THE Pirbright INSTITUTE

# SCIENCE STRATEGY
## 2026-2028

# A National Capability

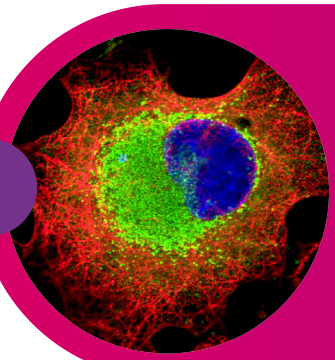
## The Pirbright Institute is a critical National Capability, helping to protect the UK and the rest of the world from existing and emerging viral threats.

Core funded by UK Research and Innovation's Biotechnology and Biological Sciences Research Council (UKRI-BBSRC), Pirbright is an essential partner within a network of international organisations controlling disease outbreaks.

Our world-class science to understand, predict and prevent viral diseases helps secure our food supply and improve animal, human and planetary health.

We address key questions in fundamental science to generate a new understanding of host-virus interactions and translate new knowledge into disease control for animals and humans.

# Reducing the burden of livestock diseases to help:



## 1 Protect the UK and global agriculture industry from viral threats

**A.** global disease surveillance linked with epidemiological modelling reduces disease threats

**B.** applied research to develop new and targeted control measures prevents outbreaks and limits disease spread

## 2 Increase agricultural efficiency to improve health and welfare

**A.** improved animal health increases productivity and quality of life for animals

**B.** fewer, more resilient animals reduce inputs and waste, decreasing the carbon footprint of livestock farming

## 3 Mitigate the increasing threat of vector-borne diseases driven by climate change

**A.** measuring vector competence predicts viral transmission

**B.** understanding vector ecology informs disease control measures

## 4 Improve human health by understanding vaccine induced protection

**A.** world-class fundamental research on natural host responses informs vaccine design, development and deployment

# **Pirbright** supports animal and human health by responding to threats in real time.

## Informing global policy on avian influenza

**Avian influenza (A), commonly known as bird flu, is a threat to humans and the worldwide poultry industry. Viruses responsible for all four global human influenza pandemics of the 20th and 21st centuries originated from birds. Investment in bespoke high containment facilities, expert researchers and fundamental science including vaccine development, breeding and diagnostics, underpins Pirbright's standing as a global authority on bird flu.**

Many Institute groups study areas including how bird flu can jump from birds to humans or other mammals, how bird immune systems react to the virus, and how Low Pathogenicity Avian Influenza, which causes mild symptoms in birds, can change to High Pathogenicity Avian Influenza, with high mortality rates.

In 2021, scientists at Pirbright developed a new technology to target vaccine delivery in the host, which triggers a faster and stronger immune response among chickens infected with the H9N2 strain of the virus. Any future vaccine candidates could be produced efficiently in a laboratory culture of insect cells.

Our work to map the movement of bird flu, predict its evolution and assess its risk helps inform proactive and reactive control strategies worldwide.

## A pig model for human respiratory viruses

**The One Health approach recognises deep connections between the wellbeing of humans, animals and the environment. Scientists at The Pirbright Institute use animal models to understand and tackle diseases that affect animals and people.**

Pirbright pioneered the use of pigs as a model to study human immune responses to influenza and coronaviruses and evaluates novel vaccines and therapeutics to prevent disease and transmission of respiratory viruses.

Flu research traditionally used small-animal models, particularly ferrets. Pirbright demonstrated the advantages of pigs, which are large natural hosts for influenza viruses and are biologically and physiologically more like humans.

Pirbright fosters collaboration with the University of Oxford's Pandemic Sciences Institute and the Gates Foundation, who promote data-sharing and coordinated responses to emerging threats.

Pirbright's work exemplifies our One Health commitment to developing novel vaccine and therapeutic strategies to improve global health and strengthen preparedness for future outbreaks.

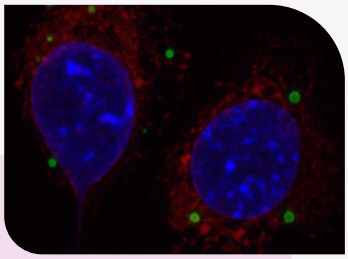
## Preventing foot-and-mouth disease

**Foot-and-mouth disease virus (FMDV) can spread rapidly in livestock, often making outbreaks difficult and expensive to control. During 2025, two separate incursions caused outbreaks in Germany and Hungary/ Slovakia, where costs may exceed €1 billion.**

FMD remains one of the highest animal disease risks identified by UK Government. Pirbright is the National Reference Laboratory (NRL), maintaining capability to rapidly respond to suspect cases 365 days a year and providing expertise to Defra.

With more than 80 years' FMD experience, Pirbright research improves global disease control. Combining expertise in virology, immunology, pathogenesis and genetics, we study how the virus transmits, grows and causes disease. We translate this knowledge into new, more potent vaccines and a better understanding of emerging viruses and disease control. Existing and new vaccines are matched to different disease outbreaks globally, improving diagnostic capability and virus surveillance.

Pirbright manages the largest global archive of FMD samples through its work as FAO's World Reference Laboratory for FMD, and as a reference laboratory for the World Organisation for Animal Health (WOAH), supporting disease control in endemic countries. We are committed to data sharing (OpenFMD: www.openfmd.org) and training veterinarians and laboratory staff from Asian and African countries where the disease is endemic.



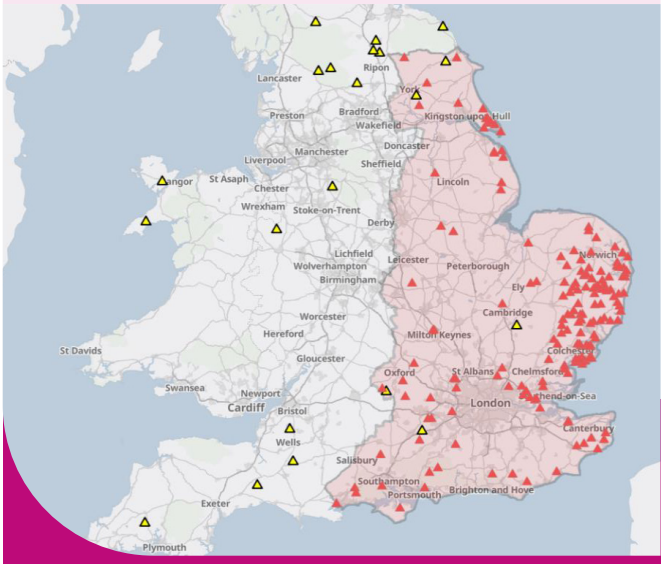
## Countering bluetongue virus

**Pirbright's role as a National Capability helped to determine the extent of the 2023 bluetongue virus 3 (BTV) incursion into the UK and the risk to farmers. Spread primarily by biting midges, BTV causes disease in sheep, cattle, and other ruminants, and the virus has spread widely in northern Europe.**

Pirbright is the National Reference Laboratory for BTV and undertakes complimentary fundamental research that together provide evidence to policy makers to support disease control measures.

The refence laboratory has tested approximately 200,000 UK samples from November 2023 to date and continues to monitor seasonal disease dynamics and midge activity through a network of insect traps. The severity of the virus to UK cattle and sheep breeds has been determined using unique lines of infected midges in controlled animal infections. Together with the Met Office weather data, Pirbright has also predicted disease spread across the UK to further support policy decisions.

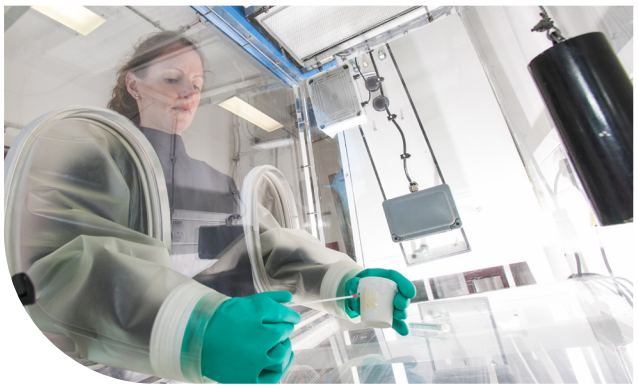
Policies associated with designations of control zones and movement restrictions were informed by the results of Pirbright's diagnostic testing and reactive research, helping to reduce viral spread and prevent significant losses of rural income and animal lives.

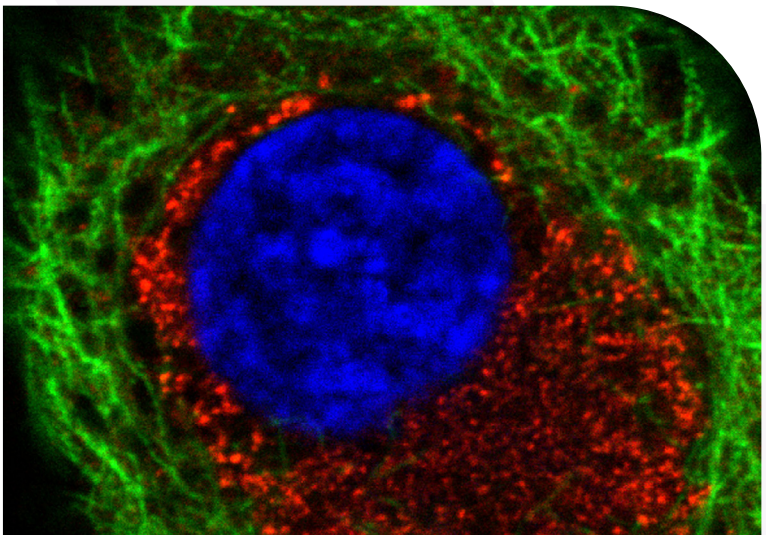


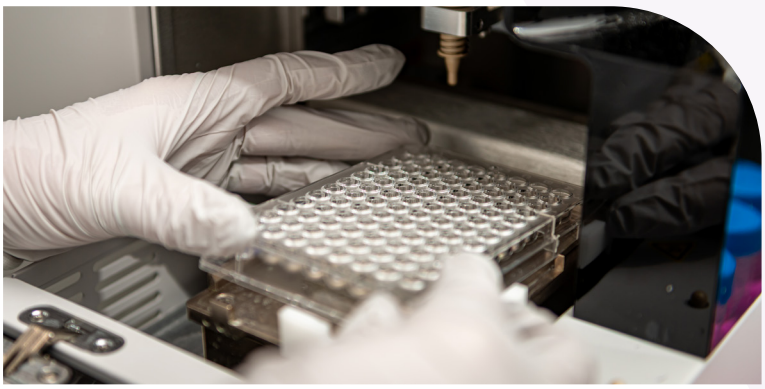

*Bluetongue case map showing the extent of the Restricted Zone and Infected Area (RZ) due to Bluetongue serotype 3 (BTV-3) as of 15/12/2024, as well as the location of positives detected through tracing tests (yellow triangles) and due to other tests (red triangles).*

# Our deliverables: **Years 1-3, 2026-2028**

| Output | Outcome |
|---|---|
| A survey of insect viral vectors in India | Improved prediction of LSDV transmission in India |
| Genetically engineered midges and mosquitos | Identification of targets to reduce viral transmission and develop a mechanistic understanding of viral replication |
| A synthetic poxvirus genome | Rapidly identify host-specific restriction factors. Inform transmission models, identify new control measures and increase host resilience |
| Established *in vitro/ex vivo models*, e.g. advanced 3D and organoid models, that reduce our reliance on animal experimentation | A reduction in animal use and an increase in experimental throughput |
| Methods to better characterise porcine germinal centres in lymphoid organs | Better understanding of immune responses to vaccination and infection |
| High-throughput and high-resolution analysis of protective immune responses against ASFV, IAV, PRCV and FMDV | Improved correlates of protection and vaccine design to increase efficacy and cross-protection |
| Physical methods to reduce midges biting livestock | Reduced vector-borne disease transmission |
| Genomic surveillance tools benchmarked across aquatic, animal and plant diseases | Faster and more integrated genomic disease surveillance across the UK to better control disease threats |
| Identification of mammalian receptors for avian IAV | More advanced risk assessment and pre-emptive control measures |
| Define the contribution of T and B cells in the protective response to ASFV | Establish correlates of protection to support ASFV vaccine development |
| Identification of restriction factors of viral replication that contribute to differential species-specific outcomes for FMDV, SVDV and ASFV. | Understand the mechanisms of differential pathology across susceptible species and breeds.<br>Gene targets identified to support the development of disease-resistant livestock species. |







| Output | Outcome |
|---|---|
| Characterise reassortment of segmented orbiviruses | Predict potential novel BTV viruses leading to epidemics |
| Define adaptation of IAV haemagglutinin protein in various avian species | Informing policy on risks of avian IAV in wild and domestic bird species |
| Integrate experimental data into existing models of viral disease outbreaks. | Increased accuracy of models to feed into policy decisions |
| Define the link between metabolomics and viral disease outcomes for IBV and MDV | Identification of biomarkers associated with metabolomic changes and antiviral targets |
| Combined multiple omics datasets to determine the genetic basis of MD resistance in chickens | Identification of targets to develop improved vaccines and control measures.<br>Gene targets identified to support the development of disease-resistant chickens. |
| Single cell and spatial transcriptomics applied to IBV, PRCV, PRRSV, IAV and ASFV infected tissues | Better prediction of disease outcomes through development of a livestock single cell atlas |
| Defined mechanisms of enhanced influenza pathology cause by coinfection with immunosuppressive viruses | Enhanced control measures for influenza |
| Further refinement of the pig as a robust, high-fidelity model for respiratory viruses | Improved prediction of human vaccine and therapeutic efficacy. Better assessment of transmission-blocking potential of novel therapeutics |
| Assessment of strategies to induce and harness mucosal immunity during IAV infection | Improved mucosal vaccines and delivery systems. Identification of correlates of protection to support clinical trials |
| Expanded antibody libraries from natural host species against IAV, PRRSV, FMDV, BTV and ASFV | Identification of new protective epitopes to support vaccine design. |
| Improved RNA vaccine scaffold with high antigen production and lower host adverse effects | Improved vaccine design to increase efficacy |

**Abbreviations:** ASFV - African swine fever virus; BTV - Bluetongue virus; FMDV - Foot-and-mouth disease virus; IAV - Influenza A virus; IBV - Infectious bronchitis virus; LSDV - Lumpy skin disease virus; MDV - Marek's disease virus; PRCV - Porcine respiratory coronavirus; PRRSV - Porcine reproductive and respiratory syndrome virus; SVDV - Swine vesicular disease virus.

# Culture

We are proud of our culture based around trust, inclusivity and excellence.

## Trust:

We are a globally trusted source of advice, knowledge and collaboration and are continuing to embed the principles of trusted and responsible research into all our activities.

## Inclusivity:

Our open culture provides an environment where everyone can achieve their potential, which in turn maximises the impact of our science. This also allows us to focus our efforts to continually improve our culture in the areas that have the most benefit for our staff.

## Excellence:

World-class bioscience underpins all our activities, from research integrity and open science to providing training and policy advice.

## Connectivity

Global collaboration is essential to deliver our impact. Access to our National Capability is driven through our global networks of disease surveillance and control, and scientific collaborations. We invest in expertise and technologies to minimise barriers to access and maintain our scientific excellence. Training the next generation of scientists for the UK and beyond maintains a network of trusted knowledge and information sharing.

## Capability

- Global collaboration is essential to deliver our unique high-containment research facilities to study animal pathogens in natural hosts.
- High-containment engineering and biosafety expertise
- International reference laboratories
- World-leading animal welfare expertise and standards
- Collections of arthropod vectors

Delivery of our science strategy requires a critical mass of knowledge and expertise as well as highly specialised infrastructure. Pirbright acts as an agile hub for research and innovation, rapidly responding to the evolving demands of studying high-consequence viruses.

## As a National Capability we achieve this through a combination of the following:

### Laboratories

- Unique infrastructure including the BBSRC National Virology Centre: The Plowright Building, and the BBSRC National Vaccinology Centre: The Jenner Building
- Expert research technical professionals to operate and manage highly specialised laboratories

### Animal experimental facilities

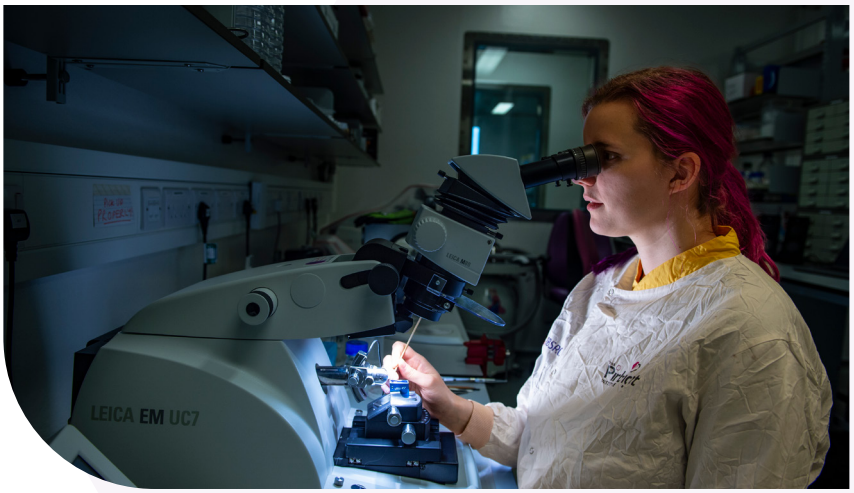
- High and low containment, specialists *in vivo* experimental facilities, with animal welfare considerations at their core
- Extensive insectary facilities used to produce unique lines of midges, large biting flies, and mosquitoes
- Skilled and highly trained technical professionals who continually foster a culture of care and strive to exceed standards, ensuring that animals are treated with compassion, and respect, and applying the 3Rs – replacement, reduction and refinement – in all animal research

### Biocontainment expertise

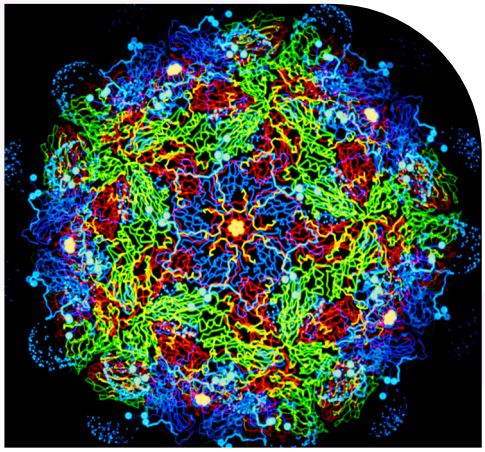
- A vast and diverse array of specialist knowledge, expertise and innovation in engineering, and building monitoring supports the substantial requirements to manage and operate specialist facilities and infrastructure
- Through a dedicated cohort of specialist staff, we maintain rigorous standards of risk and quality management

# Science Technology Platforms

## Pirbright makes significant investment in new technologies and associated experts to drive our scientific impact.



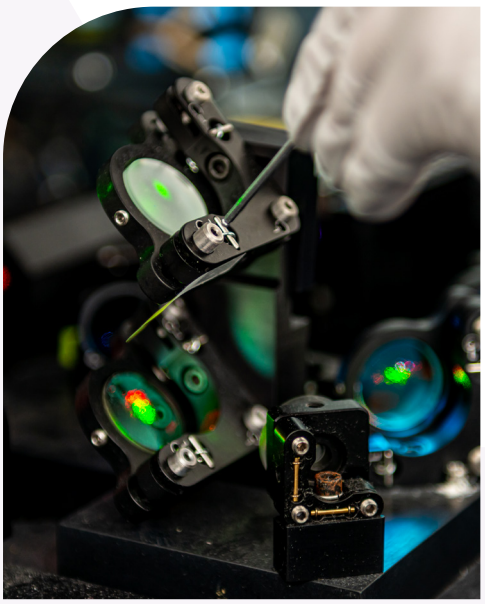

**High-throughput Sequencing** – Providing access to next-generation sequencing capability across both high and low containment, using both short (Illumina) and long read sequencing technologies (Oxford Nanopore). Our facilities deliver robust workflows, leveraging the combination of automated liquid handlers and manual expertise, which enables us to process a wide range of samples, from both DNA/RNA viral pathogens of transboundary importance and their livestock hosts.



**Bioinformatics** – Focused on the development and delivery of robust and cutting-edge data analysis pipelines for *de novo* assembly of DNA/RNA viruses, RNA-sequencing analysis and tools aimed at the evolutionary analysis of viral/host sequences. Supported by a high-performance computing cluster to provide modern cutting-edge high speed data analysis capability.

**Flow Cytometry** – Provides researchers with advanced instrumentation and cell sorting services in low- and high-containment laboratories. This includes flow cytometry theory and instrument training, access to user operated analysers, cell sorting, software training, and consultation in experiment planning, panel design and data analysis.

**Containment Level 3 Laboratories** – The core CL3 facility encompasses two laboratory suites capable of handling group 3 hazards defined by the UK Advisory Committee on Dangerous Pathogens. In addition, both suites are equipped to store and handle dangerous Schedule 5 pathogens.



**Bioimaging** – A broad scope of imaging and analytical techniques available and operated by our experts, from confocal microscopy to electron tomography. Microscopes are in both the high containment and low containment buildings making them accessible to any research project.

**Cell Culture** – Providing highly valuable primary cells and maintaining over 100 different animal and human secondary cell lines. Supports the development of tailored *in vitro* models in line with our dedication to the 3Rs principles, aligning with the UK strategic roadmap for replacing animals in research.

**Immunological Toolbox** – Comprises a repository of antibodies, reagents and resources to advance veterinary immunology research globally, including production of over 500 monoclonal antibodies, hybridoma sequencing and recombinant antibody engineering and production.

**Insect Transgenesis** – Specialises in generating genetically modified insects, including transgenic and knockout lines, and the application of advanced molecular tools to analyse and validate genetic modifications.

## Major stakeholders

- UKRI-BBSRC
- Defra
- Other UK funding agencies
- International funding and disease control agencies, WOAH, FAO, WHO, EU, Gates Foundation
- Animal health companies
- Animal breeding companies
- Farmers and livestock keepers

## Key UK delivery partners

- Animal and Plant Health Agency (National Biosecurity Centre)
- Centre for Proteome Research, University of Liverpool
- electron Bio-Imaging Centre (eBIC) at Diamond Light Source
- Met Office
- MRC University of Glasgow Centre for Virus Research (CVR)
- Pandemic Sciences Institute, University of Oxford
- The Roslin Institute
- Royal Veterinary College
- United Kingdom Health Security Agency

defra
Department for Environment Food and Rural Affairs

UKRI
Biotechnology and Biological Sciences Research Council

World Health Organization

World Organisation for Animal Health

**The Pirbright Institute**. Ash Road
Pirbright, Woking, GU24 ONF

enquiries@pirbright.ac.uk

+44 (0) 1483 232441

www.pirbright.ac.uk

**Follow us on LinkedIn**

**Sign up to our newsletter**

For printed copies of this report, contact communications@pirbright.ac.uk