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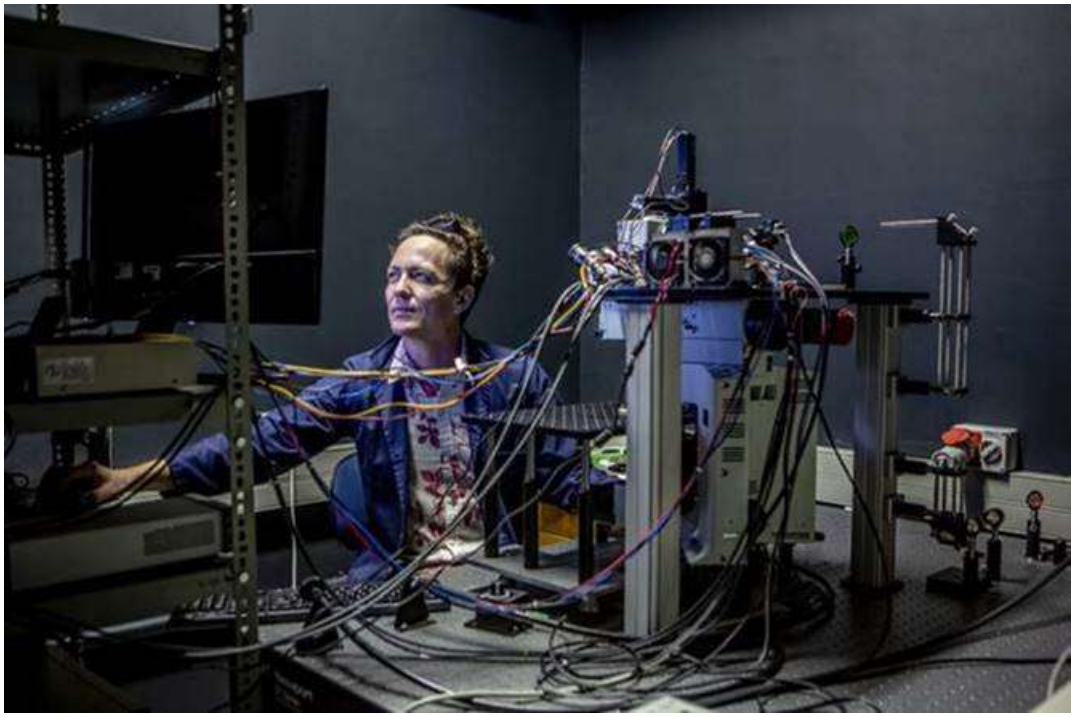
Researcher dives deep into human brain to investigate epilepsy



Dr Joseph Raimondo Photo: Neuroscience Institute

Over 50 million people worldwide live with epilepsy, a neurological disorder that arises from malfunctioning brain networks that result in seizures. Emerging researcher Dr Joseph Raimondo, a senior lecturer in the Department of Human Biology at the University of Cape Town (UCT), is investigating this disorder through his recently awarded Wellcome Trust International Intermediate Fellowship.

Due to seizure-causing brain infections – some of which can be attributed to tapeworm larvae – epilepsy figures in the country are higher than the global average, with one in every 100 people affected with the disorder, according to Epilepsy South Africa. Neurocysticercosis, a preventable parasitic infection that affects the brain, is caused by pig tapeworm larvae. It is one of the most common causes of adult-acquired epilepsy worldwide. The spread of this larva can be particularly problematic in areas where communities' habitats are near the pigs they farm.

Raimondo, a member of the Neuroscience Institute (NI) at the Faculty of Health Sciences (FHS), parallels epilepsy and cancer, saying: "It's a disorder which arises from the necessary function of our bodies. Our bodies need to grow by making new cells; but when cells replicate uncontrollably, we get cancer. Similarly with epilepsy, our brain cells need to communicate with each other and lay down memories; when this process goes awry, we get seizures.

"There are lots of different causes of seizures and epilepsy. If someone is diagnosed with epilepsy, we must find out why, to offer the best treatment to get those seizures under control."

A deep dive into the human brain

Through a new, ethically approved experimental system that makes use of otherwise discarded human brain tissue from brain surgery operations, the research will be combined with some of the latest techniques in neuroscience to explore how neurocysticercosis affects the brain.

"This is a unique collaboration which the NI enables between my team and local neurosurgeons like Anthony Figaji [a professor based at the Red Cross War Memorial Children's Hospital, whose research work in the NI focuses on paediatric neurosurgery and brain disorders relevant to the South African context]. Through his work he has allowed rare access to human brain tissue removed during surgical treatment for epilepsy," said Raimondo, who is also a member of the Institute of Infectious Disease and Molecular Medicine, based at FHS.

The epilepsy-causing larvae can't be studied in any kind of detail in live humans, and animal models don't always work well in simulating what's going on in the human body. Raimondo does use animal models when applicable in some of his epilepsy research; but in this type of study, they would not be ideal.

"We're getting the tapeworm that infects humans by harvesting them from pigs. We're getting human brain tissue from people having surgery to treat epilepsy or other disorders – the tissue is normally discarded once removed, and instead can now help contribute to understanding how to manage brain conditions in the future. We can then treat the brain tissue with the tapeworm larvae and see what they do to the brain. This is all made possible by this important collaboration."

The researchers are investigating three aims:

- determining how tapeworm larvae affect inflammation and cell death
- exploring how these larvae affect networks of nerve cells to cause seizures
- using powerful new genetic techniques to measure changes in the expression of genes in individual brain cells following exposure to these larvae.

The combination of these investigations will result in substantial gains in the study of inflammation, nerve cell networks and genes in the human brain. Through the grant, Raimondo will pursue his dual passions for investigating the basic mechanisms of how the brain works, while growing the understanding of a condition that affects the health of South Africans – ultimately to help improve their quality of life.

Raimondo's lab works with high-tech equipment: patch clamp electrophysiology, with little robotic arms that precisely control glass electrodes to record their electrical signalling and

observe how brain cells talk to each other. In addition, there are powerful microscopes, which magnify the view of individual brain cells so their activity can be observed.

"It's a unique opportunity that couldn't be done anywhere else. You have to have sophisticated neurosurgery, where you can get the brain samples; access to rural areas, where close proximity to pigs can increase the chances of exposure to infection; and people who care about a disorder that doesn't really occur in the Global North, and who have the expertise to study it at a very detailed level," Raimondo said.

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