Changing Disease Patterns Demand Cross-Field Partnerships

As changing climates widen the range of vector-borne diseases, human and animal health workers need to start talking to each other.

Terry E. Creekmore

The topics of large-scale climate change and global warming have generated intense speculation about the possible adverse effects on public health and well-being. Large-scale variations in weather patterns may cause shifts in regions suitable for farming or alter the distribution, frequency, and magnitude of diseases such as arboviruses, plague, or hantavirus. The public health community has neither the power nor authority to implement the social changes necessary to reverse the trend of global warming, but public health professionals do have a role to play in preparing for the possible results of such large-scale change.

U.S. Public Health Service demonstration unit, residual spraying for flies.

Today few scientists doubt the atmosphere is warming. However, there is considerable debate in both the popular press and scientific literature concerning the extent to which this might occur, the viability of the projected increases, and the consequences of this temperature change. The majority of the articles focus on the adverse effects of a temperature increase of between 2°C (35.6°F) and 5°C (41°F). Long-term temperature shifts of this magnitude will likely have a major effect on a wide variety of social and ecological factors, including zoonotic diseases (those transmitted from animals to humans).

Arboviruses

The principal arboviruses (arthropod-borne viruses) of concern in the western United States are St. Louis Encephalitis (SLE), including the related West Nile virus (WNV), and Western Equine Encephalitis (WEE) virus. Mosquito-borne viruses are among the diseases most sensitive to climate. Temperature, rainfall, and humidity determine the geographic range, reproductive potential, and biting rates of mosquito vectors. Viral replication within the mosquito vector is also affected by relatively minor (5-6°C) temperature changes. For instance, the viral incubation period for WEE-infected *Culex tarsalis* mosquitoes is approximately 28 days at 25°C (77°F) versus 12 days at 30°C (85°F). In addition, human outbreaks of SLE are highly correlated with periods when the temperature exceeds 30°C.

Plague

Plague, caused by the bacterium *Yersinia pestis*, is a zoonotic disease present in 17 western states. The natural cycle of plague involves transmission between various rodent species and their associated fleas. Most human exposures result from flea bites, although smaller numbers are acquired through direct contact with infected animals, or rarely, by inhaling infectious materials. Between 1960 and 1997, 381 laboratory-confirmed cases of human plague occurred in the United States.

The number of plague cases fluctuates markedly from year to year, and evidence suggests that epizootics (epidemics) occur most frequently when rodent and flea populations are high. Climatic variables, food availability, and disease can all affect rodent population dynamics, and the seasonal abundance of certain flea species and their ability to transmit *Y. pestis* are also correlated with temperature and precipitation changes. Enscore, et al., found that relatively cool summer temperatures coupled with high precipitation amounts during the late winter months are correlated with increased occurrences of human plague in northeast Arizona and northwest New Mexico.

If temperature increases associated with global warming occur, the focus of plague that currently exists in Arizona, New Mexico, southern California, and Colorado could possibly shift northward, or up slope to higher elevations, according to Ken Gage, plague section chief at the Division of Vector-Borne Infectious Diseases in the Centers for Disease and Prevention. Plague is already present in Washington, Oregon, Idaho, Montana, and Wyoming. Human cases could increase in frequency, however, if changing climate patterns resulted in the expansion northward of the distributions of certain rodents and their fleas.

Hantavirus pulmonary syndrome

There are at least 30 different hantaviruses worldwide, many of which can cause severe, often fatal, illness in humans. In 1993, Sin Nombre, a previously unknown hantavirus, was identified in the Four Corners region of the southwestern United States. This virus, which causes an acute respiratory disease named hantavirus pulmonary syndrome (HPS), is carried by numerous rodent species and transmitted to humans through rodent urine, droppings, and saliva. HPS has been identified in 31 states but is most prevalent in the western U.S. As of April 2001, there were 283 confirmed hantavirus cases in the U.S., 38% of which were fatal. About three-quarters of the patients with HPS have been residents of rural areas. Washington leads the Northwestern states with 22 reported cases, followed by Montana and Idaho with 15 cases each, Oregon and Wyoming reported 5 and 2 cases, respectively.

Ecological changes promoting rapid increases followed by decreases of rodent populations have a marked association with HPS outbreaks. For example, the 1993 HPS outbreak was preceded by a dramatic increase in rainfall associated with the 1992-1993 El Niño. This led to increased rodent food sources, a 20-fold increase in the rodent population, and an increased risk of HPS.

Public health implications

Since the first indications of an impending public health problem are often seen in wild or domestic animals rather than in humans, to address the issue of emerging infectious diseases effectively public health professionals must forge systematic relationships with professionals in other fields, such as entomology, wildlife diseases, and veterinary medicine.

The emergence of West Nile Virus, which is expected to expand its range within the next several years to include the entire U.S., is a good example of the new kinds of partnerships necessary for effective public health work. When crows began dying in New York City in June 1999, wildlife pathologists suspected an arbovirus. In August the first human cases of encephalitis were reported and diagnosed as St. Louis Encephalitis. In mid-September, veterinary and agriculture laboratories identified the exotic West Nile Virus from bird and mosquito samples, and retrospective testing confirmed WNV (which is closely related to and cross reacts with SLE) as the cause of the human encephalitis outbreak that eventually killed 7 people and resulted in the hospitalization of 63 in 1999.

Stimulated by the emergence of WNV, but also recognizing such factors as demographic and societal changes, changing climates, threats of bioterriorism, and emerging infectious diseases, the Centers for Disease Control provided funding to improve vector-borne disease surveillance in many states (see sidebar on Wyoming's WNV surveillance activities). To respond effectively to changes in patterns in the occurrence of vector-borne diseases, this surveillance effort must include not only public health, but also wild and domestic animal disciplines. Establishing communication across fields is a crucial step to an effective public health response to emerging diseases and climate-induced shifts in disease patterns.

Recommended Readings

See page17 for references and related readings.

Author

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Coordinating Public Health and Veterinary Science in Wyoming

Wyoming Department of Health's West Nile Virus Surveillance and Epidemiologic Project started in June 2000 with an application to the Centers for Disease Control and Prevention (CDC). The focus of the project is the coordination of the public health and veterinary response to West Nile in Wyoming. It concentrates on five major areas:

- Dead bird surveillance to detect the presence of West Nile activity in wild bird populations
- Equine surveillance to monitor the extent of transmission outside of the bird-mosquito cycle
- Enhanced veterinary surveillance for the reporting of neurological illness in animals
- Enhanced human surveillance for the reporting of viral encephalitis
- Laboratory diagnostic capacity

Wyoming's West Nile project is a partnership among the University of Wyoming State Veterinary Laboratory, USDA Agricultural Research Service, Wyoming Game and Fish Department, and Wyoming Department of Health. Terry Creekmore, the West Nile Project coordinator, is an employee of the health department, but is stationed at the Veterinary Laboratory. He coordinates both human and veterinary surveillance as well as leading Wyoming's West Nile and Vector-borne Disease Task Force. This collaborative project has also strengthened ties between veterinary and human health in Wyoming in other areas, including bioterrorism, emerging diseases, and zoonoses.

Vector-Borne Diseases

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Recommended Readings

Crosse M, Ball R, Iritani K, et al: West Nile Virus outbreak: Lessons for public health preparedness. Report to congressional requesters. United States General Accounting Office 2000.

Enscore RE, Biggerstaff BJ, Brown TL, et al: Modeling relationships between climate and the frequency of human plague cases in the southwestern United States, 1960-1997. *Am J Trop Med Hyg* (in press).

Gubler D: Climate change: implications for human health. *Health and Environment Digest* 1998; 12:54-56.

Longstreth J, Wisman J: The potential impact of climate change on patterns of infectious disease in the United States. In: *The Potential Effects of Global Climate Change on the United States*: *Appendix G Health*, JB Smith, DA Tirpak (eds). U.S. Environmental Protection Agency 1989; 36 pp.

Reeves WC, Hardy JL, Reisen WK, et al: Potential effect of global warming on mosquito-borne arboviruses. *J Med Entomol* 1994; 31:323-332.

Reiter P: Weather, vector biology, and arboviral recrudescence. In: *The Arboviruses: Epidemiology and Ecology,* TP Monath (ed.). CRC Press 1988, pp 245-280.

Resources Online

As a special service to Northwest Public Health readers, the Northwest Center for Public Health Practice lists learning and teaching materials related to some of the articles in this issue. Look for the list at http://healthlinks.washington.edu/nwcphp/