Livestock diseases are a major impediment to the livelihoods of cattle farmers in Africa. Vaccines are among the most successful disease interventions invented and they can significantly improve the lives of animals and the livelihoods of people. This project aims to increase cattle productivity through the development of improved vaccines for the control of East Coast fever (ECF).

ECF is caused by the protozoan parasite *Theileria parva*. It ranks first in tick-borne diseases of cattle in sub-Saharan Africa and kills one animal every 30 seconds. It has a devastating impact on pastoralists and smallholder farmers because it can kill within 3–4 weeks of infection.

ECF is present in 12 countries. It is estimated that about 60 per cent of the 75 million head of cattle in the endemic region—roughly 45 million animals—are at risk. Over one million cattle die of East Coast fever each year costing farmers in excess of $300 million.

Project goal
To design subunit vaccines for the control of East Coast fever.

Phase 1 activities
In phase 1, the project will undertake a work along the research to product development continuum to:

• Improve aspects of the current sub-optimal live (infection and treatment method - ITM) East Coast fever vaccine;
• Fill knowledge gaps on qualitative and quantitative aspects of acquired immune responses that mediate immunity to East Coast fever;
• Test the vaccine potential of candidate vaccine antigens and develop a more detailed antigen map.

Outputs from this phase will contribute in the short-term to produce a better quality live vaccine as an interim vaccine solution.

It will also provide proof-of-concept for an East Coast fever subunit vaccine with evidence of protection in 70–80% of animals of defined histocompatibility complex (MHC) genotype given a homologous parasite challenge. Success in phase 1 will contribute to our goal to develop a broad-spectrum subunit vaccine (phase 2).

Project objectives
1. To improve aspects of the current live ITM East Coast fever vaccine. This is a short-term objective over two years that should give rise to methods to determine viable sporozoite counts and relate this to infectivity, which will enable downstream improvements to be made to the production of the ITM vaccine; e.g., stabilate titration, pre-determining smaller dose sizes and testing new cryo-protectants.

   Key milestone: a new method for viable sporozoite counts.

2. To induce antibody based immunity by targeting the sporozoite stage of the parasite. This is a medium-term objective over 2–4 years, which should result in re-assessment of the role of known as well as novel sporozoite molecules as candidate vaccine antigens.

   Key milestones: a denser map of sporozoite antigens and evidence of a role for antigens in a subunit vaccine.

3. To induce T-cell mediated immunity by targeting the schizont stage of the parasite. This is a medium-term objective over 4 years, which will improve our knowledge on how the process of ITM works, assess a variety of antigen delivery systems for priming cytotoxic T lymphocytes (CTLs) in cattle and identify new schizont T cell antigens.

   Key milestones: role of other cells in priming CD8+ T cells, molecular signatures of protection, a denser map of schizont antigens, proof-of-concept of a schizont vaccine.
4. Application of evolutionary and comparative pathogen genomics to ECF vaccinology. This is a medium-term objective over 3 years, which will improve genomic resources for T. parva.

Key milestones: improved genome annotation, antigen identification and a map of genetic variation.

5. To test if a combined antibody and T-cell mediated immune response is more efficacious than either one alone. This is a medium-term objective in the second half of the project, to test if targeting immune responses to both the sporozoite and schizont stage of the parasite works synergistically. These experiments will be especially useful in testing of sporozoite and schizont antigens if isolation does not provide high levels of immunity.

Key milestone: proof-of-concept vaccine targeting two parasite stages.

Project partners
The project is implemented by a team of experts from the fields of East Coast fever research, bovine immunology, parasitology and genomics, with essential inputs from a private-public partnership and the private sector.

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Project structure and management

The consortium of organizations investing in the project comprises the International Livestock Research Institute, Institute of Tropical Medicine at Antwerp, GALVmed, the Centre for Ticks and Tick-Borne Diseases, the Institute for Genome Sciences at the University of Maryland, the Roslin Institute at the University of Edinburgh, the Royal Veterinary College, the United States Department of Agriculture-Agricultural Research Service and Washington State University.

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