk sites.

Table 6.2: ***Frequency and Percentage of Age Distributions in the High-risk Sites***

	NWNM (n =133)	Panama (n = 133)	Chile (n = 134)	χ^2 (df)	p
Age, No. (%)			Overall χ^2 (df):	15.613 (10)	.111
18-25	15 (11.3)	15 (11.3)	29 (21.6)	7.611 (2)	.022
26-34	23 (17.3)	28 (21.0)	30 (22.4)	1.152 (2)	.562
35-44	34 (25.6)	40 (30.0)	37 (27.6)	.677 (2)	.713
45-54	30 (22.6)	23 (17.3)	17 (12.7)	4.510 (2)	.105
55-64	19 (14.3)	13 (9.8)	9 (6.7)	4.206 (2)	.122
>64	6 (4.5)	11 (8.3)	9 (6.7)	1.562 (2)	.458
Average age	40.99	41.02	37.72	F = 2.334	p = .098

Overall, the chi-square results indicated no significant difference (p=.111) among age groups and the sites, indicating a similar age composition among the site samples. Difference of means tests were also calculated for average age across categories (NWNM= 40.99 years, Panama = 41.02, Chile = 37.72) for this variable. It should be noted in the chi-square detail that age group 18-25 did have significance (p = .022), which was to be expected since in this category, the percent of Chileans responded almost twice as much as New Mexicans or Panamanians.

Table 6.3: ***Frequency and Percentage of Number of Minor Children in the Household in the High-risk Sites***

	NWNM (n = 133)	Panama (n = 133)	Chile (n = 134)	χ^2 (df)	p
Number of minor children in household (as categories)			Overall χ^2 (df):	25.300 (8)	.001
No children	66 (49.6)	46 (34.6)	38 (28.4)	8.240 (2)	.016
1 child	19 (14.3)	34 (25.6)	38 (28.4)	8.419 (2)	.015
2 children	26 (19.6)	24 (20.3)	35 (26.1)	2.945 (2)	.229
3 children	11 (8.3)	23 (17.3)	19 (14.2)	4.861 (2)	.088
4 or more children	11 (8.3)	6 (4.5)	4 (3.0)	3.967 (2)	.138
Children no response	8 (6.0)	0 (0.0)	2 (1.5)	10.710 (2)	.005
Average children/home	1.15	1.34	1.37	F = 1.048	p = .351

Overall, the chi-square results showed a significant difference (p = .001) in the number of minor children in the household. This was true in households with no children (p=.016), one child (p=.015) and those respondents who did not choose to answer the question (p=.005). In households with no children, New Mexico had the highest number of respondents, while households with one child in Chile had higher respondents than in New Mexico and Panama. Those households with 2-4 or more children show no significant difference among the high-risk country sites.

Table 6.4: ***Frequency and Percentage by Ethnicity in the High-risk Sites***

	NWNM (n = 133)	Panama (n =133)	Chile (n = 134)	χ^2 (df)	p
Ethnicity, No. (%)			Overall χ^2 (df):	120.699 (12)	.000
American Indian, Indigenous, Mapucho	45 (33.8)	0 (0.0)	13 (9.7)	65.148 (2)	.000
African American/Negro	0 (0.0)	4 (3.0)	0 (0.0)	8.111 (2)	.017
Anglo/Blanco	54 (40.6)	42 (31.6)	36 (26.9)	5.878 (2)	.053
Latino, Mestizo, Chilean	23 (17.3)	70 (52.6)	61 (45.5)	39.270 (2)	.000
Mulato (Panama only)	0 (0.0)	7 (5.3)	0 (0.0)	14.303 (2)	.001
Other	5 (3.8)	1 (0.8)	2 (1.5)	3.334 (2)	.189
No response	6 (4.5)	9 (6.8)	22 (16.4)	12.736 (2)	.002

Overall, the chi-square results provided a significant difference (p = .000) in ethnicity as categories. This was true in all categories except Anglo/Blanco where p approached significance (p=.053), and other (p=.189). This was to be expected in the American Indian, Indigenous, and Mapucho category, as no respondents in Panama self-identified as Indigenous, but rather Mulato or Mestizo. Likewise, a small number of respondents in Panama identified as Negro, but none in New Mexico or Chile. A large number of respondents identified as Mestizo or Chilean rather than Latino (in New Mexico), and a larger percentage of respondents in Chile chose not to respond in comparison to New Mexico and Panama.

Table 6.5: ***Annual Average Income in the High-risk Sites***

	NWNM (n = 133)	Panama (n =133)	Chile (n = 134)
Annual Average income (USD)	40,489	2,591	3,638

Annual average income is shown in USD, USD/Balboas (equivalent conversion), and Chilean pesos converted to USD.

Table 6.6: ***Frequency and Percentage by Occupation in the High-risk Sites***

	NWNM (n = 133)	Panama (n =133)	Chile (n = 134)	χ^2 (df)	p
Occupation, No. (%)			Overall χ^2 (df):	289.019 (14)	.000
Professional	49 (36.8)	15 (11.3)	20 (14.9)	30.678 (2)	.000
Skilled labor/technical	13 (9.8)	9 (6.8)	13 (9.7)	.982 (2)	.612
Agriculture/farmer	3 (2.3)	33 (24.8)	16 (11.9)	30.116 (2)	.000
Secretary/clerical	21 (15.8)	21 (15.8)	8 (6.0)	7.855 (2)	.020
Sales	6 (4.5)	6 (4.5)	19 (14.2)	11.650 (2)	.003
Ama de Casa (PA, CL)	0 (0.0)	29 (21.8)	24 (17.9)	31.314 (2)	.000
Other	21 (15.8)	19 (14.3)	18 (13.4)	.306 (2)	.858

Overall, the chi-square results indicated a significant difference (p = .000) in occupation as categories. This was true in all categories except skilled labor/technical where p =.612, and other (p=.858). This was to be expected because overall, more New Mexicans reported occupation as professional (probably due to higher education levels) than Panamanians and Chileans, as well as skilled labor and secretary clerical. More Panamanians work in agricultural, secretarial occupations and reported as housewives (ama de casa) than Chileans.

Table 6.7: ***Frequency and Percentage by Education Levels in the High-risk Sites***

	NWNM (n = 133)	Panama (n =133)	Chile (n = 134)	χ^2 (df)	p
Education, No. (%)			Overall χ^2 (df):	112.606 (8)	.000
0-8	5 (3.8)	7 (5.3)	2 (1.5)	2.849 (2)	.241
9-12	45 (33.8)	63 (47.3)	42 (31.3)	8.456 (2)	.015
13-16	56 (42.1)	41 (30.8)	56 (41.8)	4.651 (2)	.098
>16	22 (16.5)	17 (12.8)	21 (15.7)	.808 (2)	.668
Technical school	5 (3.8)	5 (3.8)	13 (9.7)	14.451 (2)	.001
Average years of education	12.805	8.197	9.004	F = 52.025	p = .000

Overall chi-square results did emerge as significant (p = .000) in education levels among high-risk sites. A difference of means test (average years of education 12.805 New Mexico; 8.197 Panama; 9.004 Chile) confirmed significance (p = .000). While New Mexico reported higher education levels in the 13-16 and >16 years, Panama reported more respondents with 9-12 level of education as well as 0-8 years. Chileans reported more respondents with technical school and the same as New Mexico in the 13-16 years of education

Section II – Mediating Variables

Table 6.8: ***Frequency and Percentage of Length of Time in Area in the High-risk Sites***

	NWNM (n = 133)	Panama (n = 133)	Chile (n = 134)	F - test	p
Length of time in area (average years)	26.84	26.77	23.28	F = 1.485	p = .228

There was little difference in the average length of time in years that respondents lived in the area. Therefore, it was expected that no significant difference and F-test analysis confirmed that length of time in the area did not emerge as a confounding factor to consider in further analysis. While New Mexico and Panama are very close in average years in the area, Chileans are about 3 years younger on average. This is to be expected because respondents from Chile were generally younger women in the high-risk sites of Curacautin and Melipeuco.

Table 6.9: ***Frequency and Percentage in Average Age of Home and Home Ownership in the High-risk Sites***

	NWNM (n = 133)	Panama (n = 133)	Chile (n = 134)	χ^2 (df)	p
Average age of home	19.90	16.59	19.71	F = 1.140	p = .321
Own home, No. (%)	100 (75.2)	107 (80.5)	103 (76.9)	1.103 (2)	.576

There was no significant difference in the average age of homes among high-risk sites (p=.321). F-test analysis confirmed that average age of homes did not emerge as a confounding factor to consider in further analysis. Similarly, there was little difference in the percentage of homeowners among high-risk sites. Therefore, it was expected that no significant difference would emerge. Chi-square analysis confirmed that those who own homes do not present a disparate risk among sites.

Table 6.10: ***Frequency and Percentage of Observation of Rodents in the Home for the High-risk Sites***

	NWNM (n = 133)	Panama (n = 133)	Chile (n = 134)	χ^2 (df)	p
Observed rodents in home? No. (%)	68 (51.1)	104 (78.2)	45 (33.6)	54.311 (2)	.000

There was a large difference in the frequency and percentage of respondents that had observed rodents in their homes among the high-risk sites. Therefore, it was expected that significant differences would emerge and chi-square analyses confirmed this (p=.000). In Panama, 78.2 percent of the respondents in the high-risk areas of Tonosi and Pocri had observed rodents in the home, whereas as few as 33.6 percent of respondents in Chile (Melipeuco and Curacautin) had observed rodents in the home. This indicates that those in Panama have a higher risk of exposure to HPS than those in New Mexico or Chile.

Section III – Knowledge Responses

Table 6.11: ***Frequency and Percentages of Knowledge Responses for the High-risk Sites***

	NWNM (n= 133)	Panama (n= 133)	Chile (n=134)	χ^2 (df)	p
Heard of HPS? Yes, (%)	128 (96.2)	124 (93.2)	133 (99.2)	6.704	.035
When? No. (%)			Overall χ^2 (df)	92.659 (12)	.000
Prior to 1970	4 (3.0)	0 (0.0)	0 (0.0)	8.111(2)	.017
1971-1980	5 (3.8)	1 (0.7)	0 (0.0)	7.140 (2)	.028
1981-1990	9 (6.8)	0 (0.0)	5 (3.7)	9.048 (2)	.011
1991-1993	8 (6.0)	0 (0.0)	2 (1.5)	10.710 (2)	.005
1994-1999	41 (30.8)	27 (20.3)	55 (41.0)	13.489 (2)	.001
2000-2007	30 (22.6)	92 (69.2)	44 (32.8)	65.755 (2)	.000
No response	36 (27.0)	13 (9.8)	28 (20.9)	13.145 (2)	.001
How heard of HPS, no. (%)					
Newspaper	80 (60.2)	25 (18.8)	22 (16.4)	74.340 (2)	.000
Television	95 (71.4)	95 (71.4)	104 (77.6)	1.749 (2)	.417
Radio	45 (33.8)	49 (36.8)	31 (23.1)	6.457 (2)	.040
Family friends	59 (44.4)	16 (12.0)	18 (13.4)	49.837 (2)	.000
Know someone that has had HPS? No. (%)	23 (17.3)	54 (40.6)	66 (49.3)	31.726 (2)	.000

Table 6.11 Continued

	NWNM (n= 133)	Panama (n= 133)	Chile (n=134)	χ^2 (df)	p
How do people catch HPS? No. (%)					
Animal bites	10 (7.5)	7 (5.3)	6 (4.5)	1.226 (2)	.542
Other sick people	4 (3.0)	8 (6.0)	1 (0.7)	5.930 (2)	.052
Breathing contaminated air	125 (94.0)	110 (82.7)	129 (96.3)	17.158 (2)	.000
Petting dog or cat	4 (3.0)	1 (0.7)	2 (1.5)	2.046 (2)	.360
Working with livestock	6 (4.5)	3 (2.2)	0 (0.0)	6.177 (2)	.046
Kinds of animals/insects carry HPS? No. (%)					
Mosquitoes	13 (9.8)	6 (4.5)	1 (0.7)	11.554 (2)	.003
Ticks	8 (6.0)	0 (0.0)	0 (0.0)	16.388 (2)	.000
Dogs	3 (2.3)	2 (1.5)	1 (0.7)	1.029 (2)	.598
Mice	126 (94.7)	122 (91.7)	128 (95.5)	1.895 (2)	.388
Sheep	3 (2.3)	0 (0.0)	1 (0.7)	3.549 (2)	.170
Cats	4 (3.0)	1 (0.7)	2 (1.5)	2.046 (2)	.360
Fleas	13 (9.8)	1 (0.7)	0 (0.0)	23.337 (2)	.000
Symptoms of HPS No. (%)					
Aches	88 (66.2)	33 (24.8)	30 (22.4)	68.629 (2)	.000
Sore throat	40 (30.1)	23 (17.3)	12 (9.0)	19.821 (2)	.000
Rash	18 (13.5)	10 (7.5)	4 (3.0)	10.155 (2)	.006
Fever	100 (74.6)	54 (40.6)	117 (87.3)	71.705 (2)	.000
Headache	61 (45.9)	40 (30.1)	49 (36.6)	7.148 (2)	.028
Cough	58 (43.6)	91 (68.4)	21 (15.7)	76.102 (2)	.000

In terms of whether the respondent has heard of HPS, chi-square analysis showed a significant difference (p = .035) among high-risk sites. This was expected, since the number of respondents that have heard of HPS in Chile is slightly higher than respondents in New Mexico or Panama.

With respect to when the respondent heard of HPS, overall, the chi-square results showed a significant difference among all sites in both overall results (p=.000) and in the detail. This was to be expected because HPS emerged during different time frames for each site: 1993 in New Mexico, 1997 in Chile, and 2000 in Panama. Earlier time periods were left in the analysis to account for cultural history of the disease.

For those respondents who did hear about HPS, detailed chi-square results showed a significant difference among risk sites from those who heard about HPS through newspapers ($p = .000$), radio ($p = .040$) and family/friends ($p = .000$).   While the variable choices and answers are not discrete, the table does show high percentages of respondents who heard about HPS via newspaper, television, and family/friends. Respondents from New Mexico learned through newspaper, television, and family/friends, while those respondents in Panama and Chile learned about HPS through television and radio. In all sites, “Other” responses included clinic and emergency room information, school, work, and family/friends that contracted HPS.

Almost one half the Chilean respondents knew someone that contracted HPS and less than 20% of the New Mexico respondents knew someone that contracted HPS, so it was expected that a significant difference would emerge. Chi-square analysis demonstrated that there was a significant difference ($p = .000$) among the high-risk sites. Forty percent of the Panamanian respondents from Tonosi and Pocri knew someone that contracted HPS.

Most respondents in the high-risk sites know how HPS is contracted, there was a significant difference among the high-risk sites ($p = .000$) with respect to breathing contaminated air. While the variable choices were not discrete, in terms of how people contract HPS, the table does show small percentages of New Mexican respondents who compared to Panamanians and Chileans, believe that HPS may be incorrectly caught from working with livestock, which is very unlikely.

Detailed chi-square results did not provide a significant difference in knowledge among high-risk sites with respect to mice as the animal that carries HPS ($p = .388$). This is not surprising since similar numbers of respondents know that breathing contaminated air is the most likely way to contract HPS. While the variable choices were not discrete, in terms of how people contract HPS, the table does show small percentages of New Mexican respondents who compared to Panamanians and Chileans, believe that HPS may be incorrectly caught from arthropods (mosquitoes, ticks, fleas) and working with livestock (very unlikely). This could be the result of confusion with information regarding plague and West Nile virus, which are transmitted through arthropods, rather than rodent reservoirs.

In terms of symptoms of HPS, detailed chi-square results illustrated a significant difference among high-risk sites with respect to all choices of symptoms. Percentages of respondents differ greatly for these choices, and since the original outbreak occurred in New Mexico, it was not unexpected that those respondents would recognize HPS symptoms. Although the percentages are low of those who believe rash is a symptom, the result remains significant, but is an incorrect response to HPS symptoms and indicates misinformation has been received by a small percentage of respondents at each site.

Section IV – Behavior Responses

Table 6.12: ***Frequency and Percentage in Cleaning Level Change for the High-risk Sites***

	NWNM (n=133)	Panama (n=133)	Chile (n = 134)	χ^2 (df)	p
Level of cleaning change No. (%)			Overall χ^2 (df):	59.726 (8)	.000
Changed extremely	20 (15.0)	73 (54.9)	54 (40.3)	46.523 (2)	.000
Changed very much	27 (20.3)	25 (18.8)	35 (26.1)	2.349 (2)	.309
Changed a little bit	42 (31.6)	20 (15.0)	25 (18.7)	11.824 (2)	.003
Not changed much	16 (12.0)	5 (3.8)	6 (4.5)	8.880 (2)	.012
No change	17 (12.8)	1 (0.7)	10 (7.5)	14.850 (2)	.001

Overall, chi-square results indicated a significant difference (p=.000) in levels of cleaning changes among risk sites. Detailed analysis showed that more respondents in Panama and Chile than New Mexico extremely changed their cleaning habits. Conversely, New Mexico respondents overwhelmingly either changed their habits a little bit, not much, or not at all compared to those in Panama and Chile.

Table 6.13: ***Frequency and Percentage of How Habits Have Changed in the High-risk Sites***

	NWNM (n=133)	Panama (n=133)	Chile (n = 134)	χ^2 (df)	p
How have habits changed, No. (%)					
Mop more	40 (29.9)	63 (47.4)	37 (27.6)	13.576 (2)	.001
Sweep and/or vacuum more	42 (31.6)	63 (47.4)	24 (17.9)	26.551 (2)	.000
Disinfect more	63 (47.4)	53 (39.9)	77 (57.5)	8.355 (2)	.015
Set more traps	45 (33.6)	35 (26.3)	19 (14.2)	13.109 (2)	.001
Wear rubber gloves	43 (32.1)	14 (10.5)	14 (10.5)	29.016 (2)	.000
Wear dust mask	42 (31.6)	20 (15.0)	15 (11.2)	20.118 (2)	.000
Wear ventilator mask	2 (1.5)	3 (2.3)	0 (0.0)	2.855 (2)	.240

Detailed chi-square results predicted significant differences in most categories of how cleaning habits have changed among high-risk sites. Panamanians are mopping and sweeping more than New Mexicans and Chileans, but Chileans, followed by New Mexicans, are disinfecting more than any other cleaning methods, which is the most appropriate way to reduce exposure risk. New Mexicans are setting more traps, wearing rubber gloves, and wearing more dust masks than Panamanians or Chileans. While mopping is an effective way to reduce risk, the observation that Panamanians are sweeping more indicated they are not receiving correct information on how to reduce risk. This is critical information, because Panamanians observe more rodents in their home than New Mexicans or Chileans. Overall, the results from this table demonstrate that respondents from each site perform not only improper cleaning habits such as sweeping and wearing a dust mask, but also the proper methods such as mopping, disinfecting, setting traps, wearing rubber gloves, and using a ventilator mask.

Table 6.14: ***Frequency and Percentage of Purchase Changes in the High-risk Sites***

	NWNM (n=133)	Panama (n=133)	Chile (n =134)	χ^2 (df)	p
Purchases, No. (%)					
Mouse rat traps	47 (35.3)	56 (42.1)	7 (5.2)	51.680 (2)	.000
Rat poison	23 (17.3)	60 (45.1)	42 (31.3)	23.956 (2)	.000
Bleach	54 (40.6)	29 (21.8)	92 (68.7)	60.342 (2)	.000
Dust masks	23 (17.3)	13 (9.8)	5 (3.7)	13.394 (2)	.001
Disinfectants	52 (39.1)	49 (36.8)	24 (17.9)	16.847 (2)	.000
Ventilator masks	6 (4.5)	4 (3.0)	2 (1.5)	2.090 (2)	.352

Detailed analysis confirmed a significant difference in most categories among high-risk sites with the exception of ventilator masks ($p = .352$). This was to be expected, since Table 5.13 shows respondents changing habits that should reflect these purchases. In particular, since Chileans are disinfecting more compared to New Mexicans and Panamanians, more bleach purchases are made by Chileans. Still, this table demonstrates that respondents perform not only improper cleaning purchases such as dust masks, but most actually perform proper methods such as mopping, disinfecting, setting traps, wearing rubber gloves, and using a ventilator mask. Public health approaches should include the message that dust masks are inappropriate purchases.

Table 6.15: ***Frequency and Percentage of Peridomestic Improvements in the High-risk Sites***

	NWNM (n=133)	Panama (n=133)	Chile (n =134)	χ^2 (df)	p
Peridomestic improvements, No. (%)					
Mouse rat proof home	53 (39.9)	81 (60.9)	65 (48.5)	11.914 (2)	.003
Remove trash from home	64 (48.1)	63 (47.4)	45 (33.6)	7.307 (2)	.026
Clean up wood piles	39 (29.3)	31 (23.3)	47 (35.1)	4.466 (2)	.107
Cut grass weeds	50 (37.6)	47 (35.3)	88 (65.7)	30.711 (2)	.000

Detailed analysis provided significant differences among high-risk sites with respect to three categories in peridomestic improvements. More respondents from Panama are mouse/rat proofing their homes, similar numbers of New Mexicans and Panamanians are removing trash from their homes, and more Chileans are cutting grass and weeds from around the home, as well as cleaning up woodpiles. All of these tasks are not only proper for HPS prevention, but also good activities for peridomestic sanitation and general environmental conditions.

Table 6.16: ***Frequency and Percentage in Response Upon Hearing about HPS in the High-risk Sites***

	NWNM (n=133)	Panama (n=133)	Chile (n = 134)	χ^2 (df)	p
Response upon hearing about HPS, No. (%)					
Check for mice	89 (66.9)	75 (56.4)	71 (53.0)	5.804 (2)	.055
Clean the house	69 (51.9)	90 (67.7)	83 (61.9)	7.112 (2)	.029
Took vitamins	12 (9.0)	6 (4.5)	3 (2.3)	6.394 (2)	.041
Got a flu shot	20 (15.0)	9 (6.8)	3 (2.3)	15.268 (2)	.000
Nothing	20 (15.0)	3 (2.3)	10 (7.5)	14.518 (2)	.001

Detailed analysis showed a significant difference in most categories among high-risk sites, with respect to responses upon hearing about HPS. More respondents in New Mexico checked for mice, while Panamanians cleaned the house. Based upon the previous tables, however, Panamanians are sweeping more, which actually increases their risk of exposure to HPS. More New Mexicans took vitamins (ineffective), got a flu shot (ineffective) or did nothing at all. This indicates that a portion of the high-risk population is not receiving the correct information on prevention methods or is misinterpreting the information.

Table 6.17: *Frequency and Percentage of Responses to PSAs in the High-risk Sites*

	NWNM (n=133)	Panama (n=133)	Chile (n=134)	χ^2 (df)	p
Response to PSAs, No. (%)					
Panic	12 (9.0)	38 (28.6)	21 (15.7)	18.003 (2)	.000
Stayed home	10 (7.5)	19 (14.3)	5 (3.7)	9.807 (2)	.007
Avoid contact with animals	30 (22.6)	33 (24.8)	14 (10.5)	10.261 (2)	.006
Learned more about HPS	80 (60.2)	54 (40.6)	87 (64.9)	17.908 (2)	.000
Wonder about victim	31 (23.3)	14 (10.5)	15 (11.2)	10.811 (2)	.004

Detailed analysis shows a significant difference among high-risk sites in all categories with respect to responses to public service announcements. More Panamanians panicked, stayed home, and avoided contact with animals, while more Chileans learned more about HPS, and more New Mexicans wondered who the victim was while learning more about HPS. These results are not unexpected, since HPS emerged in Panama during Carnival. This appeared to result in widespread panic and the public's need to remain home and avoid contact with animals until the outbreak could be identified and discussed through media outlets and public health officials. More Chileans learned more about HPS, and again this was not unexpected, since a minor outbreak occurred a few years earlier than a major outbreak, thus public health officials had time to gear up with an outreach method designed to contain panic and keep the public informed.

Table 6.18: ***Frequency and Percentage of Concern About Catching HPS in the High-risk Sites***

	NWNM (n=133)	Panama (n=133)	Chile (n =134)	χ^2 (df)	p
Concern about catching HPS, No. (%)			Overall χ^2 (df):	69.086 (8)	.000
Very concerned	29 (21.8)	53 (39.9)	59 (44.0)	16.293 (2)	.000
Concerned	20 (15.0)	38 (28.6)	40 (29.9)	9.704 (2)	.008
Little bit of concern	24 (18.1)	20 (15.0)	11 (8.2)	5.724 (2)	.057
Not much concern	33 (24.8)	0 (0.0)	3 (2.3)	61.235 (2)	.000
Not concerned at all	21 (15.8)	14 (10.5)	17 (12.7)	1.646 (2)	.439

Overall chi-square results indicated a significant difference among most categories in high-risk sites with respect to concern for self and family about catching HPS. Detailed analysis shows that while Chileans are most concerned, they are also performing more appropriate prevention measures such as mopping, using bleach and disinfectant, and learning more about HPS in comparison to New Mexicans and Panamanians. New Mexicans, on the other hand, are the least concerned about catching HPS. For those respondents that have little or no concern, response could mean that since HPS risk rises and lowers over time, public health messages are not consistent in either quantity or access to appropriate information.

LOW-RISK SITES COMBINED

Section V: Sociodemographic characteristics

Table 6.19: ***Frequency and Percentage of Women in the Low-risk Sites***

	NWNM (n = 67)	Panama (n = 67)	Chile (n = 67)	χ^2 (df)	p
Women, No. (%)	45 (67.2)	50 (74.6)	35 (52.2)	7.2278 (2)	.026

There was a significant difference in the gender composition between Panama and New Mexico/Chile in frequency and percentage in the low-risk sites (Panama: Jagito/El Roble; New Mexico: Grants; Chile: Temuco). Overall, 52.2% to 74.6% of respondents were women in the low-risk sites.

Table 6.20: ***Frequency and Percentage of Age Distributions in the Low-risk Sites***

	NWNM (n =67)	Panama (n =67)	Chile (n =67)	χ^2 (df)	p
Age, No. (%)			Overall χ^2 (df):	12.176 (12)	.432
18-25	6 (9.0)	10 (14.9)	7 (10.4)	1.277 (2)	.528
26-34	12 (17.9)	14 (20.9)	12 (17.9)	.260 (2)	.878
35-44	14 (20.9)	19 (28.4)	19 (28.4)	1.297 (2)	.523
45-54	17 (25.4)	11 (16.4)	16 (23.9)	1.804 (2)	.406
55-64	8 (11.9)	6 (9.0)	5 (7.5)	.814 (2)	.666
>64	10 (14.9)	7 (10.4)	5 (7.5)	.814 (2)	.666
Average age	46.00	41.79	42.56	F = 1.634	p = .198

Overall, chi-square results showed no significant difference (p=.432) among age groups and low sites, indicating a similar age composition Difference of means test calculated for average age across categories (New Mexico = 46.00 years, Panama = 41.79 years, Chile = 42.56 years) for this variable confirmed that overall, age should not have a confounding effect on continued analysis. It should be noted in the χ^2 detail that no category approached significance.

Table 6.21: ***Frequency and Percentage of Number of Minor Children in the Household in the Low-risk Sites***

	NWNM (n = 67)	Panama (n = 67)	Chile (n = 67)	χ^2 (df)	p
Number of minor children in household (as categories)			Overall χ^2 (df):	19.034 (10)	.040
No children	31 (46.3)	17 (25.4)	26 (38.8)	6.459 (2)	.040
1 child	12 (17.9)	19 (28.4)	17 (25.4)	2.135 (2)	.344
2 children	10 (14.9)	20 (29.9)	13 (19.4)	4.674 (2)	.097
3 children	5 (7.5)	8 (11.9)	6 (9.0)	.814 (2)	.666
4 or more children	2 (3.0)	3 (4.5)	3 (4.5)	.260 (2)	.878
No response	7 (10.5)	0 (0.0)	2 (3.0)	9.073 (2)	.000
Average children/home	1.306	1.739	1.246	F = 2.313	p = .102

Overall, the chi-square results indicate a significant difference (p = .040) in number of minor children in the household as categories in the low-risk sites, but F-test results show overall there is no significance. F-test results should be expected since only two detail categories show significance (no children p=.040 and no response p=.000). Other ranges from one child to four or more children range from p=.097 to p=.878.

Table 6.22: ***Frequency and Percentage by Ethnicity in the Low-risk Sites***

	NWNM (n = 67)	Panama (n = 67)	Chile (n = 67)	χ^2 (df)	p
Ethnicity, No. (%)			Overall χ^2 (df):	35.777 (10)	.000
American Indian, Indigenous, Mapucho	9 (13.4)	0 (0.0)	9 (13.4)	9.885 (2)	.007
African American/Negro	0 (0.0)	9 (13.4)	0 (0.0)	18.844 (2)	.000
Anglo/Blanco	24 (35.8)	22 (32.8)	16 (23.9)	2.426 (2)	.297
Latino, Mestizo, Chilean	30 (44.8)	35 (52.2)	35 (52.2)	.995 (2)	.608
Mulato (Panama only)	0 (0.0)	0 (0.0)	0 (0.0)	---	---
Other	0 (0.0)	0 (0.0)	2 (3.0)	4.040 (2)	.133
No response	4 (6.0)	1 (1.5)	5 (6.5)	8.162 (2)	.017

Overall, the chi-square results indicated a significant difference (p = .000) in ethnicity as categories in the low-risk sites. This was true in American Indian, Indigenous, and Mapucho category as well as African American/Negro and No response categories. This was to be expected in the American Indian, Indigenous, and Mapucho category, as no respondents in Panama self-identified as Indigenous, but rather Mulato or Mestizo. Likewise, a small number of respondents in Panama identified as Negro, but none in New Mexico or Chile. A large number of respondents identified as Mestizo or Chilean rather than Latino (in New Mexico), and a small percentage of respondents in the low-risk sites chose not to respond.

Table 6.23: ***Average Income in the Low-risk Sites***

	NWNM (n = 67)	Panama (n = 67)	Chile (n = 67)
Average income (USD)	31,567	4,032	4,740

Annual average income is shown in USD, USD/Balboas (equivalent conversion), and Chilean pesos converted to USD.

Table 6.24: ***Frequency and Percentage by Occupation in the Low-risk Sites***

	NWNM (n = 67)	Panama (n = 67)	Chile (n = 67)	χ^2 (df)	p
Occupation, No. (%)			Overall χ^2 (df):	57.453 (14)	.000
Professional	18 (26.9)	11 (16.4)	12 (17.9)	2.635 (2)	.268
Skilled labor/technical	8 (11.9)	1 (1.5)	12 (17.9)	9.890 (2)	.007
Agriculture/farmer	3 (4.5)	0 (0.0)	6 (9.0)	6.281 (2)	.043
Secretary/clerical	11 (16.4)	1 (1.5)	1 (1.5)	16.448 (2)	.000
Sales	5 (7.5)	1 (1.5)	7 (10.4)	4.606 (2)	.100
Ama de Casa	0 (0.0)	30 (44.8)	18 (26.9)	37.441 (2)	.000
Other	12 (17.9)	21 (31.3)	7 (10.4)	9.426 (2)	.009

Overall, the chi-square results registered a significant difference (p = .000) in occupation as categories. This was true in all categories except professional (p=.268) and sales (p=.100). This was to be expected because overall, more New Mexicans reported occupation as professional (probably due to higher education levels) than Panamanians and Chileans. More Chileans responded as skilled labor/technical, which was expected because more Chileans went to trade school than the other sites. In the low-risk sites, more New Mexicans worked as secretarial/clerical than Panamanians or Chileans.

Table 6.25: *Frequency and Percentage by Education Levels in the Low-risk Sites*

	NWNM (n = 67)	Panama (n = 67)	Chile (n = 67)	Chi-sq (df)	p
Education, No. (%)			Overall chi-sq (df):	22.160 (8)	.005
0-8	5 (7.5)	1 (1.5)	3 (4.5)	2.792 (2)	.248
9-12	24 (35.8)	13 (19.4)	12 (17.9)	7.179 (2)	.028
13-16	30 (44.8)	37 (55.2)	28 (41.8)	2.675 (2)	.263
>16	5 (7.5)	15 (22.4)	14 (20.9)	6.443 (2)	.040
Technical	0 (0.0)	1 (1.5)	8 (11.9)	13.260 (2)	.001
Average years of education	11.93	10.13	10.39	F = 4.048	.019

Overall chi-square results show significance (p = .005) in education levels among low-risk sites. A difference of means test (average years of education 11.93 New Mexico; 10.13 Panama; 10.39 Chile) confirmed significance (p = .019). In the low-risk sites, more Panamanians have more than 16 years of education, which is expected since Jaguito/El Roble is a more urban environment than Tonosi/Pocri. More respondents in New Mexico have at least some high school education, and more respondents in Chile have technical education.

Section VI – Mediating Variables

Table 6.26: *Frequency and Percentage of Length of Time in Area in the Low-risk Sites*

	NWNM (n = 67)	Panama (n = 67)	Chile (n = 67)	F-test	p
Length of time in area (average years)	25.00	33.43	20.97	F = 6.141	p = .003

There was a great difference in the average length of time in years that respondents lived in the area. Therefore, a significant difference was expected and F-test analysis confirmed this (p=.003). While New Mexico and Chile are close in average years in the area, Panamanians have lived in their on average more than 30 years. Chileans lived the least amount of time in the low-risk site. This is to be expected because respondents from Chile were generally younger women in the low-risk sites.

Table 6.27: ***Frequency and Percentage in Average Age of Home and Home Ownership in the Low-risk Sites***

	NWNM (n = 67)	Panama (n =67)	Chile (n = 67)	Chi-sq (df)	p
Average age of home	15.90	21.72	18.58	F = 2.423	p = .091
Own home, No. (%)	52 (77.6)	64 (95.5)	55 (82.1)	9.168 (2)	.010

There was no significant difference in the average age of homes among high-risk sites (p=.321). F-test analysis confirmed that average age of homes did not emerge as a confounding factor to consider in further analysis. The percentage of home owners did vary, however (range (77.6% - 95.5%). Therefore it was expected that among homeowners in the low-risk sites that a significant difference would emerge (p = .010).

Table 6.28: ***Frequency and Percentage of Observation of Rodents in the Home for the Low-risk Sites***

	NWNM (n = 67)	Panama (n = 67)	Chile (n = 67)	Chi-sq (df)	p
Observed rodents in home? No. (%)	30 (44.8)	47 (70.2)	22 (32.8)	19.467 (2)	.000

There was a difference in the percentage of respondents that have observed rodents in their homes in the low-risk sites. Therefore, it was expected that a significant difference would emerge (p = .000). While less than 50% of respondents in New Mexico and Chile have observed rodents in the home, more than 70% of respondents in Panama have observed rodents in the home, indicating a higher risk of exposure to HPS.

Section VII – Knowledge Responses

Table 6.29: ***Frequency and Percentages of Knowledge Responses for the Low-risk Sites***

	NWNM (n= 67)	Panama (n= 67)	Chile (n=67)	Chi-sq (df)	p
Heard of HPS? Yes, (%)	56 (83.6)	67 (100.0)	66 (98.5)	19.675 (2)	.000
When? No. (%)	Overall chi-sq (df)				
Prior to 1970	1 (1.5)	0 (0.0)	0 (0.0)	2.010 (2)	.366
1971-1980	0 (0.0)	1 (1.5)	0 (0.0)	2.020 (2)	.366
1981-1990	6 (9.0)	2 (3.0)	3 (4.5)	2.500 (2)	.286
1991-1993	4 (6.0)	0 (0.0)	0 (0.0)	8.162 (2)	.017
1994-1999	9 (13.4)	19 (28.3)	23 (34.3)	8.198 (2)	.017
2000-2007	22 (32.8)	41 (61.2)	29 (43.3)	11.104 (2)	.004
No response	25 (37.3)	4 (6.0)	12 (17.9)	20.653 (2)	.000
How heard of HPS, no. (%)					
Newspaper	28 (41.8)	29 (43.3)	14 (20.9)	9.190 (2)	.010
Television	42 (62.7)	54 (80.6)	55 (82.1)	8.259 (2)	.015
Radio	15 (22.4)	21 (31.3)	6 (9.0)	10.294 (2)	.006
Family friends	20 (29.9)	7 (10.5)	6 (9.0)	13.269 (2)	.001
Know someone that has had HPS? No. (%)	5 (7.5)	47 (70.2)	9 (13.4)	75.881 (2)	.000
How do people catch HPS? No. (%)					
Animal bites	4 (6.0)	1 (1.5)	5 (7.5)	2.736 (2)	.255
Other sick people	0 (0.0)	4 (6.0)	2 (2.3)	4.123 (2)	.127
Breathing contaminated air	51 (76.1)	63 (94.0)	60 (89.6)	10.011 (2)	.007
Petting dog or cat	1 (1.5)	0 (0.0)	4 (6.0)	5.333 (2)	.070
Working with livestock	3 (4.5)	0 (0.0)	1 (1.5)	3.571 (2)	.168
Kinds of animals/insects carry HPS? No. (%)					
Mosquitoes	10 (14.9)	2 (2.3)	0 (0.0)	14.889 (2)	.001
Ticks	6 (9.0)	0 (0.0)	0 (0.0)	12.369 (2)	.002
Dogs	1 (1.5)	0 (0.0)	2 (2.3)	2.030 (2)	.362
Mice	50 (74.6)	65 (97.0)	65 (97.0)	23.929 (2)	.000
Sheep	0 (0.0)	1 (1.5)	0 (0.0)	2.010 (2)	.366
Cats	1 (1.5)	1 (1.5)	0 (0.0)	1.010 (2)	.603
Fleas	7 (10.5)	0 (0.0)	0 (0.0)	14.505 (2)	.001

Table 6.29 Continued

	NWNM (n= 67)	Panama (n= 67)	Chile (n=67)	Chi-sq (df)	p
Symptoms of HPS No. (%)					
Aches	26 (38.8)	6 (9.0)	14 (20.9)	17.140 (2)	.000
Sore throat	12 (17.9)	6 (9.0)	6 (9.0)	3.407 (2)	.182
Rash	3 (4.5)	0 (0.0)	0 (0.0)	6.091 (2)	.048
Fever	44 (65.7)	28 (41.8)	51 (76.1)	17.473 (2)	.000
Headache	13 (19.4)	27 (40.3)	17 (25.4)	7.640 (2)	.022
Cough	13 (19.4)	59 (88.1)	20 (29.9)	73.882 (2)	.000

In terms of whether respondent had heard of HPS, chi-square analysis provided a significant difference (p = .000) in the low-risk sites. This result should have been expected since the percentage difference between the sites was a margin of 16.4%. Respondents in Panama and Chile represent a higher number of respondents, which is to be expected since more Panamanians have observed rodents in the home, and those in Chile have extended and continual outreach programs in place.

With respect to when the respondent heard of HPS, chi-square results showed a significant difference among low-risk sites in the 1991-93, 1994-99, 2000-07, and no response categories. Those who heard of HPS prior to 1994 were included as categories because of cultural influences on collective memory. No response, which showed 37.3% of respondents in New Mexico was followed by 17.9% of respondents in Chile. Again, this table represents specific time frames when HPS emerged in each country, so significant differences were to be expected.

For those respondents who did hear about HPS, detailed chi-square results indicated a significant difference among low-risk sites in all categories. More New Mexicans and Panamanians than Chileans heard about HPS through newspapers. More Panamanians and Chileans heard about HPS through television than New Mexicans.

Radio was an important method of outreach in Panama and New Mexico, and finally family/friends are important methods of information reception in New Mexico.

In the low-risk sites, more than seventy percent of respondents in Panama know someone that has had HPS, while as low as 7.5% of respondents in the percentage of respondents in New Mexico know someone that has had HPS. Therefore it would be reasonable to expect a significant difference to emerge ($p=.000$).

In terms of how people contract HPS, detailed chi-square results illustrated a significant difference among low-risk sites with respect to breathing contaminated air ($p = .007$). The variable choices and answers are not discrete, and the table does show small percentages of respondents who believe that HPS may be caught from animal bites (rare), other sick people (not confirmed with SNV/HPS), petting a dog or cat (not likely) or working with livestock (not likely).

Detailed chi-square results confirmed a significant difference in knowledge among low-risk sites with respect to mice as the animal that carries HPS ($p = .000$). This is not surprising since the original outbreak was in northwestern New Mexico and the respondents from Gallup/Farmington were in the center of outbreak controversy in 1993. The table does show percentages of New Mexican respondents who believe that HPS is carried by arthropods (mosquitoes, ticks, fleas). This could be because of confusion between how plague and West Nile Virus is transmitted which are zoonotic disease problems in New Mexico.

In terms of symptoms of HPS, detailed chi-square results showed a significant difference among low-risk sites in all categories except sore throat. Respondents in Panama believe cough, followed by headache and fever are leading indicators to seeking medical attention. New Mexicans believe fever, aches, headache, cough and some sore throat are indicators, while Chileans believe fever, cough, headache and general aches are leading indicators. Although the percentages are low of those who believe rash is a symptom, the result remains significant, but is an incorrect response to HPS symptoms and indicates misinformation has been received by a small percentage of respondents in New Mexico.

Section VII – Behavior

Table 6.30: ***Frequency and Percentage in Cleaning Level Change for the Low-risk Sites***

	NWNM (n= 67)	Panama (n=67)	Chile (n = 67)	Chi-sq (df)	p
Level of cleaning change No. (%)			Overall chi-sq (df):	87.881 (8)	.000
Changed extremely	4 (6.0)	46 (68.7)	25 (37.3)	56.28 (2)	.000
Changed very much	9 (13.4)	13 (19.4)	19 (28.4)	4.657 (2)	.097
Changed a little bit	20 (29.9)	6 (9.0)	10 (14.9)	10.558 (2)	.005
Not changed much	14 (20.9)	2 (3.0)	0 (0.0)	23.359 (2)	.000
No change	8 (11.9)	0 (0.0)	10 (14.9)	10.251 (2)	.006

Overall chi-square results indicated a significant difference (p=.000) in levels of cleaning changes among low-risk sites. Respondents from Panama and Chile consider their changes either extremely or very much in comparison to those in New Mexico. Conversely, more New Mexicans consider their cleaning habits as changing a little bit, not much or no change. This is not unexpected, since concern over catching HPS shows similar results.

Table 6.31: *Frequency and Percentage of How Habits Have Changed in the Low-risk Sites*

	NWNM (n = 67)	Panama (n = 67)	Chile (n = 67)	Chi-sq (df)	p
How have habits changed, No. (%)					
Mop more	14 (20.9)	16 (23.9)	16 (23.9)	.226 (2)	.893
Sweep and/or vacuum more	15 (22.4)	37 (55.2)	14 (20.9)	22.875 (2)	.000
Disinfect more	24 (35.8)	36 (53.7)	37 (55.2)	6.256 (2)	.044
Set more traps	15 (22.4)	23 (34.3)	8 (11.9)	9.528 (2)	.009
Wear rubber gloves	15 (22.4)	0 (0.0)	12 (17.9)	16.172 (2)	.000
Wear dust mask	7 (10.5)	4 (6.0)	7 (10.5)	1.098 (2)	.577
Wear ventilator mask	2 (3.0)	0 (0.0)	1 (1.5)	2.030 (2)	.362

Detailed chi-square results illustrated a significant difference in most categories in how cleaning habits have changed among low-risk sites. Chileans are disinfecting more, which is expected, Panamanians are also disinfecting, but are also sweeping, which is recognized as an inappropriate cleaning method to reduce risk of exposure to HPS. It appears that all sites are performing both appropriate and inappropriate cleaning methods, but Panamanians are performing more inappropriate methods than the other two sites.

Table 6.32: *Frequency and Percentage of Purchase Changes in the Low-risk Sites*

	NWNM (n = 67)	Panama (n = 67)	Chile (n = 67)	Chi-sq (df)	p
Purchases, No. (%)					
Mouse rat traps	14 (20.9)	19 (28.4)	8 (11.9)	5.577 (2)	.062
Rat poison	13 (19.4)	30 (44.8)	16 (23.9)	11.852 (2)	.003
Bleach	23 (34.3)	15 (22.4)	42 (62.7)	23.962 (2)	.000
Dust masks	6 (9.0)	3 (4.5)	0 (0.0)	6.281 (2)	.043
Disinfectants	21 (31.3)	32 (47.8)	12 (17.9)	13.688 (2)	.001
Ventilator masks	2 (3.0)	0 (0.0)	2 (3.0)	2.041 (2)	.360

Detailed analysis provided a significant difference among sites in those who purchase poison, bleach, dust masks, and disinfectants in the low-risk sites. Except for purchasing dust masks, the remaining variables, are generally recognized as proper purchases methods. This demonstrates that respondents perform not only improper cleaning purchases, but most actually perform proper methods such as mopping, disinfecting, and setting traps. Public health approaches should include the message that dust masks are ineffective and continue messages that traps, poison, bleach, and disinfectants are appropriate.

Table 6.33: *Frequency and Percentage of Peridomestic Improvements in the Low-risk Sites*

	NWNM (n = 67)	Panama (n = 67)	Chile (n = 67)	Chi-sq (df)	p
Peridomestic improvements, No. (%)					
Mouse rat proof home	18 (26.9)	46 (68.7)	20 (29.9)	29.941 (2)	.000
Remove trash from home	30 (44.8)	41 (61.2)	32 (47.8)	4.102 (2)	.129
Clean up wood piles	14 (20.9)	10 (14.9)	19 (28.4)	3.609 (2)	.165
Cut grass weeds	21 (31.3)	35 (52.2)	36 (53.7)	8.459 (2)	.015

Detailed analysis indicated a significant difference among low-risk sites with respect to mouse/rat proofing the home as well as cutting grass and weeds with respect to peridomestic improvements. More respondents from Panama are performing the proper tasks but overall respondents from all low-risk sites demonstrate proper improvements such as mouse/rat proofing the home, removing trash, cleaning wood piles, and cutting grass and weeds away from the home. These tasks are not only proper for HPS prevention, but also good activities for peridomestic sanitation and general environmental conditions.

Table 6.34: ***Frequency and Percentage in Response Upon Hearing about HPS in the Low-risk Sites***

	NWNM (n = 67)	Panama (n = 67)	Chile (n = 67)	Chi-sq (df)	p
Response upon hearing about HPS, No. (%)					
Check for mice	30 (44.8)	45 (67.2)	38 (56.7)	6.832 (2)	.033
Clean the house	20 (29.9)	54 (80.6)	30 (44.8)	36.502 (2)	.000
Took vitamins	3 (4.5)	2 (3.0)	1 (1.5)	1.031 (2)	.597
Got a flu shot	4 (6.0)	7 (10.5)	1 (1.5)	4.786 (2)	.091
Nothing	17 (25.4)	0 (0.0)	6 (9.0)	21.897 (2)	.000

Detailed analysis shows a significant difference among low-risk sites in those who checked for mice, cleaned the house or did nothing at all (New Mexico). More respondents in Panama checked for mice and cleaned the house, but previous tables show that these respondents are sweeping and mopping. Panamanians obviously want to perform cleaning measures, but need clear information on what not to do as well as what to do to reduce exposure risk to themselves and family.

Table 6.35: ***Frequency and Percentage of Responses to PSAs in the Low-risk Sites***

	NWNM (n = 67)	Panama (n = 67)	Chile (n = 67)	Chi-sq (df)	p
Response to PSAs, No. (%)					
Panic	1 (1.5)	30 (44.8)	7 (10.5)	45.636 (2)	.000
Stayed home	1 (1.5)	1 (1.5)	1 (1.5)	0.000 (2)	1.000
Avoid contact with animals	11 (16.4)	11 (16.4)	7 (10.5)	1.289 (2)	.525
Learned more about HPS	26 (38.8)	40 (59.7)	48 (71.6)	15.078 (2)	.001
Wonder about victim	15 (22.4)	6 (9.0)	3 (4.5)	1.072 (2)	.004

Detailed analysis shows a significant difference among low-risk sites in those who panicked ($p = .000$) and then proceeded to learn more about HPS ($p = .001$). More respondents in Panama panicked, but more respondents in Chile (71.6%) learned more about HPS. New Mexicans learned more (38.8%), but also wondered who the victims were (22.4%).

Table 6.36: ***Frequency and Percentage of Concern About Catching HPS in the Low-risk Sites***

	NWNM (n = 67)	Panama (n = 67)	Chile (n = 67)	Chi-sq (df)	p
Concern about catching HPS, No. (%)			Overall chi-sq (df):	87.881 (8)	.000
Very concerned	7 (10.5)	32 (47.8)	22 (32.8)	22.359 (2)	.000
Concerned	12 (17.9)	24 (35.8)	28 (41.8)	9.536 (2)	.008
Little bit of concern	8 (11.9)	8 (11.9)	8 (11.9)	.000 (2)	1.000
Not much concern	20 (29.9)	1 (1.5)	4 (6.0)	28.597 (2)	.000
Not concerned at all	9 (13.4)	2 (3.0)	5 (7.5)	5.025 (2)	.081

A significant difference (p=.000) was found among low-risk sites with respect to concern for self and family about catching HPS. Detailed analysis also shows a significant difference among sites in three categories: very concerned (p = .000), concerned (p = .008) and not much concern (p = .000). As was expected, more respondents in Panama and Chile were either very concerned or concerned, and respondents in New Mexico show not much concern or no concern at all. This indicates the respondents from the low-risk areas in Panama and Chile remain aware of HPS. For those New Mexico respondents that are not concerned, they could already be practicing proper cleaning habits through accurate knowledge, or it could mean that since HPS risk rises and lowers over time and public health messages are not consistent in either amount of information or access to information.

HIGH AND LOW (ALL) RISK COMBINED SITES

Section IX: – Sociodemographic Characteristics

Table 6.37: ***Frequency and Percentage of Women in All-risk Sites***

	NWNM (n = 200)	Panama (n = 200)	Chile (n = 201)	Chi-sq (df)	p
Women, No. (%)	140 (70.0)	114 (57.0)	112 (55.7)	11.300 (2)	.004

There was a significant difference in the gender composition between New Mexico and Panama/Chile in frequency and percentage in all-risk sites. Overall, 55.7% to 70.0% of respondents were women in all-risk sites.

Table 6.38: ***Frequency and Percentage of Age Distributions in All-risk Sites***

	NWNM (n = 200)	Panama (n = 200)	Chile (n = 201)	Chi-sq (df)	p
Age, No. (%)			Overall chi-sq (df):	14.027 (10)	.172
18-25	21 (10.5)	25 (12.5)	36 (17.9)	5.005 (2)	.082
26-34	35 (17.5)	42 (21.0)	42 (20.9)	1.000 (2)	.607
35-44	48 (24.0)	59 (29.5)	56 (27.9)	1.614 (2)	.446
45-54	47 (23.5)	34 (17.0)	33 (16.4)	4.027 (2)	.134
55-64	27 (13.5)	19 (9.5)	14 (7.0)	4.842 (2)	.089
>64	14 (7.0)	17 (8.5)	14 (7.0)	.444 (2)	.801
Average age	41.01	39.75	38.37	F = 2.085	p = .125

Overall, chi-square results confirmed no significant difference (p=.172) among age groups and all-risk sites, indicating a similar age composition. Difference of means test calculated for average age across categories (New Mexico = 41.01 years, Panama = 39.75 years, Chile = 38.37 years) for this variable confirmed that overall, age should not have a confounding effect on continued analysis. It should be noted in the χ^2 detail that two categories approached significance: 18-15 (p = .082) and 55-64 (p = .089).

Table 6.39: ***Frequency and Percentage of Number of Minor Children in the Household in All-risk Sites***

	NWNM (n = 200)	Panama (n = 200)	Chile (n = 201)	Chi-sq (df)	p
Number of minor children in household (as categories)			Overall chi-sq (df):	44.325 (14)	.000
No children	89 (44.5)	63 (31.5)	62 (30.8)	10.357 (2)	.006
1 child	31 (15.5)	53 (26.5)	55 (27.4)	9.852 (2)	.007
2 children	36 (18.0)	44 (22.0)	48 (23.9)	2.156 (2)	.340
3 children	16 (8.0)	31 (15.5)	25 (12.4)	5.294 (2)	.067
4 or more children	12 (6.0)	9 (4.5)	7 (3.5)	1.447 (2)	.485
No response	15 (7.5)	0 (0.0)	4 (2.0)	19.727 (2)	.000
Average children/home	1.39	1.37	1.37	F = .006	.994

Overall, the chi-square results illustrated significant differences (p = .000) in number of minor children in the household as categories in all-risk sites, but F-test results show overall there is no significance. F-test results should be expected since three detail categories show significance (no children p=.006, one child p=.007, and no response p=.000). Other ranges from one child to four or more children range from p=.067 to p=.485.

Table 6.40: ***Frequency and Percentage by Ethnicity in the All-risk Sites***

	NWNM (n = 200)	Panama (n =200)	Chile (n = 201)	Chi-sq (df)	p
Ethnicity, No. (%)			Overall chi-sq (df):	431.132 (14)	.000
American Indian, Indigenous, Mapucho	54 (27.0)	0 (0.0)	22 (10.9)	66.784 (2)	.000
African American/Negro	0 (0.0)	13 (6.5)	0 (0.0)	26.641 (2)	.000
Anglo/Blanco	78 (39.0)	64 (32.0)	53 (25.9)	7.916 (2)	.019
Latino, Chilean, Mestizo	54 (27.0)	105 (52.5)	96 (47.8)	30.135 (2)	.000
Mulato	0 (0.0)	7 (3.5)	0 (0.0)	14.200 (2)	.001
Other	10 (5.0)	1 (0.5)	4 (2.0)	8.639 (2)	.013
No response	6 (3.0)	11 (5.5)	27 (13.4)	17.547 (2)	.000

Overall, the chi-square results indicated a significant difference (p = .000) in ethnicity as categories in all-risk sites. This was true in all categories. As with the high and low-risk sites, since no respondents in Panama self-identified as Indigenous, but rather Mulato or Mestizo. Likewise, a small number of respondents in Panama identified as Negro, but none in New Mexico or Chile. A large number of respondents identified as Mestizo or Chilean rather than Latino (in New Mexico), and a small percentage of respondents in the risk sites chose not to respond.

Table 6.41: ***Average Income in the All-risk Sites***

	NWNM (n = 200)	Panama (n = 200)	Chile (n = 201)
Average income (USD)	37,500	2,352	4,058

Annual average income is shown in USD, USD/Balboas (equivalent conversion), and Chilean pesos converted to USD.

Table 6.42: ***Frequency and Percentage by Occupation in the All-risk Sites***

	NWNM (n = 200)	Panama (n =200)	Chile (n = 201)	Chi-sq (df)	p
Occupation, No. (%)			Overall χ^2	151.564 (14)	.000
Professional	67 (33.5)	26 (13.0)	32 (15.9)	29.875 (2)	.000
Skilled labor/technical	21 (10.5)	10 (5.0)	25 (12.4)	7.059 (2)	.029
Agriculture/farmer	6 (3.0)	33 (16.5)	22 (10.9)	20.194 (2)	.000
Secretary/clerical	32 (16.0)	22 (11.0)	9 (4.5)	14.269 (2)	.001
Sales	11 (5.5)	7 (3.5)	26 (12.9)	14.619 (2)	.001
Ama de Casa	0 (0.0)	59 (29.5)	42 (20.9)	65.858 (2)	.000
Other	33 (16.5)	40 (20.0)	25 (12.4)	4.209 (2)	.122
No response	22 (11.0)	4 (2.0)	20 (10.0)	13.713 (2)	.001

Overall, the chi-square results showed significant difference (p = .000) in occupation as categories. This was true in all categories except other (p=.122). This was to be expected because overall, more New Mexicans reported occupation as professional (probably due to higher education levels) than Panamanians and Chileans. More Chileans responded as skilled labor/technical, which was expected because more

Chileans went to trade school than the other sites. More Panamanians and Chileans reported ama de casa (housewife) as occupation, so they should be keyed in as an important target for public service announcements.

Table 6.43: ***Frequency and Percentage by Education Levels in All-risk Sites***

	NWNM (n = 200)	Panama (n = 200)	Chile (n = 201)	Chi-sq (df)	p
Education, No. (%)			Overall χ^2	167.096 (10)	.000
0-8	10 (5.0)	8 (4.0)	5 (2.5)	1.744 (2)	.418
9-12	69 (34.5)	76 (38.0)	54 (26.9)	5.872 (2)	.053
13-16	86 (43.0)	78 (39.0)	84 (41.8)	.695 (2)	.707
>16	27 (13.5)	32 (16.0)	35 (17.4)	1.193 (2)	.551
Technical	0 (0.0)	5 (2.5)	20 (10.0)	26.968 (2)	.000
Average years of education	12.51	8.34	9.65	F = 50.773	.000

Overall chi-square results indicated a significance (p = .000) in education levels among all-risk sites. A difference of means test (average years of education 12.51 New Mexico; 8.34 Panama; 9.65 Chile) confirmed significance (p = .000). More New Mexicans have 13-16 years of education, more Panamanians and Chileans have 9-12 and 13-16 years of education, and Chileans generally go to trade school more than the other sites.

Section X – Mediating Variables

Table 6.44: ***Frequency and Percentage of Length of Time in Area in All-risk Sites***

	NWNM (n = 200)	Panama (n = 200)	Chile (n = 201)	F-test	p
Length of time in area (average years)	31.15	33.08	28.52	F = 2.876	p = .057

There was a difference in the average length of time in years that respondents lived in the area (range 28.52 – 33.08 years). While a significant difference was expected, F-test result approached significance. Chileans lived the least amount of time in the area; Panamanians lived the most amount of time in the area. This is to be expected because respondents from Chile were generally younger.

Table 6.45: *Frequency and Percentage in Average Age of Home and Home Ownership in All-risk Sites*

	NWNM (n = 200)	Panama (n = 200)	Chile (n = 201)	Chi-sq (df) F test	p
Average age of home	16.98	21.21	21.35	F = 4.436	.012
Own home, No. (%)	152 (76.0)	171 (85.5)	158 (78.6)	6.032 (2)	.049

There was a significant difference in the average age of homes among all-risk sites (p=.012). F-test analysis confirmed that average age of homes did emerge as a confounding factor to consider in further analysis. The percentage of home owners did vary, however (range (76.0% - 85.5%). Therefore it was expected that among homeowners in all-risk sites that a significant difference would emerge (p = .049).

Table 6.46: *Frequency and Percentage of Observation of Rodents in the Home in All-risk Sites*

	NWNM (n = 200)	Panama (n = 200)	Chile (n = 201)	Chi-sq (df)	p
Observed rodents in home? No. (%)	98 (49.0)	151 (75.5)	67 (33.3)	73.029 (2)	.000

There was a difference in the percentage of respondents that have observed rodents in their homes in all-risk sites. Therefore, it was expected that a significant difference would emerge (p = .000). While less than 50% of respondents in New Mexico and Chile have observed rodents in the home, more than 70% of respondents in Panama have observed rodents in the home, indicating a higher risk of exposure to HPS.

Section XI – Knowledge Responses

Table 6.47: *Frequency and Percentages of Knowledge Responses in All-risk Sites*

	NWNM (n = 200)	Panama (n = 200)	Chile (n=201)	Chi-sq (df)	p
Heard of HPS? Yes, (%)	184 (92.0)	191 (95.5)	199 (99.0)	11.465 (2)	.003
When? No. (%)			Overall chi-sq (df)		
Prior to 1970	1 (0.5)	0 (0.0)	0 (0.0)	2.008 (2)	.366
1971-1980	5 (2.5)	2 (0.1)	0 (0.0)	5.514 (2)	.063
1981-1990	15 (7.5)	2 (0.1)	8 (4.0)	10.622 (2)	.005
1991-1993	12 (6.0)	0 (0.0)	2 (0.1)	18.187 (2)	.000
1994-1999	50 (25.0)	46 (23.0)	78 (38.8)	14.451 (2)	.001
2000-2007	52 (26.0)	133 (66.5)	73 (36.3)	72.335 (2)	.000
No response	65 (32.5)	17 (8.5)	40 (19.9)	35.632 (2)	.000
How heard of HPS, no. (%)					
Newspaper	108 (54.0)	54 (27.0)	36 (17.9)	63.901 (2)	.000
Television	137 (68.5)	149 (74.5)	159 (79.1)	5.898 (2)	.052
Radio	60 (30.0)	70 (35.0)	37 (18.4)	14.485 (2)	.001
Family friends	79 (39.5)	23 (11.5)	24 (11.9)	2.160 (2)	.000
Know someone that has had HPS? No. (%)	28 (14.0)	101 (50.5)	75 (37.3)	60.947 (2)	.000
How do people catch HPS? No. (%)					
Animal bites	14 (7.0)	8 (4.0)	11 (54.7)	1.735 (2)	.420
Other sick people	4 (2.0)	12 (6.0)	3 (1.5)	7.974 (2)	.019
Breathing contaminated air	176 (88.0)	173 (86.5)	189 (94.0)	6.793 (2)	.033
Petting dog or cat	5 (2.5)	1 (0.5)	6 (3.0)	3.552 (2)	.169
Working with livestock	9 (4.5)	3 (1.5)	1 (0.5)	8.211 (2)	.016
Kinds of animals/insects carry HPS? No. (%)					
Mosquitoes	23 (11.5)	8 (4.0)	1 (0.5)	25.117 (2)	.000
Ticks	14 (7.0)	0 (0.0)	0 (0.0)	28.739 (2)	.000
Dogs	4 (2.0)	2 (1.0)	3 (1.5)	.678 (2)	.712
Mice	176 (88.0)	187 (93.5)	193 (96.0)	9.731 (2)	.008
Sheep	3 (1.5)	1 (0.5)	1 (0.5)	1.621 (2)	.445
Cats	5 (2.5)	2 (1.0)	2 (1.0)	2.042 (2)	.360
Fleas	20 (10.0)	1 (0.5)	0 (0.0)	37.698 (2)	.000

Table 6.47 Continued

	NWNM (n = 200)	Panama (n = 200)	Chile (n=201)	Chi-sq (df)	p
Symptoms of HPS No. (%)					
Aches	114 (57.0)	39 (19.5)	44 (21.9)	80.070 (2)	.000
Sore throat	52 (26.0)	29 (14.5)	18 (9.0)	22.015 (2)	.000
Rash	21 (10.5)	10 (5.0)	4 (2.0)	13.608 (2)	.001
Fever	144 (72.0)	82 (41.0)	16 (8.0)	86.014 (2)	.000
Headache	74 (37.0)	67 (33.5)	66 (32.8)	.888 (2)	.642
Cough	71 (35.5)	150 (75.0)	41 (20.4)	129.534 (2)	.000

In terms of if the respondent has heard of HPS, chi-square analysis showed a significant difference (p = .003) in all-risk sites. Respondents in Panama and Chile represent a higher number of respondents, which is to be expected since more Panamanians have observed rodents in the home, and those in Chile have extended and continual outreach programs in place.

With respect to when the respondent heard of HPS, chi-square results showed a significant difference among all-risk sites in all categories 1981-90 onward, including no response. Again, this table represents specific time frames when HPS emerged in each country, so significant differences were to be expected.

For those respondents who did hear about HPS, detailed chi-square results showed a significant difference among all-risk sites in all categories except television, although this category did approach significance (p = .052). More New Mexicans and Panamanians than Chileans heard about HPS through newspapers. More Panamanians and Chileans heard about HPS through television than New Mexicans. Radio was an important method of outreach in Panama and New Mexico, and finally family/friends are important methods of information reception in New Mexico.

In all-risk sites, slightly more than fifty percent of respondents in Panama know someone that has had HPS, while as low as 14.0% of respondents in New Mexico know someone that has had HPS. Therefore it would be reasonable to expect a significant difference to emerge (p=.000).

In terms of how people contract HPS, detailed chi-square results showed a significant difference among all-risk sites with respect to other sick people (p = .019) breathing contaminated air (p = .033) and working with livestock (p = .016). The table does indicate small percentages of respondents who believe that HPS may be caught from animal bites (rare), other sick people (not confirmed), petting a dog or cat (not likely) or working with livestock (not likely).

A significant difference in knowledge among all-risk sites was found with respect to arthropods and mice as the insect/animal that carries HPS. The table does show percentages of New Mexican respondents who believe that HPS is carried by arthropods (mosquitoes, ticks, fleas). This could be because of confusion between how plague and West Nile Virus is transmitted which are also zoonotic disease problems in New Mexico.

In terms of symptoms of HPS, detailed chi-square results showed a significant difference among all-risk sites in all categories except headache. Respondents in New Mexico believe fever, aches, headache, cough, sore throat and rash as leading indicators of HPS. Panamanians believe cough, fever, headache, aches, sore throat, and rash to be indicators. Chileans believe headache, aches, cough, sore through, fever, and rash to be indicators. Although the percentages are low of those who believe rash is a symptom, the result remains significant, and indicates misinformation has been received by a small percentage of respondents.

Section XII – Behavior Responses

Table 6.48: ***Frequency and Percentage in Cleaning Level Change in All-risk Sites***

	NWNM (n = 200)	Panama (n = 200)	Chile (n = 201)	Chi-sq (df)	p
Level of cleaning change No. (%)			Overall chi-sq (df):	136.125 (8)	.000
Changed extremely	24 (12.0)	119 (59.5)	79 (39.3)	97.585 (2)	.000
Changed very much	36 (18.0)	38 (19.0)	54 (26.9)	5.645 (2)	.059
Changed a little bit	62 (31.0)	26 (13.0)	35 (17.4)	21.634 (2)	.000
Not changed much	30 (15.0)	7 (3.5)	6 (3.0)	27.813 (2)	.000
No change	25 (12.5)	1 (0.5)	20 (10.0)	22.626 (2)	.000

Overall chi-square results indicate a significant difference (p=.000) in levels of cleaning changes among all-risk sites. Respondents from Panama and Chile consider their changes either extremely or very much in comparison to those in New Mexico. Conversely, more New Mexicans consider their cleaning habits as changing a little bit, not much or no change. This is not unexpected, since concern over catching HPS shows similar results.

Table 6.49: ***Frequency and Percentage of How Habits Have Changed in All-risk Sites***

	NWNM (n=200)	Panama (n=200)	Chile (n=201)	Chi-sq (df)	p
How have habits changed, No. (%)					
Mop more	54 (27.0)	79 (39.5)	53 (26.4)	10.276 (2)	.006
Sweep and/or vacuum more	57 (28.5)	100 (50.0)	38 (18.9)	46.351 (2)	.000
Disinfect more	87 (43.5)	89 (44.5)	114 (56.7)	8.704 (2)	.013
Set more traps	60 (30.0)	58 (29.0)	27 (13.4)	18.920 (2)	.000
Wear rubber gloves	58 (29.0)	14 (7.0)	26 (12.9)	37.979 (2)	.000
Wear dust mask	49 (24.5)	24 (12.0)	22 (10.9)	17.104 (2)	.000
Wear ventilator mask	4 (2.0)	3 (1.5)	1 (0.5)	1.788 (2)	.409

Detailed chi-square results showed a significant difference in most categories of how cleaning habits have changed among all-risk sites. Chileans disinfecting the most, Panamanians are also disinfecting, but are also sweeping, which is recognized as an inappropriate cleaning method to reduce risk of exposure to HPS. It appears that all sites are performing both appropriate and inappropriate cleaning methods, but Panamanians are performing more inappropriate methods than the other two sites including wearing dust masks.

Table 6.50: ***Frequency and Percentage of Purchase Changes in All-risk Sites***

	NWNM (n=200)	Panama (n=200)	Chile (n =201)	Chi-sq (df)	p
Purchases, No. (%)					
Mouse rat traps	61 (30.5)	75 (37.5)	15 (7.5)	52.684 (2)	.000
Rat poison	36 (18.0)	90 (45.0)	58 (28.9)	34.758 (2)	.000
Bleach	77 (38.5)	44 (22.0)	134 (66.7)	83.775 (2)	.000
Dust masks	29 (14.5)	16 (8.0)	5 (2.5)	19.006 (2)	.000
Disinfectants	73 (36.5)	81 (40.5)	36 (17.9)	26.972 (2)	.000
Ventilator masks	8 (4.0)	4 (2.0)	4 (2.0)	2.070 (2)	.355

Detailed analysis provided a significant difference among sites in those who purchase poison, bleach, dust masks, and disinfectants in all-risk sites. Except for purchasing dust masks, the remaining variables, are generally recognized as proper purchases and methods. This demonstrates that respondents perform not only improper cleaning purchases, but most actually perform proper methods such as mopping, disinfecting, and setting traps. Public health approaches should include the message that dust masks are ineffective and continue messages that traps, poison, bleach, and disinfectants are appropriate.

Table 6.51: ***Frequency and Percentage of Peridomestic Improvements in All-risk Sites***

	NWNM (n=200)	Panama (n=200)	Chile (n =201)	Chi-sq (df)	p
Peridomestic improvements, No. (%)					
Mouse rat proof home	71 (35.5)	127 (63.5)	85 (42.3)	34.259 (2)	.000
Remove trash from home	94 (47.0)	104 (52.0)	77 (38.3)	7.758 (2)	.021
Clean up wood piles	53 (26.5)	41 (20.5)	66 (32.8)	7.812 (2)	.020
Cut grass weeds	71 (35.5)	82 (41.0)	124 (61.7)	30.803 (2)	.000

Detailed analysis illustrated a significant difference among all-risk sites in all categories with respect to peridomestic improvements. More respondents from Panama are mouse/rat proofing the home and removing trash, while Chileans are cleaning up woodpiles and cutting grass/weeds from around the house. These tasks are not only proper for HPS prevention, but also good activities for peridomestic sanitation and general environmental conditions.

Table 6.52: ***Frequency and Percentage in Response Upon Hearing about HPS in All-risk Sites***

	NWNM (n=133)	Panama (n=67)	Chile (n =)	Chi-sq (df)	p
Response upon hearing about HPS, No. (%)					
Check for mice	119 (59.5)	120 (60.0)	109 (54.2)	1.683 (2)	.431
Clean the house	89 (44.5)	144 (72.0)	113 (56.2)	31.186 (2)	.000
Took vitamins	15 (7.5)	8 (4.0)	4 (2.0)	7.264 (2)	.026
Got a flu shot	24 (12.0)	16 (8.0)	4 (2.0)	15.008 (2)	.001
Nothing	37 (18.5)	3 (1.5)	16 (8.0)	34.862 (2)	.000

Detailed analysis confirmed a significant difference for all categories except check for mice. More respondents in Panama checked for mice and cleaned the house, but previous tables show that these respondents are also sweeping and mopping. Panamanians obviously want to perform cleaning measures, but need clear information on what not to do as well as what to do to reduce exposure risk to themselves and family. More New Mexicans took vitamins, got a flu shot or nothing at all, which would be inappropriate for reducing exposure risk to HPS. These is not unexpected since New Mexicans show the least amount of cleaning changes and are least concerned about contracting HPS.

Table 6.53: ***Frequency and Percentage of Responses to PSAs in All-risk Sites***

	NWNM (n=200)	Panama (n=200)	Chile (n =201)	Chi-sq (df)	p
Response to PSAs, No. (%)					
Panic	13 (6.5)	68 (34.0)	28 (13.9)	54.534 (2)	.000
Stayed home	11 (5.5)	20 (10.0)	6 (3.0)	8.762 (2)	.013
Avoid contact with animals	41 (20.5)	44 (22.0)	21 (10.4)	10.901 (2)	.004
Learned more about HPS	106 (53.0)	94 (47.0)	135 (67.2)	17.435 (2)	.000
Wonder about victim	46 (23.0)	20 (10.0)	18 (9.0)	20.390 (2)	.000

Detailed analysis shows a significant difference among all-risk sites in all categories. More Panamanians panicked, stayed home and avoided contact with animals, while Chileans clearly wanted to learn more about HPS. New Mexicans wondered about the victim more than Chileans or Panamanians.

Table 6.54: ***Frequency and Percentage of Concern About Catching HPS in All-risk Sites***

	NWNM (n=200)	Panama (n=200)	Chile (n = 201)	Chi-sq (df)	p
Concern about catching HPS, No. (%)			Overall chi-sq (df):	129.065 (8)	.000
Very concerned	36 (18.0)	85 (42.5)	81 (40.2)	32.954 (2)	.000
Concerned	32 (16.0)	62 (31.0)	68 (33.8)	18.679 (2)	.000
Little bit of concern	32 (16.0)	28 (14.0)	19 (9.5)	3.956 (2)	.138
Not much concern	53 (26.5)	1 (0.5)	7 (3.5)	88.847 (2)	.000
Not concerned at all	30 (15.0)	16 (8.0)	22 (10.9)	4.924 (2)	.085

Overall chi-square results confirmed a significant difference (p=.000) among all-risk sites with respect to concern for self and family about catching HPS. Detailed analysis also shows a significant difference among sites in three categories: very concerned (p = .000), concerned (p = .000) and not much concern (p = .000). As was expected, more respondents in Panama and Chile were either very concerned or concerned, and respondents in New Mexico show not much concern or no concern at all. This indicates the respondents from all low-risk areas in Panama and Chile remain aware of HPS. For those New Mexico respondents that are not concerned, they could already be practicing proper cleaning habits through accurate knowledge, or it could mean that since HPS risk rises and lowers over time and public health messages are not consistent in either amount of information or access to information.

With all of the above information provided for the reader interested in individual sites, and detail of particular behaviors for sub-populations, a summary listing of results is in order. Table 6.55 lists the significant results for each of the three comparisons on a variable by variable basis.

Table 6.55: ***Summary Table of Significant Results***

High-risk combined	**Low-risk combined**	**All-risk combined**
Mediating	**Mediating**	**Mediating**
		6.45 ave age of home p=.012
	6.26 length of time in area p=.023	
	6.27 own home p=.010	6.45 own home p=.049
6.10 observed rodents in home p=.000	6.28 observed rodents in home p=.000	6.46 observe rodents in home p=.000

Table 6.55 Continued

High-risk combined	Low-risk combined	All-risk combined
Knowledge Responses	**Knowledge Responses**	**Knowledge Responses**
6.11: heard of hps? P=.035	6.29 heard of HPS p=.000	6.47 heard of HPS p=.003
6.11 how heard of HPS	6.29 how heard of HPS	6.47 how heard of HPS
newspaper p=.000	newspaper p=.010	newspaper p=.000
	tv p=.015	
radio p=.040	radio p=.006	radio p=.001
family/friends p=.000	family/friends p=.001	family friends p=.000
6.11 know someone with HPS? P=.000	6.29 know someone with HPS? P=.000	6.47 know someone with HPS? P=.000
6.11 how do people catch HPS?	6.29 how do people catch HPS?	6.47 how do people catch HPS?
		Other sick people p=.019
breathing contaminated air p=.000	breathing contaminated air p=.007	contaminated air p=.033
working with livestock p=.046		working with livestock p=.016
	6.29 animals/insects that carry HPS	6.47 animals/insects that carry HPS
	mice p=.000	mice p=.008
Behavior Responses	**Behavior Responses**	**Behavior Responses**
6.12 cleaning level change p=.000	6.30 cleaning level change p=.000	6.48 cleaning level change p=.000
extremely p=.000	extremely p=.000	extremely p=.000
little bit p=.003	little bit p=.005	little bit p=.000
not much p=.012	not much p=.000	not much p=.000
No change p=.001	no change p=.006	no change p=.000
6.13 how habits have changed	6.31 how habits have changed	6.49 how habit have changed
mop p=.001		mop p=.006
sweep p=.000	sweep p=.000	sweep p=.000
disinfect p=.015	disinfect p=.044	disinfect p=.013
more traps p=.001	more traps p=.009	more traps p=.000
rubber gloves p=.000	rubber gloves p=.000	rubber gloves p=.000
dust mask p=.000		dust mask p=.000
6.14 purchases	6.32 purchases	6.50 purchases
traps p=.000		traps p=.000
poison p=.000	poison p=.003	poison p=.000
bleach p=.000	bleach p=.000	bleach p=.000
dust masks p=.001	dust masks p=.043	dust masks p=.000
disinfectants p=.000	disinfectants p=.001	disinfectants p=.000

Table 6.55 Continued

High-risk combined	Low-risk combined	All-risk combined
Behavior Responses	**Behavior Responses**	**Behavior Responses**
6.15 peridomestic improvements	6.33 peridomestic improvements	6.51 peridomestic improvements
mouse/rat proof home p=.003	mouse/rat proof home p=.000	rat proof p=.000
remove trash p=.026		remove trash p=.021
		clean up wood piles p=.020
cut grass p=.000	cut grass/weeds p=.015	cut grass weeds p=.000
6.16 response to hearing about HPS	6.34 response to hearing about HPS	6.52 response to hearing about HPS
	check for mice p=.033	
clean house p=.029	clean house p=.000	clean house p=.000
vitamins p=.041		vitamins p=.026
flu shot p=.000		flu shot p=.001
nothing p=.001	nothing p=.000	nothing p=.000
6.17 response to PSAs	6.35 response to PSAs	6.53 response to PSAs
panic p=.000	panic p=.000	panic p=.000
stay home p=.007		stay home p=.013
avoid animals p=.006		avoid animals p=.004
learn more p=.000	learn more p=.001	learn more p=.000
wonder about victim p=.004	wonder about victim p=.004	wonder about victim p=.000
6.18 Concern about catching HPS p=.000	6.36 concern about catching HPS p=.000	6.54 concern about catching HPS p=.000
very concerned p=.000	very concerned p=.000	very concerned p=.000
concerned p=.000	concerned p=.008	concerned p=.000
not much concern p=.000	not much concern p=.000	not much concern p=.000

CHAPTER VII:

CORRELATIONS OF SIGNIFICANT RESULTS FOR BEHAVIOR RESPONSES

This chapter describes correlations of socioeconomic status, mediating, and knowledge responses of combined sites and risk in accordance with significant behavior results in Chapter 6. SES variables are: gender, age, ethnicity, occupation, education and income by site. Mediating variables are the average age of home and whether or not the respondent owned their own home. Knowledge responses are: observe rodents in the home, has the respondent heard of HPS, how the respondent heard of HPS, does the respondent know someone with HPS, does the respondent know how people catch HPS, and does the respondent know what types of animals/insects carry HPS? Behavior correlations are: respondent's response to publicized cases, response to public service announcements, concern for self and family members of catching HPS, level of cleaning changes, how habits have changed, how purchases have changed, and peridomestic improvements.

Table 7.1	Gender
Table 7.2:	Age
Table 7.3:	Ethnicity
Table 7.4:	Occupation
Table 7.5:	Education
Table 7.6a:	Income NM
Table 7.6b:	Income Panama
Table 7.6c:	Income Chile
Table 7.7:	Average age of home
Table 7.8:	Own home
Table 7.9:	Observe rodents in home
Table 7.10:	Heard of HPS?
Table 7.11:	How heard of HPS? Newspaper
Table 7.12:	How heard of HPS? Radio
Table 7.13:	How heard of HPS? Family/friends
Table 7.14:	Know someone with HPS?
Table 7.15:	How do people catch HPS?: Other sick people

Table 7.16: How do people catch HPS? Contaminated air
Table 7.17: How do people catch HPS? Working with livestock
Table 7.18: Animals/insects that carry HPS: Mice

Table 7.1: ***Gender***

Behavior	r
Response to publicized cases	
Stay home	-.136**
Learn about HPS	.102*
Response to public service announcements	
Get a flu shot	.090*
Level of cleaning changes	
Very much changed	-.117**

* $p < 0.05$ ** $p < 0.01$

Correlation analysis of gender (women) to behavior responses yielded the following results: In response to publicized cases, women were less likely than men to remain home yet more likely to learn about HPS. Women were also more likely to get a flu shot (in the more than 64 years age category as shown in tale 7.2), and women were less likely change cleaning habits than men.

Table 7.2: ***Age***

Behavior	Age Groups					
Response to public service announcements	18-25	26-34	35-44	45-54	55-64	>64
Check for rodents	r = -.005	r = -.058	r = -.010	r = -.060	r = .104*	r = .063
Get a flu shot	r = -.037	r = -.043	r = -.028	r = .027	r = -.008	r = .114**
Level of cleaning changes	18-25	26-34	35-44	45-54	55-64	>64
Very much changed	r = .053	r = -.014	r = -.052	r = .101*	r = .044	r = .022
How habits have changed	18-25	26-34	35-44	45-54	55-64	>64
Mop more	r = -.014	r = .083*	r = -.044	r = -.067	r = .005	r = .097*
Disinfect more	r = .024	r = .122**	r =-.042	r = -.060	r = .023	r = -.022
Use rubber gloves	r = -.018	r = .007	r = -.087*	r = .048*	r = .048	r = .011

Table 7.2 Continued

Behavior	Age Groups					
How purchases have changed	18-25	26-34	35-44	45-54	55-64	>64
Buy dust masks	r = -.085*	r = .017	r = -.021	r = .023	r = .101*	r = -.017
Buy disinfectants	r = -.041	r = .084*	r = .020	r = -.037	r = .036	r = -.057

* $p < 0.05$ ** $p < 0.01$

Age correlations yielded the following: No specific age group was likely to panic, stay home, avoid animals, learn about HPS or wonder about the victim. However, Those in the 55-64 age group were more likely to check for rodents and those in the more than 64 age group were likely to get a flu shot in response to public service announcements. Respondents in the 45-54 age group were more likely to change cleaning habits, but those in 26-34 and greater than 64 age group were likely to mop more. Age group 26-34 was also likely to disinfect more than other age group and those 35-44 were less likely to use rubber gloves, while those ages 45-54 were most likely to use rubber gloves while cleaning.

Those in the 18-25 age group were least likely to buy dust masks (an ineffective method for cleaning), while those in the 55-64 group were the most likely to purchase dust masks for cleaning. Finally, the 26-34 age group was the most likely to purchase disinfectants.

Table 7.3: Ethnicity

Behavior	Ethnicity						
Response to publicized cases	Am Ind; Indig; Mapucho	Af Am; Negro	Anglo Blanco	Latino, Chilean, Mestizo	Mulato	Other	No response
Stay home	r = .028	r = -.038	r = .060	r = -.108**	r = -.0286	r = .048	r = .061
Avoid animals	r = -.018	r = .021	r = -.011	r = -.017	r = .153**	r = .010	r = -.013
Response to public service announcements	Am Ind; Indig; Mapucho	Af Am; Negro	Anglo Blanco	Latino, Chilean, Mestizo	Mulato	Other	No response
Clean the house	r = -.048	r = .035	r = -.005	r = .022	r = .093*	r = .008	r = .-.017
Take vitamins	r = -.034	r = -.032	r = .074	r = -.072	r = -.024	r = .120**	r = .001
Concern for self and family catching HPS	Am Ind; Indig; Mapucho	Af Am; Negro	Anglo Blanco	Latino, Chilean, Mestizo	Mulato	Other	No response
Very concerned	r = .005	r = -.033	r = -.092*	r = .059	r = -.077	r = .022	r = .084*
Concerned	r = .017	r = .039	r = -.026	r = .063	r = -.031	r = -.049	r = -.084*
Little concerned	r = -.118**	r = .078	r = .047	r = .005	r = .233**	r = -.062	r = -.053
Not much concern	r = -.012	r = -.050	r = .074	r = -.043	r = -.036	r = .088*	r = -.010
No concern	r = .054	r = -.017	r = .068	r = -.115**	r = -.039	r = .044	r = .021
Level of cleaning changes	Am Ind; Indig; Mapucho	Af Am; Negro	Anglo Blanco	Latino, Chilean, Mestizo	Mulato	Other	No response
Extremelychanged	r = -.063	r = .123**	r = -.056	r = .034	r = .045	r = -.012	r = .063
Changed	r = .055	r = -.075	r = .011	r = .048	r = -.055	r = -.028	r = -.111**
How habits have changed	Am Ind; Indig; Mapucho	Af Am; Negro	Anglo Blanco	Latino, Chilean, Mestizo	Mulato	Other	No response
Sweep/vacuum more	r = .014	r = .092*	r = -.007	r = -.005	r = .157**	r = .003	r = -.086*
Use rubber gloves	r = .157**	r = -.066	r = .004	r = -.051	r = -.048	r = -.013	r = -.055
Use dust mask	r = .110**	r = -.064	r = .033	r = -.114**	r = -.047	r = -.048	r = .036
Use ventilator mask	r = -.044	r = -.017	r = .013	r = -.041	r = -.013	r = -.019	r = .135**
How purchases have changed	Am Ind; Indig; Mapucho	Af Am; Negro	Anglo Blanco	Latino, Chilean, Mestizo	Mulato	Other	No response
Buy traps	r = .057	r = -.007	r = -.014	r = -.016	r = .152**	r = .030	r = -.060
Buy poison	r = -.101*	r = .000	r = .020	r = .036	r = -.005	r = -.083*	r = .063
Buy bleach	r = .058	r = -.081*	r = -.038	r = .033	r = -.093*	r = .035	r = .004
Buy dust masks	r = .049	r = -.045	r = .114**	r = -.100*	r = -.033	r = -.010	r = -.038
Buy ventilator masks	r = -.032	r = -.025	r = .041	r = -.058	r = -.018	r = -.026	r = .112**

Table 7.3 Continued

Behavior	Ethnicity						
Peridomestic improvements	Am Ind; Indig; Mapucho	Af Am; Negro	Anglo Blanco	Latino, Chilean, Mestizo	Mulato	Other	No response
Remove trash from yard	r = .093*	r = .024	r = -.077	r = .043	r = .087*	r = -.018	r = -.079
Move wood piles away from home	r = -.088*	r = -.090*	r = -.005	r = -.030	r = .005	r = -.024	r = .047
Cut grass/weeds away from home	r = -.010	r = -.115**	r = .033	r = .037	r = -.038	r = -.041	r = .009

* $p < 0.05$ ** $p < 0.01$

In response to publicized cases, Latinos were least likely to remain home than were other ethnic groups. Mulatos were most likely to avoid animals. In response to public service announcements, Mulatos were most likely to clean the house, and the Other individuals (generally mixed identity) were most likely to take vitamins.

Anglos were least likely to be very concerned for self and family members of catching HPS, while respondents who chose not to identify by race were most likely to be very concerned, but least likely to express some concern. Mulatos were most likely to have little concern, and American Indians were least likely to have little concern for self and family members. Other respondents were most likely to show not much concern (they were also most likely to simply take vitamins as noted above), and finally Latinos were least likely to show no concern.

In response to levels of cleaning change, African Americans were most likely to change cleaning practices the most, while those who did not respond to ethnicity were least likely to have changed at all.

African Americans were likely to sweep/vacuum more, but Mulatos (Panama) were most likely to sweep/vacuum more, which is a poor prevention measure. American

Indians were most likely to use rubber gloves, while Latinos were least likely to use a dust mask, compared to the other ethnic groups. No response was most likely to use a ventilator mask.

Mulatos were most likely to purchase traps, yet least likely to buy bleach. American Indian, Indigenous, and Other groups were least likely to purchase poison. Like Mulatos, African Americans were least likely to purchase bleach. Anglos were most likely to purchase dust masks, but by comparison, Latinos were least likely to purchase dust masks. Those who did not identify with an ethnicity were most likely to purchase dust masks.

American Indian and Indigenous were most likely to remove trash from the yard, but not as likely to move woodpiles away from the home. African Americans were least likely to move wood away from the home and were also least likely to cut grass and weeds away from the home. Mulatos were also likely to remove trash from the yard.

Table 7.4: *Occupation*

Behavior	Occupation						
Response to publicized cases	Prof	Skilled labor	Agri Farmer	Secretary Clerical	Sales	Ama de Casa	No Response
Panic	r = -.092*	r = -.047	r = .056	r = .008	r = -.049	r = .170**	r = -.021
Stay home	r = -.097*	r = .013	r = .097*	r = -.020	r = -.019	r = -.060	r = .037
Avoid animals	r = -.054	r = -.013	r = -.040	r = .027	r = -.030	r = .014	r = .103*
Learn about HPS	r = .143**	r = -.002	r = -.144**	r = .042	r = .019	r = -.030	r = -.060
Wonder about victim	r = .042	r = -.047	r = .039	r = .097*	r = -.058	r = -.040	r = -.035
Response to public service announcements	Prof	Skilled labor	Agricul Farmer	Secretary Clerical	Sales	Ama de Casa	No Response
Check for rodents	r = .088*	r = -.051	r = -.037	r = -.060	r = .020	r = .023	r = -.016
Nothing	r = -.009	r = .094*	r = -.013	r = .077	r = .020	r = -.098*	r = -.033

Table 7.4 Continued

Behavior	Occupation						
Concern for self and family catching HPS	Prof	Skilled labor	Agricul Farmer	Secretary Clerical	Sales	Ama de Casa	No Response
Very concerned	r = -.026	r = .051	r = -.029	r = -.037	r = .016	r = .104*	r = -.038
Concerned	r = -.043	r = -.001	r = .019	r = -.073	r = .002	r = .128**	r = -.014
Little concerned	r = .031	r = -.057	r = -.017	r = .044	r = -.034	r = -.083*	r = .108**
Not much concern	r = .113**	r = -.051	r = -.040	r = .101*	r = .032	r = -.122**	r = -.044
Level of cleaning changes	Prof	Skilled labor	Agricul Farmer	Secretary Clerical	Sales	Ama de Casa	No Response
Extremely changed	r = -.146**	r = .004	r = .051	r = .019	r = -.017	r = .191**	r = -.011
Very much changed	r = -.006	r = .029	r = .027	r = -.085*	r = .041	r = -.027	r = .056
Changed	r = .106**	r = -.077	r = -.061	r = .015	r = -.048	r = -.085*	r = .044
Not much change	r = .065	r = .022	r = -.008	r = .158**	r = -.078	r = -.090*	r = -.035
No Change	r = .068	r = .037	r = -.055	r = -.017	r = .111**	r = -.012	r = -.093*
How habits have changed	Prof	Skilled labor	Agricul Farmer	Secretary Clerical	Sales	Ama de Casa	No Response
Mop more	r = -.086*	r = -.029	r = .085*	r = .029	r = -.009	r = .103*	r = -.013
Disinfect more	r = .030	r = -.012	r = -.016	r = -.004	r = -.029	r = .091*	r = -.039
Use rubber gloves	r = .007	r = .091*	r = .016	r = .099*	r = -.055	r = -.090*	r = -.049
Use dust mask	r = .171**	r = .002	r = -.010	r = .060	r = .034	r = -.146**	r = -.043
How purchases have changed	Prof	Skilled labor	Agricul Farmer	Secretary Clerical	Sales	Ama de Casa	No Response
Buy poison	r = -.019**	r = -.051	r = .123**	r = -.051	r = .007	r = .136**	r = -.029
Buy dust masks	r = .083*	r = -.034	r = .058	r = .094*	r = -.015	r = -.135**	r = .014
Buy disinfectants	r = .137**	r = -.070	r = -.039	r = .129**	r = -.026	r = -.028	r = -.077
Buy ventilator masks	r = .094*	r = .018	r = -.021	r = .045	r = -.007	r = -.047	r = -.073
Peridomestic improvements	Prof	Skilled labor	Agricul Farmer	Secretary Clerical	Sales	Ama de Casa	No Response
Mouse/rat proof the home	r = -.040	r = -.027	r = -.019	r = .015	r = -.060	r = .129**	r = -.001
Remove trash from yard	r = -.043	r = .004	r = -.021	r = .089*	r = -.015	r = .061	r = .001
Move wood piles away from home	r = .062	r = .027	r = -.015	r = .027	r = .004	r = .011	r = -.093*

* $p < 0.05$ ** $p < 0.01$

In response to publicized cases, professionals were not likely to panic or stay home, but “Amas de Casa” (housewives in Panama and Chile) were most likely to panic. Respondents that work in agriculture were most likely to stay home in response to publicized cases, yet least likely to learn about HPS. Those in the clerical fields were most likely to wonder about the victim.

In response to public service announcements, those in the professional occupations were most likely to check for rodents. Those in the skilled labor fields were most likely to do nothing, while amas de casa were least likely to do nothing upon hearing about HPS.

Amas de casa were most likely to show a lot of concern, and some concern for self and others, and were least likely to show little or not much concern for self and others about catching HPS. Professionals were most likely to show not much concern about catching HPS.

Amas de casa were most likely to show an extreme amount of cleaning changes, and least likely to show some change or not much change. Sales occupations were most likely to show no change in cleaning levels, and professionals were most likely to show some change in cleaning changes.

With respect to how habits have changed, Amas de casa were most likely to mop and disinfect more and least likely to use rubber gloves or dust masks. Professionals were least likely to mop more, but they were more likely to use a dust mask. Skilled labor was likely to use rubber gloves.

Again, Amas de casa were most likely to purchase poison and least likely to purchase dust masks. Secretary/clerical workers were most likely to purchase dust masks and disinfectants, along with professionals. Professionals were also most likely to buy ventilator masks, in comparison to other occupations.

Amas de casa were most likely to mouse/rat proof the home, secretary/clerical workers were most likely to remove traps from the yard. Those who chose not to identify by occupations were least likely to move woodpiles away from the home.

Table 7.5: *Education*

Behavior	Education				
Response to publicized cases	0-8	9-12	13-16	>16	Technical
Stay home	r = .021	r = .114**	r = -.032	r = -.110**	r =-.053
Avoid animals	r = -.092*	r = .083*	r = .029	r = -.091*	r =-.031
Learn about HPS	r = -.067	r = -.220**	r = .046	r = .218**	r = .102*
Wonder about victim	r = -.030	r = .083*	r = -.006	r = -.068	r = -.036
Response to public service announcements	0-8	9-12	13-16	>16	Technical
Check for rodents	r = 0.093*	r = -.045	r = -.018	r = .080	r = .059
Clean the house	r = -.145**	r = -.033	r = .084*	r = .008	r = .027
Take vitamins	r = -.001	r = .018	r = -.084*	r = .061	r = -.005
Nothing	r = .026	r = -.019	r = .080*	p = -.059	r = -.038
Concern for self and family catching HPS	0-8	9-12	13-16	>16	Technical
Little concerned	r = -.026	r = -.054	r = -.046	r = 1.44**	r = .018
No concern	r = .120**	r = .050	r = -.054	r = -.038	r = .005
Level of cleaning changes	0-8	9-12	13-16	>16	Technical
Extremely changed	r = -.099**	r = .070	r = .045	r = -.102*	r = .048
Very much changed	r = -.040	r = .014	r = .001	r = .033	r = -.007
Changed	r = .028	r = -.085*	r = .044	r = .065	r = -.023
Not much change	r = .012	r = .052	r = -.088*	r = .040	r = -.026
How habits have changed	0-8	9-12	13-16	>16	Technical
Mop more	r = -.096*	r = .126*	r = -.-13	r = -.070	r = .005
Disinfect more	r = -.106**	r = -.028	r = .090*	r = .024	r = =-.001

Table 7.5 Continued

Behavior	Education				
How purchases have changed	0-8	9-12	13-16	>16	Technical
Buy traps	r = -.036	r = .090*	r = -.018	r = -.017	r = -.063
Buy poison	r = -.202	r = .154**	r = -.058	r = -.057	r = -.066
Buy disinfectants	r = -.098*	r = -.091*	r = .077	r = .101*	r = .002
Peridomestic improvements	0-8	9-12	13-16	>16	Technical
Move wood piles away from home	r = -.081*	r = -.008	r = .038	r = .010	r = .006
Cut grass/weeds away from home	r = -.132**	r = -.033	r = .079	r = -.003	r = .092*

* $p < 0.05$ ** $p < 0.01$

In response to publicized cases, no one educational level was more or less likely to panic, stay home, avoid animals, learn about HPS, or wonder about the victim. However, in response to public service announcements, those in 0-8 years of education were most likely to check for rodents, but least likely to clean the house. Those with 13-16 years of education were most likely to clean the house or nothing at all and least likely to take vitamins.

Levels of cleaning changes analysis shows that those in 0-8 (grade school equivalent), and >16 (graduate school) years of education were least likely to have changed cleaning habits extremely. Those with 9-12 (high school equivalent) years of education were least likely to show not much change.

Respondents with 0-8 years of education were least likely to mop or disinfect more. Those with 9-12 years of education were most likely to mop more and those with 13-16 years of education were most likely to disinfect more than other education levels.

Concerning how purchases have changed, those with 0-8 years of education were least likely to buy disinfectants, those with 9-12 years of education were most likely to purchase traps and poison and less likely to purchase disinfectants. Respondents with more than 16 years of education were most likely to purchase disinfectants.

With respect to peridomestic improvements, those with 0-8 years of education were least likely to move wood piles away from the home or cut grass/weeds away from the home, while those with technical levels of education (trade schools) were most likely to cut grass/weeds away from the home.

Table 7.6a: ***Income NM (n = 200)***

Behavior	Income New Mexico					
Response to publicized cases	0-10K	10-20K	20-30K	30-40K	40-50K	>50K
Avoid animals	r = .216**	r = .067	r = .025	r = -.060	r = -.087	r = -.115
Learn about HPS	r = -.015	r = -.214**	r = -.030	r = -.021	r = .00	r = .176*
Response to public service announcements	0-10K	10-20K	20-30K	30-40K	40-50K	>50K
Take vitamins	r = .092	r = -.028	r = .047	r = .021	r = .158*	r = -.057
Concern for self and family catching HPS	0-10K	10-20K	20-30K	30-40K	40-50K	>50K
Very concerned	r = .070	r = .204**	r = -.007	r = -.082	r = -.026	r = -.087
Little concerned	r = -.095	r = -.052	r = -.014	r = -.066	r = .036	r = .170*
No concern	r = .055	r = -.078	r = -.035	r = -.058	r = .000	r = .155*
How habits have changed	0-10K	10-20K	20-30K	30-40K	40-50K	>50K
Disinfect more	r = -.147*	r = .113	r = .066	r = .014	r = .044	r = .032
How purchases have changed	0-10K	10-20K	20-30K	30-40K	40-50K	>50K
Buy dust masks	r = -.085	r = .078	r = .043	r = -.145*	r = .052	r = .061
Buy disinfectants	r = -.139*	r = -.011	r = .036	r = -.001	r = .163*	r = .008
Buy ventilator masks	r = -.066	r = .111	r = -.102	r = .010	r = .187**	r = -.045
Peridomestic improvements	0-10K	10-20K	20-30K	30-40K	40-50K	>50K
Move wood piles away from home	r = -.156*	r = .120	r = .040	r = .006	r = -.011	r = .072

* p < 0.05 ** p < 0.01

In response to publicized cases, New Mexican respondents with income $0-$10,000/year were most likely to avoid animals. Respondents with $10,001 to $20,000/year were least likely to learn about HPS, and respondents earning more than $50,000/year were most likely to learn about HPS. In response to public service announcements, respondents that earn $40,001 - $50,000/year were most likely to take vitamins.

Respondents earning between $10,000 - $20,000 were most likely to be very concerned for self and others about catching HPS, and those who earn greater than $50,000 were most likely to show little concern or no concern for catching HPS.

No particular income bracket showed a likelihood to change cleaning levels at any range. However, for habits that have changed, those who earn $0 - $10,000 were least likely to disinfect more. The $0 - $10,000 income bracket was also least likely to purchase more disinfectants. Respondents earning between $30,001 - $40,000 were least likely to purchase dust masks, and those who earn between $40,001 - $50,000 were most likely to purchase disinfectants and ventilator masks.

Similarly, respondents in the $0 - $10,000 income levels were least likely to move woodpiles away from the home.

Table 7.6b: *Income Panama (n = 200)*

Behavior	Income Panama						
Response to publicized cases	0-100	100-200	200-300	300-400	400-500	>500	No response
Panic	r = -.016	r = -.174*	r = .072	r = -.004	r = -.027	r = -.017	r = .112
Stay home	r = -.030	r = .333**	r = .037	r = -.084	r = -.048	r = -.037	r = -.187**
Learn about HPS	r = -.139*	r = -.170*	r = .100	r = .057	r = .080	r = .165*	r = .040
Response to public service announcements	0-100	100-200	200-300	300-400	400-500	>500	No Response
Clean the house	r = -.014	r = -.134	r = .155*	r = -.124	r = .010	r = .143*	r = .081
Take vitamins	r = -.032	r = .026	r = -.074	r = -.052	r = -.029	r = .060	r = .139*
Nothing	r = -.059	r = -.062	r = .084	r = -.031	r = .276**	r = -.036	r = .006
Concern for self and family catching HPS	0-100	100-200	200-300	300-400	400-500	>500	No Response
Not much concern	r = .149*	r = .035	r = -.026	r = -.018	r = -.010	r = -.021	r = -.048
Level of cleaning changes	0-100	100-200	200-300	300-400	400-500	>500	No response
No Change	r = -.034	r = -.035	r = -.026	r = -.018	r = -.010	r = .240**	r = -.048
How habits have changed	0-100	100-200	200-300	300-400	400-500	>500	No response
Mop more	r = .142*	r = .005	r = -.003	r = -.161*	r = .104	p = -.125	r = -.011
Use dust mask	r = .022	r = -.031	r = .012	r = .036	r = .167*	r = .061	r = -.114
How purchases have changed	0-100	100-200	200-300	300-400	400-500	>500	No response
Buy poison	r = .113	r = .000	r = -.074	r = -.017	r = -.057	r = -.156*	r = .133
Buy bleach	p = .058	r = -.145*	r = .073	r = .018	r = -.076	r = -.023	r = .062
Peridomestic improvements	0-100	100-200	200-300	300-400	400-500	>500	No response
Cut grass/weeds away from home	r = -.162*	r = -.036	r = .082	r = .003	r = .171*	r = .204**	r = -.031

* $p < 0.05$ ** $p < 0.01$

In response to publicized cases, those in the 0-100 BBl/month were less likely to learn about HPS. Respondents in the 100 – 200 Bbl/month were least likely to panic, most likely to stay home and least likely to learn about HPS. Those who made more than 500 Bbl/month were most likely to learn about HPS.

In response to public service announcements, respondents earning between 200-300 Bbl/month were most likely to clean the house. Those earning between 400 – 500 Bbl/month were most likely to do nothing. Respondents who did not answer income levels were most likely to take vitamins.

Panamanian respondents earning between 200 – 300 Bbl/month were most likely to clean the house, those earning between 400 – 500 Bbl/month were most likely to do nothing, and those earning more than 500 Bbl/month were likely to clean the house. The only income bracket that was likely to take vitamins were those who chose not to identify an income bracket.

In response to concern for self and family members catching HPS, those in the 0 – 100 Bbl/month income level were most likely to show not much concern.

Respondents earning more than 500 Bbl/month were most likely to show no change in cleaning levels.

For respondents who did change cleaning habits, respondents earning between 0 – 100 Bbl/month were most likely to mop more, while those earning between 300 – 400 Bbl/month were least likely to mop more. Respondents earning between 400 – 500 Bbl/month were most likely to use a dust mask.

In response to how purchases have changed, those earning between 100 – 200 Bbl/month were least likely to buy bleach, and those earning greater than 500 Bbl/month were least likely to purchase poison.

Respondents in the 0 – 100 Bbl/month were least likely to cut grass/weeds away from the home, while those earning between 400 – 500 Bbl/month were likely to cut grass/weeds and those earning more than 500 Bbl/month were most likely to cut grass/weeds away from the home.

Table 7.6c: *Income Chile (n = 201)*

Behavior	Income Chile				
Response to publicized cases	0-50K	50K-150K	150K-250K	250K-350K	>350K
Panic	r = .154*	r = .061	r = .016	r = .118	r = -.147*
Avoid animals	r = -.011	r = -.074	r = -.020	r = .140*	r = -.071
Learn about HPS	r = -.224**	r = -.024	r = .053	r = -.029	r = .237**
Wonder about victim	r = .187**	r = .031	r = -.092	r = -.092	r = -.098
Response to public service announcements	0-50K	50K-150K	150K-250K	250K-350K	>350K
Check for rodents	r = -.130	r = -032	r = .003	r = .049	r = .159*
Concern for self and family catching HPS	0-50K	50K-150K	150K-250K	250K-350K	>350K
Little concerned	r = -.121	r = -.056	r = .086	r = -.32	r = .166*
Level of cleaning changes	0-50K	50K-150K	150K-250K	250K-350K	>350K
Extremely changed	r = .098	r = .072	r = .056	r = -.048	r = -.208**
How habits have changed	0-50K	50K-150K	150K-250K	250K-350K	>350K
Mop more	r = .145*	r = .142*	r = 0.082	r = -.134	r = -.156*
Set more traps	r = .054	r - .007	r = .101	r = -.008	r = -.143*
Use ventilator mask	r = -.036	r = -.045	r = -.031	r = -.021	r = .154*
Peridomestic improvements	0-50K	50K-150K	150K-250K	250K-350K	>350K
Move wood piles away from home	r = .067	r = .116	r = -.167*	r = -.088	r = .070

* $p < 0.05$ ** $p < 0.01$

In response to publicized cases, Chileans that earn between 0 – 50,000 Clp/month are most likely to panic and wonder about the victim, and least likely to learn about HPS. Chileans that earn between 250,000 and 350,000 Clp/month were most likely to avoid animals, and those earning more than 350,000 Clp/month are least likely to panic and most likely to learn about HPS. Additionally, Chileans that earn more than 350,000 Clp/month are most likely to check for rodents in response to public service announcements. This income bracket also shows little concern about self and family member in catching HPS and is least likely to extremely change cleaning habits.

For those Chileans that have changed cleaning habits, respondents earning between 0 – 50,000 Clp/month are likely to mop more, followed by Chileans in the next income bracket, 50,000 – 150,000 Clp/month. Respondents earning more than 350,000 Clp/month are least likely to mop more or set more traps, and are most likely to use a ventilator mask.

There were no significant single order correlations for Chileans across income brackets with respect to how purchases have changed. However, with respect to peridomestic improvements, Chileans that earned between 150,000 – 250,000 Clp/month were least likely to move woodpiles away from the home.

Table 7.7: ***Average age of home***

Behavior	r
Peridomestic improvements	
Mouse/rat proof the home	.106*
Cut grass/weeds away from home	.101*

* $p < 0.05$ ** $p < 0.01$

With respect to the average age of homes across sites, respondents from all sites were most likely to mouse/rat proof the home and cut grass/weeds away from the home.

Table. 7.8: ***Own home***

Behavior	r
Level of cleaning changes	
Changed	-.118**
How habits have changed	
Disinfect more	-.084*
Peridomestic improvements	
Mouse/rat proof the home	.113**

* $p < 0.05$ ** $p < 0.01$

Homeowners were more likely to mouse/rat proof the home and least likely to change cleaning habits or disinfect more.

Table 7.9: ***Observe rodents in home***

Behavior	r
Response to publicized cases	
Panic	.136**
Response to public service announcements	
Clean the house	.122**
Level of cleaning changes	
Extremely changed	.175**
No Change	-.090*
How habits have changed	
Mop more	.146**
Sweep/vacuum more	.160**
Set more traps	.263**
How purchases have changed	
Buy traps	.274**
Buy poison	.240**
Buy dust masks	.093*
Peridomestic improvements	
Mouse/rat proof the home	.182**

* $p < 0.05$ ** $p < 0.01$

With respect to observing rodents in the home, in response to publicized cases, respondents were more likely to panic. Respondents were also more likely to clean the house in response to public service announcements, most likely to change cleaning habits extremely, and least likely to show no change. Homeowners mop more, sweep/vacuum more and set more traps. They also purchase more traps, poison, and dust masks. Homeowners are also more likely to mouse/rat proof the home than non-home owners.

Table 7.10: *Heard of HPS?*

Behavior	r
Response to publicized cases	
Panic	.081*
Avoid animals	.100*
Learn about HPS	.243**
Wonder about victim	.087*
Response to public service announcements	
Check for rodents	.238**
Clean the house	.253**
Concern for self and family catching HPS	
Very concerned	.137**
Concerned	.132**
Little concerned	.084*
Level of cleaning changes	
Extremely changed	.149**
Very much changed	.113**
Changed	.110**
How habits have changed	
Mop more	.145**
Sweep/vacuum more	.150**
Disinfect more	.209**
Set more traps	.104*
Use rubber gloves	.096*
Use dust mask	.094*
How purchases have changed	
Buy traps	.107**
Buy poison	.127**
Buy bleach	.170**
Buy disinfectants	.130**

Table 7.10 Continued

Behavior	r
Peridomestic improvements	
Mouse/rat proof the home	.180**
Remove trash from yard	.183**
Move wood piles away from home	.131**
Cut grass/weeds away from home	.201**

* $p < 0.05$ ** $p < 0.01$

Respondents who have heard about HPS in response to publicized cases are more likely to panic, avoid animals, learn about HPS, and wonder about the victim. In response to public service announcements, respondents check for rodents and clean the house. They show concern levels from very concerned, concerned, and little concern. Additionally, levels of cleaning changes range from extremely changed to changed. Respondents are more likely to mop more, sweep/vacuum more, disinfect, set more traps, use rubber gloves, and dust masks.

Additionally, respondents who have heard about HPS are more likely to buy traps, poison, bleach, and disinfectants. They are also likely to mouse/rat proof the home, remove trash, move wood piles and cut grass/weeds away from the home in comparison to those respondents who have not heard about HPS.

Table 7.11: *How heard of HPS? Newspaper*

Behavior	r
Response to publicized cases	
Avoid animals	.094*
Learn about HPS	.126**
Response to public service announcements	
Check for rodents	.246**
Clean the house	.108*
Get a flu shot	.129**
Concern for self and family catching HPS	
Little concerned	.104*
No much concern	.151**

Table 7.11 Continued

Behavior	r
Level of cleaning changes	
Extremely changed	-.104*
Changed	.101*
Not much change	.080*
No Change	.091*
How habits have changed	
Sweep/vacuum more	.096*
Set more traps	.101*
Use rubber gloves	.093*
Use dust mask	.152**
How purchases have changed	
Buy traps	.133**
Buy dust masks	.135**
Buy disinfectants	.216**
Peridomestic improvements	
Remove trash from yard	.145**
Move wood piles away from home	.138**

* $p < 0.05$ ** $p < 0.01$

Respondents who learned about HPS by the newspaper were more likely to avoid animals and learn about HPS in response to publicized cases. In response to public service announcements, they were more likely to check for rodents, clean the house and get an influenza shot. However, they were also likely to show little or no concern about catching HPS. Level of cleaning changes ranged from least likely to extremely likely change to most likely to changed somewhat. Those who learned about HPS though the newspaper were more likely to sweep/vacuum more, set more traps, use rubber gloves and a dust mask. They buy more traps, dust masks, and disinfectants. They are also more likely to remove trash from the yard and move woodpiles away from the home.

Table 7.12: *How heard of HPS? Radio*

Behavior	r
Response to public service announcements	
Check for rodents	.145**
Clean the house	.157**
Take vitamins	.099*
Get a flu shot	.139**
Concern for self and family catching HPS	
Very concerned	.085*
Little concerned	-.098*
No concern	.083*
Level of cleaning changes	
Extremely changed	.087*
How habits have changed	
Mop more	.147**
Sweep/vacuum more	.173**
Set more traps	.136**
Use rubber gloves	.088*
Use dust mask	.179**
How purchases have changed	
Buy traps	.189**
Buy bleach	.091*
Buy dust masks	.190**
Buy disinfectants	.169**
Peridomestic improvements	
Mouse/rat proof the home	.159**
Remove trash from yard	.146**
Move wood piles away from home	.122**
Cut grass/weeds away from home	.149**

* $p < 0.05$ ** $p < 0.01$

Respondents who learned about HPS via radio, and in response to public service announcements were most likely to clean the house, check for rodents, get an influenza shot, and then take vitamins. Concern for self and others ranged from least likely to show little concern to very concerned and were most likely to extremely change their cleaning habits. Those who did change habits were likely to do the following: mop, sweep/vacuum more, set more traps, use rubber gloves, and a dust mask. They were more likely to purchase more traps, bleach, dust masks, and disinfectants. And those who learned about HPS via radio were also likely to mouse/rat proof the home, remove trash, move woodpiles, and cut grass weeds away from the home.

Table 7.13: ***How heard of HPS? Family/friends***

Behavior	r
Response to publicized cases	
Wonder about victim	.146**
Response to public service announcements	
Check for rodents	.125**
Concern for self and family catching HPS	
Concerned	-.083*
No much concern	.165**
Level of cleaning changes	
Extremely changed	-.115**
Changed	.124**
How habits have changed	
Set more traps	.149**
Use rubber gloves	.094*
Use dust mask	.191**
How purchases have changed	
Buy dust masks	.156**
Peridomestic improvements	
Move wood piles away from home	.087*

* $p < 0.05$ ** $p < 0.01$

Respondents who heard of HPS through family/friends in response to publicized cases were more likely to simply wonder who the victim was, but in response to public service announcements, they were more likely to check for rodents. They were least likely to show concern for self and other and most likely to show no concern. With respect to cleaning level changes, respondents were least likely to change extremely and most likely to simply change. Respondents set more traps, use rubber gloves, and dust masks, as well as buy dust masks. They are also most likely to move woodpiles away from the home.

Table 7.14: *Know someone with HPS?*

Behavior	r
Response to publicized cases	
Panic	.155**
Learn about HPS	.094*
Wonder about victim	-.086*
Response to public service announcements	
Check for rodents	.133**
Clean the house	.103*
Nothing	-.133**
Concern for self and family catching HPS	
Very concerned	.204**
No much concern	-.125**
No concern	-.123**
Level of cleaning changes	
Extremely changed	.179**
No Change	-.101*
How habits have changed	
Sweep/vacuum more	.081*
Use rubber gloves	-.117**
How purchases have changed	
Buy poison	.096*
Peridomestic improvements	
Mouse/rat proof the home	.119**

* $p < 0.05$ ** $p < 0.01$

With respect to respondents who know someone who has had HPS, in response to publicized cases, they were most likely to panic, likely to learn about HPS, and least likely to wonder about the victim, which makes sense, because the respondents knew the victim. In response to public service announcements, respondents who know someone with HPS, check for rodents, clean the house, and are least likely to do nothing. Concern for self and others ranges from most likely to be very concerned, and least likely to show not much concern. Additionally, level of cleaning changes ranges from extremely changed to least likely to show no change. Unfortunately, respondents are more likely to sweep/vacuum more and least likely to use rubber gloves. They do, however buy poison and mouse/rat proof the home.

Table 7.15: *How do people catch HPS?: Other sick people*

Behavior	r
How habits have changed	
Mop more	.126**
How purchases have changed	
Buy traps	.115**

* $p < 0.05$ ** $p < 0.01$

For respondents that think HPS is caught from other sick people, they are more likely to mop more and buy more traps.

Table 7.16: *How do people catch HPS? Contaminated air*

Behavior	r
Response to publicized cases	
Learn about HPS	.275**
Wonder about victim	.107**
Response to public service announcements	
Check for rodents	.236**
Clean the house	.212**
Take vitamins	-.109**
Concern for self and family catching HPS	
Very concerned	.105**
Not much concern	.097*
Level of cleaning changes	
Extremely changed	.093*
Very much changed	.112**
Changed	.093*
How habits have changed	
Sweep/vacuum more	.110**
Disinfect more	.233**
Use dust mask	.133**
How purchases have changed	
Buy bleach	.173**
Buy dust masks	.083*
Buy disinfectants	.174**

Table 7.16 Continued

Behavior	r
Peridomestic improvements	
Mouse/rat proof the home	.160**
Remove trash from yard	.162**
Move wood piles away from home	.132**
Cut grass/weeds away from home	.153**

* p < 0.05 ** p < 0.01

With respect to how people catch HPS through contaminated air and in the context of publicized cases, they are most likely to learn about HPS and more likely to wonder about the victim. In response to public service announcements, they are more likely to check for rodents and clean the house, and least likely to take vitamins. Concern for self and other catching HPS ranged from very concerned to not much concern. Levels of cleaning changes ranged from very much changed to extremely changed. Respondents were more likely to sweep/vacuum more, disinfect and use dust masks. They purchase bleach, dust masks, and disinfectants. They were most likely to make all of the appropriate peridomestic improvements of mouse/rat proofing the home, removing trash, moving woodpiles and cutting grass/weeds away from the home.

Table 7.17: *How do people catch HPS? Working with livestock*

Behavior	r
Response to public service announcements	
Take vitamins	.133**
Get a flu shot	.178**
How habits have changed	
Sweep/vacuum more	.092*
Use rubber gloves	.120**
Peridomestic improvements	
Remove trash from yard	.093*

* p < 0.05 ** p < 0.01

For respondents who think working with livestock is how people catch HPS, those who learned from public service announcements took vitamins and got a flu shot. They are also more likely to sweep/vacuum more, use rubber gloves, and remove trash from the yard.

Table 7.18: *Animals/insects that carry HPS: Mice*

Behavior	r
Response to publicized cases	
Panic	.117**
Learn about HPS	.243**
Response to public service announcements	
Check for rodents	.231**
Clean the house	.306**
Take vitamins	-.091*
Concern for self and family catching HPS	
Very concerned	.122**
Level of cleaning changes	
Extremely changed	.152**
Very much changed	.102*
No Change	.082*
How habits have changed	
Mop more	.108**
Sweep/vacuum more	.157**
Disinfect more	.224**
Set more traps	.087*
Use dust mask	.089*
How purchases have changed	
Buy traps	.092*
Buy poison	.093**
Buy bleach	.193**
Buy disinfectants	.139**
Peridomestic improvements	
Mouse/rat proof the home	.180**
Remove trash from yard	.160**
Move wood piles away from home	.114**
Cut grass/weeds away from home	.162**

* $p < 0.05$ ** $p < 0.01$

With respect to respondents who think mice are the animals/insects that carry HPS in response to publicized cases, they were likely to panic and learn about HPS. In response to public service announcements, respondents were more likely to check for rodents, clean the house, and least likely to take vitamins. Respondents were very concerned for self and others in catching HPS, and were likely to change extremely cleaning habits. For those who did change cleaning habits, respondents were likely to mop, sweep/vacuum, disinfect, set traps and use dust masks. They were more likely to buy traps, poison, bleach, and disinfectants. They were also more likely to make proper peridomestic changes of mouse/rat proofing the home, remove trash, move woodpiles, and cut grass/weeds away from the home.

CHAPTER VIII:

LOGISTIC STEPWISE MULTIPLE REGRESSIONS AND BEHAVIORAL INDICES

This chapter describes the index behavioral characteristics of community patterns that influence exposure risk-reduction or risk-increase to HPS. Three key positive behavior factors that reduce risk to HPS exposure are mopping, disinfecting, and rodent proofing the home. Negative behavior factors that increase risk are sweeping and wearing a dust mask. Subpopulations constant among all three-country sites are those respondents who live in the high-risk areas compared those who live in low-risk areas. As seen in the graph below, the sequence of variables entry for the initial stepwise logistic regression was based upon the high-risk/low-risk factor, followed by gender, age groups, occupation, and education. This entry method follows general literature on importance, with education being the most important variable to consider, and therefore is placed last in the sequence. By using logistic regression it is hoped that key independent variables by high-risk and low-risk sites shall help predict how to construct the behavioral index since this analyses method is sensitive to high correlations among the independent variables.

A behavioral index follows the logistic regression analysis, which outlines the various, yet important sequences of positive and negative behaviors common to the independent variables. This sequence ranges from positive 3 to negative 2, based upon reported behavioral changes. Tables outline the overall results, which identifies the key independent variables with specific behavior: mopping, disinfecting, rodent proofing, sweeping, and wearing a dust mask. A summary additive index table follows the detailed tables. This table identifies the key significant behaviors associated with the additive index. Final results should lead to the public health model approach needed to HPS targeted interventions for specific age groups, occupations, and levels of education.

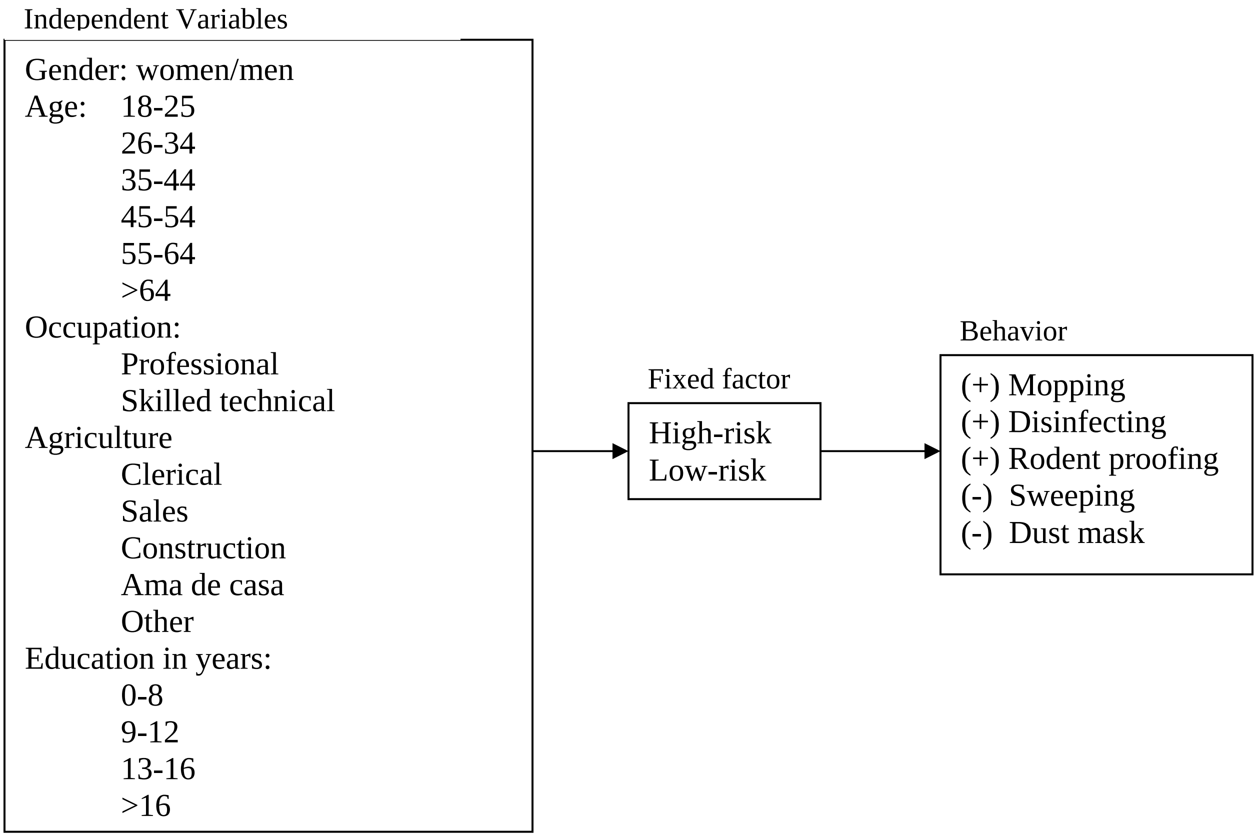

Figure 8.1: **Selected independent variables, and high-risk, low-risk factors used in the step-wise logistic regression model to predict specific positive and negative behavior changes.**

Single Index Tables
8.1.a: Mopping (Effect Selection Tests)
8.1.b: Mopping (Likelihood Ratio Tests)
8.2.a: Disinfecting (Effect Selection Tests)
8.2.b: Disinfecting (Likelihood Ratio Tests)
8.3.a: Rodent proofing home (Effect Selection Tests)
8.3.b: Rodent proofing home (Likelihood Ratio Tests)
8.4.a: Sweeping/vacuuming (Effect Selection Tests)
8.4.b: Sweeping/vacuuming (Likelihood Ratio Tests)
8.5.a: Wear a dust mask (Effect Selection Tests)
8.5.b: Wear a dust mask (Likelihood Ratio Tests)

Additive Index Tables
8.6: Additive index ratings table
8.7: Descriptive numbers and percentages
8.8: High-risk sites
8.9: Low-risk sites
8.10: All-risk sites

Single Index Tables

Table 8.1.a: ***Mopping (Effect Selection Tests)***

		Model Fitting Criteria	Effect Selection Tests		
Model	Effect(s)	-2 Log Likelihood	Chi-Square[a]	df	Sig.
0	Intercept	527.617	.		
1	High risk/low risk	516.911	10.705	1	.001
2	Education 0-8 years	506.520	10.392	1	.001
3	Ama de Casa	497.809	8.711	1	.003
4	Age 65 or more years	491.398	6.411	1	.011
5	Agricultural/farmer	487.419	3.979	1	.046

a. The chi-square for entry is based on the likelihood ratio test.
Stepwise method: Forward Entry

Table 8.1.b: ***Mopping (Likelihood Ratio Tests)***

	Model Fitting Criteria	Likelihood Ratio Tests		
Effect(s)	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	487.419[a]	.000	0	.
High risk/low risk	499.683	12.262	1	.000
Education 0-8 years	499.291	11.872	1	.001
Ama de Casa	497.950	10.531	1	.001
Age 65 or more years	493.396	5.977	1	.014
Agricultural/farmer	491.398	3.979	1	.046

The chi-square statistic is the difference in the -2 Log-likelihoods between the final model and the reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

The most important variables for predicting mopping were: high-risk sites, 0-8 years of education, housewife, older, and agricultural worker. In mopping, both effect selection and likelihood ratio tests indicated that living in the high-risk areas is the best predictor, followed by those that have attained the least amount of education (0-8 years), having the role of housewife, greater than 64 years of age, followed by agricultural workers. Mopping as a predictor in high-risk areas is not surprising since two-thirds of the data collected was from high-risk sites, with the low-risk sites representing the control site.

The category of 0-8 years of obtained education appears counter-intuitive, because this category had the least number of respondents overall, and was least likely to engage in proper cleaning behaviors such as peridomestic improvements and cutting grass/weeds away from the home. However, mopping may also indicate that in the 0-8 years of education, that mopping may be the least expensive way to clean the home with limited access to resources. I believe that a larger number of respondents captured in the lower education levels would be necessary to make an accurate assessment of the validity of this particular result because the 0-8 years of education group was least likely to mop or disinfect than other groups as indicated in Table 7.5.

It is not surprising that ama de casa (housewife in Panama and Chile) is an indicator of mopping since this category indicated the desire to learn more about HPS and there were more women respondents than men. Table 7.4 also indicates that ama de casa are more likely to mop and disinfect along with those who are agricultural/farm workers. Finally, advanced age is an indicator of mopping and table 7.2 indicates that that those in the >64 age category are more likely to mop than other categories with the exception of 26-34 years. This may be learned behavior, which was more popular in past generations.

Table 8.2.a: *Disinfecting (Effect Selection Tests)*

		Model Fitting Criteria	Effect Selection Tests		
Model	Effect(s)	-2 Log Likelihood	Chi-Square[a]	df	Sig.
0	Intercept	577.610	.		
1	Education 0-8 years	568.166	9.444	1	.002
2	Age 26-34 years	561.098	7.068	1	.008
3	Ama de Casa	557.040	4.058	1	.044

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Stepwise method: Forward Entry

Table 8.2.b: *Disinfecting (Likelihood Ratio Tests)*

	Model Fitting Criteria	Likelihood Ratio Tests		
Effect(s)	-2 Log Likelihood	Chi-Square[a]	df	Sig.
Intercept	559.991	2.951	1	.086
Education 0-8 years	565.822	8.782	1	.003
Age 26-34 years	563.217	6.177	1	.013
Ama de Casa	561.098	4.058	1	.044

The chi-square statistic is the difference in the -2 Log-likelihoods between the final model and the reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

The most important variables for disinfection were 0-8 years of education; 26-34 years age group, housewife. Disinfecting selection and likelihood ratio tests indicates lowest level of education (0-8 years obtained education) as the greatest predictor, but like the mopping results, this group was least likely to disinfect than other groups as indicated in Table 7.5. This may suggest a learned behavior since older respondents with fewer economic resources and lower educational status may be practicing inexpensive, old-fashioned behavior they have known for generations. However, respondents in the 26-34 age group and ama de casa appear to be good predictors. As noted above, in Table 7.2, age category 26-34 years are most likely to disinfect as well as ama de casa (Table 7.4).

Table 8.3.a: *Rodent proofing the home (Effect Selection Tests)*

		Model Fitting Criteria	Effect Selection Tests		
Model	Effect(s)	-2 Log Likelihood	Chi-Square[a]	df	Sig.
0	Intercept	564.127	.		
1	Ama de Casa	554.147	9.979	1	.002
2	High/low risk area	546.960	7.188	1	.007
3	Education 0-8 years	4.057	4.058	1	.044

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Stepwise method: Forward Entry

Table 8.3.b: *Rodent proofing the home (Likelihood Ratio Tests)*

	Model Fitting Criteria	Likelihood Ratio Tests		
Effect(s)	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept	542.903[a]	.000	0	.
Ama de Casa	555.410	12.507	1	.000
High/low risk area	550.030	7.127	1	.008
Education 0-8 years	546.960	4.057	1	.044

The chi-square statistic is the difference in the -2 Log-likelihoods between the final model and the reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

The most important variables for rodent proofing the home were housewife, high-risk site, and lower education. Rodent proofing the home produced similar results that ama de casa was the greatest predictor of rodent proofing, followed by those in the high-risk areas and finally education obtained 0-8 years. Correlation tables confirm that ama de casa was the most likely to mouse/rat proof the home, and those in high-risk areas have a high percentage of respondents that are more likely to rodent proof the home (Table 6.15). Lower education levels have also emerged in this area as a predictor, but again, should be questioned since a low number of respondents have these lower levels of education.

Table 8.4.a: ***Sweeping (Effect Selection Tests)***

		Model Fitting Criteria	Effect Selection Tests
Model	Effect(s)	-2 Log Likelihood	Chi-Square[a]
0	Intercept[b]	518.338	.

a. The chi-square for entry is based on the likelihood ratio test.
b. No effects can be added to the initial model.

Table 8.4.b: ***Sweeping (Likelihood Ratio Tests)***

	Model Fitting Criteria	Likelihood Ratio Tests		
Effect(s)	-2 Log Likelihood	Chi-Square[a]	df	Sig.
Intercept	586.478	68.140	1	.000

The chi-square statistic is the difference in the -2 Log-likelihoods between the final model and the reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

There were no significant variables for sweeping predictors. Sweeping in both effect selection and likelihood ratio tests showed no particular predictors. This result indicates that all categories are sweeping at some level, and overall results from the individual site comparisons, high-risk/low-risk site comparisons, and correlation tables indicate that all categories are sweeping. This observation is critical because this result indicates that while respondents are doing proper prevention methods, they are also doing improper prevention methods. Public health messages have greatly emphasized proper prevention behavior, but to a lesser degree emphasize what improper prevention behavior are. Therefore, this statistic indicates that messages need to include information that sweeping and vacuuming and stirring up contaminated dust increases risk of exposure to HPS because no one group emerges as the greatest predictor.

Table 8.5.a: *Wearing a dust mask (Effect Selection Tests)*

		Model Fitting Criteria	Effect Selection Tests		
Model	Effect(s)	-2 Log Likelihood	Chi-Square[a]	df	Sig.
0	Intercept	379.946	.		
1	Ama de Casa	363.940	16.006	1	.000
2	Professional	354.760	9.181	1	.002
3	High/Low risk areas	346.538	8.222	1	.004

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Stepwise method: Forward Entry

Table 8.5.b: *Wearing a dust mask (Likelihood Ratio Tests)*

	Model Fitting Criteria	Likelihood Ratio Tests		
Effect(s)	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept	346.538[a]	.000	0	.
Professional	356.367	9.829	1	.002
Ama de Casa	354.924	8.387	1	.004
High/Low risk areas	354.760	8.222	1	.004

The chi-square statistic is the difference in the -2 Log-likelihoods between the final model and the reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

The most important variables for wearing a dust mask by *effect* were housewives, professionals, and high-risk location. However, the most important variables for wearing a dust mask predictor by *likelihood* shifted to professionals, housewives, and high-risk location. Predictors of wearing a dust mask by *effect* were ama de casa, professionals, and respondents living in high-risk sites. Predictors of wearing a dust mask by *likelihood* were professionals, ama de casa, and respondents living in high-risk sites. As a likelihood predictor, professionals emerged as most likely to wear a dust mask.

Additive Index Tables

Additive index tables were created based upon positive and negative behavior characteristics that emerged from single index tables above. These tables follow the logistic regression analysis, which outlines the various, yet important sequences of positive and negative behaviors common to the independent variables. This sequence ranges from positive 3 to negative 2, based upon a combination of positive and/or negative behavior. The statistical results tables outline the overall results, which identifies the key independent variables with specific behavior: mopping, disinfecting, rodent proofing, sweeping, and wearing a dust mask. Final results should lead to the public health model approach needed to HPS targeted interventions for specific age groups, occupations, and levels of education.

Linear regression analysis was performed on the dependent variable index for high-risk, low-risk, and all-risk sites. Models were constructed with three stepwise blocks consisting of age groups, education groups, and occupation based upon the analysis performed above. Statistical output (R^2) on the model summary shows for the three models for each level of risk: age; age and education; age, education, and occupation. For each of the three models within high-risk, low-risk, and all-risk sites, predictors were listed with the individual coefficients of the standardize coefficient for Beta as well as the significance of individual variables.

Table 8.6: ***Additive index ratings table***

		Positive Behavior			Negative Behavior		Rating
Model number	Model	Mopping (Mop)	Disinfecting (Dis)	Rodent proofing (RP)	Sweeping	Dust Mask	Total
1	All positive behavior	1	1	1	0	0	3
2	Mop, Dis, RP, Dust mask	1	1	1	0	(1)	2
3	Mop, Dis	1	1	0	0	0	2
4	Mop, Dis, Sweep	1	1	0	(1)	0	1
5	Mop, Dis, Dust mask	1	1	0	0	(1)	1
6	Mop, RP, Dust mask	1	0	1	0	(1)	1
7	Mop only	1	0	0	0	0	1
8	Dis only	0	1	0	0	0	1
9	Mop, Dis, Sweep, Dust mask	1	1	0	(1)	(1)	0
10	Mop, Sweep	1	0	0	(1)	0	0
11	Dust mask	0	0	0	0	(1)	(1)
12	All negative behavior	0	0	0	(1)	(1)	(2)

The additive index ratings in Table 8.6 describes twelve scores of various key behavior changes, both positive and negative. This table was used to construct the individual ratings for the 601 respondents in both high-risk and low-risk sites. Based upon specific reported behaviors, individuals were assigned a rating from three (all positive behavior) to negative two, which is all negative behavior. This rating then became the dependent variable for the final regression models.

Table 8.7: ***Descriptive numbers and percentages***

Ratings	High-risk n (%)	Low-risk n (%)	All-risk n (%)
-1	30 (7.5)	12 (6.0)	42 (7.0)
0	126 (31.5)	72 (35.8)	198 (32.9)
1	147 (36.8)	83 (41.3)	230 (38.3)
2	82 (20.5)	30 (14.9)	112 (18.6)
3	15 (3.8)	4 (2.0)	19 (3.2)
Totals	400 (100)	201 (100)	601 (100)

Grouped individual ratings are described in Table 8.7. In all categories, most individual ratings fell into either zero or one category, which indicates most respondents are performing a combination of negative and positive behaviors. The next highest grouping was two. Combined ratings of one and two, when compared to combined ratings of zero and negative one, suggest that overall, most respondents exhibit more positive than negative behavior changes, but that some negative behavior changes are also being performed. It is interesting to note and also encouraging that no respondent fell into the negative two category of only negative behavior.

Table 8.8: ***Final Logistic Regression Model for High-risk sites***

Model	Beta	Adj Beta	R	R^2
Model 1: Age			.231	.053
>64 years old	.804	.205		
26-34 years old	.328	.119		
Model 2: Age, Education			.290	.075
>64 years old	.756	.193		
26-34 years old	.293	.122		
0-8 years education	-.797	-.151		
>16 years education	-.280	-.103		
Model 3: Age, Education, Occupation			.371	.138
>64 years old	.689	.176		
26-34 years old	.234	.097		
0-8 years education	-.840	-.160		
Ama de casa	.526	.184		
Professional	-.300	.125		

For high-risk sites, the model summary shows how much variance in the individual score is explained by the model which included age (model one), age and education (model two), and age, education, and occupation (model three). In high-risk groups, model one explained 5.3% of the variance in individual scores for age, 7.5% for model two and 13.8% for model three.

When all other variables are controlled, the strongest contributor to the prediction of model one was being more than 64 years of age, followed by 26-34 year old age group when all other variables are controlled for. In model two, age and education, the strongest predictors were being more than 64 years old, followed by 0-8 years of education, 26-34 years old, and finally more than 16 years of attained education. In model 3, the strongest predictor was ama de casa, followed by more than 64 years old, 0-8 years of education, professionals, and finally 26-24 years old.

Table 8.9: ***Final Logistic Regression Model for Low-Risk Sites***

Model	Beta	Adj Beta	R	R^2
Model 1: Age			.147	.022
26-34 years old	.323	.147		
Model 2: Age, Education			.223	.050
26-34 years old	.310	.141		
9-12 years education	-.337	.139		
Model 3: Age, Education, Occupation			.294	.087
9-12 years education	-.352	.137		
Ama de casa	.391	.139		

For low-risk sites, the model summary shows how much variance in the individual score is explained by the model which included age (model one), age and education (model two), and age, education, and occupation (model three). In low-risk groups, model one explained 2.2% of the variance in individual scores for age, 5.0% for model two and 8.7% for model three.

When all other variables are controlled, the strongest contributor to the prediction of model one was the 26-34 year old age group when all other variables are controlled. In model two, the strongest predictor was the 26-34 years old age category, followed by 9-12 years of education. In model three, the strongest predictor was ama de casa, followed by 9-12 years of attained education.

Table 8.10: *Final Logistic Regression Model for All-Risk Sites*

Model	Beta	Adj Beta	R	R^2
Model 1: Age			.170	.029
26-34 years old	.324	.138		
>64 years old	.427	.120		
Model 2: Age, Education			.197	.029
26-34 years old	.312	.133		
>64 years old	.439	.144		
0-8 years education	-.484	-.099		
Model 3: Age, Education, Occupation			.274	.075
26-34 years old	.272	.116		
>64 years old	.437	.123		
0-8 years education	-.492	-.101		
Ama de casa	.480	.192		

For all-risk sites, the model summary shows how much variance in the individual score is explained by the model which included age (model one), age and education (model two), and age, education, and occupation (model three). In all-risk groups, model one explained 2.9% of the variance in individual scores, 2.9% for model two and 7.5% for model three.

When all other variables are controlled for, the strongest contributor to the prediction of model one was the 26-34 year old age group followed by when all other variables are controlled for. In model two, the strongest predictor was the 26-34 years old age category, followed by 9-12 years of education. In model three, the strongest predictor was ama de casa, followed by greater than 64 years old, 26-34 years old, and finally 0-8 years of attained education.

Based upon age, education, and occupation, overall conclusions of the last regressions indicate that in high-risk areas, ama de casa (housewives), those older than 64 years old, 0-8 years of education, professionals and 26-34 years age group are the strongest predictors for the additive index ratings. In the low-risk areas, ama de casa and 9-12 years of education (high school equivalent) are the strongest predictors. In all risk sites, ama de casa, respondents over the age of 64, 26-34 years age group, and those with 0-8 years of education attained were the strongest predictors. Since the descriptive table shows that most respondents fall within an index of one or two, when compared with negative one and zero, most housewives are performing more positive than negative behavior changes. However, since prior analysis showed that while these respondents are performing the correct changes, this final analysis shows that housewives should be the target of clear information in all-risk sites. In addition to public health messages including information on proper methods, a note on what is not proper or ineffective (sweeping and wearing a dust mask) should also be emphasized. In this way, the overall health of the population could be improved by further reducing risk of exposure to hantavirus in any environment where it poses a threat.

When considering these three final analytic uses of the data, one fact stands out. Variance in behavior explained is highest for the highest risk sites (13.8%) and lowest in all sites comparison (7.5%). Statistically, the most effective behavior change and prevention practices are occurring at the sites where risk and need are greatest. This is good, and public health education efforts can utilize the information from disease cases for effective prevention in the areas that need it most. So what about living in high risk area gets people’s attention more? Analysis of this phenomenon and developing themes and methods of translation to all areas is promising.

CHAPTER IX:

RESULTS DISCUSSION, CONCLUSIONS, STUDY IMPROVEMENTS, AND THE WAY FORWARD

Results Discussion

Chapter V: Individual Site Comparisons by High and Low Risk

Chapter V provided descriptives on each country by socio-demographic characteristics, mediating variables, knowledge responses, and behavior responses. Overall each country site demonstrated reasonable socio-demographic samples. For example, respondents were mostly from the selected high-risk and low-risk sites in each area rather than some other geographic area that did not represent the desired sample. Age distribution groups were captured in the age ranges similar to average age of hantavirus victims, which is in the 35-44 ranges. Mediating variables such as length of time in area indicated that respondents lived in the area at least half of their lives. While respondents noticed rodents in the home, more respondents in New Mexico and Panama observed rodents than respondents in Chile.

Large percentages of respondents have heard about hantavirus at all sites, and within reasonable timeframes of when HPS first emerged within each country. This is not surprising in the New Mexico or Panama samples, since New Mexico experienced a national splash of attention to the problem in 1993 and Panama's problem emerged prior to Carnival, an important cultural event. Most respondents also know that people are most likely to catch HPS by breathing air contaminated with rodent droppings. All respondents demonstrated positive and negative prevention responses to HPS, but in varying levels and effectiveness. Upon hearing about HPS, most respondents wanted to learn more about hantavirus and proceeded to check for mice and clean the house. This indicates that all respondents wanted to lower risk of HPS for themselves and their families, but more respondents in New Mexico and Panama swept/vacuumed more compared to respondents in Chile. Chilean respondents tended to mop and disinfect more, but also swept, just at lower levels than those from New Mexico and Panama.

Chapter VI: Combined Country Site Comparisons by High Risk, Low Risk, and All Risk

Chapter VI provided descriptives for each country combined by high-risk, low-risk, and all-risk sites combined. Overall, women represented 55.7% (Chile) to 70.0% (New Mexico) of respondents in all-risk sites. Average age was 38.37 years for all age groups, which is close to average age represented by HPS victims. Average years of education varied from 8.34 years in Panama to 12.51 years in New Mexico. Chileans had a tendency to attend technical trade school than the other sites. Observing rodents in the home ranged from 33.3% in Chile to 75.5% in Panama, which indicates a higher risk of exposure to HPS in Panama, which was borne out by incidence rates and may indicate better home construction and rodent trapping in Chile. Most respondents heard about HPS by Television, and at least 50% of Panamanian respondents knew someone that had contracted HPS.

Panamanians have considered their cleaning habits as changing the most (59.5%), but this is the group that is also mopping the most (39.5%), an appropriate behavior, and they are sweeping the most (50%), which is an inappropriate cleaning behavior. Chileans also consider their cleaning habits as having changed extremely (39.9%), but are disinfecting more (56.7%) and sweeping the least (18.9%) than the other sites. New

Mexicans do not consider their cleaning habits as changed extremely (12.0%) or changed very much (18.0%). New Mexicans disinfect more (43.5%), but also set more traps (30.0%), wear rubber gloves (29.0%), disinfect (43.5%), and mop (27.0%), but unfortunately are sweeping (28.5%) more as a result of changing cleaning habits. This indicates that respondents want to protect themselves and family from contracting HPS, but Chileans are performing more of the appropriate behaviors than those in Panama and New Mexico.

Chapter VII: Correlations of Significant Results for Behavior Responses

Chapter VII described correlations of socioeconomic status, mediating, and knowledge responses of combined sites and risk in accordance with significant behavior results in Chapter VI. In summary, women were less likely than men to remain home upon learning about HPS. Those in an older age group (55-64) were most likely to check for rodents, but also more likely to purchase dust masks, which is ineffective in HPS prevention. Those in the 26-34 age group were most likely to mop and disinfect, and purchase disinfectants. African American (NM)/Negro and Mulato (Panama) were most likely to sweep, which is not surprising since these indicators already emerged in correlation analyses. Indigenous populations were most likely to use rubber gloves and dust masks and least likely to purchase poison.

Professionals were least likely to panic in response to publicized cases, and housewives in Panama and Chile were most likely to panic and avoid animals. Housewives also considered their cleaning habits as extremely changed, and have a tendency to mop and disinfect more as indicated by correlation analyses. They were also most likely to rodent proof the home, which is an effective way to lower exposure to

HPS. Those with the least amount of education and the most amount of education were likely to avoid animals, but those with the least amount (0-8 years) were less likely to clean the house. When they did clean, they were least likely to mop or disinfect, which indicates that they were sweeping. The lowest education category was also least likely to buy disinfectants, move woodpiles away from the home and cut grass weeds away from the home. Respondents that own their own home were most likely to make peridomestic improvements. Respondents who have observed rodents in the home are more likely to mop, sweep, set traps, and make peridomestic improvements. Those who have heard about HPS are most likely to learn about HPS, but also perform positive and negative prevention measures.

Overall, Chapter VII analyses show that respondents want to know about proper methods, and are acting upon current knowledge. Since the indicated behavior is both positive and negative, a look at socio-demographic predictors may offer a way for public health messages to target specific populations such as low income, low education levels, and poor rural areas that need better messages as well as to improve the overall messages to the general public.

Chapter VIII: Index Behavior Predictors

Chapter VIII described the index behavioral characteristics of community patterns that best predict risk-reduction or risk-increase of exposure to HPS. Positive behavior indicators are mopping, disinfecting, and rodent proofing the home. Negative behavior indicators are sweeping and wearing a dust mask while cleaning.

The best predictor for mopping, both effect selection and likelihood ratio tests was living in the high-risk areas, followed by those that have attained the least amount of education (0-8 years), having the role of housewife, being greater than 64 years of age, and agricultural workers. Mopping as a predictor in high-risk areas is not surprising since two-thirds of the data collected was from high-risk sites, with the low-risk sites representing the control site. It is not surprising that ama de casa (housewife in Panama and Chile) is an indicator of mopping since this category indicated the desire to learn more about HPS and there were more women respondents than men. Table 7.4 also indicates that ama de casa are more likely to mop and disinfect along with those who are agricultural/farm workers. Finally, advanced age is an indicator of mopping and Table 7.2 indicates that that those in the >64 age category are more likely to mop than other categories with the exception of 26-34 years. This may be learned behavior, which was more popular in past generations.

Disinfecting selection and likelihood ratio tests indicate the lowest level of education (0-8 years obtained education) as the greatest predictor, but like the mopping results, this group was least likely to disinfect than all other groups (indicated in Table 7.5). Mopping may suggest a learned behavior since older respondents with fewer economic resources and lower educational status may be practicing inexpensive, old-fashioned behavior they have known for a generations. However, respondents in the 26-34 age group and ama de casa appear to be good predictors.

Rodent proofing the home produced similar results that ama de casa was the greatest predictor of rodent proofing, followed by those in the high-risk areas and finally education obtained 0-8 years. Correlation tables confirm that ama de casa was the most likely to mouse/rat proof the home, and those in high-risk areas have a high percentage of respondents that are more likely to rodent proof the home (Table 6.15). Lower education levels have also emerged in this area as a predictor, but again, should be questioned since a low number of respondents have these lower levels of education.

Sweeping in both effect selection and likelihood ratio tests showed no particular predictors. Overall results from the individual site comparisons, high-risk/low-risk site comparisons, and correlation tables indicate that all categories are sweeping. This is critical because this result indicates that while respondents are doing proper prevention methods, they are also performing improper prevention methods. Public health messages have greatly emphasized proper prevention behavior, but to a lesser degree emphasize improper prevention behavior. Therefore, this statistic indicates that messages need to include information that sweeping and vacuuming stirs up contaminated dust, which increases risk of exposure to HPS. Encouraging positive behavior should be accompanied by messages to discourage negative behavior.

Predictors of wearing a dust mask were ama de casa, professionals, and respondents living in high-risk sites. These results were surprising because correlations in Table 7.4 showed ama de casa as least likely to use or purchase a dust mask, but professionals were most likely to use a dust mask.

The behavioral additive index Table 8.6 organized the initial regression results by individual rank to predict behavior and to determine which populations need to be targeted for specific improvements in outreach messages. The descriptive Table 8.7 shows that most respondents fall within an index of one or two, when compared with negative one and zero. Final results for high-risk, low-risk, and all-risk showed that ama de casa was the occupation type that was the best practice of positive behavior. Therefore, final results show that most housewives are performing more positive than negative behavior changes. However, since prior analysis showed that while respondents are performing the correct changes, this final analysis shows that housewives should be the target of clear information in all-risk sites. Also, since model 3 in the high-risk sites explained more variance in positive behavior, health education messages which convey the spirit or experience of living in high risk areas to those targeted for prevention in other areas will be most effective.

In addition to public health messages including information on proper methods, a note on what is not proper or ineffective (sweeping and wearing a dust mask) should also be emphasized. In this way, the overall health of the population could be improved by further reducing risk of exposure to hantavirus in any environment where it poses a threat. Therefore, to improve outreach programs, public service announcements should target amas de casa in high-risk locations, but also utilize themes gained from housewives in high risk programs. Focus groups of older and younger housewives in the high-risk areas are warranted to determine effective messages for any and all areas. Content should continue to emphasize mopping, disinfecting, and rodent proofing the home as the best cleaning methods to lower risk of exposure. However, messages targeted to amas de casa in all locations should also emphasize that wearing a dust mask is ineffective and should be avoided.

Conclusions

In May 1993 an outbreak of a seemingly new, deadly disease emerged in the Four Corners region of northwestern New Mexico. Scientists identified the cause of the disease outbreak as a previously unknown hantavirus which eventually became known as Sin Nombre Virus (SNV). In 1995, Andes Virus (AND) was confirmed in the Los Lagos region of Chile. In 2000, Choclo Virus (CHOC) emerged in the Los Santos region of Panama. New World hantaviruses such as SNV, AND, and CHOC prove to by highly pathogenic, causing a potentially fatal respiratory condition in humans known as Hantavirus Pulmonary Syndrome (HPS) (Duchin 1994; Schmaljohn 1997). There is no vaccine available. Risk-reduction prevention methods are encouraged by public health officials.

Transmission of HPS is believed to occur through contaminated aerosolized dust particles, rodent saliva/bites, and through handling of rodents. Prevention practices include disinfecting, mopping, trapping, and rodent proofing the home (CDC 1993, 2002). Because of the rodent reservoirs' natural habitats rural and poor human populations are at higher risk of exposure to hantavirus. Fortunately, simple, inexpensive prevention measures offer the possibility to transcend socio-economic status of those who need correct prevention information and to elucidate positive behavior change.

Understanding the roles of human demographics, disease ecology, and subsequent human behavior in the disease process is critical to the examination of community responses in terms of reported positive and negative behavior. Effectiveness of hantavirus prevention messages is not well understood, even though outreach programs in Chile appear to be more extensive than programs in northwestern New Mexico and Panama. Prior to this study, no one has researched human behavioral patterns in response to HPS prevention messages.

Incidence of HPS in northwestern New Mexico, Panama, and Chile indicates that since hantavirus emerged, it continues to be a problem. One out of every three patients in New Mexico and Chile does not survive, while one fifth of the patients in Panama do not survive hantavirus. On-going research is investigating why the death/case rates are so high. Some research suggests varying virulence within virus species and rodent-host populations (Figueiredo et al. 2009). However, key to reducing overall human incidence is the lowering of exposure risk and measuring how effective public health measures are in terms of transmitting information to susceptible human populations.

Four aims of this project were to: 1) assess attitudes across public health conditions with respect to hantavirus within three human populations, 2) assess whether the exposure to public heath information make a difference, 3) assess whether knowledge of hantavirus is greater in high prevalence areas vs. low prevalence areas, and 4) to assess how much change in reported preventive practices has occurred and what types of change have occurred.

Social behavior changes were measured via the implementation of a simple, self-administered 28 question survey. Countries and subsites were chosen based upon the following criteria: 1) ongoing biological fieldwork indicated where HPS is prevalent and of immediate concern for general public health, 2) some sort of outreach program was in place, and 3) behavioral outcomes could be measured in the context of each country. Information collected included general mediating variables, knowledge of HPS, reported behavior changes, and standard demographic information, including socio-economic status indicators.

The analyses plan included individual site analyses by high-risk, low-risk, and all-risk combinations (Chapter V), site comparisons by high-risk, low-risk, and all-risk combinations (Chapter VI), and comparisons of sites across countries (Chapter VII) as the guide to the next step of inferential analyses (Chapter VIII). Inferential analyses was investigated with respect to all country sites and all risk sites in order to hone in on what common factors in all sites need to be addressed. That is, I wanted to determine commonalities to be able to direct behavior information to public health officials that need specific hantavirus prevention information. To that end, overall remarks may be made with respect to general knowledge, prevention, and behavior across country sites.

Overall *knowledge* results indicated that in terms of knowledge, the survey showed that approximately 87% or more respondents at each site knew about hantavirus and that it comes from rodents such as mice and rats. Rates were higher in Panama and Chile than in New Mexico. In terms of *prevention*, respondents in Chile have a tendency to engage in more proper cleaning methods such as disinfecting than respondents in northwestern New Mexico and Panama. *Behavior* responses suggested that respondents in lower education levels check for rodents but are least likely to mop or disinfect than those of higher education levels. Finally, public health messages *appear* to be more effective in Chile, and while all three populations perform proper prevention measures, improper cleaning behavior also occurs in all three populations.

Public health messages should utilize the following themes to improve the effectiveness of HPS outreach. Based upon predictors described and inferential analyses in Chapter VIII and behavior response correlations from Chapter VII, HPS prevention should follow these lines in New Mexico, Panama, and Chile. The most common theme to emerge is that the public wants to know about hantavirus. Analyses demonstrated that respondents know about hantavirus, its transmission and concomitant disease symptoms. They also checked for rodents, and cleaned the house. But while all respondents are doing positive behavior changes such as rodent-proofing the home, mopping, and disinfecting, they were also performing inappropriate behavior prevention measures such as sweeping/vacuuming, and using dust masks. In all three sites, public health measures need to include clear and precise information on reducing inappropriate prevention methods in addition to appropriate prevention measures.

In New Mexico, target populations should continue to be those in the rural, poor communities. Pilot research conducted in northwestern New Mexico during 2000 indicated that populations in the lower-risk, urban, higher income areas were performing more positive prevention measures than populations in high-risk, rural, lower income areas. Data collected and analyzed in this project confirmed initial findings in New Mexico, and indicated similar comparisons in Panama and Chile. While prevention is generally effective, improvements could be made in all areas with clear messages that target all age groups, education levels, and occupations categories, but pay particular attention to the rural poor.

Because disease is not random and affects the rural poor with less access to critical resources, specific messages should target populations who are of higher risk of exposure due to poor housing conditions. For example, most respondents in New Mexico live in mobile homes, which are notorious for poor construction and easy access for rodents to enter. Messages that accentuated rodent-proofing mobile homes in addition to mopping instead of sweeping could be effective in New Mexico.

In Panama, home construction is primarily cement, but also has open access and homes are in close proximity to agriculture. Since respondents are most likely to attempt rodent proofing and are more likely to sweep, messages should continue to emphasize rodent proofing as well as emphasize mopping and to discontinue sweeping.

In Chile, where a tremendous amount of resources have been expended toward positive prevention measures, including the training of medical personnel, messages and activities should continue with addition information to discontinue sweeping ant the wearing of dust masks since these are negative behaviors that increase exposure to risk.

This project examined the social epidemiology of Hantavirus Pulmonary Syndrome (HPS) and subsequent disease correlations with human social and occupational conditions in three countries. While HPS is found in almost all regions of North and South America, specific regions in New Mexico (United States), Panama, and Chile were chosen for analysis because of certain similarities: 1) those highly affected by exposure to HPS are the rural poor with limited resources; 2) HPS is thought to be endemic to each area and it is believed to experience outbreaks in similar ways through climate change and human disturbance, and; 3) the goals of the outreach methods developed by public health officials are similar, but the results are dissimilar.

The goal of the project was to assess, through an analysis of a simple, self-administered questionnaire, outreach most effective in creating reported positive and negative behavior changes in the most susceptible human populations. Because the contraction of this disease is the result of multiple, rather than a single etiology, it was predicted that the common disease determinants of gender, age, occupation, and education would play significantly in the analysis of how public health messages were received and responded to by those at risk of contracting hantavirus.

The basic goal of the HPS outreach in each country was to reduce the risk of exposure through improved household cleanliness by proper cleaning methods and improved living conditions via simple, inexpensive methods. As noted in previous chapters, in the middle of the 20th century, the reduction of infectious diseases came through improved sanitation (McKeown, 1975; McNeil, 1976) and later through improved medical technology. That same premise holds true with the new wave of emerging diseases; that is, improved sanitation is the best, most efficient way to reduce infectious disease, while medical technology aids in the identification, treatment and hopefully the recovery of the patient.

Epidemiologic transition theory attempts to explain long-term temporal changes in health patterns and disease in populations. Omran (1971) postulated a transition model based upon interactions between demographic, economic and sociological determinants. While his fourth stage predicted that infectious diseases would disappear to be replaced with chronic diseases, his models were based upon a linear cultural evolution. This meant that with each successive transition, the next stage is more advanced and desirable than the previous one. For example, during a brief amount of time in the late 20th century, infectious diseases were on the decline and thought to have been on the verge of eradication as the fourth stage of chronic diseases and low fertility emerged. However, with the emergence of infectious diseases such as Hantavirus Pulmonary Syndrome and the continual battle with malaria, incidence of infectious diseases are rising rather than declining, giving pause to the linearity of such transition models.

While transition can and does occur, it does not now proceed in the singular, linear direction as once thought. Examining the newly emerging infectious diseases in the modern context thus requires a new paradigm; that is, prediction models may be now formed based upon modern epidemiological transition assumptions that 1) diseases will emerge, 2) the division of labor prescribes that competition for scarce resources is difficult at best for the rural poor because populations are not homogenous, and 3) disease is not random, that is the disadvantaged are more likely to be exposed to disease via higher-risk environments. Mediating variables in this study included environmental elements such as human roles in determining exposure risk. For example, in northwestern New Mexico, the mediating variable was the link to where the population lived, which would be remote areas where housing is most likely to be a mobile home.

As noted above, there were certain predictors utilized to elicit which outreach program was most effective for positive behavior change. That is, compared to northwest New Mexico and Panama, the Chilean population reflected more reported positive cleaning behaviors by purchasing and using proper cleaning materials, as well as making appropriate peridomestic improvements. Even though the target populations in each country most at risk was also rural and poor with limited resources, the key difference was that in Chile, the government has invested large amounts of resources to implement and continue outreach programs.

New Mexico, Panama, and Chile Summary

New Mexico

During the initial outbreaks of Hantavirus Pulmonary Syndrome, New Mexico, Panama, and Chile were compelled to address specific experiences upon the onset of HPS. While northwest New Mexico was the first site in which new world HPS emerged and be recognized through a splash of media attention, the unfortunate, immediate consequence was that the disease was initially identified pejoratively as a “Navajo flu” disease. Additionally, New Mexico faced losses of critical tourism income because of an unknown disease and unknown consequences of vacationing in the popular tourist destination. Upon the identification of HPS and rodent connection, public health officials set up hantavirus hotlines, distributed critical medical information to health clinics, and proceeded to keep the media updated about the latest developments, to alleviate community fears of an unknown disease. Unfortunately, as the immediate crisis subsided, public information dissemination shifted into an ad hoc, as-needed basis. The medical community continues to improve its knowledge and medical information, but the best application of a public health model is one that shares responsibility with the public and medical community, so they may work in concert.

This is evidenced by the results of the analyses, which show that overall, New Mexicans do not show much concern about catching hantavirus nor are they demonstrating an overall appropriate behavior to protect themselves and their families from exposure. Perhaps it is because effective outreach is expensive and the hantavirus prevention message is lost among other important community health problems such as Type II diabetes, heart disease, and alcoholism. A possible solution for New Mexico, where infectious diseases such as hantavirus remain endemic, but not in the forefront of disease news, would be to combine hantavirus prevention methods with plague prevention messages. Eisen, et al., (2007) noted that that both hantavirus and plague share a common denominator: rodents. While HPS is a virus and plague is caused by bacteria (Y. pestis), rodent control is the key to reducing exposure risk to both diseases. Using GIS and remote sensing, Eisen, et al., (2007) noted that both diseases are common within the same socio-economic and geographic regions and reporting both diseases to the Centers for Disease Control is mandatory. In today's troubled economy, public health messages could be combined to promote better information and enable communities to reduce disease risk.

Panama

Panama's initial experience was in many ways similar to New Mexico's experience. On the cusp of Carnival, an important national event as well as a route to potential tourism income, HPS presented in the community of Tonosi. Because an alert physician knew to send a sample to the Centers for Disease Control in Atlanta, Georgia, the first case of hantavirus in Central America was confirmed (Dr. Juan Pascuale, MD, PhD, personal conversation). Questionnaire frequencies within all three Panama sites confirm that the public does know about hantavirus, and indeed more than 50% of the respondents know someone that has had hantavirus. Perhaps that is why the level of concern in Panama is greater than that in Chile and New Mexico about exposure and contracting hantavirus. Certainly, all three populations are aware that the most common route of exposure is through rodent droppings. The population's collective conscious also recalls the cancellation of Carnival 2000 due to an unknown, mysterious, and potentially fatal disease.

Death-case rate per 100 in Panama remains at 20.19, which is an incidence level which has changed little from the initial outbreak to the present, but still represents one-fifth of the patients that contract HPS do not survive. In Panama, the medical community is knowledgeable about hantavirus and is cognizant of how to triage patients to immediate intensive care and transport to Panama City. There is evidence of posters in health clinics, and small notices in doorways of the dangers of hantavirus, but there do not appear to be explicit, on-going instructions appropriate to the population on best practices to reduce exposure risk. Again, analysis showed that the population has great concern about catching HPS, but the message received is neither conveyed correctly nor is it well understood because the population is more likely to sweep rather than mop when cleaning and to purchase dust masks, which are ineffective in exposure prevention.

Armien et al. (2004) examined the seroprevalence of hantavirus in human populations at the three sub-sites in Panama where the questionnaires were administered. In their analysis they sought to analyze occupational and human activity with peridomestic risk factors toward developing effective outreach programs. They discovered that not only did certain human activities such as handling animal feed, cleaning houses, sheds and barns and dealing with rodents increase their risk, but gender, age, and locality were significant factors in which part of the population tested positive for hantavirus antibodies (Armien et al, 2004). They also speculated that altered land use related to deforestation and agriculture has led to decreased biodiversity, thus reducing natural barriers that kept seropositive rodents at bay from the human population (Armien, et al, 2004). That natural barrier reduction increased the risk of seropositive rodents encroaching on human populated areas was confirmed by Suzan, et al, (2006). An important model of outreach for Panama to thus consider is that of Chile, where there is a recognition that altered land use is an important economic factor to address and extensive outreach programs should be geared to informing the public of appropriate measures to implement in their daily lives to improve their environment and overall health.

Chile

Unlike New Mexico and Panama, Chile had some “gear-up” time between the initial outbreak near Coyhaique in 1995 and the larger outbreak that occurred in 1998, which coincided with an El Nino event. Like New Mexico, the initial outbreak in Chile was in a family cluster, which led to a quick investigation of housing and living conditions of the family, affected by hantavirus. Because of the media splash of attention in New Mexico two years prior to the Chilean event, health officials had a pretty good idea of what was going on in Coyhaique. Soon after the outbreak, the primary rodent reservoir and virus were identified. Informative posters were quickly developed and distributed to the public, which depicted a rat and a circle with a line through it. Even though the poster was crudely drawn and illustrated with the incorrect rat, the message was clear: prevent rodents from encroaching in peridomestic areas.

Since that time, and with extensive research and international collaborations with the United States, Chilean outreach programs have continued to progress into a high level of involvement and sophistication. During the time span between the initial event and the larger 1998 outbreak, Chilean health officials were in direct communication with the same scientists that identified HPS in New Mexico, thus organizing better outreach messages. Chile continues to invest in formulating better messages and creating community events geared specifically to inform the public on how to recognize problems and avoid increased risk of exposure. Since 2004, Chile has invested approximately 600 million pesos (USD $1.38 million) into outreach programs that involve teaching the medical community about hantavirus and informing the public of proper safety measures. There are also appropriate community level prevention programs that include hantavirus days, poster dissemination, television and radio spots, and calendars and pamphlets that demonstrate safety measures and personal protection from exposure to hantavirus. In addition, there is a second outreach phase for "off-season," wherein messages are still out in the public, but running in collective background.

Recently, HPS became a reportable disease for health and occupational standards which is critical for those of lower socio economic status who work as manual laborers in agricultural occupations. There is a deliberate effort to create sanitary and appropriate working and living conditions for forestry workers living in the field. Those workers who are unfortunate enough to contract HPS now qualify for workers' compensation and associated medical care. Outreach measures in Chile are based upon health education for the general population as well as the medical community.

The goal, of course, is to enable the population to achieve better health outcomes for susceptible persons with limited access to resources needed for improved quality of life and health. Analysis showed that in Chile, the overall population has received, understood, and made more positive changes than those in New Mexico or Panama. It was interesting that in general, Chileans are not all that concerned about catching hantavirus, but this may be due to an adequate saturation of appropriate messages and the reception of these messages, which translates to appropriate behavior. Risk perceptions and cues to action appear to be different in Chile than those in New Mexico and Panama, where the cues are intermittent media attention (New Mexico) or knowing someone that has had contracted hantavirus (Panama). Certainly, health officials in all three sites know how hantavirus is contracted, namely through inhalation of contaminated dust.

With alert and well-trained medical professionals, survival rates among HPS victims remain strong at 67.96 per 100 cases, but the process from illness to recovery can vary. Actually, in Chile, a bit of medical community retraining may be in order.

Recently there has been an increase in the mortality among women. Health department officials suspect that women are so aware of how hantavirus presents with respect to human activity that they are actually going to the hospital for treatment while still in the prodromic stages of HPS (fever, aches, pains, and similar flu-like symptoms). Physicians are thus sending women home a bit too early without considering HPS. By the time these women return to the emergency room, it is either almost too late or too late altogether for recovery. (This is actually reminiscent of the initial outbreak in northwest New Mexico where the first two victims were sent home because physicians thought they had influenza.) Men on the other hand, are waiting later to go to the hospital, when the initial flu-like symptoms have passed, the illness is critical, and physicians admit the patient into immediate care. Still, an alert medical community does contribute to the high overall survival rates among Chileans, and it appears that the efforts are because the general population and the medical communities work in concert.

Study Improvements

All things being equal, this study was not without a few issues that need to be addressed. First, even though analysis was exploratory in nature, data collected were not based on true random samples of the populations in each country. This is because targeted populations were those who were in health clinics seeking medical attention for some other reason. Secondly, the data were collected over an extended period of time, rather than within a few months of each other. The Panama and Chile data collection occurred during the first half of 2004, but the northwest New Mexico data collection took a longer period of time. There were several reasons for this, but a critical issue was that initial contact with the New Mexico clinics was met with a reluctance to participate. This could be because of time constraints on staff (yet one more thing to do on their daily list of patient care), and it could be that in northwestern New Mexico, there is a reluctance to participate in HPS infectious disease research. Perhaps the collective memory of what occurred in 1993 lingered, and there was suspicion that incorrect stereotype that this was a “Navajo flu” would continue. However, once the initial barriers to participate were lowered, the clinicians and administrators at the clinics were amenable to assisting in the research. The anonymity of the questionnaire probably helped in the decision making process of whether or not to participate in the research.

Another area to address is that data collected were from populations that were already in health clinics seeking medical attention for some other ailment. A couple of factors need to be accounted for in this process. First, in Chile clinics have a tendency to have some sort of hantavirus information already posted on the walls. The majority of the public heard about HPS from television, but there were some respondents who learned about HPS at health clinics and by the medical professionals. Secondly, data collected from those at health clinics skews the patients’ SES to those who have access to medical care and may already be aware of specific diseases. This is especially relevant in northwest New Mexico, where those of a higher SES have better access to medical care. Higher SES implies a higher income, better education, and better occupation. They are also more likely to live in the city, rather than in a rural, poor area in substandard housing with fewer resources. Indeed, the pilot study in 2000 revealed that those in more affluent urban areas are more likely to practice positive prevention measures than those in rural, poor areas.

Another consideration is that of population migration; that is, movement in and out of high/low risk areas. While the questionnaire addressed the city/county/area of residence, there was some overlap. The questionnaire asked respondents how and when they first heard about HPS, but not where they heard about the disease. Some respondents alluded to the where in the "other" open-ended parts of the questions, but it would be interesting to know in a bit more detail just where the information was first received. This is not really a problem, but it is something that should be addressed in future data collection, or simply explained in analysis.

Lastly, respondents were asked to identify their biome as city, rural, or somewhere in between. This question actually is very difficult to answer because transitional spaces could be considered rural, rural agriculture, city, or suburb. This is especially true in Panama where respondents from Jaguito/El Roble considered themselves as city, but their homes are actually close to agricultural-use land. In Melipeuco, a rural community in Chile, there are paved roads and homes near each other so it appears to be more of a centralized community rather than a rural locale. However, to get to Melipueco, one must travel on 6 miles of unpaved gravel roads, and immediately leaving the community, roads are well maintained, but not paved.

The Way Forward

This study was the first of its kind and the first step in understanding the complex dynamics of the human disease process with respect to Hantavirus Pulmonary Syndrome. To that end, information gleaned from this study may be utilized to target specific populations who should be receiving clear prevention information. Second, measuring the types of communication efforts was not addressed in this study design, and should be investigated in detail. Third, addressing the types of misinformation (wearing dust masks) and how that information is transmitted/received needs to be addresses. In the same vein, no or little information on negative behavior such as sweeping needs to be addressed. Finally, as I begin to work within specific countries, this type of study can enable public health officials to focus on specific messages geared toward appropriate age groups, education levels, and occupations.

To be sure, further analyses and information dissemination within each country is now in order since the initial project analysis was a broad comparison. The effectiveness among the sub-sites within the three countries may direct the most effective methods of outreach involvement. This is because public health officials at each site have already expressed interest in the overall results and are specifically interested in separate sub-site analysis in terms of the practical application of their outreach methods.

To that end, it would also be most beneficial for this type of investigation to continue as an interdisciplinary activity. While this project adds to the body of knowledge, specifically in the realm of social epidemiology, the basic premise of what to tell the public could not be achieved without the expertise of several disciplines that provide input into outreach programs. The emerging “One World One Health” concept recognizes the various disciplines required for improving overall health of populations. For example, biologists and mammalogists continue to contribute to the extensive knowledge of rodent reservoir studies by identifying where and possibly how sero-positive reservoir populations increase and interact with humans. Ecologists are actively attempting to forecast weather/climate changes as well as utilize Remote Sensing and GIS to predict where sero-positive reservoirs may be expanding territory. Physicians and the medical community are trained to recognize hantavirus and train others in the etiology of HPS as well as assist in the design of effective messages which are geared toward the cultural practices of their own communities. While all of these research activities are critical to understanding disease as discrete processes, measuring the end point effectiveness would not likely occur unless sociologists examine the outreach programs formulated from previous field and laboratory research. Therefore, sociologists add considerable value to through the discovery of effectiveness and efficacy of the outreach programs. All of these activities from many resources help in the identification of high-risk populations and enable the communities to act accordingly when a hantavirus presents itself as a threat to public health.

HPS continues to be a problem in other South American countries, especially in Argentina, Bolivia, Paraguay and Brazil. Further examination of outreach programs and population behavior in these countries may produce inexpensive messages, perhaps through health clinics and posters, that could help the populations understand the severity of the disease and how simple prevention measures are to implement. Currently in the Bolivian lowlands, where hantavirus is a continuing problem, the medical community is searching for methods to inform the public quickly and effectively. I have already been asked to participate as a member of the larger team of scientists, representing the social science component of the research. So once the basic knowledge is obtained, the most efficient and effective ways to disseminate the knowledge can be determined.

The implications of this study certainly are not limited to hantavirus in potential or scope. Similar methods and inquiries could be used to assess the effectiveness of Asian Flu outreach, or another “surprise” infectious disease such as SARS or the importation of West Nile Virus from the Middle East. Indeed, upon the implementation of the study questionnaires in Gallup, New Mexico, the lead hospital administrator considered this type of investigation as necessary to assess proper emergency preparedness and response to any number of social epidemiology problems such as influenza. Again, these types of studies are not based upon one individual's assessments but on the collective knowledge of a body of scientists and professionals that have a collective interest in keeping the public informed and enabling the public to keep them safe.

The implications of how this type of study is relevant to other diseases may be addressed is also at hand. For example, the increase of multidrug-resistant (MDR) tuberculosis and concomitant transmission problems is not just a problem in a country far away on another continent such as Africa. Here in New Mexico and along the United States boarder towns and cities, MDR tuberculosis is a rising problem. Specific behaviors and socio-cultural environments that put people at risk for MDR tuberculosis need to be examined. Measles, once considered eradicated through vaccination programs has shown a dramatic increase during the first four months of 2008 (CDC website, 27 July 2008). Most of the measles cases were imported from other countries by unvaccinated travelers who exposed unvaccinated residents. The risk factors of host, agent, and environment, particularly in the behavioral realm need to be studied in the country of origin. Information properly conveyed to the target audiences (such as an unvaccinated population) could greatly reduce not only the risk to resident populations, but also help prevent the disease from spreading and becoming truly epidemic.

So the list is great of the types of emerging diseases that social epidemiology studies can address. But through careful consideration and interdisciplinary cooperation, the emergence of diseases may be addressed quickly and efficiently. The end result will be that not only will populations enable themselves to reduce risk, and stay healthy, but they also can promote a better quality of life, that which is one not consumed by coping with illness and disease as a lifestyle. In the realm of public health, understanding the dynamics of HPS will add significantly to future prevention efforts.

APPENDICES

APPENDIX A

SURVEYS IMPLEMENTED IN NORTHWESTERN NEW MEXICO, PANAMA, AND CHILE

Monitoring the Effectiveness of Hantavirus Awareness Outreach in NW New Mexico

(Your participation is voluntary and anonymous. You can choose not to participate or not complete the survey and the decision will not affect your medical attention.)

1. Have you heard about hantavirus (Sin Nombre)?
   a. yes
   b. no (If no, please proceed to question number 21.)

2. In what year did you hear about hantavirus?
   Year ____________

3. How did you hear about hantavirus? (Circle all that apply.)
   a. newspaper
   b. television
   c. radio
   d. family/friends
   e. other (specify) ______________________

4. Since you first heard of hantavirus, how have you responded to public service announcements about the virus? (Circle all that apply.)
   a. checked for mice
   b. cleaned the house
   c. took more vitamins
   d. got a flu shot
   e. I didn't do anything at all
   f. other (specify) ______________________

5. Whenever cases of hantavirus were publicized, how did you respond? (Circle all that apply.)
   a. panicked
   b. stayed home
   c. avoided contact with animials
   d. learned more about hantavirus
   e. wondered who the "victim" was

6. Do you know someone that has contracted hantavirus?
   a. yes
   b. no

7. I am concerned about my family members or myself catching hantavirus:
   a. very concerned
   b. concerned
   c. a little bit of concern
   d. not much concern
   e. not concerned at all

8. How do people catch hantavirus? (Circle all that apply.)
   a. animal bites
   b. other sick people
   c. breathing contaminated air with mouse droppings
   d. petting a dog and/or cat
   e. working with livestock

9. What kind(s) of animal(s)/insect(s) carry hantavirus? (Circle all that apply.)
   a. mosquitoes
   b. ticks
   c. dogs
   d. mice
   e. sheep
   f. cats
   g. fleas

10. Do you know the symptoms of hantavirus? (Circle all the apply.)
    a. aches and pains
    b. sore throat
    c. rash
    d. fever and chills
    e. headache
    f. cough

11. How long have you lived in the area?
    Year _____________

12. Describe your home:
    a. mobile home
    b. cabin
    c. wood frame
    d. brick/mortar
    e. adobe/stucco
    f. other (specify) _______________

13. Age of your home:
    Years old ________________

14. Do you:
    a. own your own home
    b. rent your home

OVER →

15. How would you describe your home surrounding?
   a. city/town
   b. rural, grassland/pasture
   c. rural, desert
   d. rural, pinon/juniper forest
   e. rural, ponderosa/pine forest

16. Have you ever observed a mouse and/or a rat in your home or garage?
   a. yes
   b. no

17. Describe if your cleaning habits have changed since you heard about hantavirus:
   a. changed extremely
   b. changed very much
   c. changed a little bit
   d. not changed much
   e. not changed at all (skip to question 21.)

18. If your habits have changed, how have they changed? (Circle all that apply.)
   a. mop more frequently
   b. sweep/vacuum more frequently
   c. disinfect more frequently
   d. set more mouse/rat traps
   e. wear rubber gloves
   f. wear dust mask
   g. wear ventilator mask
   h. other (specify) _______________

19. Do you purchase more: (Circle all that apply.)
   a. mouse/rat traps
   b. rat poison
   c. bleach
   d. dust masks
   e. disinfectants
   f. ventilator masks
   g. other (specify) _______________

20. What else have you done to improve your home and surroundings? (Circle all that apply.)
   a. mouse/rat proof your home
   b. remove trash from home
   c. clean up wood piles
   d. cut grass/weeds down around home
   e. other (specify) _______________

The information requested below is going to be used to analyze different patters of information in our society. It will be used by the public health service to better serve you and your community an make improvements in your public health.

21. County of residence: _______________

22. Gender
   a. male b. female

23. Age:
   a. 18-25
   b. 26-34
   c. 35-44
   d. 45-54
   e. 55-64
   f. 65 or older

24. Number of children under the age of 18 living with you: _____________

25. Ethnicity:
   a. American Indian
   b. African-American/Black
   c. Anglo, non-Hispanic
   d. Hispanic or Latino
   e. Asian/Pacific Islander
   f. Other ______________________

26. Average yearly household income:
   a. $ 0 to $10,000
   b. $10,001 to $20,000
   c. $20,001 to $30,000
   d. $30,001 to $40,000
   e. $40,001 to $50,000
   f. $50,000 or more

27. Occupation/Activity:
   a. professional
   b. skilled labor
   c. farmer
   d. rancher
   e. clerical/secretarial
   f. sales
   g. other (specify) _______________

28. Years of education:
   a. 0 – 8
   b. 9 – 12
   c. 13 – 16
   d. more than 16 years

Monitoreo de la Efectividad de Prog. amas de Conocimiento sobre Hantavirus en Panamá

(Su participación es voluntaria y confidencial. Ud. puede escoger no participar o puede abandonar el estudio y esta decisión no afectará su atencion médica. Este estudio es con Instituto Conmemorativo Gorgas de Estudios de las Salud y una estudiante graduada de Sociologia de la Universidad de Nuevo México en Los Estados Unidos.)

1. ¿Ha escuchado Usted sobre el hantavirus (Choclo)?
   a. si
   b. no **(Si no, pase a la pregunta 21.)**

2. ¿En que año se enteró sobre el hantavirus?
   Año ________

3. ¿Como se enteró sobre el hantavirus? (Encierre en un círculo los que aplican)
   a. periódico
   b. televisión
   c. radio
   d. familia/amigos
   e. otro (explique)____________________

4. ¿Desde que Usted se enteró del hantavirus, como Usted ha reaccionado ante las noticias que hablaban sobre el virus? (Encierre en un círculo los que aplican)
   a. verifiqué si habían ratones
   b. limpié la casa
   c. tomé más vitaminas
   e. vacuné contra la influenza
   f. nada
   g. otro (explique)
   ____

5. ¿Como Usted reaccionó ante las noticias que hablaban de casos del hantavirus? (Encierre en un círculo los que aplican)
   a. con pánico
   b. me quedé en la casa
   c. evité contacto con animales
   d. aprendí mas sobre el hantavirus
   c. pensé quién era la víctima

6. ¿Conoce Usted a alquien que se haya enfermado con el hantavirus?
   a. si
   b. no

7. Está preo..apado sobre la posibilidad de que su familia o Ud. puedan enfermar de hantavirus:
   a. muy preocupado
   b. preocupado
   c. un poco preocupado
   d. no muy preocupado
   e. no estoy preocupado

8. ¿Como se pega el hantavirus a las personas? (Encierre en un círculo los que aplican)
   a. mordidas de animales
   b. otras personas enfermas
   c. respirando aire contaminado con heces de ratones/ratas
   d. tocando un perro o gato
   e. trabajando con animales domésticos

9. ¿Qué tipo(s) de animal(es)/insecto(s) transmiten el hantavirus? (Encierre en un círculo los que aplican)
   a. mosquitos
   b. garrapatas
   c. perros
   d. ratones/ratas
   e. ovejas
   f. gatos
   e. pulgas

10. ¿Conoce Usted las síntomas del hantavirus? (Encierre en un círculo los que aplican)
    a. dolores
    b. dolor de garganta
    c. salpullido
    d. fiebre y escalofrios
    e. dolor de cabeza
    f. tos

11. ¿Cuánto tiempo ha vivido en el área?
    Años ________

12. De qué material está constuida su vivienda
    a. cemento
    b. madera
    c. pencas
    d. ladrillo
    e. quincha (barro)
    f. Otro (explique) ______________

13. Edad de su casa:
    Años ______

14. Usted:
    a. es dueño de su casa
    b. alquila su casa

15. ¿Como describiría los alrededores de su casa ?
   a. cuidad/pueblo
   b. rural, potrero
   c. rural, desierto
   d. rural, maizal
   e. rural, arrozal

16. ¿Ha observado algún ratón o rata en su casa o garaje?
   a. si b. no

17. Describa si sus hábitos de limpieza han cambiado desde que ha escuchado sobre hantavirus:
   a. cambiado mucho
   b. cambiado bastante
   c. cambiado un poco
   d. no ha cambiado mucho
   e. no ha cambiado nada (Pase a la pregunta 21.)

18. ¿Si sus hábitos han cambiado, cómo han cambiado? (Encierre en un círculo los que aplican)
   a. pone trampas con más frequentemente
   b. barre más frequentemente
   c. desinfecta más frequentemente
   d. coloca más trampas para ratones y ratas
   e. usa guantes de goma
   f. usa máscara contra el polvo
   g. usar máscara ventiladora
   h. otro (especifique)__________________

19. ¿Compra usted más: (Encierre en un círculo los que aplican)
   a. trampas de ratones y ratas
   b. veneno para ratas
   c. blanqueador
   d. máscaras contra el polvo
   e. desinfectantes
   f. máscaras ventiladoras
   g. otro (especifique)__________________

20. ¿Qué más ha hecho para mejorar su casa y sus alrededores? (Circule los que aplican.)
   a. mantener su casa libre de ratones y ratas
   b. remover la basura de su casa
   c. limpiar pilas de leña
   d. cortar grama/maleza alrededor de su casa
   e. otro (especifique)__________________

La información solicitada abajo se usará para analizar los diferentes patrones de información en nuestra sociedad. El Servicio de Salud Pública usará esta información para mejor servir a su comunidad y mejorar la salud pública.

21. Corregimineto: _________

22. Sexo
   a. masculino
   b. femenino

23. Años
   a. 18-25
   b. 26-34
   c. 35-44
   d. 45-54
   e. 55-64
   f. 65 o mas

24. Número de niños menores de 18 años viviendo con usted ________

25. Grupo étnico:
   a. Indígena
   b. Blanco, no Hispano
   c. Hispano o Latino
   d. Asiático
   e. Negro
   f. Mulato (Zambito)
   g. otro (especifique)__________________

26. ¿Quánto gana al mes?: $__________________

27. Ocupación/Actividad
   a. profesional
   b. técnico
   c. agricultor
   d. obrero de la construcción
   e. oficinista
   f. vendador
   g. otro (especifique)__________________

28. Tipo de educación
   a. Ninguna
   b. Pimaria
   c. Sucundaria
   d. Universitaria
   e. Técnica

Monitoreo de la Efectividad de Prog. amas de Conocimiento del Hantavirus en Chile

(Su participación es voluntaria y confidencial. Ud. puede escoger no participar o puede abandonar el estudio y esta decisión no afectará su atencion médica. Este estudio es con Universidad de la Frontera Temuco y una estudiante graduada de Sociologia de la Universidad de Nuevo México en Los Estados Unidos.)

1. ¿Ha escuchado Ud. sobre el hantavirus (Andes)?
   a. sí
   b. no **(Si no, pase a la pregunta 21.)**

2. ¿En que año supo sobre el hantavirus?
   Año _________

3. ¿Como supo sobre el hantavirus? (Marque lo que corresponde.)
   a. periódico
   b. televisión
   c. radio
   d. familia/amigos
   e. otro (explique)______________________

4. ¿Desde que Ud. supo sobre el hantavirus, como ha respondido Ud a los medidos de prevención sugeridos por el Servicio público sobre el virus? (Marque lo que corresponde.)
   a. observé si hay ratones
   b. limpié la casa
   c. tomé más vitaminas
   e. me vacuné contra la influenza
   f. nada
   g. otro (explique)
   ____

5. ¿Como ha respondido Ud a los anuncios de casos de hantavirus? (Marque lo que corresponde.)
   a. con pánico
   b. me quedé en la casa
   c. evité contacto con animales
   d. aprendí mas sobre el hantavirus
   e. pensé sobre quien era la víctima

6. ¿Conoce Usted alquien que se enfermó con el hantavirus?
   a. sí
   b. no

7. Sobre la posi..idad de que mi familia o yo nos podamos enfermar con el hantavirus estoy:
   a. muy preocupado
   b. preocupado
   c. poco preocupado
   d. muy poco preocupado
   e. no preocupado

8. ¿Como se contagian las persones con el hantavirus? (Marque lo que corresponde.)
   a. mordidas de animales
   b. por otras personas enfermas
   c. respirando aire contaminado con caca u orina de ratones/ratas
   d. tocando un perro o gato
   e. trabajando con animals domésticos

9. ¿Qué tipo(s) de animal(es)/insecto(s) transmiten el hantavirus? (Marque lo que corresponde.)
   a. mosquitos
   b. garrapatas
   c. perros
   d. ratones/ratas
   e. ovejas
   f. gatos
   g. pulgas

10. ¿Conoce Usted las síntomas del hantavirus? (Marque todo lo que corresponde.)
    a. dolores
    b. dolor de garganta
    c. sarpullido
    d. fiebre y escalofrios
    e. dolor de cabeza
    f. tos (existe más de una opción válida)

11. ¿Cuánto tiempo ha vivido en el área?
    Desde el Año __________

12. Describa su casa
    a. ruca
    b. cabaña
    c. casa de madera
    d. casa de ladrillo/cemento
    e. case de adobe
    f. Otro (explique) _________________

13. Antiqüedad de su casa:
    Años ________

14. Usted:
    a. es dueño de su casa
    b. arrienda la casa

15. ¿Como describiría el sector donde se ubica su casa
  a. cuidad/urbano
  b. rural, concentrado
  c. rural, aislado
  d. rural, bosque de piñón/araucarias
  e. rural, bosque de pino

16. ¿Ha observado algún ratón o rata en:

su casa	sí	no
garaje	sí	no
bodega?	sí	no

17. Diga si sus hábitos de limpieza han cambiado desde que ha escuchado sobre hantavirus:
  a. cambiado mucho
  b. cambiado bastante
  c. cambiado un poco
  d. cambiado muy poco
  e. no ha cambiado nada (Pase a la pregunta 21.)

18. ¿Si sus hábitos han cambiado, como han cambiado? (Marque lo que corresponde.)
  a. trapeado más frecuentemente
  b. barrer/pasar aspiradora más frequentemente
  c. desinfectar más frequentemente
  d. colocar más trámpas para ratones y ratas
  e. usar guantes de goma al limpiar
  f. usar máscara común contra el polvo
  g. usar máscara protectora con otro filtro
  h. otro (especifique)_________________

19. ¿Compra Ud. más: (Marque lo que corresponde.)
  a. trampas de ratones y ratas
  b. veneno para ratas
  c. blanqueador
  d. máscaras contra el polvo
  e. desinfectantes
  f. máscaras protectora con otro filtro
  g. otro (especifique)_________________

20. ¿Qué más ha hecho para mejorar su casa y sus alrededores? (Marque lo que corresponde.)
  a. mantengo la casa libre de ratones y ratas
  b. remuevo la basura de la casa
  c. limpio rumas de leña
  d. corto la maleza alrededor de la casa
  e. otro (especifique)_________________

La informacion solicitada abajo se usará para analizar los diferentes patrones de información en nuestra sociedad. El Servicio de Salud Pública podría utlizar esta información para mejorar el servicio a su comunidad y mejorar la salud pública.

21. Comuna: _________

22. Sexo
  a. masculino
  b. femenino

23. Edad
  a. 18-25
  b. 26-34
  c. 35-44
  d. 45-54
  e. 55-64
  f. 65 o mas

24. Número de niños menores de 18 anos viviendo con usted ________

25. Raza:
  a. Mapuche
  b. Blanco, no Hispano
  c. Hispano o Latino
  d. Asiático/Isleño Pacífico
  e. otro (especifique)_________________

26. Ingreso mensual familiar en pesos:
  a. $ 0 a $50,000
  b. $50,001 a $150,000
  c. $150,001 a $250,000
  d. $250,001 a $350,000
  e. $350,000 o más

27. Ocupación/Actividad
  a. profesional
  b. labor especializada
  c. trabajador agrícola
  d. trabajador forestal
  e. secretaria/junior
  f. vendedor
  g. pescador
  h. otro (especifique)_________________

28. Nivel de educación
  a. ninguna
  b. enseñanza básica
  c. enseñanza media
  d. universitaria
  e. técnica

APPENDIX B

ANTECEDENT CHART OF VARIABLES: INDEPENDENT, MEDIATING, AND DEPENDENT

Antecedent	Independent Variables	Mediating Variables	Dependent Variables	
Survey Sites	Socio Economic Variables	Environmental and predicating	Knowledge responses	Behavior responses
Chile Temuco (control) Melipeuco Curacautin Panama Jaguito (control) Pocri Tonosi NW New Mexico Grants (control) Gallup Farmington	Q. 21 Residence Q. 22 Sex Q. 23 Age Group Q. 24 # of minor children Q. 25 Ethnicity Q. 26 Household income Q. 27 Occupation Q. 28 Years of Education	Q. 11 Length of time in area Q. 12 Type of home Q. 13 Age of home Q. 14 Own/rent home Q 15 Biome Q. 16 Observed rodents in home	Q. 1 If heard of hantavirus Q. 2 When heard of hantavirus Q. 3 How heard of hantavirus Q. 6 Know someone who has contracted hantavirus? Q. 8 How do people catch hps? Q. 9 Animals that carry hps Q. 10 Symptoms of hps	Q. 17 Levels of change How cleaning habits changed: Q. 18 Mop more Q. 18 Sweep/vacuum more Q. 18 Disinfect more Q. 18 Set traps Q. 18 Wear rubber gloves Q. 18 Wear dust mask Q. 18 Wear ventilator mask Purchase more: Q. 19 Traps Q. 19 Poison Q. 19 Bleach Q. 19 Dust masks Q. 19 Disinfectants Q. 19 Ventilator masks Improvements: Q. 20 Mouse proof home Q. 20 Remove trash Q. 20 Clean up wood piles Q. 20 Cut grass/weeds Reactions to HPS Q. 4 Response upon hearing about hps Q. 5 Response to PSA Q. 7 Concern about catching hps

APPENDIX C

CHAPTER 7 COMPLETE CORRELATIONS TABLES

Chapter 7 All Correlations as Behavior responses to SES and significant results in all sites risk comparisons.

Table 7.1: Gender

Behavior	r	p
Response to publicized cases		
Panic	.061	.144
Stay home	-.136**	.001
Avoid animals	.003	.952
Learn about HPS	.102*	.013
Wonder about victim	.017	.674
Response to public service announcements		
Check for rodents	.051	.218
Clean the house	.066	.114
Take vitamins	.034	.417
Get a flu shot	.090*	.030
Nothing	-.032	.438
Concern for self and family catching HPS		
Very concerned	.057	.172
Concerned	-.029	.480
Little concerned	-.054	.196
Not much concern	.049	.236
No concern	.001	.988
Level of cleaning changes		

Extremely changed	.036	.391
Very much changed	-.117**	.005
Changed	.068	.100
Not much change	-.102	.782
No Change	.049	.241
How habits have changed		
Mop more	.024	.569
Sweep/vacuum more	-.022	.591
Disinfect more	.053	.200
Set more traps	.054	.195
Use rubber gloves	.075	.069
Use dust mask	.026	.528
Use ventilator mask	.029	.480
How purchases have changed		
Buy traps	-.033	.432
Buy poison	-.048	.243
Buy bleach	.076	.068
Buy dust masks	-.019	.647
Buy disinfectants	.060	.146
Buy ventilator masks	-.010	.808
Peridomestic improvements		
Mouse/rat proof the home	.075	.071
Remove trash from yard	.004	.925
Move wood piles away from home	.057	.170
Cut grass/weeds away from home	.029	.489

Table 7.2: Age

Behavior						
Response to publicized cases	18-25	26-34	35-44	45-54	55-64	>64
Panic	r = -.024 p = .564	r = .048 p = .241	r = -.005 p = .894	r = -.029 p = .471	r = .016 p = .694	r = -.003 p = .948
Stay home	r = .060 p = .145	r = -.040 p = .323	r = -.001 p = .989	r = -.036 p = .383	r = -.016 p = .695	r = -.020 p = .620
Avoid animals	r = -.006 p = .886	r = .066 p = .107	r = -.047 p = .254	r = -.046 p = .263	r = .006 p = .882	r = .034 p = .402
Learn about HPS	r = .052 p = .206	r = -.020 p = .632	r = -.014 p = .732	r = -.039 p = .342	r = .040 p = .331	r = .024 p = .551
Wonder about victim	r = -.034 p = .400	r = -.020 p = .631	r = -.019 p = .638	r = .062 p = .129	r = .026 p = .527	r = -.005 p = .897
Response to public service announcements	18-25	26-34	35-44	45-54	55-64	>64
Check for rodents	r = -.005	r = -.058	r = -.010	r = -.060	r = .104*	r = .063

	p = .908	p = .153	p = .798	p = .140	p = .011	p = .121
Clean the house	r = .037 p = .363	r = .055 p = .179	r = .054 p = .184	r = -.057 p = .163	r = -.029 p = .485	r = -.063 p = .124
Take vitamins	r = -.016 p = .695	r = -.027 p = .507	r = -.006 p = .887	r = -.043 p = .287	r = .008 p = .842	r = .060 p = .139
Get a flu shot	r = -.037 p = .362	r = -.043 p = .287	r = -.028 p = .497	r = .027 p = .510	r = -.008 p = .838	r = .114* p = .005
Nothing	r = .023 p = .579	r = -.044 p = .278	r = .023 p = .568	r = .064 p = .118	r = -.030 p = .457	r = -.048 p = .243
Concern for self and family catching HPS	18-25	26-34	35-44	45-54	55-64	>64
Very concerned	r = .015 p = .718	r = .062 p = .130	r = -.006 p = .879	r = -.066 p = .107	r = .057 p = .164	r = -.055 p = .177
Concerned	r = .010 p = .811	r = .009 p = .832	r = .026 p = .527	r = .022 p = .595	r = -.102 p = .012	r = .012 p = .762
Little concerned	r = .003 p = .938	r = .004 p = .914	r = .062 p = .131	r = -.063 p = .125	r = .035 p = .396	r = -.017 p = .675
Not much concern	r = -.037 p = .362	r = -.015 p = .715	r = -.069 p = .092	r = .062 p = .127	r = .017 p = .682	r = .051 p = .213
No concern	r = -.020 p = .632	r = -.059 p = .150	r = -.017 p = .677	r = .042 p = .309	r = .004 p = .928	r = .058 p = .155
Level of cleaning changes	18-25	26-34	35-44	45-54	55-64	>64
Extremely changed	r = -.013 p = .751	r = .035 p = .392	r = .060 p = .139	r = -.063 p = .126	r = -.013 p = .743	r = .005 p = .904
Very much changed	r = .053 p = .196	r = -.014 p = .737	r = -.052 p = .201	r = .101* p = .013	r = .044 p = .285	r = .022 p = .593
Changed	r = .063 p = .125	r = .058 p = .153	r = .015 p = .710	r = -.067 p = .103	r = -.018 p = .667	r = -.066 p = .106
Not much change	r = .021 p = .602	r = -.041 p = .319	r = -.024 p = .555	r = -.003 p = .950	r = .037 p = .368	r = .019 p = .640
No Change	r = -.023 p = .569	r = -.065 p = .114	r = .021 p = .600	r = .052 p = .201	r = -.012 p = .762	r = .061 p = .137
How habits have changed	18-25	26-34	35-44	45-54	55-64	>64
Mop more	r = -.014 p = .724	r = .083* p = .042	r = -.044 p = .102	r = -.067 p = .102	r = .005 p = .899	r = .097* p = .018
Sweep/vacuum more	r = -.048 p = .243	r = .039 p = .338	r = .001 p = .982	r = -.009 p = .826	r = .042 p = .305	r = -.022 p = .597
Disinfect more	r = .024 p = .564	r = .122** p = .002	r =-.042 p = .300	r = -.060 p = .145	r = .023 p = .578	r = -.022 p = .596
Set more traps	r = -.032 p = .440	r = -.036 p = .376	r = .032 p = .432	r = -.005 p = .903	r = .007 p = .903	r = .032 p = .438

Use rubber gloves	r = -.018 p = .660	r = .007 p = .869	r = -.087 p = .037	r = .048 p = .237	r = .048 p = .237	r = .011 p = .782
Use dust mask	r = -.013 p = .755	r = -.032 p = .431	r = -.008 p = .848	r = .046 p = .257	r = .069 p = .092	r = -.054 p = .187
Use ventilator mask	r =-.046 p = .258	r = .015 p = . 711	r = -.038 p = .350	r = .018 p = .662	r = .058 p = .154	r = .022 p = .588
How purchases have changed	18-25	26-34	35-44	45-54	55-64	>64
Buy traps	r = -.063 p = .125	r = -.018 p = .655	r = .044 p = .287	r = -.026 p = .527	r = .025 p = .547	r = .039 p = .337
Buy poison	r = -.033 p = .424	r = .032 p = .429	r = -.032 p = .438	r = -.027 p = .513	r = .044 p = .285	r = .044 p = .279
Buy bleach	r = .031 p = .441	r = .030 p = .468	r = -.039 p = .339	r = .048 p = .237	r = .006 p = .882	r = -.052 p = .200
Buy dust masks	r = -.085* p = .038	r = .017 p = .684	r = -.021 p = .605	r = .023 p = .569	r = .101* p = .014	r = -.017 p = .677
Buy disinfectants	r = -.041 p = .317	r = .084* p = .039	r = .020 p = .627	r = -.037 p = .367	r = .036 p = .376	r = -.057 p = .159
Buy ventilator masks	r = -.036 p = .383	r = -.030 p = .458	r = -.031 p = .446	r = .052 p = .205	r = .014 p = .734	r = .031 p = .441
Peridomestic improvements	18-25	26-34	35-44	45-54	55-64	>64
Mouse/rat proof the home	r = -.025 p = .535	r = .043 p = .309	r = .024 p = .551	r = -.074 p = .071	r = -.014 p = .733	r = .061 p = .136
Remove trash from yard	r = .053 p = .192	r = .072 p = .079	r = -.042 p = .305	r = -.053 p = .199	r = .051 p = .215	r = -.020 p = .621
Move wood piles away from home	r = -.009 p = .824	r = .003 p = .941	r = -.054 p = .185	r = .025 p = .533	r = .038 p = .352	r = .058 p = .159
Cut grass/weeds away from home	r = -.017 p = .670	r = .035 p = .395	r = .014 p = .731	r = -.013 p = .748	r = .060 p = .145	r = -.047 p = .246

Table 7.3: Ethnicity

Behavior							
Response to publicized cases	Am Ind; Indig; Mapucho	Af Am; Negro	Anglo Blanco	Latino, Chilean, Mestizo	Mulato	Other	No response
Panic	r = -.075 p = .066	r = .019 p = .641	r = .035 p = .389	r = -.020 p = .631	r = -.051 p = .211	r = .063 p = .122	r = .033 p = .413
Stay home	r = .028 p = .501	r = -.038 p = .351	r = .060 p = .141	r = -.108** p = .008	r = -.028 p = .496	r = .048 p = .242	r = .061 p = .136
Avoid animals	r = -.018 p = .652	r = .021 p = .604	r = -.011 p = .781	r = -.017 p = .670	r = .153** p = .000	r = .010 p = .808	r = -.013 p = .755
Learn about HPS	r = .006 p = .875	r = -.006 p = .890	r = -.015 p = .708	r = .026 p = .522	r = .003 p = .940	r = -.029 p = .474	r = .006 p = .881
Wonder about	r = -.009 p = .826	r = -.060 p = .142	r = -.052 p = .199	r = .071 p = .080	r = -.044 p = .284	r = .059 p = .152	r = -.021 p = .603

victim							
Response to public service announcements	Am Ind; Indig; Mapucho	Af Am; Negro	Anglo Blanco	Latino, Chilean, Mestizo	Mulato	Other	No response
Check for rodents	r = .020 p = .621	r = -.035 p = .387	r = -.002 p = .953	r = -.011 p = .783	r = .061 p = .134	r = .072 p = -.032	r = -.032 p = .433
Clean the house	r = -.048 p = .239	r = .035 p = .391	r = -.005 p = .904	r = .022 p = .594	r = .093* p = .022	r = .008 p = .847	r = .-.017 p = .674
Take vitamins	r = -.034 p = .403	r = -.032 p = .430	r = .074 p = .071	r = -.072 p = .076	r = -.024 p = .565	r = .120** p = .003	r = .001 p = .986
Get a flu shot	r = .047 p = .252	r = -.042 p = .306	r = .025 p = .548	r = -.009 p = .832	r = -.031 p = .455	r = .078 p = .056	r = -.054 p = .182
Nothing	r = .033 p = .419	r = -.048 p = .243	r = -.038 p = .357	r = .038 p = .358	r = -.035 p = .394	r = .022 p = .589	r = -.024 p = .554
Concern for self and family catching HPS	Am Ind; Indig; Mapucho	Af Am; Negro	Anglo Blanco	Latino, Chilean, Mestizo	Mulato	Other	No response
Very concerned	r = .005 p = .906	r = -.033 p = .417	r = -.092* p = .024	r = .059 p = .148	r = -.077 p = .058	r = .022 p = .596	r = .084* p = .040
Concerned	r = .017 p = .676	r = .039 p = .345	r = -.026 p = .518	r = .063 p = .125	r = -.031 p = .448	r = -.049 p = .229	r = -.084* p = .039
Little concerned	r = -.118** p = .004	r = .078 p = .057	r = .047 p = .246	r = .005 p = .907	r = .233** p = .000	r = -.062 p = .127	r = -.053 p = .198
Not much concern	r = -.012 p = .772	r = -.050 p = .221	r = .074 p = .069	r = -.043 p = .290	r = -.036 p = .372	r = .088* p = .032	r = -.010 p = .809
No concern	r = .054 p = .188	r = -.017 p = .677	r = .068 p = .096	r = -.115** p = .005	r = -.039 p = .343	r = .044 p = .283	r = .021 p = .614
Level of cleaning changes	Am Ind; Indig; Mapucho	Af Am; Negro	Anglo Blanco	Latino, Chilean, Mestizo	Mulato	Other	No response
Extremelychanged	r = -.063 p = .123	r = .123** p = .002	r = -.056 p = .167	r = .034 p = 412	r = .045 p = .266	r = -.012 p = .770	r = .063 p = .124
Very much changed	r = -.015 p = .723	r = .006 p = .874	r = .041 p = .319	r = -.011 p = .792	r = .019 p = .637	r = -.031 p = .446	r = -.037 p = .365
Changed	r = .055 p = .177	r = -.075 p = .065	r = .011 p = .780	r = .048 p = .235	r = -.055 p = .178	r = -.028 p = 489	r = -.111** p = .006
Not much change	r = .030 p = .458	r = -.041 p = .312	r = .043 p = .292	r = -.029 p = .473	r = -.030 p = .461	r = .038 p = .348	r = -.053 p = .192
No Change	r = -.034 p = .402	r = -.043 p = .295	r = .015 p = .706	r = -.007 p = .873	r = -.031 p = .444	r = .034 p = .403	r = .039 p = .337
How habits have changed	Am Ind; Indig; Mapucho	Af Am; Negro	Anglo Blanco	Latino, Chilean, Mestizo	Mulato	Other	No response
Mop more	r = .049 p = .235	r = -.050 p = .220	r = .007 p = .857	r = -.021 p = .603	r = .062 p = .13	r = .031 p = .443	r = -.036 p = .376
Sweep/vacuum more	r = .014 p = .726	r = .092* p = .023	r = -.007 p = .860	r = -.005 p = .897	r = .157** p = .000	r = .003 p = .941	r = -.086* p = .036
Disinfect more	r = .043 p = .289	r = -.075 p = .066	r = -.054 p = .185	r = .047 p = .251	r = -.012 p = .774	r = .016 p = .691	r = .010 p = .810

Set more traps	r = .031 p = .446	r = -.004 p = .929	r = .010 p = .808	r = -.004 p = .920	r = -.061 p = .134	r = .009 p = .816	r = .006 p = .888
Use rubber gloves	r = .157** p = .000	r = -.066 p = .108	r = .004 p = .931	r = -.051 p = .213	r = -.048 p = .241	r = -.013 p = .753	r = -.055 p = .179
Use dust mask	r = .110** p = .007	r = -.064 p = .115	r = .033 p = .426	r = -.114** p = .005	r = -.047 p = .25	r = -.048 p = .244	r = .036 p = .381
Use ventilator mask	r = -.044 p = .279	r = -.017 p = .63	r = .013 p = .751	r = -.041 p = .316	r = -.013 p = .758	r = -.019 p = .649	r = .135** p = .001
How purchases have changed	Am Ind; Indig; Mapucho	Af Am; Negro	Anglo Blanco	Latino, Chilean, Mestizo	Mulato	Other	No response
Buy traps	r = .057 p = .166	r = -.007 p = .864	r = -.014 p = .727	r = -.016 p = .694	r = .152** p = .000	r = .030 p .459	r = -.060 p = .144
Buy poison	r = -.101* p = .014	r = .000 p = .990	r = .020 p = .623	r = .036 p = .378	r = -.005 p = .906	r = -.083* p = .042	r = .063 p = .124
Buy bleach	r = .058 p = .154	r = -.081* p = .046	r = -.038 p = .349	r = .033 p = .423	r = -.093* p = .022	r = .035 p = .388	r = .004 p = .917
Buy dust masks	r = .049 p = .235	r = -.045 p = .273	r = .114** p = .005	r = -.100* p = .424	r = -.033 p = .424	r = -.010 p = .815	r = -.038 p = .347
Buy disinfectants	r = .054 p = .190	r = .071 p = .082	r = -.018 p = .662	r = -.012 p = .775	r = .026 p = .521	r = .029 p = .480	r = -.054 p = .188
Buy ventilator masks	r = -.032 p = .436	r = -.025 p = .547	r = .041 p = .321	r = -.058 p = .153	r = -.018 p = .660	r = -.026 p = .517	r = .112** p = .006
Peridomestic improvements	Am Ind; Indig; Mapucho	Af Am; Negro	Anglo Blanco	Latino, Chilean, Mestizo	Mulato	Other	No response
Mouse/rat proof the home	r = -.028 p = .494	r = -.026 p = .529	r = -.045 p = .268	r = .074 p = .071	r = .084 p = .040	r = -.001 p = .974	r = -.022 p = .590
Remove trash from yard	r = .093* p = .023	r = .024 p = .555	r = -.077 p = .059	r = .043 p = .296	r = .087* p = .033	r = -.018 p = .651	r = -.079 p = .054
Move wood piles away from home	r = -.088* p = .031	r = -.090* p = .028	r = -.005 p = .899	r = -.030 p = .469	r = .005 p = .907	r = -.024 p = .558	r = .047 p = .245
Cut grass/weeds away from home	r = -.010 p = .801	r = -.115** p = .005	r = .033 p = .423	r = .037 p = .366	r = -.038 p = .350	r = -.041 p = .316	r = .009 p = .821

Table 7.4: Occupation

Behavior							
Response to publicized cases	Prof	Skilled labor	Agri Farmer	Secretary Clerical	Sales	Ama de Casa	No Response
Panic	r = -.092* p = .024	r = -.047 p = .251	r = .056 p = .168	r = .008 p = .843	r = -.049 p = .227	r = .170** p = .000	r = -.021 p = .612
Stay home	r = -.097* p = .017	r = .013 p = .748	r = .097* p = .017	r = -.020 p = .627	r = -.019 p = .645	r = -.060 p = .145	r = .037 p = .367
Avoid animals	r = -.054 p = .184	r = -.013 p = .747	r = -.040 p = .329	r = .027 p = .510	r = -.030 p = .470	r = .014 p = .735	r = .103* p = .012
Learn about HPS	r = .143** p = .000	r = -.002 p = .952	r = -.144** p = .000	r = .042 p = .299	r = .019 p = .643	r = -.030 p = .470	r = -.060 p = .141
Wonder about victim	r = .042 p = .3078	r = -.047 p = .253	r = .039 p = .336	r = .097* p = .017	r = -.058 p = .155	r = -.040 p = .328	r = -.035 p = .391

Response to public service announcements	Prof	Skilled labor	Agricul Farmer	Secretary Clerical	Sales	Ama de Casa	No Response
Check for rodents	r = .088* p = .031	r = -.051 p = .209	r = -.037 p = .364	r = -.060 p = .140	r = .020 p = .630	r = .023 p = .579	r = -.016 p = .697
Clean the house	r = .042 p = .307	r = -.072 p = .077	r = -.012 p = .760	r = .008 p = .844	r = -.017 p = .674	r = .080 p = .051	r = .005 p = .897
Take vitamins	r = .047 p = .248	r = -.042 p = .305	r = -.046 p = .257	r = .004 p = .913	r = .032 p = .440	r = -.012 p = .778	r = -.009 p = .830
Get a flu shot	r = -.018 p = .658	r = -.024 p = .554	r = -.010 p = .809	r = .071 p = .084	r = -.054 p = .182	r = .027 p = .502	r = .032 p = .440
Nothing	r = -.009 p = .823	r = .094* p = .021	r = -.013 p = .751	r = .077 p = .059	r = .020 p = .628	r = -.098* p = 016	r = -.033 p = 419
Concern for self and family catching HPS	Prof	Skilled labor	Agricul Farmer	Secretary Clerical	Sales	Ama de Casa	No Response
Very concerned	r = -.026 p = .522	r = .051 p = .215	r = -.029 p = .475	r = -.037 p = .372	r = .016 p = .689	r = .104* p = .011	r = -.038 p = .358
Concerned	r = -.043 p = .288	r = -.001 p = .976	r = .019 p = .636	r = -.073 p = .073	r = .002 p = .961	r = .128** p = .002	r = -.014 p = .725
Little concerned	r = .031 p = .446	r = -.057 p = .163	r = -.017 p = .685	r = .044 p = .285	r = -.034 p = .409	r = -.083* p = .043	r = .108** p = .008
Not muchconcern	r = .113** p = .006	r = -.051 p = .213	r = -.040 p = .328	r = .101* p = .013	r = .032 p = .427	r = -.122** p = .003	r = -.044 p = .282
No concern	r = -.015 p = .717	r = -.006 p = .882	r = .036 p = .372	r = .015 p = .715	r = -.020 p = .629	r = -.076 p = .062	r = .013 p = .751
Level of cleaning changes	Prof	Skilled labor	Agricul Farmer	Secretary Clerical	Sales	Ama de Casa	No Response
Extremely changed	r = -.146** p = .000	r = .004 p = .927	r = .051 p = .212	r = .019 p = .634	r = -.017 p = .685	r = .191** p = .000	r = -.011 p = .784
Very much changed	r = -.006 p = .879	r = .029 p = .478	r = .027 p = .508	r = -.085* p = .037	r = .041 p = .31	r = -.027 p = .504	r = .056 p = .167
Changed	r = .106** p = .009	r = -.077 p = .058	r = -.061 p = .134	r = .015 p = .716	r = -.048 p = .244	r = -.085* p = .038	r = .044 p = .281
Not much change	r = .065 p = .114	r = .022 p = .589	r = -.008 p = .849	r = .158** p = .000	r = -.078 p = .056	r = -.090* p = .027	r = -.035 p = .390
No Change	r = .068 p = .094	r = .037 p = .367	r = -.055 p = .176	r = -.017 p = .681	r = .111** p = .006	r = -.012 p = .765	r = -.093* p = .022
How habits have changed	Prof	Skilled labor	Agricul Farmer	Secretary Clerical	Sales	Ama de Casa	No Response
Mop more	r = -.086* p = .035	r = -.029 p = .480	r = .085* p = .038	r = .029 p = .835	r = -.009 p = .835	r = .103* p = .011	r = -.013 p = .751
Sweep/vacuum more	r = -.014 p = .739	r = -.063 p = .122	r = .026 p = .525	r = .053 p = .195	r = -.017 p = .670	r = .050 p = .224	r = .031 p = .451
Disinfect more	r = .030 p = .460	r = -.012 p = .775	r = -.016 p = .699	r = -.004 p = .699	r = -.029 p = .485	r = .091* p = .344	r = -.039 p = .344
Set more traps	r = .027 p = .505	r = -.047 p = .250	r = -.009 p = .821	r = .074 p = .071	r = -.039 p = .339	r = -.014 p = .728	r = .004 p = .927
Use rubber gloves	r = .007 p = .867	r = .091* p = .026	r = .016 p = .701	r = .099* p = .015	r = -.055 p = .179	r = -.090* p = .027	r = -.049 p = .235

Use dust mask	r = .171** p = .000	r = .002 p = .955	r = -.010 p = .812	r = .060 p = .141	r = .034 p = .02	r = -.146** p = .000	r = -.043 p = .291
Use ventilator mask	r = .048 p = .242	r = -.037 p = .362	r = .009 p = .825	r = .008 p = .852	r = -.033 p = .424	r = -.052 p = .201	r = .067 p = .103
How purchases have changed	Prof	Skilled labor	Agricul Farmer	Secretary Clerical	Sales	Ama de Casa	No Response
Buy traps	r = .015 p = .712	r = .067 p = .101	r = .034 p = .406	r = .065 p = .113	r = -.045 p = .271	r = -.045 p = .271	r = .056 p = .172
Buy poison	r = -.019** p = .007	r = -.051 p = .208	r = .123** p = .002	r = -.051 p = .216	r = .007 p = .858	r = .136** p = .001	r = -.029 p = .473
Buy bleach	r = -.025 p = .538	r = .003 p = .946	r = -.032 p = .432	r = .058 p = .156	r = -.009 p = .832	r = .001 p = .974	r = .013 p = .752
Buy dust masks	r = .083* p = .042	r = -.034 p = .400	r = .058 p = .153	r = .094* p = .022	r = -.015 p = .709	r = -.135** p = .001	r = .014 p = .735
Buy disinfectants	r = .137** p = .001	r = -.070 p = .085	r = -.039 p = .341	r = .129** p = .001	r = -.026 p = .521	r = -.028 p = .493	r = -.077 p = .058
Buy ventilator masks	r = .094* p = .022	r = .018 p = .658	r = -.021 p = .601	r = .045 p = .275	r = -.007 p = .868	r = -.047 p = .253	r = -.073 p = .074
Peridomestic improvements	Prof	Skilled labor	Agricul Farmer	Secretary Clerical	Sales	Ama de Casa	No Response
Mouse/rat proof the home	r = -.040 p = .329	r = -.027 p = .506	r = -.019 p = .643	r = .015 p = .722	r = -.060 p = .139	r = .129** p = .002	r = -.001 p = .974
Remove trash from yard	r = -.043 p = .295	r = .004 p = .916	r = -.021 p = .605	r = .089* p = .029	r = -.015 p = .722	r = .061 p = .138	r = .001 p = .972
Move wood piles away from home	r = .062 p = .127	r = .027 p = .507	r = -.015 p = .705	r = .027 p = .503	r = .004 p = .919	r = .011 p = .784	r = -.093* p = .023
Cut grass/weeds away from home	r = .028 p = .495	r = .025 p = .538	r = -.045 p = .266	r = .010 p = .797	r = .022 p = .590	r = .049 p = .234	r = -.0202 p = .632

Table 7.5: Education

Behavior					
Response to publicized cases	0-8	9-12	13-16	>16	Technical
Panic	r = -.004 p = .925	r = .-45 p = .270	r = -.009 p = .834	r = -.012 p = .760	r = -.033 p = .417
Stay home	r = .021 p = .606	r = .114** p = .005	r = -.032 p = .435	r = -.110** p = .007	r =-.053 p = .191
Avoid animals	r = -.092* p = .024	r = .083* p = .043	r = .029 p = .479	r = -.091* p = .026	r =-.031 p = .451
Learn about HPS	r = -.067 p = .102	r = -.220** p = .000	r = .046 p = .260	r = .218** p = .000	r = .102* p = .013
Wonder about victim	r = -.030 p = .457	r = .083* p = .041	r = -.006 p = .875	r = -.068 p = .096	r = -.036 p = .380
Response to public service announcements	0-8	9-12	13-16	>16	Technical
Check for rodents	r = 0.093*	r = -.045	r = -.018	r = .080	r = .059

	p = .022	p = .275	p = 663	p = .051	p = .145
Clean the house	r = -.145** p = .000	r = -.033 p = .424	r = .084* p = .040	r = .008 p = .841	r = .027 p = .507
Take vitamins	r = -.001 p = .973	r = .018 p = .658	r = -.084* p = .040	r = .061 p = .133	r = -.005 p = .904
Get a flu shot	r = -.023 p = .577	r = -.021 p = .602	r = .024 p = .558	r = -.016 p = .704	r = .005 p = .894
Nothing	r = .026 p = .532	r = -.019 p = .646	r = .080* p = .050	p = -.059 p = .147	r = -.038 p = .351
Concern for self and family catching HPS	0-8	9-12	13-16	>16	Technical
Very concerned	r = -.068 p = .093	r = -.007 p = .871	r = .019 p = .643	r = -.006 p = .888	r = .063 p = .120
r = .063	r = -.043 p = .293	r = .003 p = .944	r = .032 p = .439	r = -.014 p = .735	r = -.014 p = .734
Little concerned	r = -.026 p = .520	r = -.054 p = .186	r = -.046 p = .260	r = 1.44** p = .000	r = .018 p = .667
Not much concern	r = -.038 p = .348	r = -.037 p = .360	r = .065 p = .110	r = -.023 p = .567	r = -.042 p = .299
No concern	r = .120** p = .003	r = .050 p = .221	r = -.054 p = .186	r = -.038 p = .351	r = .005 p = .912
Level of cleaning changes	0-8	9-12	13-16	>16	Technical
Extremely changed	r = -.099** p = .015	r = .070 p = .089	r = .045 p = .273	r = -.102* p = .013	r = .048 p = .242
Very much changed	r = -.040 p = .325	r = .014 p = .733	r = .001 p = .971	r = .033 p = .415	r = -.007 p = .872
Changed	r = .028 p = .496	r = -.085* p = .037	r = .044 p = .037	r = .065 p = .109	r = -.023 p = .573
Not much change	r = .012 p = .770	r = .052 p = .206	r = -.088* p = .030	r = .040 p = .322	r = -.026 p = .533
No Change	r = .040 p = .322	r = -.070 p = .088	r = .013 p = .751	r = .-48 p = .237	r = .034 p = .405
How habits have changed	0-8	9-12	13-16	>16	Technical
Mop more	r = -.096* p = .019	r = .126* p = .002	r = -.-13 p = .754	r = -.070 p = .085	r = .005 p = .908
Sweep/vacuum more	r = -.046 p = .264	r = .071 p = .081	r = .026 p = .532	r = -.054 p = .188	r = -.020 p = .628
Disinfect more	r = -.106** p = .009	r = -.028 p = .486	r = .090* p = .027	r = .024 p = .553	r = =-.001 p = .979
Set more traps	r = .029 p = .472	r = .008 p = .842	r = .001 p = .974	r = .014 p = .729	r-.040 p = .333
Use rubber gloves	r = -.018 p = .666	r = .044 p = .286	r = -.013 p = .747	r = -.016 p = .687	r = -.002 p = .966
Use dust mask	r = -.039 p = .341	r = -.014 p = .730	r = -.020 p = .618	r = .077 p = .059	r = .001 p = .978
Use ventilator mask	r = -.023	r = -.020	r = -.009	r = .070	r = -.024

	p = .571	p = .624	p = .828	p = .087	p = .554
How purchases have changed	0-8	9-12	13-16	>16	Technical
Buy traps	r = -.036 p = .384	r = .090* p = .028	r = -.018 p = .660	r = -.017 p = .676	r = -.063 p = .123
Buy poison	r = -.202 p = .632	r = .154** p = .000	r = -.058 p = .155	r = -.057 p = .160	r = -.066 p = .106
Buy bleach	r = -.048 p = .236	r = -.039 p = .341	r = .074 p = .071	r = -.008 p = .841	r = .057 p = .161
Buy dust masks	r = -.034 p = .404	r = .006 p = 889	r = -.032 p = .431	r = .020 p = .632	r = .028 p = .497
Buy disinfectants	r = -.098* p = .016	r = -.091* p = .026	r = .077 p = .059	r = .101* p = .013	r = .002 p = .966
Buy ventilator masks	r = .021 p = .609	r = .015 p = .706	r = -.013 p = .757	r = -.014 p = .726	r = .01 p = .672
Peridomestic improvements	0-8	9-12	13-16	>16	Technical
Mouse/rat proof the home	r = -.067 p = .103	r = .023 p = .568	r = .029 p = .484	r = -.030 p = .464	r = .037 p = .363
Remove trash from yard	r = -.009 p = .823	r = .042 p = .302	r = .004 p = .931	r = -.037 p = .367	r = .026 p = .523
Move wood piles away from home	r = -.081* p = .047	r = -.008 p = .848	r = .038 p = .352	r = .010 p = .805	r = .006 p = .874
Cut grass/weeds away from home	r = -.132** p = .001	r = -.033 p = .41	r = .079 p = .052	r = -.003 p = .942	r = .092* p = .025

Table 7.6a: Income: NM in USD/year (n = 200)

Behavior						
Response to publicized cases	0-10K	10-20K	20-30K	30-40K	40-50K	>50K
Panic	r = -.016 p = .819	r = -.011 p = .873	r = -.030 p = .669	r = .037 p = .603	r = .047 p = .506	r = .010 p = .887
Stay home	r = -.003 p = .962	r = .066 p = .353	r = -.011 p = .878	r = -.015 p = .836	r = -.080 p = .258	r = -.126 p = .075
Avoid animals	r = .216** p = .002	r = .067 p = .346	r = .025 p = .728	r = -.060 p = .400	r = -.087 p = .222	r = -.115 p = .105
Learn about HPS	r = -.015 p = .139	r = -.214** p = .002	r = -.030 p = .673	r = -.021 p = .766	r = .00 p = .259	r = .176* p = .013
Wonder about victim	r = -.137 p = .054	r = .006 p = .936	r = .024 p = .738	r = -.002 p = .974	r = .016 p = .824	r = .061 p = .391
Response to public service announcements	0-10K	10-20K	20-30K	30-40K	40-50K	>50K
Check for rodents	r = -.115 p = .105	r = -.060 p = .395	r = .031 p = .668	r = -.101 p = .156	r = .105 p = .138	r = .134 p = .058
Clean the house	r = .019	r = .050	r =-.020	r = -.090	r = .037	r = .046

	p = .793	p = .481	p = .777	p = .206	p = .604	p = .521
Take vitamins	r = .092 p = .194	r = -.028 p = .696	r = .047 p = .505	r = .021 p = .765	r = .158* p = .025	r = -.057 p = .426
Get a flu shot	r = .038 p = .595	r = .079 p = .268	r = .008 p = .914	r = -.081 = .256	r = .133 p = .060	r = -081 p = .255
Nothing	r = -.067 p = .349	r = .093 p = .191	r = -.045 p = .526	r = .038 p = .591	r = .013 p = .856	r = -.030 p = .674
Concern for self and family catching HPS	0-10K	10-20K	20-30K	30-40K	40-50K	>50K
Very concerned	r = .070 p = .324	r = .204** p = .004	r = -.007 p = .927	r = -.082 p = .251	r = -.026 p = .714	r = -.087 p = .222
Concerned	r = -.048 p = .496	r = -.052 p = .462	r = .123 p = .083	r = .021 p = .769	r = -.009 p = .898	r = -.096 p = .178
Little concerned	r = -.095 p = .181	r = -.052 p = .462	r = -.014 p = .848	r = -.066 p = .351	r = .036 p = .609	r = .170* p = .016
Not much concern	r = -.079 p = .268	r = -.061 p = .394	r = -.017 p = .811	r = .079 p = .269	r = .064 p = .366	r = -.066 p = .353
No concern	r = .055 p = .440	r = -.078 p = .271	r = -.035 p = .623	r = -.058 p = .413	r = .000 p = 1.000	r = .155* p = .028
Level of cleaning changes	0-10K	10-20K	20-30K	30-40K	40-50K	>50K
Extremely changed	r = .038 p = .595	r = .079 p = .268	r = .046 p = .516	r = -.081 p = .256	r = .031 p = .665	r = -.043 p = .541
Very much changed	r = -.019 p = .793	r = -.004 p = .953	r = .026 p = .714	r = -.040 p = .575	r = .017 p = .807	r = -.023 p = .742
Changed	r = -.033 p = .645	r = -.016 p = .827	r = .043 p = .543	r = -.028 p = .690	r = .029 p = .685	r = .044 p = .537
Not much change	r = -.041 p = .568	r = -.041 p = .564	r = .035 p = .623	r = .076 p = .284	r = .000 p = 1.000	r = .019 p = .792
No Change	r = -.019 p = .786	r = -.010 p = .888	r = .076 p = .287	r = -.036 p = .610	r = -.025 p = .723	r = .097 p = .174
How habits have changed	0-10K	10-20K	20-30K	30-40K	40-50K	>50K
Mop more	r = -.005 p = .944	r = .115 p = .106	r = .034 p = .635	r = .002 p = .976	r = -.053 p = .460	r = -.017 p = .814
Sweep/vacuum more	r = .022 p = .756	r = .127 p = .073	r = .072 p = .311	r = -.045 p = .527	r = -.063 p = .377	r = .020 p = .778
Disinfect more	r = -.147* p = .038	r = .113 p = .111	r = .066 p = .356	r = .014 p = .846	r = .044 p = .539	r = .032 p = .655
Set more traps	r = .011 p = .875	r = -.064 p = .369	r = .027 p = .701	r = -.091 p = .202	r = -.036 p = .609	r = .109 p = .125
Use rubber gloves	r = -.019 p = .788	r = .004 p = .954	r = .039 p = .588	r = -.049 p = .494	r = .118 p = .097	r = -.013 p = .859
Use dust mask	r = -.026 p = .715	r = .021 p = .771	r = .035 p = .624	r = -.126 p = .076	r = .081 p = .252	r = .013 p = .853
Use ventilator mask	r = -.046	r = .030	r = .018	r = -.050	r = -.048	r = .099

	p = .515	p = .669	p = .802	p = .480	p = .503	p = .163
How purchases have changed	0-10K	10-20K	20-30K	30-40K	40-50K	>50K
Buy traps	r = .008 p = .915	r = -.069 p = .335	r = .103 p = .146	r = -.025 p = .729	r = -.076 p = .285	r = .050 p = .483
Buy poison	r = -.019 p = .793	r = .065 p = .359	r = .091 p = .200	r = -.123 p = .082	r = -.113 p = .112	r = .135 p = .057
Buy bleach	r = .059 p = .406	r = .052 p = .462	r = .015 p = .829	r = .050 p = .480	r = -.024 p = .736	r = -.039 p = .585
Buy dust masks	r = -.085 p = .231	r = .078 p = .271	r = .043 p = .549	r = -.145* p = .041	r = .052 p = .464	r = .061 p = .391
Buy disinfectants	r = -.139* p = .049	r = -.011 p = .873	r = .036 p = .609	r = -.001 p = .989	r = .163* p = .021	r = .008 p = .914
Buy ventilator masks	r = -.066 p = .352	r = .111 p = .116	r = -.102 p = .150	r = .010 p = .891	r = .187** p = .008	r = -.045 p = .530
Peridomestic improvements	0-10K	10-20K	20-30K	30-40K	40-50K	>50K
Mouse/rat proof the home	r = -.133 p = .060	r = -.002 p = .978	r = .047 p = .509	r = -.060 p = .395	r = -.003 p = .961	r = .120 p = .089
Remove trash from yard	r = .105 p = .139	r = .107 p = .131	r = .080 p = .259	r = -.011 p = .878	r = .020 p = .778	r = -.054 p = .449
Move wood piles away from home	r = -.156* p = .027	r = .120 p = .090	r = .040 p = .577	r = .006 p = .931	r = -.011 p = .873	r = .072 p = .312
Cut grass/weeds away from home	r = -.062 p = .382	r = .026 p = .716	r = .125 p = .077	r = -.027 p = .704	r = -.073 p = .303	r = .120 p = .089

Table 7.6b: Income: Panama in Balboas/month (n = 200)

Behavior							
Response to publicized cases	0-100	100-200	200-300	300-400	400-500	>500	No response
Panic	r = -.016 p = .825	r = -.174* p = .014	r = .072 p = .310	r = -.004 p = .960	r = -.027 p = .703	r = -.017 p = .810	r = .112 p = .113
Stay home	r = -.030 p = .673	r = .333** p = .000	r = .037 p = .607	r = -.084 p = .236	r =-.048 p = .503	r = -.037 p = .604	r = -.187** p = .008
Avoid animals	r = .058 p = .416	r = -.054 p = .445	r = .111 p = .117	r = -.083 = .241	r = .076 p = .286	r = -.023 p = .745	r = .035 p = .618
Learn about HPS	r = -.139* p = .050	r = -.170* p = .016	r = .100 p = .158	r = .057 p = .420	r = .080 p = .259	r = .165* p = .019	r = .040 p = .571
Wonder about victim	r = -.030 p = .673	r = .042 p = .558	r = -.016 p = .826	r = .056 p = .430	r = -.048 p = .50	r = -.037 p = .604	r = -.043 p = .543
Response to public service announcements	0-100	100-200	200-300	300-400	400-500	>500	No Response
Check for rodents	r = -.005 p = .941	r = .026 p = .720	r = -.058 p = .418	r = .077 p = .276	r = -.029 p = .682	r = -.023 p = .751	r = -.004 p = .951

Clean the house	r = -.014 p = .141	r = -.134 p = .059	r = .155* p = .028	r = -.124 p = .081	r = .010 p = .893	r = .143* p = .044	r = .081 p = .255
Take vitamins	r = -.032 p = .657	r = .026 p = .720	r = -.074 p = .468	r = -.052 p = .468	r = -.029 p = .682	r = .060 p = .397	r = .139* p = .050
Get a flu shot	r = -.093 p = .190	r = -.055 p = .437	r = .09 p = .897	r = -.075 p = .294	r = -.042 p = .554	r = .049 p = .492	r = .121 p = .087
Nothing	r = -.059 p = .408	r = -.062 p = .385	r = .084 p = .234	r = -.031 p = .661	r = .276** p = .000	r = -.036 p = .609	r = .006 p = .930
Concern for self and family catching HPS	0-100	100-200	200-300	300-400	400-500	>500	No Response
Very concerned	r = -.097 p = .172	r = -.126 p = .074	r = .039 p = .585	r = .081 p = .255	r = .094 p = .186	r = .119 p = .092	r = .036 p = .612
Concerned	r = .015 p = .836	r = .016 p = .820	r = .029 p = .679	r = -.033 p = .645	r = -.019 p = .794	r = -.118 p = .096	r = .042 p = .559
Little concerned	r = .030 p = .669	r = .086 p = .223	r = -.100 p = .158	r = -.041 p = .562	r = .058 p = .418	r = -.013 p = .858	r = -.021 p = .766
Not much concern	r = .149* p = .035	r = .035 p = .618	r = -.026 p = .719	r = -.018 p = .801	r = -.010 p = .887	r = -.021 p = .769	r = -.048 p = .504
No concern	r = -.046 p = .522	r = .037 p = .604	r = .067 p = .003	r = .003 p = .965	r = -.042 p = .554	r = .049 p = .492	r = -.038 p = .591
Level of cleaning changes	0-100	100-200	200-300	300-400	400-500	>500	No response
Extremely changed	r = -.105 p = .138	r = .005 p = .943	r = .042 p = .555	r = .080 p = .261	r = .045 p = .526	r = -.020 p = .784	r = .002 p = .973
Very much changed	r = .065 p = .363	r = -.051 p = .473	r = .025 p = .724	r = -.069 p = .334	r = .022 p = .759	r = .045 p = .526	r = .006 p = .932
Changed	r = -.031 p = .663	r = .067 p = .347	r = -.046 p = .517	r = -.035 p = .622	r = -.055 p = .437	r = -.114 p = .108	r = .062 p = .380
Not much change	r = -.021 p = .771	r = -.095 p = .180	r = .017 p = .815	r = .066 p = .350	r = -.027 p = .702	r = .144* p = .041	r = -.010 p = .888
No Change	r = -.034 p = .635	r = -.035 p = .618	r = -.026 p = .719	r = -.018 p = .801	r = -.010 p = .887	r = .240** p = .001	r = -.048 p = .504
How habits have changed	0-100	100-200	200-300	300-400	400-500	>500	No reponse
Mop more	r = .142* p = .045	r = .005 p = .943	r = -.003 p = .969	r = -.161* p = .023	r = .104 p = .144	p = -.125 p = .077	r = -.011 p = .879
Sweep/vacuum more	r = .039 p = .587	r = .000 p = 1.000	r = .047 p = .509	r = -.042 p = .554	r = -.071 p = .315	r = .074 p = .300	r = -.043 p = .543
Disinfect more	r = -090 p = .206	r = .055 p = .436	r = -.007 p = .917	r = .070 p = .322	r = -.056 p = .430	r = -.079 p = .268	r = .096 p = .177
Set more traps	r = .008 p = . 914	r = -.017 p = .816	r = -.023 p = .745	r = .117 p = .099	r = -.091 p = .199	r = -.026 p = .715	r = .024 p = .733
Use rubber gloves	r = .071 p = .317	r = .010 p = .890	r = -.037 p = .598	r = -.069 p = .329	r = .101 p = .156	r = .064 p = .371	r = -.099 p = .162

Use dust mask	r = .022 p = . 755	r = -.031 p = .665	r = .012 p = .871	r = .036 p = .610	r = .167* p = .018	r = .061 p = .389	r = -.114 p = .107
Use ventilator mask	r = .047 p = .507	r = .041 p = .563	r = -.044 p = .532	r = -.031 p = .661	r = -.018 p = .804	r = -.036 p = .609	r = .006 p = .930
How purchases have changed	0-100	100-200	200-300	300-400	400-500	>500	No response
Buy traps	r = .110 p = .122	r = -.077 = .276	r = -.020 p = .776	r = -.022 p = .760	r = -.037 p = .604	r = .038 p = .593	r = -.028 p = .695
Buy poison	r = .113 p = .112	r = .000 p = 1.000	r = -.074 p = .297	r = -.017 p = .812	r = -.057 p = .419	r = -.156* p = .028	r = .133 p = .061
Buy bleach	p = .058 p = .416	r = -.145* p = .041	r = .073 p = .302	r = .018 p = .797	r = -.076 p = .286	r = -.023 p = .745	r = .062 p = .386
Buy dust masks	r = .049 p = .488	r = .037 p = .604	r = -.049 p = .495	r = .081 p - .256	r = .090 p = .207	r = .049 p = .492	r = -.118 p = .096
Buy disinfectants	r = -.052 p = .464	r = -.005 p = .943	r = .086 p = .227	r = .049 p = .492	r = .028 p = .698	r = .095 p = .183	r = -.068 p = .335
Buy ventilator masks	r = .024 p = .737	r = .018 p = .802	r = -.051 p = .469	r = -.036 p = .512	r = -.020 p = .774	r = .090 p = .207	r = -.019 p = .794
Peridomestic improvements	0-100	100-200	200-300	300-400	400-500	>500	No response
Mouse/rat proof the home	r = -.040 p = .574	r = -.010 p = .884	r = -.085 p = .232	r = -.027 p = .703	r = -.040 p = .573	r = .070 p = .322	r = .082 p = .251
Remove trash from yard	r = -.006 p = .931	r = -.045 p = .527	r = .033 p = .647	r = -.010 p = .887	r = .066 p = .355	r = -.049 p = .494	r = -.005 p = .942
Move wood piles away from home	r = .109 = .125	r = -.037 p = .601	r = -.028 p = .696	r = -.024 p = .736	r = .016 p = .823	r = .079 p = .269	r = -.073 p = .307
Cut grass/weeds away from home	r = -.162* p = .022	r = -.036 p = .617	r = .082 p = .249	r = .003 p = .962	r = .171* p = .015	r = .204** p = .004	r = -.031 p = .661

Table 7.6c: Income: Chile in Pesos/month (n = 201)

Behavior					
Response to publicized cases	0-50K	50K-150K	150K-250K	250K-350K	>350K
Panic	r = .154* p = .030	r = .061 p = .390	r = .016 p = .826	r = .118 p = .094	r = -.147* p - .038
Stay home	r = .129 p = .068	r = -.112 p = .114	r = .080 p = .258	r = .056 p = .26	r = -.081 p = .256
Avoid animals	r = -.011 p = .872	r = -.074 p = .297	r = -.020 p = .782	r = .140* p = .048	r = -.071 p = .316
Learn about HPS	r = -.224** p = .001	r = -.024 p = .731	r = .053 p = .459	r = -.029 p = .681	r = .237** p = .001
Wonder about victim	r = .187** p = .008	r = .031 p = .662	r = -.092 p = .194	r = -.092 p = .193	r = -.098 p = .166
Response to public service	0-50K	50K-	150K-	250K-	>350K

announcements		150K	250K	350K	
Check for rodents	r = -.130 p = .066	r = -032 p = .652	r = .003 p = .968	r = .049 p = .491	r = .159* p = .025
Clean the house	r = .049 p = .494	r = .075 p = .289	r = -.069 p = .330	r = -.037 p = .603	r = .035 p = .622
Take vitamins	r = -.072 p = .309	r = -.012 p = .864	r = .129 p = .068	r = -.042 p = .555	r = -.065 p = .356
Get a flu shot	r = .105 p = .139	r = -.091 p = .200	r = .033 p = .20	r = -.042 p = .555	r = -.065 p = .356
Nothing	r = .034 p = .636	r = -.025 p = .724	r = .019 p = .794	r = -.019 p = .793	r = -.087 p - .222
Concern for self and family catching HPS	0-50K	50K-150K	150K-250K	250K-350K	>350K
Very concerned	r = .113 p = .111	r = .036 p = .608	r = -.036 p = .616	r = .058 p = .412	r = -.056 p = .427
Concerned	r = -.049 p = .491	r = .032 p = .652	r = -.005 p = .948	r = -.016 p = .821	r = .004 p = .950
Little concerned	r = -.121 p = .086	r = -.056 p - .433	r = .086 p = .223	r = -.32 p = .650	r = .166* p = .019
Not much concern	r = -.029 p = .685	r = -.061 p = .389	r = .062 p = .379	r = .044 p = .531	r = .056 p = .431
No concern	r = .020 p = .775	r = -.047 p = .504	r = .017 p = .814	r = -.044 p = .533	r = -.077 p = .278
Level of cleaning changes	0-50K	50K-150K	150K-250K	250K-350K	>350K
Extremely changed	r = .098 p = .165	r = .072 p = .310	r = .056 p = .431	r = -.048 p = .494	r = -.208** p = .003
Very much changed	r = -.056 p = .429	r = -.039 p = .581	r = -.026 p = .712	r = .112 p = .113	r = .077 p = .278
Changed	r = -.070 p = .326	r = -.032 p = .654	r = .044 p = .531	r = -.038 p = .591	r = .135 p = .056
Not much change	r = .056 p = .427	r = .082 p = .248	r = .001 p = .987	r = -.052 p = .467	r = -.081 p = .256
No Change	r = -.045 p = .530	r = -.065 p = .359	r = -.058 p = .417	r = .025 p = .724	r = .110 p = .119
How habits have changed	0-50K	50K-150K	150K-250K	250K-350K	>350K
Mop more	r = .145* p = .039	r = .142* p = .044	r = 0.082 p = .245	r = -.134 p = .057	r = -.156* p = .027
Sweep/vacuum more	r = -.024 p = .739	r = .085 p = .230	r = -.008 p = .908	r = .046 p = .519	r = .013 p = .856
Disinfect more	r = .093 p = .187	r = =.042 p = .554	r = -.019 p = .784	r = -.040 p = .574	r = .057 p = .422
Set more traps	r = .054 p = .446	r - .007 p = .924	r = .101 p = .153	r = -.008 p = .910	r = -.143* p = .044
Use rubber gloves	r = .136	r = .016	r = -.011	r = -.113	r = -.060

	p = .054	p = .819	p = .880	p = .109	p = .400
Use dust mask	r = .020 p = .775	r = -.012 p = .863	r = .017 p = .814	r = .074 p = .300	r = -.035 p = .623
Use ventilator mask	r = -.036 p = .614	r = -.045 p = .526	r = -.031 p = .659	r = -.021 p = .770	r = .154* p = .029
How purchases have changed	0-50K	50K-150K	150K-250K	250K-350K	>350K
Buy traps	r = .138 p = .050	r = .028 p = .692	r = -.024 p = .739	r = -.014 p = .848	r = -.080 p = .256
Buy poison	r = -.050 p = .482	r = .055 p = .439	r = -.045 p = .525	r = .016 p = .827	r = .026 p = .713
Buy bleach	r = .096 p = .175	r = .054 p = .443	r = .028 p = .688	r = -.065 p = .359	r = -.037 p = .601
Buy dust masks	r = .078 p = .273	r = .039 p = .580	r = .015 p = .828	r = -.047 p = .508	r = -.073 p = .301
Buy disinfectants	r = -.075 p = .287	r = -.068 p = .335	r = -.032 p = .653	r = .102 p = .148	r = 1.28 p = .071
Buy ventilator masks	r = .016 p = .819	r = -.012 p = .864	r = .033 p = .642	r = .090 p = .205	r = -.065 p = .356
Peridomestic improvements	0-50K	50K-150K	150K-250K	250K-350K	>350K
Mouse/rat proof the home	r = .092 p = .196	r = .033 p = .645	r = .110 p = .120	r = -.103 p = .146	r = -.127 p = .071
Remove trash from yard	r = -.018 p = .800	r = .131 p = .065	r = .038 p = .597	r = -.081 p = .256	r = -.011 p = .877
Move wood piles away from home	r = .067 p = .347	r = .116 p = .101	r = -.167* p = .018	r = -.088 p = .213	r = .070 p = .323
Cut grass/weeds away from home	r = .094 p = .184	r = .028 p = .698	r = -.038 p = .597	r = .043 p = .547	r = -.124 p = .080

Table 7.7: Average age of home

Behavior	r	p
Response to publicized cases		
Panic	.024	.565
Stay home	.016	.700
Avoid animals	.008	.850
Learn about HPS	.058	.176
Wonder about victim	-.009	.832
Response to public service announcements		
Check for rodents	.060	.160
Clean the house	.019	.659
Take vitamins	.007	.877
Get a flu shot	-.054	.208
Nothing	-.036	.402

Concern for self and family catching HPS		
Very concerned	.026	.542
Concerned	.051	.232
Little concerned	-.013	.759
No much concern	-.011	.790
No concern	.014	.735
Level of cleaning changes		
Extremely changed	.025	.557
Very much changed	.037	.384
Changed	.069	.102
Not much change	.015	.726
No Change	-.040	.344
How habits have changed		
Mop more	-.054	.203
Sweep/vacuum more	.024	.575
Disinfect more	.043	.313
Set more traps	.064	.129
Use rubber gloves	-.032	.450
Use dust mask	-.043	.311
Use ventilator mask	-.001	.974
How purchases have changed		
Buy traps	-.001	.987
Buy poison	.054	.204
Buy bleach	.074	.081
Buy dust masks	.021	.626
Buy disinfectants	-.028	.510
Buy ventilator masks	-.008	.847
Peridomestic improvements		
Mouse/rat proof the home	.106*	.013
Remove trash from yard	-.002	.968
Move wood piles away from home	.047	.273
Cut grass/weeds away from home	.101*	.017

Table. 7.8: Own home

Behavior	r	p
Response to publicized cases		
Panic	.019	.641
Stay home	-.063	.126
Avoid animals	-.053	.196
Learn about HPS	.024	.554
Wonder about victim	.069	.090
Response to public service announcements		
Check for rodents	.055	.181
Clean the house	.060	.144
Take vitamins	.028	.494

Get a flu shot	.076	.061
Nothing	-.083	.041
Concern for self and family catching HPS		
Very concerned	.038	.350
Concerned	-.006	.881
Little concerned	-.064	.115
Not much concern	-.053	.197
No concern	-.019	.647
Level of cleaning changes		
Extremely changed	.063	.122
Very much changed	.046	.257
Changed	-.118**	.004
Not much change	-.039	.340
No Change	-.028	.487
How habits have changed		
Mop more	.055	.176
Sweep/vacuum more	.026	.523
Disinfect more	-.084*	.039
Set more traps	.038	.347
Use rubber gloves	.029	.479
Use dust mask	.022	.583
Use ventilator mask	.022	.596
How purchases have changed		
Buy traps	.030	.460
Buy poison	.016	.701
Buy bleach	-.060	.144
Buy dust masks	-.045	.266
Buy disinfectants	.018	.651
Buy ventilator masks	-.021	.610
Peridomestic improvements		
Mouse/rat proof the home	.113**	.006
Remove trash from yard	-.034	.403
Move wood piles away from home	-.001	.990
Cut grass/weeds away from home	-.039	.338

Table 7.9: Observe rodents in home

Behavior	r	p
Response to publicized cases		
Panic	.136**	.001
Stay home	.049	.229
Avoid animals	.046	.260
Learn about HPS	-.008	.852
Wonder about victim	.008	.845
Response to public service announcements		
Check for rodents	.020	.617

Clean the house	.122**	.003
Take vitamins	-.019	.638
Get a flu shot	.062	.127
Nothing	.018	.663
Concern for self and family catching HPS		
Very concerned	.055	.178
Concerned	.051	.210
Little concerned	-.035	.393
Not much concern	-.023	.576
No concern	.045	.274
Level of cleaning changes		
Extremely changed	.175**	.000
Very much changed	.014	.735
Changed	-.006	.892
Not much change	.005	.902
No Change	-.090*	.027
How habits have changed		
Mop more	.146**	.000
Sweep/vacuum more	.160**	.000
Disinfect more	-.063	.122
Set more traps	.263**	.000
Use rubber gloves	.031	.443
Use dust mask	.055	.176
Use ventilator mask	.052	.202
How purchases have changed		
Buy traps	.274**	.000
Buy poison	.240**	.000
Buy bleach	-.061	.134
Buy dust masks	.093*	.023
Buy disinfectants	.022	.587
Buy ventilator masks	.054	.190
Peridomestic improvements		
Mouse/rat proof the home	.182**	.000
Remove trash from yard	.050	.225
Move wood piles away from home	-.031	.446
Cut grass/weeds away from home	.063	.126

Table 7.10: Heard of HPS?

Behavior	r	p
Response to publicized cases		
Panic	.081*	.047
Stay home	.056	.174
Avoid animals	.100*	.014
Learn about HPS	.243**	.000
Wonder about victim	.087*	.032

Response to public service announcements		
Check for rodents	.238**	.000
Clean the house	.253**	.000
Take vitamins	.047	.250
Get a flu shot	.061	.136
Nothing	.070	.089
Concern for self and family catching HPS		
Very concerned	.137**	.001
Concerned	.132**	.001
Little concerned	.084*	.039
No much concern	.073	.074
No concern	.077	.058
Level of cleaning changes		
Extremely changed	.149**	.000
Very much changed	.113**	.006
Changed	.110**	.007
Not much change	.060	.140
No Change	.062	.126
How habits have changed		
Mop more	.145**	.000
Sweep/vacuum more	.150**	.000
Disinfect more	.209**	.000
Set more traps	.104*	.011
Use rubber gloves	.096*	.019
Use dust mask	.094*	.021
Use ventilator mask	.025	.538
How purchases have changed		
Buy traps	.107**	.009
Buy poison	.127**	.002
Buy bleach	.170**	.000
Buy dust masks	.036	.375
Buy disinfectants	.130**	.001
Buy ventilator masks	.036	.380
Peridomestic improvements		
Mouse/rat proof the home	.180**	.000
Remove trash from yard	.183**	.000
Move wood piles away from home	.131**	.001
Cut grass/weeds away from home	.201**	.000

Table 7.11: How heard of HPS? Newspaper

Behavior	r	p
Response to publicized cases		
Panic	-.054	.184
Stay home	-.018	.668
Avoid animals	.094*	.022

Learn about HPS	.126**	.002
Wonder about victim	.075	.067
Response to public service announcements		
Check for rodents	.246**	.000
Clean the house	.108*	.008
Take vitamins	.036	.379
Get a flu shot	.129**	.002
Nothing	.055	.175
Concern for self and family catching HPS		
Very concerned	-.019	.640
Concerned	-.075	.067
Little concerned	.104*	.010
No much concern	.151**	.000
No concern	-.027	.511
Level of cleaning changes		
Extremely changed	-.104*	.011
Very much changed	-.019	.646
Changed	.101*	.014
Not much change	.080*	.050
No Change	.091*	.025
How habits have changed		
Mop more	.036	.376
Sweep/vacuum more	.096*	.018
Disinfect more	.067	.101
Set more traps	.101*	.013
Use rubber gloves	.093*	.022
Use dust mask	.152**	.000
Use ventilator mask	.073	,074
How purchases have changed		
Buy traps	.133**	.001
Buy poison	-.074	.070
Buy bleach	.014	.727
Buy dust masks	.135**	.001
Buy disinfectants	.216**	.000
Buy ventilator masks	-.006	.884
Peridomestic improvements		
Mouse/rat proof the home	.062	.128
Remove trash from yard	.145**	.000
Move wood piles away from home	.138**	.001
Cut grass/weeds away from home	.055	.178

Table 7.12: How heard of HPS? Radio

Behavior	r	p
Response to publicized cases		

Panic	.074	.069
Stay home	-.004	.915
Avoid animals	.044	.278
Learn about HPS	.074	.069
Wonder about victim	.039	.337
Response to public service announcements		
Check for rodents	.145**	.000
Clean the house	.157**	.000
Take vitamins	.099*	.016
Get a flu shot	.139**	.001
Concern for self and family catching HPS		
Very concerned	.085*	.036
Concerned	.025	.541
Little concerned	-.098*	.016
No much concern	.049	.234
No concern	.083*	.041
Level of cleaning changes		
Extremely changed	.087*	.033
Very much changed	.004	.924
Changed	-.048	.243
Not much change	.001	.985
No Change	.073	.074
How habits have changed		
Mop more	.147**	.000
Sweep/vacuum more	.173**	.000
Disinfect more	.048	.243
Set more traps	.136**	.001
Use rubber gloves	.088*	.031
Use dust mask	.179**	.000
Use ventilator mask	.058	.158
How purchases have changed		
Buy traps	.189**	.000
Buy poison	.072	.080
Buy bleach	.091*	.025
Buy dust masks	.190**	.000
Buy disinfectants	.169**	.000
Buy ventilator masks	.059	.149
Peridomestic improvements		
Mouse/rat proof the home	.159**	.000
Remove trash from yard	.146**	.000
Move wood piles away from home	.122**	.003
Cut grass/weeds away from home	.149**	.000

Table 7.13: How heard of HPS? Family/friends

Behavior	r	p
Response to publicized cases		
Panic	-.051	.208
Stay home	-.030	.465
Avoid animals	.073	.075
Learn about HPS	.047	.245
Wonder about victim	.146**	.000
Response to public service announcements		
Check for rodents	.125**	.002
Clean the house	.062	.131
Take vitamins	.66	.107
Get a flu shot	.044	286
Concern for self and family catching HPS		
Very concerned	-.029	.478
Concerned	-.083*	.043
Little concerned	.042	.309
No much concern	.165**	.000
No concern	.035	.386
Level of cleaning changes		
Extremely changed	-.115**	.005
Very much changed	-.008	.838
Changed	.124**	.002
Not much change	.079	.053
No Change	.052	.207
How habits have changed		
Mop more	-.026	.517
Sweep/vacuum more	-.025	.538
Disinfect more	.026	.522
Set more traps	.149**	.000
Use rubber gloves	.094*	.022
Use dust mask	.191**	.000
Use ventilator mask	.047	.248
How purchases have changed		
Buy traps	.079	.054
Buy poison	.022	.599
Buy bleach	.071	.084
Buy dust masks	.156**	.000
Buy disinfectants	.054	.184
Buy ventilator masks	.042	.306
Peridomestic improvements		
Mouse/rat proof the home	.038	.349
Remove trash from yard	.052	.202
Move wood piles away from home	.087*	.032
Cut grass/weeds away from home	.008	.852

Table 7.14: Know someone with HPS?

Behavior	r	p
Response to publicized cases		
Panic	.155**	.000
Stay home	-.096	.019
Avoid animals	-.018	.655
Learn about HPS	.094*	.021
Wonder about victim	-.086*	.034
Response to public service announcements		
Check for rodents	.133**	.006
Clean the house	.103*	.011
Take vitamins	.014	.729
Get a flu shot	-.026	.523
Nothing	-.133**	.001
Concern for self and family catching HPS		
Very concerned	.204**	.000
Concerned	.016	.697
Little concerned	.012	.763
No much concern	-.125**	.002
No concern	-.123**	.003
Level of cleaning changes		
Extremely changed	.179**	.000
Very much changed	-.004	.925
Changed	-.033	.424
Not much change	-.076	.062
No Change	-.101*	.014
How habits have changed		
Mop more	-.009	.833
Sweep/vacuum more	.081*	.047
Disinfect more	.046	.259
Set more traps	-.010	.807
Use rubber gloves	-.117**	.004
Use dust mask	-.041	.317
Use ventilator mask	-.053	,198
How purchases have changed		
Buy traps	-.026	.519
Buy poison	.096*	.019
Buy bleach	-.025	.536
Buy dust masks	.013	.749
Buy disinfectants	.027	.517
Buy ventilator masks	-.075	.067
Peridomestic improvements		
Mouse/rat proof the home	.119**	.003
Remove trash from yard	.033	.422
Move wood piles away from home	.029	.473

Cut grass/weeds away from home	.049	.229

Table 7.15: How do people catch HPS?: Other sick people

Behavior	r	p
Response to publicized cases		
Panic	.014	.738
Stay home	-.007	.870
Avoid animals	.066	.106
Learn about HPS	.027	.509
Wonder about victim	.037	.367
Response to public service announcements		
Check for rodents	.038	.346
Clean the house	.059	.149
Take vitamins	.007	.869
Get a flu shot	.059	.150
Nothing	-.025	.537
Concern for self and family catching HPS		
Very concerned	.073	.075
Concerned	.019	.645
Little concerned	-.042	.302
No much concern	-.029	.474
No concern	-.035	.398
Level of cleaning changes		
Extremely changed	.078	.055
Very much changed	-.001	.979
Changed	.003	.949
Not much change	-.050	.220
No Change	-.052	.203
How habits have changed		
Mop more	.126**	.002
Sweep/vacuum more	.078	.056
Disinfect more	-.003	.938
Set more traps	.031	.441
Use rubber gloves	.049	.231
Use dust mask	.078	.056
Use ventilator mask	.062	.129
How purchases have changed		
Buy traps	.115**	.005
Buy poison	-.017	.680
Buy bleach	-.059	.149
Buy dust masks	-.020	.625
Buy disinfectants	.020	.619
Buy ventilator masks	-.030	.465
Peridomestic improvements		
Mouse/rat proof the home	-.096	.018

Remove trash from yard	.044	.281
Move wood piles away from home	.020	.620
Cut grass/weeds away from home	.024	.562

Table 7.16: How do people catch HPS? Contaminated air

Behavior	r	p
Response to publicized cases		
Panic	.034	.403
Stay home	-.003	.946
Avoid animals	.073	.074
Learn about HPS	.275**	.000
Wonder about victim	.107**	.009
Response to public service announcements		
Check for rodents	.236**	.000
Clean the house	.212**	.000
Take vitamins	-.109**	.007
Get a flu shot	.034	.411
Nothing	.016	.691
Concern for self and family catching HPS		
Very concerned	.105**	.010
Concerned	.061	.135
Little concerned	.069	.092
No much concern	.097*	.017
No concern	.002	.957
Level of cleaning changes		
Extremely changed	.093*	.022
Very much changed	.112**	.006
Changed	.093*	.023
Not much change	-.010	.800
No Change	.058	.158
How habits have changed		
Mop more	.053	.196
Sweep/vacuum more	.110**	.007
Disinfect more	.233**	.000
Set more traps	.053	.192
Use rubber gloves	.048	.239
Use dust mask	.133**	.01
Use ventilator mask	.040	.331
How purchases have changed		
Buy traps	.048	.241
Buy poison	.074	.069
Buy bleach	.173**	.000
Buy dust masks	.083*	.041
Buy disinfectants	.174**	.000
Buy ventilator masks	-.011	.790

Peridomestic improvements		
Mouse/rat proof the home	.160**	.000
Remove trash from yard	.162**	.000
Move wood piles away from home	.132**	.001
Cut grass/weeds away from home	.153**	.000

Table 7.17: How do people catch HPS? Working with livestock

Behavior	r	p
Response to publicized cases		
Panic	.049	.233
Stay home	.010	.816
Avoid animals	-.009	.830
Learn about HPS	-.075	.067
Wonder about victim	.006	.883
Response to public service announcements		
Check for rodents	.011	.789
Clean the house	-.011	.784
Take vitamins	.133**	.001
Get a flu shot	.178**	.000
Nothing	-.008	.839
Concern for self and family catching HPS		
Very concerned	.015	.709
Concerned	.013	.755
Little concerned	.044	.285
No much concern	-.012	.767
No concern	-.053	.194
Level of cleaning changes		
Extremely changed	-.019	.642
Very much changed	-.021	.599
Changed	.066	.104
Not much change	-.041	.312
No Change	.000	.996
How habits have changed		
Mop more	.074	.071
Sweep/vacuum more	.092*	.023
Disinfect more	.040	.333
Set more traps	.077	.061
Use rubber gloves	.120**	.003
Use dust mask	.030	.468
Use ventilator mask	-.017	.673
How purchases have changed		
Buy traps	.072	.077
Buy poison	.000	.990
Buy bleach	.057	.159
Buy dust masks	.038	.352

Buy disinfectants	-.003	.947
Buy ventilator masks	-.025	.547
Peridomestic improvements		
Mouse/rat proof the home	-.003	.946
Remove trash from yard	.093*	.023
Move wood piles away from home	.040	.330
Cut grass/weeds away from home	.000	.996

Table 7.18: Animals/insects that carry HPS: Mice

Behavior	r	p
Response to publicized cases		
Panic	.117**	.004
Stay home	.020	.620
Avoid animals	.049	.233
Learn about HPS	.243**	.000
Wonder about victim	.060	.142
Response to public service announcements		
Check for rodents	.231**	.000
Clean the house	.306**	.000
Take vitamins	-.091*	.026
Get a flu shot	.056	.173
Nothing	.026	.526
Concern for self and family catching HPS		
Very concerned	.122**	.003
Concerned	.073	.073
Little concerned	.073	.073
No much concern	.054	.188
No concern	.062	.131
Level of cleaning changes		
Extremely changed	.152**	.000
Very much changed	.102*	.013
Changed	.066	.106
Not much change	-.019	.640
No Change	.082*	.045
How habits have changed		
Mop more	.108**	.008
Sweep/vacuum more	.157**	.000
Disinfect more	.224**	.000
Set more traps	.087*	.034
Use rubber gloves	.074	.069
Use dust mask	.089*	.030
Use ventilator mask	.033	.419
How purchases have changed		
Buy traps	.092*	.024
Buy poison	.093**	.000

Buy bleach	.193**	.000
Buy dust masks	.063	.124
Buy disinfectants	.139**	.001
Buy ventilator masks	.008	.849
Peridomestic improvements		
Mouse/rat proof the home	.180**	.000
Remove trash from yard	.160**	.000
Move wood piles away from home	.114**	.005
Cut grass/weeds away from home	.162**	.000

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1999 - 2007. Dr. Robert Parmenter, Ph.D., Senior Research Scientist, Valles Caldera, New Mexico.

2002. Dr. Fred T. Koster, M.D., Associate Scientist, Respiratory Immunology and Asthma Program, Lovelace Respiratory Research Institute.

2003. Mr. George Baca, Panama Finca owner. Personal Conversation.

2002-2008. Dr. Gary Simpson, M.D., Ph.D., MPH. Infectious Diseases, New Mexico Department of Health. Retired.

2004. Dr. Karl Johnson, M.D. Retired.

On-going. Dr. Roberto Belmar, M.D. Former Director of Environmental Health of the Chilean Ministry of Health; Professor of public health at the University of Santiago, and Professor of Social Epidemiology of Albert Einstein College of Medicine in New York City

On-going. Dr. Juan Pascale, M.D., Ph.D. Gorgas Institute. Panama City, Panama.

On-going. Dr. James Mills, Ph.D. Centers for Disease Control. Atlanta, GA.

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