

HANTAVIRUS AND THE NAVAJO NATION —A DOUBLE-JEOPARDY DISEASE¹

By Linda Moon Stumpff²

Abstract:

This case discusses the outbreak of hantavirus in 1993, focusing on the impacts to the Navajo Nation in terms of the loss of life and health from the disease, followed by events that were sometimes linked to negative external and internal events. The investigation and media coverage following the disease itself created a double-jeopardy situation for the Navajo people who were already suffering from the impacts of the disease. The case unfolds around the differing, but sometimes parallel approaches of Western medicine and Navajo traditional medical knowledge in the areas of understanding, diagnosing, and caring for patients who came down with what came to be known as Sin Nombre Virus. This particular variety of the global disease hantavirus appeared in the United States in 1993. The case offers the opportunity to compare perceptions about the scientific investigations into the disease from the perspectives of Western science and from the unique perspectives of Navajo culture and healing methodologies.

Two Incidents

In 1993 a young Navajo woman died suddenly of respiratory failure without a history of previous illness. A few days later, her fiancé died in a similar way, leading to widespread concern. On May 18, the New Mexico Department of Health called in the Centers for Disease Control and Prevention (CDC), and soon many health organizations and research institutions were involved. At first, the disease was tagged “the Navajo flu” in *USA Today* and the *Arizona Republic* called it “the Navajo epidemic,” only because this outbreak of new viral strain was discovered in the Four Corners Region. It was ultimately identified as a new strain of a long-known hantavirus family. A year later, over forty people in seventeen states were dead from similar strains. Scientific research eventually pointed to hantavirus as the explanation for the outbreak and for earlier deaths, going back to 1959.

In 1998, the death of another Navajo man who was a well-known basketball star led to continuing concern. Despite symptoms typical of hantavirus and the regional location of

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the onset of his illness, he was not tested or diagnosed for hantavirus when he entered the emergency room of an Indian Health Service (IHS) hospital.

Hantavirus - The Global Disease

Hantavirus gets its name not from the Southwest, but from the Hantaan River area in North and South Korea, where a related virus was confirmed in the early 1950's by Dr. Lee Ho Wang. Hantavirus belongs to a group of viruses, borne by different rodent vectors that are responsible for 200,000 illnesses every year in Asia alone, and it was well-known that American soldiers died from it in the Korean War. (Mills). It is a global disease with multiple strains and a long history.

The particular variety of hantavirus that appeared in the Southwest was eventually named Sin Nombre Virus (SNV), after considerable objection from the Navajo Nation to the first CDC cultural and regional tags like Canyon del Muerto Virus.. The CDC also used a descriptive medical name, Hantavirus Pulmonary Syndrome (HPS). All three terms are used for the virus at various times.. Unlike the Asian variants of hantavirus that mainly affected the kidneys and circulation, this one infected the walls of tiny blood vessels in the lungs. When the body's immune system reacted by attacking the virus, it winds up destroying the capillaries. The capillaries turned into sieves, filling the chest cavity with fluids and patients drowned in their own fluids in 24 hours. SNV has a mortality rate of around 45%, while Asian viruses are much less deadly with mortality rates of 5-15%. (Mills). Related hantaviruses have turned up in South America and other places. There were no documented cases of human to human transmission of SNV or other variants of hantavirus in the U.S. Only in South America did a strain of hantavirus turn up for which human-to-human transmission was documented. Varieties of hantavirus also appeared in New York, Florida and other areas of the United States. Hantavirus Pulmonary Syndrome (HPS) has been reported in 31 states, with over half reported outside the Four Corners area, affecting people with a mean age of 37. Since 1993, 503 cases were identified and American Indians account for eighteen percent of the cases. (CDC, Hantavirus, Case Information).

Hantaviruses are zoonoses---diseases that can be transmitted to humans by animals. All hantaviruses known to cause HPS are carried by New World rats and mice of the family Muridae, containing at least 430 species. A percentage of the population of deer mice tested throughout their range over much of the US tested positive for infection with SNV. (CDC, Ecology) The actual size of the SNV virus outbreak on the Navajo Nation was not large, but the mortality rate, plus the lack of knowledge about this "mystery disease" and who had been exposed, greatly increased concern and led to a major government response. Dr. James N, Mills, Chief of Medical Ecology, Pathogens Branch of the CDC testified to Congress in 1999 that "Evidence indicates that these viruses have been co-evolving with their rodent hosts for millions of years, implying that these viruses have been present in our environment since before recorded history. (Mills) SNV can move quickly into a life-threatening stage. After a two-week incubating period, hantavirus resembles other viral illnesses during its early stages. But death from hantavirus can occur within a matter of hours after the onset of the respiratory symptom stage. Earlier

symptoms of fever, severe muscle aches and malaise may rapidly progress to acute respiratory distress. Severe respiratory illness and cardiovascular collapses occur in healthy adults.

Navajo Medical Knowledge and Tradition

Some Navajo elders and haatalli (medicine people) predicted the 1993 outbreak and identified similar cyclical outbreaks in 1918 and 1933-34. Navajo medical traditions on hantavirus identified mice and other rodents as bearers of disease that predated bubonic plague and other infectious diseases in the region. Elders knew that the entrance of mice into homes puts people at risk of infection when they come into contact with feces and urine, and recommended burning any affected clothing and isolating food supplies. The disease entered through the mouth, nose or eyes and even the strongest people would be subject to the disease. Oral traditions held that increased rainfall led to bigger pinyon crops and more mice and rodents, leading to hanta outbreaks. (CDC, Hantavirus, Navajo Medical Traditions).

By May, fifty Navajo medicine people met behind closed doors in Window Rock and discussed the recent deaths. They warned people to be careful of deer mice and prairie dogs, referring to long held traditions that death and destruction was connected to large increases in the population of rodents (Donavan) The hantavirus epidemic had a close relationship to Navajo traditional medicine and beliefs as shown by the following two excerpts. The first discussion deals with the relationship to mice:

According to the Navajo creation myth, when the Navajo entered the world, the Mice brought the seeds to establish the present day ecosystem. For this reason, mice are considered the landlords of the earth. However, mice inhabit the nocturnal and outside world and people the daytime and indoor world: there should be no close contact between people and mice. Such contact will result in sickness and possibly death. Additionally, when the landlord mice enter a home and see that it is unkempt and not in harmony, it I said that they become angry and may strike down someone in the household, usually a young, healthy member of the family. (Simpson, et al)

At a conference, Ben Muneta, M.D. described his knowledge that he gained of a traditional healing ceremony:

Mr. Andy Natonobah has described a ceremony that has been passed down for generations in his family of traditional healers for curing hantavirus pulmonary syndrome. The ceremony entails the use of several herbal medicines that have known inotropic properties in very high doses. The herbal meds a titrated in response to the patient's respiratory status for up to 4 days with the goals of delivering the maximum amount of meds without drug toxicity until the patient recovers. This mirrors the function of a modern intensive care unit in that respect. The Navajo however use this curing ceremony to integrate their holistic view of unity of the patient and the universe in achieving this cure. (Muneta)

Scientific conclusions seemed unfounded to some Navajo people, who pointed out that areas of their lands like the Tsaiile and the Chuska Mountains, with the largest concentration of deer mice that harvest pinyon there, remained unaffected by hantavirus. The hantavirus outbreak pointed up the continuing value that was placed on traditional medicine and medical knowledge, since cultural ceremonies have been handed down and are part of cultural identity. (Davies). As Davies, notes, 'traditional healers also understand a great deal about health care and offer those benefits to their patients.'" (Davies, p. 196). At the end of the day, both Western medical and Navajo medical traditions have benefits, but they are not melded. The hantavirus outbreak highlighted their distinctly different approaches to identifying and treating illness. From the Navajo cultural perspective, neither the deer mice nor the hantavirus disease provided a casual explanation. There was no medical "cure" and both had distinctive types of treatment that were not mutually exclusive. Navajo traditional methods had the additional benefits of easing stress and moving towards harmony.

Impacts on the Navajo Nation

Media coverage relied heavily on government sources and associated press releases. As a result, the first available bullets of broadcast knowledge sped away with an imperfect story, portraying hantavirus as a regional disease, with particular emphasis on the location of the Navajo Nation and thus on the Navajo people. It often led to negative portrayal of Navajo culture and association of the disease with the Navajo region. Though many journalists later contacted Navajo spokespersons, the initial story was responsible for widespread half-truths.

The stories led to economic impacts, cancelled vacations and reduced income from tourism. Worse yet, Navajo people were subjected to negative racial stereotyping. There were reports that some Phoenix restaurants discouraged Navajo customers and threw away their plates after they finished eating to avoid the threat of transmission.³ Not long after the outbreak, New Mexico State University and the University of Colorado announced that Indian students would need a medical screening before coming on campus. Marshall Plummer, then Vice President of the Navajo Nation, spoke to the issue: "Be assured that this illness is not Navajo-specific. The illness has struck non-Indians and people who live far away from Navajo lands. This is not a racial illness, but a regional one. I believe that it behooves you as an educational institution to learn the known facts about this illness before resorting to actions that discriminate against our students" (Valenti,).

Western Science Approach

³ Such accounts of discrimination in Phoenix have been questioned due to the reporter's unwillingness to identify the locations of the discriminatory incident and the persons involved. Vivian Arviso, who was handling contacts for the Navajo Nation concerning the hantavirus outbreak at the time, noted that these news reports occurred only a day after the first reports of the hantavirus.

Initially, laboratory tests failed to identify the pathogen and confusion about the disease reigned. In 1993, the CDC began a joint investigation with state health departments, research institutions, the IHS and the Navajo Nation. Three weeks later they identified the disease as a hantavirus. By mid-June 1993 they identified the primary carrier as the deer mouse, though other rodents like the cotton rat, the white-footed mouse and the rice mouse were vectors for hantavirus in other parts of the country. The infected mice don't show any symptoms and the virus does not seem to make them ill. Humans can get the disease through "aerosolization," or inhaling particles of mouse saliva, urine or droppings from the air, especially if they have been disturbed. "Within 4 months of the outbreak, the viral genome was sequenced and the previously undiscovered virus of the genus hanta virus, family Bunyviridae was confirmed". (Simpson, et al. p. 66S) Scientists using polymerase chain reaction tests could make a definitive diagnosis within 24 hours of hospital admission. (Simpson, et al. p. 67S)

The CDC provided the IHS and other facilities with a drug called ribavirin, obtaining an investigational drug protocol for patients associated with the hantavirus outbreak. However the effectiveness of the drug in this outbreak was yet to be demonstrated. (CDC Wonder) By 1997 the CDC was making it clear that ribovirin failed to demonstrate a clinical benefit for HPS neither in the open-label trial conducted during 1993 nor in a later placebo-controlled trial, and they stated that ribavirin is not recommended for treatment off HPS and is not available for such use under any existing medical protocol.

Investigators began examining stored autopsy specimens from individuals who had died of undiagnosed respiratory illnesses in previous years and confirmed that hantavirus was endemic to the area for decades. Rothman,) The earliest documented case was now 1959. Epidemiologists then tried to understand the risk factors. They asked if humans were now contracting the disease, and if their contact with the carrier increased. Though little is actually known about the activities that lead to a greater risk for hantavirus, a control study suggested that increased numbers of rodents in the household was the strongest risk factor for the infection. Travel to and within areas where hanta virus has been reported was not considered a risk factor. (CDC, Hantavirus, Epidemiology)

Since it takes some time for the mouse population to increase enough to make their contact significantly more likely, it seemed that they would need to look back in time before the outbreak to see if there was an environmental connection. Gregory Glass of John Hopkins and his fellow researchers compared cases of people who became ill with those who did not and they used precipitation data from a six year period followed by an examination of Landsat Thematic Mapper satellite imagery to determine vegetation. (Glass, et al) Vegetation in arid areas was difficult to accurately interpret from satellite data without an interdisciplinary effort. Glass & colleagues continued to work with the CDC in order to "ground-truth"⁴ the information between 1992 and 1998, but answers were still hard to come by. The preferences of mice for different kinds of vegetation and

⁴ A procedure "to establish the relationship between local ecological dynamics of plant and rodent populations and satellite sensor readings will be needed to determine which of these alternatives may apply." (Glass, et al.)

other attributes of mouse behavior had to be factored in and remote sensing scientists were needed to interpret the data. In the end, it was easier to predict outbreaks linked to environmental conditions when the carriers were arthropods, since they are more tightly tied to temperature and precipitation. Yet epidemiologists and fellow researchers still hoped to be able to predict disease outbreaks as easily as weather predictions are made. (Scott, Glass, et al)

Other theories about deer mice were tested in an attempt to discover if breeding behavior or gender had anything to do with the potential for increased risk and what type of deer mouse was the most likely to transmit the virus. The general assumption was that increased vegetation leads to population increases in deer mice. As population density increases, rodents have more encounters, resulting in virus-transmission between rodents. They postulated that transmission could occur when an infected rodent bit an uninfected rodent or had other close contacts (CDC, Hantavirus, El Nino report) An independent university study was conducted in Utah using day-glo powder that was applied to deer mice. They tested the theory that fighting and mating behaviors, especially by males, would transfer the powder to other mice and help this would reveal whether or not males had the greatest role in disease transmission. Mice were collected from a six acre area. Each day, five mice treated with day-glo talcum powder were released into the area and captured before the next set of mice treated with a different color were released. Black lights were used to identify the mice that had contact with the day-glo mice, assuming that the powder rubbed off on them. The results of the study pointed to larger and older mice as higher-contact animals with greater chances of transmitting the virus, rather than males as previously thought, and they found that about 20 % of the mice were responsible for 80% of the potential for contact transmissions. (Clay). It is important to mention that mice have poor vision, but deer mice have more visual acuity than other mice. They have a different physical setup for seeing colors, but can see color except for the red spectrum. (Jacobs, Williams & Fenwick)

Hantavirus: Manifestation

Although the virus itself was identified quickly, diagnosis and treatment did not proceed with as much speed. It was not until 1997 that a more precise clinical description was available:

Hantavirus pulmonary syndrome (HPS), commonly referred to as hantavirus disease, is a febrile illness characterized by bilateral interstitial pulmonary infiltrates and respiratory compromise usually requiring supplemental oxygen and clinically resembling acute respiratory disease syndrome (ARDS). The typical prodrome consists of fever, chills, myalgia, headache, and gastrointestinal symptoms. Typical clinical laboratory findings include hemoconcentration, left shift in the white blood cell count, neutrophilic leukocytosis, thrombocytopenia, and circulating immunoblasts (CDC, Hantavirus, HPS Case Definition)

The pathogenesis of HPS was found to be complex. A myocardial depressant may contribute to mortality of this disease, although functional impairment of vascular

endothelium is central to its pathogenesis. (CDC Hantavirus, Clinical disease manifestations). Diagnostics were identified early in the investigation because of the laboratory work that was done. A positive serological test result, evidence of viral antigen in tissue by immunohistochemistry, or the presence of amplifiable viral RNA sequences in blood of tissue with compatible history of HPS was considered diagnostic for HPS, (CDC, Hantavirus, Diagnostics) Symptoms were identified that made an HPS diagnosis unlikely. Rashes, conjunctival or other hemorrhages, throat or conjunctival erythema, petechiae and peripheral or periorbital edema symptoms separated hantavirus from other possible illnesses. And the test protocol was clear: if a hantavirus infection is suspected, a CBC and blood chemistry should be repeated every eight to 12 hours In addition, HPS had a characteristic radiological evolution, beginning with minimal changes of interstitial pulmonary edema, progressing to alveolar edema with severe bilateral involvement (CDC, Hantavirus, Clinical Disease Manifestation)

Hantavirus: Prevention

Although removing the threat of infection by trapping or poisoning deer mice was considered by the CDC, these methods carry with them some problems. First, they may be neither desirable nor feasible. Dr. James Miller testified that “Mice are a natural and inextricable component of natural ecosystems, forming an important part of the food web.”(Mills). Their eradication from large natural area is just not feasible. Second, mice are an important part of the ecosystem.

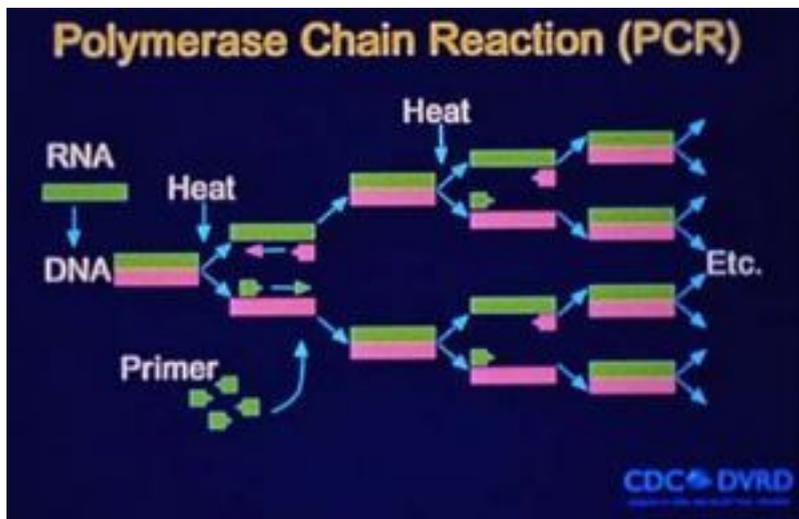
A second line of preventative defense was to avoid stirring up dust, and to wet areas to be cleaned with disinfectant to minimize the chance of breathing in the virus. Outdoor air circulation naturally dissipates aerosols and ultraviolet rays from sunlight reduce the survival of the virus, so airing out areas could be helpful. (Mills)

It Happened *This* Way

The death of the two young people in 1993 drew attention to the outbreak. The New Mexico Office of Medical Investigations (OMI) launched an investigation to find any others who had a similar medical case history. Dr. Bruce Tempest of the IHS, working with OMI, located an additional five healthy people who had all died after acute respiratory failure. OMI called in the CDC, launching a major investigation into the mystery disease. Initial lab tests failed to identify any known diseases. Tissue samples of victims were sent to the CDC: using the latest technologies to pinpoint virus genes at the molecular level: the CDC virologists were able to link the syndrome with a previously unknown type of hantavirus. The virus was isolated and grown by the CDC and the U.S. Army Medical Research Institute of Infections Diseases (USARMRIDD) from human tissue and from a mouse trapped in California. (CDC, Hantavirus, Tracking a mystery disease)

Through laboratory testing of RNA extracted from cell culture and autopsy material, the entire genomic sequence was established for SNV. Molecular biology was used to match DNA sequences with other known hantaviruses to identify segments they had in

common. Polymerase chain reaction was employed. Sequences of DNA were synthesized that could recognize the common segments in extracts of tissue containing the yet unknown virus. DNA was “melted” into two strands called primer pairs that were added to a solution, and they began to couple and break apart, making new copies...now four, now eight, now 16, in a chain reaction ((Wrobel, p. 1251). . They acted like “Velcro” lining up the common parts as well as the known sequences of DNA between the parts (Wroebel, 1251). With this magnifying power, they created a probe that could find the new virus wherever it hid. They sought out and paired with the virus if it was present in a tissue sample. The primer pairs would be visible on slides because they were tagged with a label that allowed them to be seen in the tissue. The scientists at the CDC and USAMRIID had isolated and cultured the new hantavirus, enabling them to develop a diagnostic test based on this molecular biology investigation.



Since researchers knew that all other known hantaviruses were transmitted by rodents like mice or rats, they began a rodent trapping program from June through August. Trapping went on inside and outside homes where people had come down with hantavirus, as well as neighboring homes, pine groves, sheep camps---1700 rodents were trapped in all. At first, during the week of June 6, the CDC collected rodents from peridomestic settings of several case-patients. Of 42 rodents that they tested, 29% had serological evidence of hantavirus infection and all of those were of the species *Peromyscus maniculatus*-the deer mouse). They trapped more rodents in case households than in control households, so more rodents may have been living in close contact in these households. Second, they postulated that the people in case households were more likely to do cleaning in the house or planting in hand-plowed fields or gardens. Still, it remained unclear if the risk for contracting HPS was due to performing these tasks, or entering closed up areas to get tools or other items. (CDC, Hantavirus, Tracking a mystery disease) Next, they were able to match the hantaviral genetic sequences recovered from human tissues to those from the rodents captured at the site of the patient’s presumed infection. (CDC, Hantavirus, Virology) They first named this new

type of hantavirus Muerto Canyon Virus after an area on Navajo lands. Soon, by working with autopsy samples, they discovered that the virus was not new and they documented cases going back to 1959. Late in the summer of 1993, researchers confirmed that the disease was not transmitted from person-to-person. It was also determined that there is not just one hantavirus that causes HPS: other strains were confirmed in Florida and New York. CDC, Hantavirus, Tracking a mystery disease)

The CDC continued to hypothesize about environmental conditions as a factor in the HPS outbreak. In a special report on El Nino, they looked at this cyclically recurrent disruption of oceanic/atmospheric system that increased rainfall across the southwest. They suggest that a resulting increase in the number of deer mice in El Nino years may lead to more contact between humans and infected rodents, leading to more exposure. (CDC, Hantavirus, El Nino)

The CDC and many scientists felt the investigation was a great success. An article called them “public heroes, superstars, detectives, Colombo in laboratory coats,” who rapidly identified the cause of the mysterious disease, warned people how to avoid exposure and developed a test to make early diagnosis for those feared infected, thus saving an unknown number of lives and immeasurable grief, fear and money (Wrobel). The CDC announced:

The isolation of the virus in a matter of months was remarkable. This success was based on close cooperation of all the agencies and individuals involved in investigating the outbreak, years of basic research on other hantaviruses that had been conducted by CDC and USARMRIID, and on the continuing development of modern molecular virologic tests. To put the rapid isolation of the Sin Nombre Virus in perspective, it took several decades for the first hantavirus discovered, the Hantaan virus, to be isolated.....Navajo medical beliefs concur with public health recommendations for preventing the disease. (CDC, Hantavirus, Tracking a mystery disease)

It Happened *That* Way

The loss of healthy, often young family members was a terrible tragedy for Navajo families. Since traditional beliefs focused on harmony and beauty, the disruption of this devastating disease had profound emotional as well as physical effects. This was followed by a double-jeopardy-like impact from the investigation and the media. (Bales), Discussion of death and disease with outsiders was uncomfortable, and yet the main methods of the CDC investigation were to probe the victims and their families with personal and culturally inappropriate questions about sexuality, diet, alcohol/drug abuse and disease history or deaths. Their investigation pierced the borders of the Navajo Nation without really effective forethought for preparation, educational materials, or cultural sensitivity.

The CDC and State Public Health Department investigators descended on the Navajo families of the hantavirus victims, entering homes and outbuildings and trapping mice.

They also moved into control groups, trapping in and around homes of families without victims. No educational programs or materials to explain the investigative techniques were provided: many people were not familiar with the methods of scientific investigation. Protective gear was strange to rural residents and the invasion of their privacy was difficult to understand. In the first stages at some places, CDC personnel dressed in containment suits for their investigation around Navajo homes and work areas, though they later shifted to respirators, backpacks and gloves. Residents were unable to tend livestock, work in the fields, or carry out everyday activities, while the CDC requested that they wear masks, gloves and other biohazard clothing (Denetclaw, PowerPoint, 2000). They made reports of homes contaminated with mouse urine and feces. In the meantime, Navajo President Peterson Zah understood that practitioners of Navajo traditional medical knowledge and Western scientists could benefit from working together. He focused on the need to recognize the limits of Western medicine, dispatching tribal employees to seek information from the healers, resulting in knowledge of critical clues about the increased number of rodents and the larger pinyon crop that year. (Davies).

Once the media descended, they spread the reactions to family tragedies across the world via newspapers and television. The “Navajo disease” labels were a terrible affront and led to stereotyping and perceptions of racism as Navajos faced discrimination on and off the reservation. Though a few native journalists like Pattie Talahongva, then a producer for a Phoenix TV station, tried to set the story straight, pointing out that many victims were not Navajo and avoiding the labels, the underrepresentation of Indians in the media resulted in news stories that were discriminatory (Trahan, 2005). In the first year of reporting, 34% of the references to Navajo culture were negative (Valenti). In a move aimed at damage control, the Navajo Nation voted unanimously for a resolution against the earlier attempt by the CDC to name the strain of hantavirus after Muerto Canyon, a location on the Navajo Reservation.

The technical and medical aspects of the disease were not well-understood throughout the Navajo Nation, and although three Ph.D. Navajo biologists were available in 1993 to consult, they were not asked to participate. (Denetclaw, 2006). Critics noted that the CDC revealed after less than 10 days of investigation that the unexplained respiratory distress illnesses were caused by a new hantavirus and predicted many more cases because of contact with deer mice. Early on, it was assumed that agriculturalists, like many Navajo, would be the most likely victims. But a study of workers in Arizona and New Mexico showed that workers in most occupations had opportunities for rodent exposure at work, so the findings failed to support a model for SNV hantavirus infection that would be consistent with exposure to rodent habitats. (Zeitzy) In the study, all workers were negative for SNV as shown by enzyme-linked immunoassay. In this study, set up to determine occupational exposure of 494 workers in Arizona and New Mexico, including 57 farm workers, 20 laborers, 211 repair workers, 83 service industry workers, 53 technicians, and 70 professionals, it was found that 70% of the laborers and 64% of service industry workers experienced handling of rodents. (Zeitzy) The study also found that 60% of all types of workers, except technicians re-opened, cleaned or worked in closed spaces. And yet none of the workers showed exposure to hantavirus.

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In addition, Denetclaw compared the number of suspected HPS illnesses in 1993 and 1994 to the number of verified cases, showing that 75% of suspected cases in the Four Corners region were negatives for Hantavirus. (Denetclaw, 1994) These studies suggested that some of the scientific assumptions that had been made were not entirely credible.

In an attempt to find a treatment for the disease, the CDC authorized an emergency trial of the drug ribavirin. Brenda Norrell wrote in *Indian Country Today*, “The Navajo people are tired of being used as guinea pigs” in a proposed ribavirin drug trial to determine the effectiveness of the drug in the treatment of hantavirus, quoting Councilman Herbert Pioche, “It won’t be the first time.” (Norrell) Some questioned the trial by saying that the Navajo people might be used in corporate pharmaceutical profiteering.

Trust in the government was low, and some believed that the virus might not be related to mice, which were always common on the Navajo lands, but rather to activities around the de-commissioning of Fort Wingate: there were claims that the Fort was the center point on a map of the first cases of hantavirus. .

Even after the research, investigation and prevention guidelines, a young Navajo man collapsed at a basketball game in 1998. He was taken to the Indian Health Service hospital, but he was not diagnosed or treated for hantavirus. After his death, his family filed a lawsuit. A federal judge in Santa Fe awarded the family 2.1 million dollars and held the Indian Health Service hospital responsible for negligence in failing to assure that emergency room workers were trained in diagnosing hantavirus. (Glaberson) Some felt that health research was out of control. In 1995, the Navajo Nation passed Navajo Nation Health Research Code establishing the Health Research Review Board to better regulate research on the reservation to influence what is written about the Nation and to assure that researchers do not single-handedly impose their research protocols on Navajo people. (Brugge and Missaghian) The Navajo Institutional Review Board (IRB) was a move toward self-determination in health care: the function of reviewing ethics and proposals and coordination with external health care investigations was moved from the HIS to the IRB. (Maldonado, personal communication, August, 2010).

Despite all the scientific investigation, hantavirus cases continued to appear sporadically across the nation and in the Four Corners region. And despite all the tests and protocols that were developed for SNV, knowledge of how and when to use them did not make it into some IHS hospitals. At the end of the day, modern western medicine still has no easy diagnosis, no cure, and no predictive model for hantavirus. It kills nearly half of its victims.

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