JOHNS HOPKINS MEDICINE

Fisher Focus

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News from the Sherrilyn and Ken Fisher Center for Environmental Infectious Diseases

Preparing for Highly Contagious Disease Outbreaks

Brian Garibaldi, MD and Lauren Sauer, MS are 2018 Fisher Center Discovery Program (FCDP) grant recipients for, *Environmental transmission and traceability of aerosolized bio-simulants in a clinical biocontainment unit.*

The 2014-2016 Ebola epidemic in West Africa demonstrated a need for the US healthcare system to expand its capabilities to safely provide care for patients infected with high consequence pathogens. At the time of the first reported case of Ebola in the US, there were only three dedicated high-level isolation units (Emory University, University of Nebraska Medical Center, and the National Institutes of Health) that were prepared to care for patients with diseases such as Ebola, Lassa fever, Crimean-Congo Hemorrhagic Fever (CCHF), SARS, and smallpox. Globalization and the ease of international travel means that the US must be prepared to screen, isolate and treat patients infected with such pathogens that were previously not likely to be found in North America. As more US healthcare workers travel abroad to provide clinical and research services during epidemics, we must also be prepared to care for individuals that become ill during those outbreaks. The current Ebola outbreak in the Democratic Republic of Congo is an important reminder of this need to bolster our national preparedness for highly infectious diseases.

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In response to the threat of emerging infectious diseases, the Office of the Assistant Secretary for Preparedness and Response (ASPR) funded the creation of 10 Regional Ebola and Special Pathogen Treatment Centers (RESPTCs). Johns Hopkins Hospital (JHH) was selected to be the RESPTC for Health and Human Services (HHS) Region 3. In order to serve in this role, JHH built a state of the art biocontainment unit (BCU). This four-bed isolation unit has a custom designed air-handling system to provide care for patients with airborne pathogens, an onsite waste management system with two steam sterilizers (or autoclaves) to disinfect clinical waste, and an on-unit laboratory to safely process diagnostic specimens. The BCU is staffed by a highly engaged group of physicians, nurses, laboratory technicians, and other healthcare providers who have received special training in infection control and the care of patients with highly infectious diseases.

One of the core mission areas of the JHH BCU is to advance the science of high-level isolation in order to ensure the safety of patients, staff, and the surrounding community. Most of our understanding of high-level isolation comes from biosafety level 3 and level 4 research laboratories. There is little data to guide the design and construction of clinical biocontainment units, or to inform standard operating procedures for clinical staff. Over the last 3 years, the BCU team has tackled several important research questions.

In collaboration with the Microbiology Biosafety Level-3 Laboratory, we conducted a series of experiments to validate the proper handling and sterilization of highly

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Inside

Mission Statement

The Sherrilyn and Ken Fisher Center for Environmental Infectious Diseases is dedicated to the clinical research of environmental pathogens which improves the diagnosis and treatment of these infections.

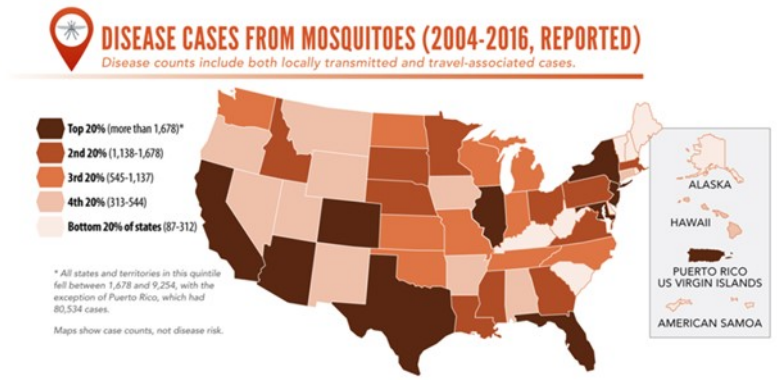
A word from our Director
Paul Auwaerter, M.D., M.B.A.

Clinical Director, Division of Infectious Diseases

Bugs Transmitting Bugs: More Common than Ever

Every spring, I am asked if this year will be a good or a bad tick season. You might think an extremely cold winter would bode for fewer of these blood-sucking demons or that a mild winter would mean a bumper crop of these animals related to spiders and horseshoe crabs. Sadly, much like the confidence of long-range weather forecasting, entomologists, the experts who study these trends most frequently predict severe tick seasons such as this year, though they have been about half-right in the recent past.

Though other experts argue about the effect of climate, changes to land use as well as rodent and deer populations that may influence how many ticks are in your neighborhood, the Centers for Disease Control has issued a report that confirms what many physicians and patients have long suspected. Since 2004, the number of vector-borne diseases spread by ticks and insects such as mosquitoes and fleas has **tripled**. Most of the increases are attributable to Lyme disease and the Zika virus; however, it is notable that this report covers 640,000 reported infections from all causes and includes **nine** newly discovered pathogens.



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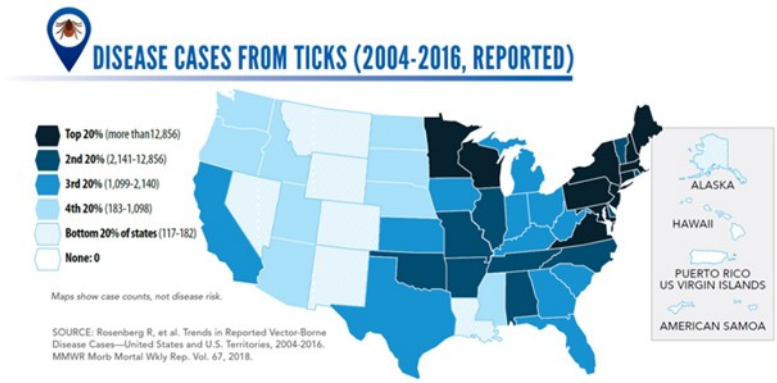

These trends suggest further increases in diseases transmitted as well as the discovery of new pathogens spread by such insects and ticks. The CDC report helps buttress arguments that funds for research of such environmental infectious diseases have been underfunded relative to their frequency. Better efforts at diagnosis, treatment, and control would have a payoff to avoid infections and lead to better care for patients. This report also finds state and local organizations cannot frequently respond rapidly to vector-borne disease. Many groups are working with congressional leaders and federal agencies to devote more resources to these infections. Otherwise, where should you live to avoid tick-borne or insect-borne infections? The only state in the bottom fifth percentile for both tick- and insect-based diseases: Alaska.

Thank you to those who contributed so generously to support environmental Infectious disease research and education in the past six months. Such gifts help facilitate innovative research, especially targeted to early-career investigators. In particular we would like to acknowledge:

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Preparing for Highly Contagious Disease Outbreaks *continued from page 1*

infectious waste using our steam sterilizers. This validation process, which employs a combination of temperature, pressure and biological indicators, is now used at biocontainment units across the country.

We partnered with the Johns Hopkins University Applied Physics Laboratory (APL) to better understand the movement of infectious particles in high level isolation units. APL created a cough simulator that disperses fluorescent polystyrene microbeads in a pattern that mimics a human cough. We are able to track the movement of these particles using sensors that are placed throughout the unit. Using this approach, we have been able to show that the BCU air handling system contains simulated infectious particles in the patient isolation room under static conditions. However, when health care workers move through the unit, particles can travel with them into the doffing area (where they remove their personal protective equipment - PPE). These particles are likely re-aerosolized when providers remove their PPE. The risk posed to the healthcare worker from such re-aerosolizing is unknown.

The Biocontainment Unit has completely separate ventilation systems from the rest of Johns Hopkins hospital, as well as strict entry/exit protocols to prevent spread of infection.

Biocontainment Unit (BCU) Nurse Mallory Reimers caring for a mock-infected patient while exposed to aerosols generated by the Applied Physics Lab-developed cough simulator.

A generous award from the Sherrilyn and Ken Fisher Center for Environmental Infectious Diseases will allow us to examine this critical issue. Through this award, we will create a new DNA-labelled fluorescent microbead, that will allow us to track the movement of particles with a higher degree of fidelity. We will also be able to swab the mucous membranes of providers after they remove their PPE. This will allow us to understand if the re-aerosolization of particles might lead to a potential exposure with the subsequent risk of a healthcare worker infection. This methodology will inform the structural design of high level isolation units, and can be used to examine the safety of the doffing process as well as new PPE designs.

The science of containment care is still in its infancy. **With support from the Fisher Center, the JHH BCU is positioned to be a leader in the field of high level isolation.** The work from our growing research portfolio will inform the national preparedness agenda for highly infectious diseases, and will also have a broader impact on infection control throughout our healthcare system.

The dirty side (left panel) and clean side (right panel) of the Biocontainment Unit waste management area. The dirty side of the unit requires high-temperature autoclaving of all materials before removal. The clean side of the unit means all material passing through the autoclave may be safely handled.

Fisher Fellow Completes Residency

Former Fisher Research Fellow, **Takaaki Kobayashi, MD**, completed an internal medicine residency at Mount Sinai Beth Israel Hospital, in New York, receiving the "Resident of the Year" award out of 30 post-graduate year three (PGY3) residents. Dr. Kobayashi will begin an Infectious Diseases fellowship at the University of Iowa Hospitals and Clinics located in Iowa City.

While in New York, Dr. Kobayashi continued his relationship with the Fisher Center by preparing scientific posters and journal articles related to Lyme disease research. His paper on *Lyme disease consultations at Johns Hopkins 2000-2013* is currently under preparation.

Takaaki and his wife, Nao, are expecting their first child in August. The Fisher Center wishes them well.

Funding Our Future

Thanks to all of you that believe in the mission of environmental infectious disease research. As always, we are extremely grateful to those who have contributed. To donate, please consider the following options and designate the **Fisher Center for Environmental Infectious Diseases**

Online: To make a gift or pledge online, please complete our secure online giving form, https://secure.jhu.edu/form/infdis
Phone: To speak to someone directly about making a gift, please call 410-550-9893.
Mail: The Fisher Center, 725 N. Wolfe St., Suite 211, Baltimore, MD 21205

Partnering with Business for Research Discovery

Lyme disease is a bacterial infection transmitted by tick bites. The infection may cause symptoms such as fatigue, muscle aches, joint aches, joint swelling, and rash. If untreated, the symptoms may progress or become more severe. Current blood tests for Lyme disease rely on testing for antibodies, proteins the body develops in response to an infection. Antibodies may take 2-4 weeks to develop after a tick bite, which may cause a delay in diagnosis and treatment. Also, it is impossible to monitor treatment effectiveness with antibody testing.

The Fisher Center is collaborating with **MicroB-plex, Inc.** of Atlanta, Georgia to evaluate a new blood test for early Lyme disease based on cells the body makes before antibodies are detectable in the blood. This test may also measure the therapeutic effects of medication for Lyme disease. If successful, the test may lead to breakthroughs in the diagnosis and management of Lyme disease.

People with early Lyme disease (symptoms less than seven days) with a rash consistent with erythema migrans may join the study.

We are also recruiting healthy people as controls. Study visits include a questionnaire and blood draws. For details, call Yvonne Higgins, (443) 287-4840.

"Bull's eye" rash, associated with Lyme Disease.
Image source: CDC

Recent Presentations

A New Way ID Care Is Valued. **Paul G. Auwaerter, MD, MBA**. Medscape Infectious Diseases. https://www.medscape.com/viewarticle/890266. January 02, 2018

Influenza and MRSA Pneumonia: More Than an 'Achoo' to the Flu. **Paul G. Auwaerter, MD, MBA**. Medscape Infectious Diseases. https://www.medscape.com/viewarticle/892994. March 05, 2018

Not So Common? Late Neuroborreliosis in a Referred Population. Takaaki Kobayashi, **Yvonne Higgins**, Paul Lantos, Michael Melia, **Paul Auwaerter**. Poster Session: Mid-Atlantic Tick Summit VII, Maryland Department of Health and Mental Hygiene, Laurel, MD, February 21, 2018 and JHU Department of Medicine Research Retreat, Johns Hopkins University School of Medicine, Baltimore, MD, March 16, 2018.

Consulting an ID Specialist Saves Lives and Money. **Paul G. Auwaerter, MD, MBA**. Medscape Infectious Diseases. https://www.medscape.com/viewarticle/894625. April 12, 2018

Prevalence and Contact Precautions Status of CRE Colonized Patients at Hospital Unit Admission, For the CDC Prevention Epicenters Program. **Goodman KE**, **Simner PJ**, Kazmi A, Klein EY, Gadala A, Rock C, Maragakis L, Cosgrove SE, **Milstone AM.** Poster, Selected for a *Top Abstract award*. Society for Healthcare Epidemiology of America Spring 2018 Conference, Portland, OR. April 20, 2018.

A Call for a Lyme disease Vaccine. **Paul G. Auwaerter, MD, MBA**. Medscape Infectious Diseases. https://www.medscape.com/viewarticle/896500. May 22, 2018

Recent Publications

Astrovirus Infection and Diarrhea in 8 Countries. **Kosek, Margaret,** et al. MAL-ED Network. Pediatrics. 2018 Jan;141(1). pii: e20171326. doi: 10.1542/peds.2017-1326. Epub 2017 Dec 19. PMID: 29259078

Rates of and Risk Factors for Adverse Drug Events in Outpatient Parenteral Antimicrobial Therapy. **Keller Sara**, et al. Clin Infect Dis. 2018 Jan 6;66(1):11-19. doi: 10.1093/cid/cix733. PMID: 29020202

Effect of home exposure to Staphylococcus aureus on asthma in adolescents. **Davis Meghan, Matsui, Elizabeth**, et al. J Allergy Clin Immunol. 2018 Jan;141(1):402-405.e10. doi: 10.1016/j.jaci.2017.06.031. Epub 2017 Jul 21. No abstract available. PMID: 28739287

Pregnancy and infection: using disease pathogenesis to inform vaccine strategy. ***Vermillion MS, Klein SL***.. NPJ Vaccines. 2018 Feb 1;3:6. doi: 10.1038/s41541-017-0042-4. eCollection 2018. Review. PMID: 29423318

The other Campylobacters: Not innocent bystanders in endemic diarrhea and dysentery in children in low-income settings. **Kosek, Margaret**, et al. PLoS Negl Trop Dis. 2018 Feb 7;12(2):e0006200. doi: 10.1371/journal.pntd.0006200. eCollection 2018 Feb. PMID: 29415075

Bacteroides fragilis Toxin Coordinates a Pro-carcinogenic Inflammatory Cascade via Targeting of Colonic Epithelial Cells. **Sears, Cynthia**, et al. Cell Host Microbe. 2018 Mar 14;23 (3):421. doi: 10.1016/j.chom.2018.02.004. PMID:29544099

Fisher Focus

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