Presence of Hantavirus in Small Mammals of the Ouachita Mountains

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In 1993, an outbreak of human hantavirus pulmonary syndrome (HPS) occurred in the southwestern United States causing severe pulmonary disfunction and death among most of those infected. Shortly after the outbreak, the causative agent was identified as the Sin Nombre virus (SNV), a virus of the genus *Hantavirus*. Several hantaviruses have since been identified in North America and rodents have been identified as the hosts of these hantaviruses. Each hantavirus has been associated with a single primary host species in which it causes a chronic, persistent infection involving the shedding of virus in salva, feces, and urine (LeDuc, 1987). Infection to humans is thought to be from inhalation of aerosolized virus (breathing of small particles such as dust from feces, blood, or urine) (Tsai, 1987). However, rodent bites or direct contact with broken skin or mucus membranes also are potential sources of infection (Nuzum et al., 1988).

The deer mouse (*Peromyscus maniculatus*) was found to be the primary reservoir of SNV, however, other small mammals have been found to carry antibodies for this and other potentially deadly hantaviruses (Childs et al., 1994). It is not known whether human infection can occur from non-primary host species which carry antibodies for the virus (Centers for Disease Control and Prevention, pers. comm.). The Blackwater Creek Canal virus (hosted by the cotton rat *Sigmodon hispidus*), Bayou virus (hosted by the rice rat *Oryzomys palustris*), and SNV have all been associated with human HPS, however, SNV has caused the most human mortality (Childs et al., 1995). The Prospect Hill virus (hosted by the pine vole *Microtis pennsylvanicus*) and the El Moro Canyon virus (hosted by the western harvest mouse *Reithrodontomys megalotis*) have not been associated with any reported cases of HPS, however, little is known about the potential risks of these and other yet undiscovered hantaviruses (Childs et al., 1995).

Cases of SNV-induced HPS have been reported from surrounding states including Texas, Louisiana, Oklahoma, and Kansas but none has been documented in Arkansas, and the risk of infection is unknown (Centers for Disease Control and Prevention, 1997). Research conducted by the USDA Forest Service Southern Research Station, in conjunction with state and private cooperators, involves extensive small mammal trapping and handling in Arkansas. Because two of the first 102 recognized cases of SNV-induced HPS in the United States occurred in field biologists with a history of contact with rodents (Mills et al., 1995), we sought to determine the incidence of hantavirus antibodies in Arkansas small mammals to ascertain potential risks for human hantavirus infection.

Small mammals were captured in kill traps at 19 locations in Garland and Saline counties within the Ouachita Mountains of west-central Arkansas in 1994 and 1995. These mammals were collected primarily in forested riparian areas on Weyerhaeuser Company lands. A total of 520 small mammals was sent to the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia for testing. Each mammal was tested for the presence of hantavirus antibodies using laboratory methods described in detail by Mills et al. (1997). Assays used by the CDC would detect, but not distinguish among, infections caused by other North American hantaviruses. Results were forwarded to us from the Arkansas Department of Health.

Of the 520 small mammals submitted for analysis, 4 were reactive for hantavirus antibodies (Table 1), indicating they either carried or had been exposed to SNV or one of the other North American hantaviruses. Although the deer mouse is thought to be the primary host of SNV, our sample included only two of this species. Nevertheless, one of the two deer mice we submitted was positive. SNV infection rates in deer mice have ranged from 11% to 30% of individuals in the American Southwest (Mills et al., 1997). Two cases of HPS that have occurred outside the range of the deer mouse have been linked to the white-footed mouse (*Peromyscus leucopus*), indicating the white-footed mouse may be a potential vector for SNV or another deadly hantavirus (Mills et al., 1997). In our sample, the cotton mouse (*Peromyscus gossypinus*) and the white-footed mouse were lumped into a single group (*Peromyscus* spp.) because of difficulties in distinguishing the two species. However, no *Peromyscus* other than *maniculatus* were positive in our sample. One non-rodent species, the short-tailed shrew (*Blarina carolinensis*) was found to be positive.

For all species combined, the infection rate was 0.8%. This is probably a low estimate of hantavirus infection rates among Ouachita small mammals because of the low numbers of deer mice included in our sample. Nevertheless, it

does present the first evidence that SNV or another closely-related hantavirus is present among small mammals in Arkansas and presents the first data indicating the presence of hantavirus antibodies in the golden mouse (*Ochrotomys nuttalli*). Although laboratory tests did not discern SNV from other hantaviruses, three of the five hantaviruses that occur in North America are known to cause HPS and other hantaviruses may exist that have not yet been identified. Further testing needs to be done to determine exact hantavirus infection levels as well as tests to determine which hantaviruses are present and what species, if any, may be primary vectors for these viruses in Arkansas.

Table 1. Numbers of small mammals tested for hantavirus antibodies, numbers positive, and percent positive, collected in the Ouachita Mountains of Arkansas, 1994-1995.

Species	Number tested	Number positive	Percent positive
Blarina carolinensis	134	1	0.7
Glaucomys volans	10	0	0.0
Microtus pinetorum	11	0	0.0
Neotoma floridana	6	0	0.0
Ochrotomys nuttalli	285	2	0.7
Oryzomys palustris	1	0	0.0
Peromyscus attwateri	5	0	0.0
Peromyscus maniculatus	2	1	50.0
Peromyscus spp.	43	0	0.0
Reithrodontomys fulvescens	20	0	0.0
Sylvilagus floridanus	1	0	0.0
Tamias striatus	3	0	0.0
All species	520	4	0.8

Concern for hantavirus among mammalogists in Arkansas ranges from no concern to extreme caution in dealing with small mammals (pers. comms). Since 1994, the USDA Forest Service Southern Research Station, Weyerhaeuser Company, and the University of Arkansas at Monticello's School of Forest Resources have been using the CDC's precautionary interim guidelines (Centers for Disease Control and Prevention, 1993) to reduce risk of possible hantavirus exposure. These guidelines include wearing respirators and surgical gloves when handling small mammals and sterilizing equipment that has come in contact with small mammals. Although there have been no documented cases of HPS in Arkansas and biologists have been handling small mammals in Arkansas for years, our findings indicate that hantaviruses are present in at least Garland and Saline counties. Given the high mortality rate associated with HPS, other biologists may want to review safety procedures (Mills et al., 1995).

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