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### References

1. Sengupta R, Rosenschein L, Gilbert M, Weiller C. Ecoregional dominance in spatial distribution of avian influenza (H5N1) outbreaks. Emerg Infect Dis. 2007;13:1269–70.
2. Jourdain E, Gauthier-Clerc M, Bicout DJ, Sabatier P. Bird migration routes and risk for pathogen dispersion into western Mediterranean wetlands. Emerg Infect Dis. 2007;13:365–72.
3. Olsen B, Munster VJ, Wallensten A, Waldenstro J, Osterhaus A, Fouchier R. Global patterns of influenza A virus in wild birds. Science. 2006;312:384–8.
4. Gauthier-Clerc M, Lebarbenchon C, Thomas F. Recent expansion of highly pathogenic avian influenza H5N1: a critical review. Ibis. 2007;149:202–14.

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**In Response:** Sengupta et al. (*1*) discuss the role of ecoregions in the distribution of HPAI (H5N1) outbreaks. Although the concept of ecoregions is undoubtedly useful in global biogeography, we do not understand the point they are trying to make. In our article (*2*), which is cited in their letter, we undertook a descriptive study to determine whether spread of HPAI (H5N1) virus was consistent in time with ecologic drivers of bird migration and in space with distribution of major migratory flyways of Anatidae. It is obvious that the distribution pattern of Anatidae is dependent on ecologic variables, and some of these variables are summarized by the ecoregion concept.

However, apart from a strictly descriptive point of view, we do not see how the ecoregion concept applies to describe patterns in HPAI (H5N1) spread and distribution. Sengupta et al. list ecoregions where reports of HPAI (H5N1) were concentrated. However, what do they infer from this? They observe regions with many reports of HPAI (H5N1) and conclude that these ecoregions are at risk. We find this reasoning completely circular, and any geographic zonation would provide the same observation. They may mean that ecoregions define boundaries within which secondary spread of HPAI is more likely than across ecoregions. However, this hypothesis would need to be more clearly demonstrated and quantified before the ecoregion concept can be used for global monitoring of HPAI (H5N1) outbreaks.

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### References

1. Sengupta R, Rosenshein L, Gilbert M, Weiller C. Ecoregional dominance in spatial distribution of avian influenza (H5N1) outbreaks. Emerg Infect Dis. 2007;13:1269–70.
2. Gilbert M, Xiao X, Domenech J, Lubroth J, Martin V, Slingenbergh J. Anatidae migration in the western Palearctic and spread of highly pathogenic avian influenza H5N1 virus. Emerg Infect Dis. 2006;12:1650–6.

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## Nephropathia Epidemica in Metropolitan Area, Germany

**To the Editor:** Old World hantaviruses (family *Bunyaviridae*) are rodentborne pathogens that can cause hemorrhagic fever with renal syndrome (HFRS) (*1*). At least 3 different pathogenic hantavirus species have been detected in Europe: *Dobrava-Belgrade virus* (DOBV), *Tula virus,* and *Puumala virus* (PUUV) (*1–3*). Most human hantavirus infections in Europe are assigned to PUUV transmitted by bank voles (*Myodes glareolus*, formerly *Clethrionomys glareolus*). Although PUUV is thought to cause a mild form of HFRS, designated as nephropathia epidemica (NE), severe courses have been described with a case-fatality ratio of up to 0.6% (*3*).

Even though human hantavirus infections have sporadically been reported in Germany since 1983 (e.g., *4–7*), clinically apparent hantavirus infections (HFRS, NE) did not become notifiable diseases in Germany until 2001. From 2001 through 2004, ≈140 to 240 cases per year have officially been documented in Germany; most were caused by PUUV. Regions endemic for PUUV have been identified in southern Germany, especially the Alb-Danube region (*4*,*6*,*8*). Since 2004, 2 aspects of the situation in Germany have changed. First, the number of clinical cases has increased dramatically to a total of 448 in 2005. Second, hantavirus infections have been observed in regions previously not recognized as endemic for hantaviruses (*9*). An increased number of human cases were also observed in other European countries (*10*).

Here we report the first, to our knowledge, documented PUUV-associated urban NE outbreak, which occurred in a city park in Germany. In 2005, a total of 89 cases were reported in the district of Cologne with

41 cases recorded in the city center (incidence 4.2/100 000). In the past, (2001–2004), 3–22 cases were reported annually for the district of Cologne and 2–6 cases for the city of Cologne. Clinical symptoms, documented by responses to a questionnaire, resembled those typical for NE found in previous studies in Germany (*4*,*5*,*7*,*8*) and included fever (93%), headache (43%), and arthralgia (40%), without hemorrhage. Renal dysfunction was found in ≈83% of patients, and approximately three-fourths of the patients were temporarily hospitalized (n = 29). Serologic investigations by ELISA and indirect immunofluorescence assay confirmed PUUV-reactive immunoglobulin M (IgM) and IgG antibodies in serum specimens from all 89 patients. The average age of the patients was 39 years (range 6–65 years), and the male/female ratio was 2.6:1.

For a large number of patients, the exposure to PUUV most likely occurred in a forested park and recreation area ("Stadtwald," 20 ha) in Cologne's inner city circle (Figure) where they lived, worked, or enjoyed recreational activities. Five patients had homes adjacent to this area. Four patients were evaluated for likely exposure due to employment at the RheinEnergie Stadium, 1 player in the German Football League and 3 employees who had cleaned basements or attics at the stadium (Figure). Three patients were members of a tennis club located near the stadium. To further investigate these cases, in April and June 2005, rodents were trapped in the Stadtwald. The effort yielded 35 bank voles, 17 yellow-necked mice, and 1 wood mouse. Screening of 48 available serum specimens by ELISA with yeast-expressed nucleocapsid (N) proteins of PUUV and DOBV (*9*) demonstrated 19 reactive blood samples. Seventeen had a higher endpoint titer to PUUV, and 2 showed identical endpoint titers for PUUV and DOBV. These 19 reactive samples (63%) originated from 30 *M. glareolus* bank voles.

Lung tissues of all 53 mice were analyzed by PUUV-specific reverse transcription (RT)–PCRs targeting the S segment (for primers, see [*9*]). In 23 (66%) of the 35 bank voles, but in none of the other rodents, PUUV-specific RNA was amplified and sequenced. The concordance of ELISA– and RT-PCR–positive samples was 98% (online Appendix Table, available from www.cdc.gov/EID/content/13/8/1271-appT.htm).

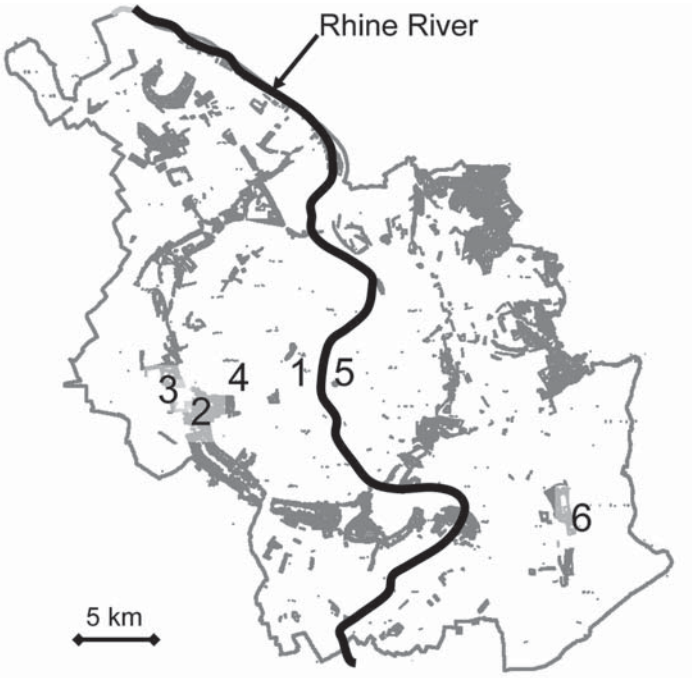


Figure. City of Cologne, showing its corridor of wooded public parks (shaded area) and the location of the exposure sites in the Stadtwald stadium area: 1, Cologne cathedral; 2, Stadtwald; 3, RheinEnergie Stadium; 4, university; 5, trade fair; 6, airport.

Comparison of the partial S-segment nucleotide sequences obtained showed intersequence distances of 0%–1.2%. The level of the nucleotide sequence divergence from previously described German PUUV strains was 14.7%–16%. In phylogenetic analyses (neighbor-joining, maximum likelihood) based on this fragment, all sequences from the Cologne cluster formed a distinct group next to the branch consisting of strain Erft (95.4%–96% identical). These strains were clearly separated from additional PUUV strains originating from Germany (Berkel, southeastern Germany, Heidelberg), and Belgium, a neighboring European country (data not shown).

The only hantavirus known in an urban environment is Seoul virus, which is transmitted mainly by the peridomestic brown rat (*Rattus norvegicus*). As with most other hantaviruses, PUUV patients, including those previously observed in Germany, were reported to become infected in their rural residences or, when living in urban regions, during visits to the countryside in their spare time (*4*).

To our knowledge, this is the first report describing an outbreak of PUUV infections in a metropolitan area in Europe with a defined exposure site in the city center. The PUUV outbreak in 1990 in the city of Ulm occurred due to exposure during field military maneuvers in the outskirts of the city near the Danube River, and the surrounding civilian population did not experience a similar outbreak (*6*). The exposure site of a previous cluster of PUUV-infected patients reported from the city of Ulm and its surroundings remain uncertain but might be also rural because almost all patients lived outside

the city of Ulm (*8*). In Cologne, about two thirds of the bank voles captured at the exposure site carried PUUV and are assumed to be the most probable source of infection. Increased sightings of rodents were reported by local health offices and pest control units. Studies at putative exposure sites in southeastern Germany in 2004 also showed a high prevalence of PUUV in the respective bank vole populations.

These cases are also the first indication, to our knowledge, that recreational activities in a forested city park, infested by hantavirus-infected rodents, may lead to human infections. This possibility should be investigated carefully in outbreak situations and may have practical implications for the future surveillance and prevention of NE in Europe.

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### References

1. Plyusnin A, Krüger DH, Lundkvist A. Hantavirus infections in Europe. Adv Virus Res. 2001;57:105–36.
2. Klempa B, Meisel H, Räth S, Bartel J, Ulrich R, Krüger DH. Occurrence of renal and pulmonary syndrome in a region of North-East Germany where Tula hantavirus circulates. J Clin Microbiol. 2003;41:4894–7.
3. Mustonen J, Vapalahti O, Henttonen H, Pasternack A, Vaheri A. Epidemiology of hantavirus infections in Europe. Nephrol Dial Transplant. 1998;13:2729–31.
4. Pilaski J, Ellerich C, Kreutzer T, Lang A, Benik W, Pohl-Koppe A, et al. Haemorrhagic fever with renal syndrome in Germany. Lancet. 1991;337:111.
5. Pilaski J, Feldmann H, Morzunov S, Rollin PE, Ruo SL, Lauer B, et al. Genetic identification of a new Puumala virus strain causing severe haemorrhagic fever with renal syndrome in Germany. J Infect Dis. 1994;170:1456–62.
6. Clement J, Underwood P, Ward D, Pilaski J, LeDuc J. Hantavirus outbreak during military manoeuvres in Germany. Lancet. 1996;347:336.
7. Heiske A, Anheier B, Pilaski J, Volchkov VE, Feldmann H. A new *Clethrionomys*-derived hantavirus from Germany: evidence for the distinct genetic sublineages of Puumala viruses in Western Europe. Virus Res. 1999;61:101–12.
8. Rasche FM, Uhel B, Ulrich R, Krüger DH, Karges W, Czock D, et al. Thrombocytopenia is a predictor for acute renal failure in Puumala hantavirus infections. Emerg Infect Dis. 2004;10:1420–5.
9. Essbauer S, Schmidt J, Conraths FJ, Friedrich R, Koch J, Hautmann W, et al. A new Puumala hantavirus subtype in rodents associated with an outbreak of nephropathia epidemica in South-East Germany in 2004. Epidemiol Infect. 2006;134:1333–44.
10. Mailles A, Abu Sin M, Ducoffre G, Heyman P, Koch J, Zeller H. Larger than usual increase in cases of hantavirus infections in Belgium, France and Germany, June 2005. Eurosurveill. 2005;10: E050721.4.

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## Effect of Hurricane Katrina on Arboviral Disease Transmission

**To the Editor:** Rarely has the aftermath of a natural disaster in the continental United States resulted in increased transmission of mosquito-borne viruses (*1*). However, on August 29, 2005, Hurricane Katrina struck Louisiana and Mississippi, where mosquito-borne West Nile (WNV) and St. Louis encephalitis viruses are endemic.

Using data from the ArboNET system of the Centers for Disease Control and Prevention, we evaluated the short-term effects of Hurricane Katrina on the reported incidence of human West Nile neuroinvasive disease (WNND) and Saint Louis encephalitis (SLE) in Louisiana and Mississippi using the reported week of onset and the year (2003–2005). We also evaluated incidence by onset date and county (or parish) over 3 time intervals (January 1–August 31, September 1–September 30, and October 1–October 30) in 2005. Reporting lag was evaluated by onset dates and corresponding dates of reports. Because the completeness of reporting of West Nile fever and other arboviral fever cases is highly variable, only reports of human WNND and SLE were considered.

In Louisiana, the highest reported incidence of WNND occurred in the second week of August 2005, before Hurricane Katrina made landfall. Al-

**Appendix Table.** ELISA and RT-PCR results of the investigated rodent samples*

| | RT-PCR | | |
|---|---|---|---|
| | Positive | Negative | NT |
| ELISA | | | |
| Positive | 19 | 0 | 0 |
| Negative | 1 | 28 | 0 |
| NT | 3 | 2 | 0 |
| | 23 | 30 | |

*RT, reverse transcription; NT, not tested.