Focus Areas

VECTOR CONTROL

Global travel, natural disasters, and changing climates all promote the migration of disease vectors and the pathogens they carry. Given the prevalence of all three of these in the modern era, it is unsurprising that vector-borne diseases are on the rise. Altogether, almost half the world's population is at risk of vector-borne disease.[1] While most parts of the US have not suffered large-scale outbreaks of virulent vector-borne diseases in recent years, important vectors—such as *Aedes* species mosquitos and *Ixodes scapularis* ticks—are found in large swaths of the country. It is not difficult to imagine a situation in which an effectively transmitted pathogen is introduced into local vector populations, prompting sudden disease outbreaks.

The Problem

Vector-borne diseases pose a serious threat to public health. In the past 20 years, the US has become acquainted with three arthropod-borne diseases previously unknown in North America: West Nile virus (1999), chikungunya virus (2013), and Zika virus (2015).[2] At the same time, some formerly endemic arthropod-borne illnesses are reemerging, such as dengue virus, which has caused outbreaks in Texas, Hawaii, and Florida; and St. Louis encephalitis, which researchers believe was reintroduced from Argentina to the US Southwest after an 11-year absence.[3, 4]

Climate Change Impacts Vector-borne Outbreaks

Climate change can increase the incidence of vector-borne diseases by altering the survival rate, population growth, and habitats of vectors, and by changing disease transmission patterns.[5] Rain events and drought cycles could profoundly influence the spread of vector-borne disease in the United States, not only due to displacement of populations of humans and disease reservoirs, but in terms of vector abundance. Drought conditions, for example, could favor closer contact among vectors, pathogen reservoirs, and hosts, facilitating disease transmission. Or some areas could become too arid or too wet to remain hospitable to vectors, thus hindering disease transmission. Higher temperatures have already been correlated with increased incidence of vector-borne disease at local, regional, and national levels.[6]

Since climate change is altering temperature and precipitation patterns across the country, it is critical that public health professionals prepare for a potential increase in the geographic ranges and periods of seasonal activity of vectors, such as mosquitoes.

Vector Control Preparedness is Key to Saving Lives and Money

Planning ahead improves efficiency, allowing sustainable vector control programs to save valuable local emergency response resources. Vector control programs are relatively inexpensive, costing about $3.67 per person, per year—far less than the costs associated with the emergency use of contractors, pesticides, and application equipment.[7] For example, the cost of a West Nile virus outbreak in Louisiana during an eight-month period covering 2002 and 2003 was $20.1 million, which included $9.2 million in public health response, $4.4 million in medical costs, and $6.5 million in nonmedical costs.[8]

Workforce Development

Thorough planning necessitates ongoing professional development of vector control staff, whose training might include meetings with entomologists and epidemiologists to better understand vector life cycles, disease patterns in an affected area, and other important public health considerations.

A Healthy Home Reduces Vector Risk

Assuring proper housing conditions is integral to vector-borne disease management. Health problems, such as asthma, can be triggered by the excrement of cockroaches, rodents, and other pests. Some of these same pests can also be vectors for significant problems that affect human health and well-being and are capable of transmitting diseases to humans. According to a 1997 American Housing Survey, rats and mice infested 2.7 million housing units.[9]

States and localities can help diminish the Zika virus threat by implementing the recommendations found in the 2015 International Property Maintenance Code (IPMC), which require homeowners to meet certain minimum standards in the upkeep of their property.[10] These include installing screens on windows and doors and grading the property to prevent the accumulation of standing water. Communities may wish to supplement IPMC guidelines with applicable provisions from the National Healthy Housing Standard (NHHS). For example, the NHHS encourages the use of Integrated Pest Management (IPM) practices to reduce the sources of pests before resorting to chemical pesticides. CDC's Vector Control/IPM Program provides training, tools, resources, and expert guidance for states and localities to address vector-related challenges.[11]

Syndromic Surveillance

The US needs comprehensive, linked surveillance and tracking systems. For instance, in 2016 CDC stood up the Zika Pregnancy Registry—a combined federal, state, local, and tribal registry that enables health agencies to track pregnancy and infant outcomes following Zika infection during pregnancy.[12] This information could feed into a larger surveillance system to discern disease patterns, identify affected areas, and help plan an appropriate public health response.

Furthermore, syndromic surveillance can enhance outbreak detection by identifying morbidity trends before diagnoses are confirmed.[13] This public health tool applies existing and real-time data—such as the number of patients presenting in emergency departments with specific symptoms—for early detection of unusual disease clusters or sentinel cases. It might also provide information on the geospatial trajectory of an outbreak after it begins and provide situational awareness in the absence of an outbreak.[14]

Of course, laboratory-based disease surveillance is essential to confirm infection with specific pathogens. When emerging vector-borne diseases are detected in an area, then state, regional, or local public health laboratory staff need adequate resources to develop and implement disease-specific tests and to build capacity for rapid, large-scale response in the event of an outbreak.

Opportunities for Action

Funding for vector control programs is limited or discontinued in many jurisdictions. The following opportunities for action aim to guide the establishment of new programs or augmentation of existing programs to ensure a measure of public health protection from vector-borne diseases:

1) Ensure the continuity of disease surveillance and data collection from people and a variety of vectors, including immature mosquitoes, adult mosquitoes, horses, wild birds, and sentinel vertebrates.
2) Prepare cooperative emergency resource-sharing agreements with other jurisdictions.
3) Establish shared service agreements, equipment pools, regional districts, and standard service contracts with nearby jurisdictions before an emergency occurs.
4) Establish partnerships with agricultural extension agents and subject matter experts.
5) Work with state agricultural and public health agencies to facilitate access to important surveillance data from veterinary diagnostic laboratories, zoos, and equine, falconry, and raptor rehabilitation organizations.
6) Coordinate with public health laboratories for testing and surveillance services during an emergency, and expand laboratory capacity to identify existing and emerging vector-borne pathogens in human, animal, and vector samples.
7) Provide training and continuing education on outbreak investigation in humans and animals and collection of vector samples and abatement activities.
8) Enhance data-sharing systems to facilitate effective communication among federal, state, and local jurisdictions.
9) Participate in longitudinal monitoring programs for vectors and pathogens to discern changes in vector distribution and abundance over time.
10) Develop models to predict the effects of climate change on vector-borne disease risk and the projected distribution and abundance of major hosts and vectors.

11) Create disease control and prevention plans to reduce the impacts of vector-borne diseases on local communities, including vulnerable populations.
12) Support integrated mosquito management programs designed to benefit or cause minimal harm to people, domestic animals, wildlife, and the environment.

For more information, visit:

Association of State and Territorial Health Officials

- *Before the Swarm* report: http://www.astho.org/programs/environmental-health/natural-environment/before-the-swarm/

Centers for Disease Control and Prevention, National Center for Environmental Health

- Integrated pest management tools, resources, expert guidance, and trainings: http://www.cdc.gov/nceh/ehs/Topics/VectorControl.htm
- Mosquito Control, Zika Virus: https://www.cdc.gov/zika/vector/index.html

National Association of County and City Health Officials

- Policy statement on climate change and vector-borne disease: http://www.naccho.org/uploads/downloadable-resources/14-05-climate-change-and-vector-borne.pdf

National Center for Healthy Housing

- Resources for professional groups, families, researchers, and others: http://nchh.org/

References

1. World Health Organization. The world health report 2004: changing history. 2004.
2. Anthony S. Fauci and David M. Morens. Zika Virus in the Americas — Yet Another Arbovirus Threat. *New England Journal of Medicine*. 2016;374:601-604.
3. Nidhi Bouri, Tara Kirk Sell, Crystal Franco, Amesh A. Adalja, D. A. Henderson and Noreen A. Hynes. Return of Epidemic Dengue in the United States: Implications for the Public Health Practitioner. *Public Health Reports*. 2012;127:259-266.
4. Gregory S White, Kelly Symmes, Pu Sun, Ying Fang, Sandra Garcia, Cody Steiner, Kirk Smith, William K Reisen and Lark L Coffey. Reemergence of St. Louis Encephalitis Virus, California, 2015. *Emerging Infectious Diseases*. 2016;22:2185.
5. Charles B. Beard, Rebecca J. Eisen, Christopher M. Barker, Jada F. Garofalo, Micah Hahn, Mary Hayden, Andrew J. Monaghan, Nicholas H. Ogden and Paul J. Schramm. Ch. 5: Vectorborne Diseases. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. 2016. *Retrieved from:* https://health2016.globalchange.gov/downloads#vectorborne-diseases.
6. American Public Health Association and U.S. Centers for Disease Control and Prevention. Extreme Rainfall and Drought. 2016. *Retrieved from*: https://apha.org/~/media/files/pdf/factsheets/climate/precipitation.ashx on April 10, 2017.
7. Mosquito and Vector Control Association of California. 2013 Yearbook. 2013.
8. Armineh Zohrabian, Martin I. Meltzer, Raoult Ratard, Kaafee Billah, Noelle A. Molinari, Kakoli Roy, R. Douglas Scott and Lyle R. Petersen. West Nile Virus Economic Impact, Louisiana, 2002. *Emerging Infectious Diseases*. 2004;10:1736-1744.
9. U.S. Centers for Disease Control and Prevention and U.S. Department of Housing and Urban Development. Ch. 4: Disease Vectors and Pests *Healthy Housing Reference Manual* Atlanta, GA; 2006.
10. National Center for Healthy Housing. International Code Council. 2008. *Retrieved from*: http://www.nchh.org/policy/nationalpolicy/internationalcodecouncil.aspx on April 13, 2017.
11. U.S. Centers for Disease Control and Prevention. Vector Control / Integrated Pest Management (IPM). 2016. *Retrieved from*: https://www.cdc.gov/nceh/ehs/topics/vectorcontrol.htm on April 13, 2017.
12. U.S. Centers for Disease Control and Prevention. U.S. Zika Pregnancy Registry. 2017. *Retrieved from*: http://www.cdc.gov/zika/hc-providers/registry.html on April 7, 2017.
13. Jean-Paul Chretien, Howard S. Burkom, Endang R. Sedyaningsih, Ria P. Larasati, Andres G. Lescano, Carmen C. Mundaca, David L. Blazes, Cesar V. Munayco, Jacqueline S. Coberly, Raj J. Ashar and Sheri H. Lewis. Syndromic Surveillance: Adapting Innovations to Developing Settings. *PLOS Medicine*. 2008;5:e72.
14. Kelly J. Henning. What is Syndromic Surveillance? *Morbidity and Mortality Weekly Report*. 2004:7-11.