STAR IDAZ International Research Consortium on Animal Health

Executive Summary of Priority Research Needs: Foot-and-Mouth Disease

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STAR IDAZ IRC is the 'Global Strategic Alliances for the Coordination of Research on the Major Infectious Diseases of Animals and Zoonoses - International Research Consortium'. It is a global consortium that brings together funders and programme owners for research on animal health to maximise funding for coordinated animal health research. To achieve its aim, STAR IDAZ facilitates networking among funders, researchers, industry experts, policymakers and other stakeholders to collaborate on research and innovation in the field of infectious animal diseases. This document was produced by SIRCAH, the Scientific Secretariat of the STAR IDAZ IRC.

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More information on STAR IDAZ IRC can be found at www.star-idaz.net

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Executive Summary of Priority Research Needs: Foot-and-Mouth Disease (FMD)

Research priorities for foot-and-mouth disease

Foot-and-mouth disease (FMD) is one of the world's most significant livestock diseases, affecting trade, livelihoods, and food security. The STAR IDAZ International Research Consortium (IRC) has developed coordinated research roadmaps on FMD to accelerate the development of improved diagnostics, vaccines, and control strategies for this major transboundary animal disease.

The roadmaps focus on three key areas:

1. Diagnostics
2. Vaccines
3. Control strategies

These areas include the development of rapid field diagnostics, next-generation cross-protective vaccines, improved epidemiological models, strengthened surveillance systems, and socio-economic integration to support global FMD control and eventual eradication.

STAR IDAZ IRC and foot-and-mouth disease

The STAR IDAZ IRC is a global initiative that brings together research funders and programme owners to coordinate and accelerate research on major infectious diseases of animals, including transboundary and zoonotic pathogens. FMD is a core priority for the consortium because of its significant impact on livestock health, productivity, livelihoods, and international trade. FMD remains endemic in many regions of the world, with continuous viral evolution and the circulation of multiple serotypes and topotypes posing major challenges for disease control. Through its coordinated approach, STAR IDAZ IRC promotes strategic alignment of research agendas, fosters collaboration among leading experts and institutions, and supports the development of innovative diagnostics, next-generation vaccines, and evidence-based control strategies. The aim is to fast-track the delivery of improved tools and solutions that enable global progress toward the progressive control and long-term eradication of FMD.

Main research priorities identified for foot-and-mouth disease based on the STAR IDAZ IRC roadmaps

1. Diagnostics

- Develop rapid, reliable pen-side diagnostic tests, including antigen detection and serotype/strain determination.
- Advance DIVA-compatible assays for distinguishing vaccinated from infected/exposed animals.

- Improve genetic and antigenic typing tools, especially for vaccine matching across globally circulating topotypes.
- Validate new diagnostic tests across all serotypes, including real-field conditions in endemic regions.
- Expand portable, field-adapted molecular platforms (RT-LAMP, isothermal PCR, portable PCR).
- Identify biomarkers for early, peri-clinical, subclinical, and carrier detection.
- Develop herd immunity tests correlated with vaccine efficacy.
- Strengthen diagnostic validation systems, including access to sample banks and archived materials.
- Establish new expression systems enabling safe production of diagnostic reagents outside BSL-3 laboratories.
- Improve understanding of host–pathogen interaction for identification of new diagnostic targets (antibodies, cellular responses, persistence markers).
- Oral swabs show equivalent sensitivity to nasal swabs for detecting active infection offering a potential improvement for sampling strategies.
- Equity of diagnostic access is a socio-economic diagnostic gap, access to high-quality testing varies across regions.

2. Vaccine development

- Develop genetically stable, highly efficacious DIVA-capable vaccines with:
    - Rapid onset of immunity (0–4 days)
    - Long-lasting protection
    - Prevention of infection, including sterile immunity
    - Strong efficacy in cattle, pigs, and small ruminants.
- Improve cross-protection across serotypes and antigenic lineages.
- Advance next-generation platforms:
    - DNA/RNA vaccines
    - Virus-like particles (VLPs)
    - Rationally attenuated vaccines
    - Vectored vaccines
    - Subunit/peptide vaccines.
- Improve potency, antigen stability, and reduce antigen payload needs.
- Develop suitable adjuvants capable of stimulating strong VN-Ab and cellular responses.
- Design standardised challenge models to evaluate vaccine performance.
- Overcome production constraints: adapting field strains to cell culture; reducing cellular toxicity in expression systems.
- Explore intradermal vaccination for improved immune responses and potential sterile immunity.
- Pirbright's anti-VP4 ELISA for assessing capsid integrity fills a key gap in vaccine quality control and could be added as a roadmap component.
- WOAH FMD vaccine chapter is under revision, thus future regulatory and quality standards may shift.

3. Control strategies

- Establish a global FMD surveillance system with real-time, high-quality information on viral circulation and risk assessment.

- Improve epidemiological understanding of transmission, persistence, hotspots, and cross-border spread.
- Develop mathematical and simulation models to:
    - Predict spread
    - Evaluate vaccine strategies
    - Assess cost-effectiveness
    - Optimise sampling strategies.
- Integrate socio-economic and behavioural factors into control strategy design (farmer compliance, compensation schemes, market dynamics).
- Develop LMIC-appropriate control approaches, including accessible vaccination and improved biosecurity.
- Strengthen stakeholder communication and acceptance, including farmer participation, public opinion, and awareness of disease burden.
- Improve understanding of costs and benefits of different control strategies (culling, vaccination, movement control, surveillance).
- Evaluate biosafety risks related to transportation of inactivated virus in diagnostic kits.
- Develop harmonised disinfection protocols and low-cost disinfectants for FMD virus inactivation under farm conditions.
- Advance tools for biotherapeutics capable of providing rapid, short-term antiviral protection.
- Recombination in carrier animals appears to be an important driver of antigenic variation, a missing element in current virology and control sections.
- Behavioural economics, equity of access to diagnostics and vaccines, and better accounting of outbreak versus routine control costs are critical socio-economic gaps

4. Epidemiology and data integration

- Improve global integration of molecular, antigenic, and epidemiological data to support real-time risk assessment.
- "Open FMD" (Pirbright World Reference Laboratory database) should be added as a core global data source for antigenic and genetic results.
- Support development of tools to map movement networks and quantify high-risk transmission pathways.
- Integrate field data with modelling outputs to support decision-making and resource allocation.

5. Conclusion

The updated FMD research roadmaps highlight a clear set of priorities across diagnostics, vaccines, epidemiology and control strategies. These priorities reflect both long-standing scientific challenges and the most recent gaps identified by the global FMD research community. Accelerating progress requires the development of rapid DIVA compatible diagnostics, next generation vaccine platforms and strengthened surveillance systems, as well as deeper understanding of virus evolution, transmission dynamics and host pathogen interactions. This includes new evidence on recombination in carrier animals and improved sampling approaches such as oral swabs.

The socio-economic and behavioural dimensions of FMD control are equally important. Ensuring equitable access to diagnostics and vaccines, understanding the behavioural drivers of compliance and accurately capturing the costs of routine control and outbreak management

are now recognised as essential elements of an effective global strategy. Tools such as OpenFMD and the GBADs dashboards and Model Builder offer valuable opportunities to enhance data-driven decision making and resource allocation.

In this context, the STAR IDAZ IRC supports the alignment of global research priorities, encourages scientific cooperation and contributes to the development of innovative tools that can accelerate progress. Addressing the identified gaps, both scientific and socio-economic, will be essential for advancing toward the long-term goal of reducing the global burden of FMD and supporting resilient livestock systems, sustainable livelihoods and global food security.

GFRA and STAR IDAZ FMD Roadmap Development

The Global Foot and Mouth Disease Research Alliance (GFRA) has played an important role in strengthening international scientific collaboration on FMD. Over the years, GFRA and its network of experts have organised workshops and scientific meetings that helped identify and refine research needs in areas such as epidemiology, diagnostics, vaccines and virology. Through regular exchanges between GFRA scientists and members of the STAR IDAZ IRC expert groups, the latest scientific knowledge, emerging challenges and newly identified gaps have been shared and discussed. These contributions have informed the updates of the FMD research roadmaps within STAR IDAZ and ensured that the priorities remain aligned with global scientific developments. Recent updates, including advances in diagnostic sampling, vaccine quality assessment, understanding of antigenic variation, recombination and socio-economic drivers, reflect the valuable inputs provided through the GFRA community. The refined roadmaps have been reviewed and validated by the STAR IDAZ Scientific and Executive Committees.

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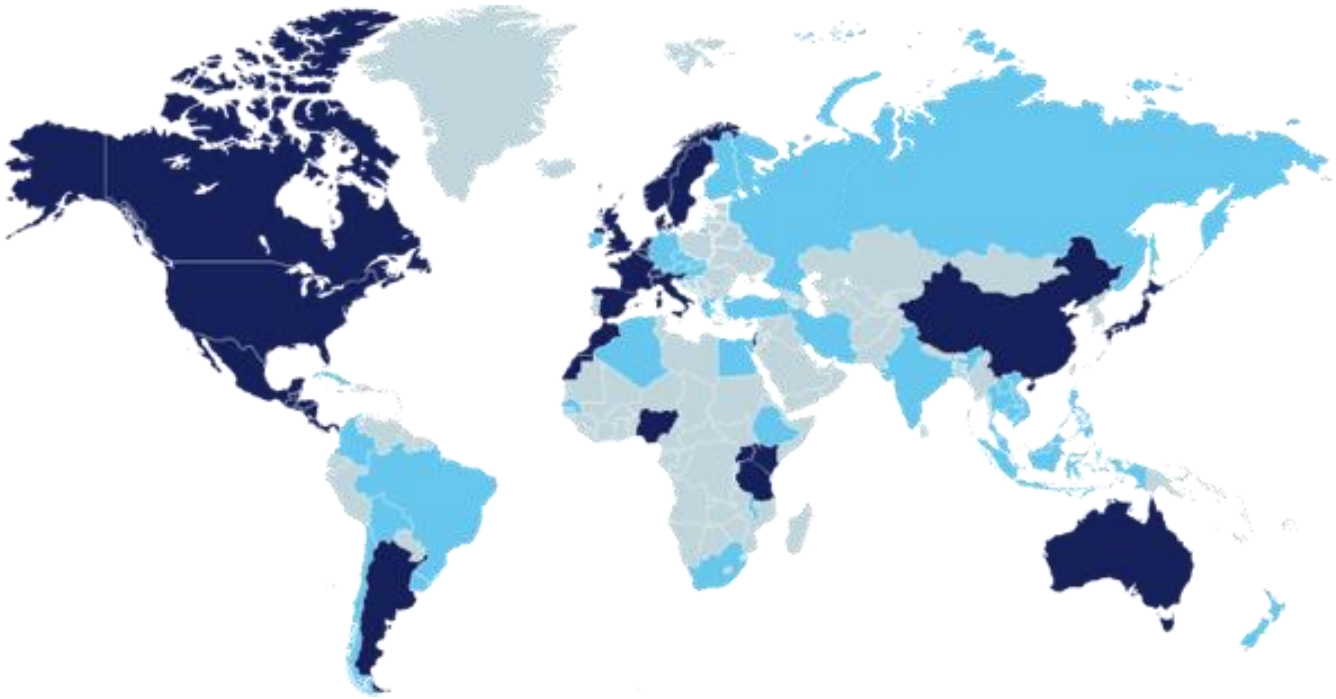

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