Mosquito-borne viruses affect millions of individuals globally but still little is understood about their transmission, prevalence, associated risk factors and socioeconomic impact. Dr Desiree LaBeaud is working on several projects which aim to uncover more about arboviruses in Kenya.

How did your interest in tropical arboviruses develop and what are the reasons underlying the lack of sufficient funding to support research toward potential preventative and curative therapies?

As a paediatric resident, I spent six weeks in Laos during the monsoon season. A massive outbreak of dengue erupted while I was there and I witnessed the devastation that an arbovirus can cause. From then on I committed myself to studying infectious diseases and global health, and pursued a paediatric infectious diseases fellowship. During these three years, I focused my research on studying the epidemiology of another arbovirus – Rift Valley fever – in Kenya. I continue to work in Kenya on arboviruses today.

I believe the lack of funding for tropical viral infections in particular has a lot to do with the epidemic and episodic nature of these diseases. There is always a progressive loss of institutional memory about how bad they can be. This is ‘the curse of public health’; prevention becomes invisible when it’s working really well. After years of neglecting the health threat that arboviruses pose, people tend to want immediate answers (and results) when outbreaks occur.

What methodology does your research utilise to better understand the prevalence, transmission and burden of these diseases? How can these data be used to better predict and prevent outbreaks?

Our focus is mainly on community-based surveys of populations to identify risk factors for viral exposure and disease. By knowing who is getting exposed, where and when the exposure is occurring, and what specific viruses are circulating, we can work with our Ministry of Health colleagues to dedicate precious public health resources to vector control and health education campaigns.

Why is it a significant challenge for health providers in African countries to accurately identify the specific type of infection in a particular individual?

The most accurate and specific diagnostics are viral detection by nucleic acid sequence (PCR, LAMP) or by culture, but patients in endemic areas often present after the first few days of infection when the virus is no longer detectable in the bloodstream. Other tests, which involve antibody detection, can be performed in district hospitals but depend on reliable electricity and electronics. As a result, diagnosis of an arboviral fever outbreak is often delayed by three-to-four weeks. In the meantime, patients cannot receive vaccinations or get specific antiviral therapy (if it exists). We need to build capacity in at-risk countries, and push diagnosis toward the front lines where outbreaks are likely to occur.

How are results from the study of one arboviral disease applicable to the others?

Each virus is unique. All arboviruses are spread by specific vectors and for that reason knowing which virus is causing an outbreak is crucial for disease prevention via vector control. Because the human disease syndromes and complications of arboviruses overlap, the study of long-term consequences may be generalised to other viruses in some circumstances.

In addition to arboviruses, your research also considers how the burden of parasitic disease affects child development. Do parasitic infections such as malaria, urinary schistosomiasis and lymphatic filariasis have different effects on the health of children compared to that of adults?

You have to think of these infections as chronic inflammatory diseases that take a serious toll, in terms of the energy supply and growth potential, on a child – including their mental development. It has taken time for researchers to recognise the growth stunting and anaemia impacts of such chronic infections, which have many significant consequences for growing children, particularly in the first five years of life. These infections are not in any sense benign. Later, chronic parasite-related disease plus mild cognitive impairment means that children do not reach their full potential. Many of the current anti-schisto and anti-filaria campaigns focus on school-age children and older. In terms of loss of human potential, we need to reconsider what happens to pre-schoolers and younger children who have these infections. The need for much earlier preventive treatment for these infections is an area that should be actively researched.

Can you elaborate on some of the significant challenges that must be overcome to carry out your research in poverty-stricken and remote villages?

Working in remote rural Kenya is very rewarding, but it takes a lot of determination and patience. Specific challenges include lack of reliable electricity, access to village sites and unpredictable climatic events. When it rains, you can’t get there!
Tropical arboviruses and parasitic diseases have detrimental effects on health. Researchers at the Children’s Hospital Oakland Research Institute, USA, are investigating their socioeconomic impact on communities in Kenya, with additional consideration of their interference with the development of children.

**RIFT VALLEY FEVER VIRUS**

Despite the challenges associated with tackling neglected tropical diseases in developing countries, Dr Desiree LaBeaud has dedicated her career to better understanding the risk factors for arboviral infections, the long-term consequences of disease, the development of diagnostic tests that can be administered in the field, and the genetic and immunologic investigation of why different people respond differently to the same infection. Currently based at the Children’s Hospital Oakland Research Institute (CHORI) in California, her work focuses on RVFV, dengue virus, chikungunya virus, West Nile virus, and others, within populations in Kenya.

RVFV causes acute disease affecting humans and domestic animals, which can be transmitted via multiple mosquito species, and passed from animals to humans. RVFV occurs in episodic epidemics and causes retinitis, encephalitis and haemorrhagic fever. The rural communities that suffer repeated outbreaks of RVFV are negatively impacted by the associated loss of work, income and food, and the uncertainties imposed by episodic catastrophes lead to structural and social instability.

LaBeaud’s work on this virus focuses on risk factors for exposure and the long-term consequences of disease. Since 2006 she has completed multiple studies on the prevalence of RVFV exposure in many Kenyan villages, linking seropositivity to demographics, socioeconomic status, mosquito density and other risk factors. Her group demonstrated that older age, male gender and the practice of animal husbandry activities are the main risk factors for RVFV exposure. They also documented hidden long term morbidities in terms of vision impairment, and therefore proposed that vision screening may be a helpful diagnostic tool in rural areas during inter-epidemic periods.

**DENGUE AND CHIKUNGUNYA**

The dengue and chikungunya viruses are different types of arbovirus that are also important...
are to contribute to a deeper understanding of arboviral infections and their long-term health consequences, and to optimise control strategies to prevent these emerging infections. She is passionate about promoting the crucial role of surveillance in preventing exposure as well as improving preparation and planning for outbreaks. “We also need to bring new modalities to the realm of arboviral diagnostics to provide accurate and rapid tests, since that is the first step toward outbreak prevention,” LaBeaud explains.

In sub-Saharan Africa, current routine passive surveillance only detects a fraction of the impact of mosquito-borne viruses

ANTENATAL PARASITIC INFECTIONS

Alongside their arboviral work in Kenya, the CHORI researchers are also working with collaborators from Case Western Reserve University, Ohio, on a project, funded by the Bill and Melinda Gates Foundation, to investigate the impact of parasitic diseases on children in resource-limited tropical communities. There are few studies that have examined at what age parasitic infections begin and the effects that they have on early growth. This work will determine the incidence and prevalence of malaria, filaria, schistosomiasis and soil-transmitted helminthic parasitic infections in pregnant women and their children during the first two years of life. The project team will also analyse the effect of these infections on the child’s response to vaccinations as well as their development.

In preliminary studies, initial data for 180 children demonstrate that parasitic infections begin early in infancy and increase in incidence in the first two years of life, with many children polyparasitised by 24 months of age. LaBeaud also found that if the mother, or the foetus itself, was infected by parasites during pregnancy, physical development was significantly delayed. For example, in the cases of malaria and soil-transmitted helminthic infections, parasitic infection during infancy is associated with decreases in body length and head circumference at 24 months. Furthermore, infected children were found to have lower vaccine titres than uninfected children. Eventually, LaBeaud hopes to elucidate the mechanisms for these effects and determine whether antiparasitic treatment can ameliorate this developmental disruption. Many arboviruses and infectious parasitic diseases cause long-term health consequences that are continually ignored but lead to a great deal of human suffering. “I just hope after I finish my life’s work, I can look back and easily see that I have made an important difference in improving the lives of children in this world,” LaBeaud concludes.