

# GLOBAL

UF'S EMERGING PATHOGENS INSTITUTE MONITORS DISEASE



# VISION

WORLDWIDE IN ITS EFFORTS TO PROTECT FLORIDA

BY JOSEPH KAYS AND DELENE BEELAND

In the 14th century when the Black Death killed 25 million people in Europe, most died within miles of where they were born.

In 1918, when influenza killed at least 50 million people worldwide, ships filled with troops fighting in World War I carried the disease to the corners of the globe.

Today, the world's airlines carry more than 2 billion people a year and a person who gets sick in China can be in New York or Miami in less than 24 hours, and vice versa.

"Controlling the spread of new diseases in the 21st century requires a global vision," says Glenn Morris, director of the University of Florida's Emerging Pathogens Institute. "Microorganisms do not respect state or national boundaries. Only by understanding the global picture can we anticipate and prevent problems in Florida."

Since arriving at UF in 2007, Morris has helped to shape the creative vision behind a web of campuswide projects aimed at anticipating, understanding and controlling the emergence of new, disease-causing microorganisms.

"Understanding why and how new pathogens emerge requires a multidisciplinary approach, with the ability to move from basic genetics to global public health," Morris says. "My goal is to bring faculty together to build a strong interdisciplinary spirit and to play on each other's strengths."

UF took a major step toward combating these new diseases in January, when it dedicated a 90,000-square-foot home for the Emerging Pathogens Institute. The building has more than two dozen labs specially equipped to conduct research on human, animal and plant pathogens. It also has an entire wing devoted to bioinformatics, where statisticians and computer scientists mine data sources like cell phone records, airline ticket purchases and digital maps to better understand and predict how diseases spread.

UF President Bernie Machen marvels at the fact that in the four years since UF launched its pathogens research initiative, the university has brought together more than 150 faculty under a world-renowned director in a state-of-the-art facility.

“This really is a dream come true,” Machen said at the building dedication on January 26. “To have an idea hatched, formulated and now articulated and brought to fruition in just four years is unbelievable for an academic institution in this day and time.”



## INSECTS AND DISEASE

Modern science has provided a wealth of knowledge about the role insects play in moving an infectious agent from one host to another. But we still have a long way to go, as dynamic forces such as climate change alter what we thought we knew, and as human populations expand into new environments.

Historical initiatives in Florida and the United States eradicated classic vector-borne diseases such as malaria and yellow fever decades ago, but with 1.4 million commercial airline takeoffs and landings annually, the chances for an insect to stow away and bring a new disease to the state's shores are considerable.

Once here, our climate is welcoming to insects. One bug that has settled in is the Asian psyllid, which is responsible for



the epidemic of citrus greening impacting Florida's citrus industry.

Researchers at EPI are working globally and locally to address insect-borne diseases before they arrive in Florida, and to develop control strategies for those already here. The first step is partnering with, and linking, existing but sometimes disparate resources at UF.



For example, Bernard Okech began his work on mosquitoes when he was at UF's Whitney Laboratory for Marine Bioscience in St. Augustine. Now in Gainesville, Okech is looking at cellular factors involved in the survival of mosquitoes and the pathogens they carry. His work could yield insight into novel methods of environmentally

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— GLENN MORRIS

DIRECTOR, EMERGING PATHOGENS INSTITUTE

EPI's new home is designed to foster collaboration among the more than 150 biologists, epidemiologists, geographers, mathematicians, veterinarians and other scientists who will be based there or visit regularly from other laboratories on campus. From its open floor plan to its wall-sized whiteboards and video-conferencing equipment, the Emerging Pathogens Institute promotes a sharing of ideas.

“At EPI, we are aligning the best minds and best science to create a strong, interdisciplinary institute with the ability to understand, predict and control infectious threats,” Morris says. “This requires collaboration across disciplines and scales, from infectious disease and pulmonary specialists to microbiologists; from human, animal and plant pathologists to entomologists; from mathematical modelers to epidemiologists and evolutionary geneticists.”

Indeed, EPI is all about collaboration. Eight colleges — Agriculture, Dentistry, Engineering, Liberal Arts and Sciences, Medicine, Pharmacy, Public Health and Health Professions,



safe mosquito control, and a “green” alternative to chemicals such as DDT.

At the Florida Medical Entomology Laboratory in Vero Beach, Jonathan Day and his colleagues focus research efforts on mosquito-borne disease risk assessment and prediction. The pathogens mosquitoes carry can cause human



epidemics that severely impact Florida's tourism industry.

“Our ability to predict high levels of mosquito-borne disease transmission weeks before the onset of the first human case allows public health agencies to attempt epidemic mitigation before a large number of people become infected,” Day says.

1. Plant pathologist Bill Dawson with a citrus plant infected by citrus greening.

2. Entomologist Bernard Okech is studying environmentally safe mosquito repellents.

3. Jonathan Day tracks mosquito-borne diseases from UF's Florida Medical Entomology Lab in Vero Beach.

4. Disease ecologist Dave Smith tracks malaria transmission in Africa.

Andy Tatem and Dave Smith, with funding from the Bill and Melinda Gates Foundation, are working to map and model the spread of malaria in sub-Saharan Africa — using techniques directly applicable to the understanding of the spread of mosquito-carried diseases in Florida.

and Veterinary Medicine — contribute faculty and resources to the institute, which is managed by the Office of Research.

While construction workers were building EPI's home, Morris was building a team to occupy it. He has connected dozens of researchers already on campus and recruited several world-class laboratories and individuals to relocate to Gainesville.

He has also ramped up UF's collaborations with state, national and international agencies and with private organizations.

Under his leadership, and with funding from the World Health Organization, the Bill and Melinda Gates Foundation, the National Institutes of Health, and the U.S. Department of Agriculture, EPI has developed new collaborations with investigators in Africa, Asia, Europe and the Americas.

"There is really no comparable institute anywhere in the United States," Morris says. "There are institutes that deal with a specific pathogen, but our uniqueness is that we cut across



## DRUG-RESISTANT DISEASES

Over the decades, the image of HIV has become indelibly stamped on our national conscience as it devastates swaths of Africa and invades communities here at home. It's a story Floridians know well.

But a lesser-known story is emerging today — one where tuberculosis is the leading cause of death among people infected with HIV, according to the World Health Organization. In fact, TB spread like wildfire among this group and then made inroads into the greater community.

Consider this: One person with active TB will spread the airborne disease to between 10 and 15 others, on average. In 2005 alone, TB killed nearly 1.6 million people, and of these about 200,000 also had HIV-AIDS. Today, a new threat is emerging because the bacterium that causes TB has evolved resistance

to first-line drugs and, in rare cases, even resistance to second-line drugs.

Drug-resistant TB is emerging fast, with about 450,000 new cases per year. Most of these are in China and areas of the former Soviet Union, but these seemingly distant places are only a few hours away by plane.

2005 marked the first year in nine years that Florida's TB cases increased, and nearly 15 percent of the cases were documented in foreign-born people, according to the Florida Department of Health. Those infected with malaria have also seen a decrease in the efficacy of certain drugs, especially in pockets of Asia.

The future is clouded by increasing problems with resistance of these diseases to existing drug therapies. EPI is linking nationally recognized TB clinical investigators such as Mike Lauzardo with scientists such as Charles Peloquin, one of the world's leading experts on TB drug administration and metabolism, and Marco Salemi, who uses molecular techniques to

monitor the spread and evolution of HIV-AIDS.

Their work is guided by data from EPI projects in Morocco and the Dominican Republic, as well as global initiatives where drug-resistant TB is becoming a major public health threat.

By understanding the spread of TB and drug-resistant TB abroad, and



1. Nationally recognized TB investigator Mike Lauzardo.
2. Young girl ill with cholera.
3. Anna Wright displaying wild cultured *Vibrios* and mutant lab *Vibrios* used in research to investigate genes tied to virulence factors.



animal, plant and human pathogens. A lot of attention is being given to what we're doing here."

If there is one thing Morris has learned during his 30 years in the public health field, it's that controlling the spread of disease requires bold, decisive action.

"By the time a problem is identified it frequently is almost impossible to do something about it," he says. "You have to attack before it arrives or as soon as it arrives. That's the moment in time when you've got the ability to stop something in its tracks." ✕

**J. Glenn Morris**

Director, Emerging Pathogens Institute  
(352) 273-7526  
jgmorris@epi.ufl.edu

**Related Web site:**

<http://www.epi.ufl.edu>

understanding how it affects individuals with associated diseases such as HIV-AIDS, Florida will be in a better position to inform both health-care providers at home, and policymakers dealing with immigration, regarding best practices for treatment.

## SOLVING MYSTERIES

At least seven cholera pandemics have occurred since the early part of the 19th century. Even though modern water treatment systems have dramatically reduced the developed world's exposure to the disease, many people in developing countries are still at risk.

As recently as 2009, a widespread cholera outbreak killed 4,000 and sickened 98,000 in Zimbabwe.

EPI links researchers in multiple disciplines across UF's campus and around the globe to investigate how pandemic diseases occur, from the microbial mechanisms by which *Vibrio cholera* bacteria swap virulence genes to how diseases travel through transportation networks such as airports.

In sub-Saharan Africa, microbiologist Volker Mai is working to develop methodologies to identify cholera and other infectious causes of diarrhea.

"Powerful new high-throughput sequence analysis tools allow us to determine the presence of potential pathogens in human and environmental samples with unprecedented sensitivity," Mai says. "We are eager to determine if these tools have utility in the monitoring of outbreaks or in the detection of novel pathogens."

As part of the EPI "cholera team," Mai is working with EPI researchers Afsar Ali and Judy Johnson to understand how the cholera bacterium survives in the environment — and how it is affected by the steady increases in ocean temperature. With pathologist Yuansha Chen, they are also looking at how cholera and cholera-like bacteria evolve, leading to the spread of disease across continents.

And scientists such as Anita Wright are using these same approaches to understand how to reduce the risk of cholera's "first cousins," such as *Vibrio vulnificus* in oysters in Florida.



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