

BRI Research Fellows LECTURE SERIES



Mosquito-borne Disease Surveillance: Can Technology Help Us Find the Needle in the Haystack?

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Molecular methods of detecting viruses have advanced considerably over the years. Mosquito-borne viruses (MBV) such as St. Louis encephalitis virus, Murray Valley encephalitis virus and Japanese encephalitis virus are known killers and have traditionally been monitored using either seroconversions in sentinel animals or virus isolation from mosquito collections. These methods are not without their issues. Sentinel animals, such as chickens and pigs, require increasingly testing animal ethics clearance. Cross reaction between closely related viruses can make results unreliable. Mosquito collections are often very large, requiring laborious pooling of mosquitoes for virus culture that can take several days. It is not a quick sentinel system! And MBV are rare - maybe 1:1000 mosquitoes are infected, a proverbial needle in the haystack. Modern molecular methods (Q-PCR) that can be used to detect viral RNA offer to transform the way we monitor for these viruses. Our lab, together with a network of collaborators, have been approaching the quest for more rapid, sensitive MBV detection system from both the mosquito trapping and virus processing angles. First, we have developed passive box traps that are fanless and don't require batteries... and capture large numbers of mosquitoes. Secondly, mosquitoes within traps are induced to feed on honey-soaked nucleic acid preservative cards (FTA cards) that are then

tested for expectorated viral antigen using PCR. This passive trap + FTA card system (the Sentinel Mosquito Arbovirus Capture Kit; SMACK) has been deployed at several sites across northern Australia leading to detections of MVEV, JEV and West Nile (Kunjin) virus. FTA card (honey card) have also been used in a variety of mosquito traps to detect a range of viruses in Australia. That said, honey card systems are not without their problems. In particular, Ct scores from PCR are generally high, often in the mid-upper 30s, approaching the limit of detection. Traps still require CO₂ and the associated logistics of moving gas cylinders in remote areas. We are exploring methods to improve sensitivity. In one exciting area we are investigating the detection of virus from mosquito excreta. Laboratory studies, and our preliminary results, indicate virus is shed both earlier and in larger amounts than is expectorated in the mosquitoes' saliva. To collect mosquito excreta in the field, we are developing a mosquito loo...a world's first I believe. We are also hoping to work with colleagues to explore floral baits that do not require CO₂, and the use of water rinses to collect viral RNA from captured mosquitoes...a mozzie shower to go with the loo. Hopefully, reliable, sensitive methods to detect MBV in the field will be developed and used to investigate virus ecology as well as serve as a warning system.

Professor Ritchie leads a diverse group of health practitioners and research scientists whose collective goal is to prevent vector-borne disease, especially dengue, in north Queensland. Since its inception in 2005, he has been a PI in the Eliminate Dengue program funded by the Bill and Melinda Gates Foundation. New projects include studying the potential impact of global warming on dengue in Australia, new pesticides for the control of Ae. Aegypti, and development of novel passive mosquito traps for the detection of pathogens in mosquitoes and other disease vectors.

3:00 p.m., Tuesday, August 22, 2017
Lecture Hall, Biosecurity Research Institute
Pat Roberts Hall, 1900 Denison

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