



Global Foot-and-Mouth Disease Research Alliance (GFRA)

Fighting foot-and-mouth disease together



**The Global Foot-and-Mouth Disease Research Alliance (GFRA):
A worldwide association of animal health research organizations to assist the
global control and eventual eradication of foot-and-mouth disease**

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Foreword

The Global Foot-and-Mouth Disease Research Alliance (GFRA) aims to increase our fundamental knowledge of foot-and-mouth disease (FMD), and to use that knowledge to develop new tools to assist the control and eventual eradication of the disease. The Alliance provides a forum in which current research and future plans can be discussed in an environment of trust and confidentiality.

The development of new tools is, however, only one element of the global effort to eradicate FMD, and synergistic interaction with key stakeholders involved in regional control programs is essential. GFRA is already active in this regard, and the backing and activities of the Alliance have been instrumental in developing collaborative agreements, initiating joint programs of work and securing substantial funding. GFRA members currently manage a research budget of over US\$10 million dedicated to the global control and eradication of FMD.

We will hold regular meetings of GFRA members and plan to organize open GFRA forums, usually in conjunction with international conferences. It is hoped that the detailed discussions and interactions resulting from these open forums will encourage sharing of research outcomes and facilitate a process of identifying and prioritizing appropriate areas for research into FMD.

GFRA offers an exciting opportunity to gather together the different strands of FMD research that are being pursued worldwide and focus them in a collaborative effort that has the potential to finally make telling inroads in combating the disease on a truly global level.

GFRA Executive Committee



Vision of GFRA

A coordinated global alliance of scientists producing information and innovation to enable the progressive control and eradication of foot-and-mouth disease

Mission of GFRA

To establish and sustain global research partnerships to generate scientific knowledge and discover the tools to successfully prevent, control and eventually eradicate foot-and-mouth disease

Background to GFRA

While 130 years of impressive research by dedicated institutions has amassed a body of knowledge on FMD and enabled its eradication from some areas of the world, major gaps remain in our understanding of the disease and how to combat it.

The problems are too great to tackle alone.

GFRA, therefore, aims to build a consortium of institutions conducting research into FMD to provide the scientific evidence and tools needed to control FMD in both FMD-free and FMD-endemic countries.

Only by maximizing the available resources and expertise, through international collaboration, can FMD be tackled effectively in the future.

GFRA in a nutshell

Why?

Foot-and-mouth disease (FMD) is highly infectious and remains a threat to livestock production and trade worldwide. Through the efforts of research centers we've learnt a lot about this complex disease – now is the time to accelerate progress by working more closely together.

Who?

Launched in 2003, GFRA is a worldwide association of animal health research organizations who are involved in combating FMD. Its aim is to build a global alliance of partners to generate and share knowledge – in a virtual FMD laboratory – to develop tools that can better combat the disease.

How?

Collaborative research is central to the fulfillment of GFRA's vision and mission. GFRA members act as focal points in putting together strong teams, drawing in other institutions with the specific skills required to achieve the aims of a particular project.

Five strategic goals, encompassing 18 objectives, give structure to the overall process.

What next?

GFRA will continue to build the Alliance by adding new members and reaching out to partners and stakeholders worldwide. It will organize and hold regular meetings, will further develop its website and other outreach media, and will pursue funding opportunities in its effort to combat FMD through more effective research outcomes.

How can I help?

Find out more about GFRA membership, programs and activities by visiting our website at

<http://www.ars.usda.gov/gfra/>,
or email us at
ars-gfra@ars.usda.gov.

Some basics

What do we know?

- FMD was the first animal disease shown to be caused by a virus, and it is now known to occur as 7 serotypes and over 60 subtypes
- It affects cloven-hoofed animals – cattle, sheep, goats, pigs, deer and certain wildlife species such as buffalo – and is extremely infectious
- Animals with FMD do not usually die, but the disease is devastating and the productivity of the animal can be permanently affected
- Outbreaks have enormous economic impact due to the costs of control measures and loss of trade opportunities
- In some parts of the world it is endemic, while in others it has been successfully eradicated

What do we need to know more about?

- Predicting the virulence and spread of the FMD virus under different circumstances
- Mechanisms of protection against disease and viral replication
- How to generate long-lasting protective immunity after vaccination
- The factors driving viral evolution and geographical distribution of the disease
- Ways to improve vaccine stability and widen protection to multiple serotypes

What are the consequences of FMD?

- It inhibits livestock development in many poor countries
- It creates a barrier to international trade in livestock and their products
- It remains a great threat to animal agriculture in FMD-free countries

What are we doing now?

- Some laboratories have advanced research and development programs
- Their work is leading to significant progress in vaccine development and diagnostics
- Outbreaks of the disease in FMD-free countries are stringently contained, with strategies based on both vaccination and stamping out (slaughter)

What can we do better in the future?

- Accelerate the development of effective biological countermeasures through improved international collaboration and coordination
- Create an integrated package of knowledge, tools and products, with guidance on their proper use
- Harmonize approaches while recognizing the different needs of FMD-free and FMD-endemic countries

FMD research: Current thrusts, future requirements

The FMD research community, based in laboratories located throughout the world, has achieved considerable progress in several areas:

- Vaccines are being improved in incremental but distinct steps
- Diagnostics are also improving, though much remains to be done in terms of test validation and international standardization
- Progress on biotherapeutics is promising

However, there are currently no research laboratories with the necessary critical mass, support structures and investment potential to fill, through individual activity, the important gaps that remain, including in epidemiology, model use, immunology, pathogenesis and effective countermeasures.

It is therefore imperative that laboratories worldwide with active FMD research programs work together to reach the scale needed to take the fight against FMD to the next level, as encapsulated in the GFRA strategic goals (next page).

A key part of this process will be the establishment of research programs that will meet the needs of countries where FMD is endemic, and where the devastating economic impacts of the disease are most keenly felt. Such research programs can complement each other to produce the necessary knowledge and tools for control and eradication.

GFRA was established to give crucial impetus to building this research framework, through which a new generation of vaccines and other technologies to control FMD can be developed. GFRA thus aims to provide tools to countries affected with FMD to help control the virus and to improve control methods to better manage and reduce the risk of outbreaks in FMD-free countries.

Linked to the Global Framework for the Progressive Control of Transboundary Animal Diseases, an initiative of the World Organisation for Animal Health (OIE) and the Food and Agriculture Organization of the United Nations (FAO), these research efforts will ensure that the most effective science is used to reach the eventual goal of global eradication.

Through the implementation of its action plan, and with the active support of collaborative organizations, GFRA will guide FMD research along a new and more productive path.



GFRA: Strategic goals and objectives

GOAL 1 Facilitate research collaborations and serve as a communication gateway for the global FMD research community

Objective 1.1

Hold meetings to facilitate and coordinate information exchange and research collaborations on FMD

Objective 1.2

Identify research priorities for FMD control based on expert focus group consultation, gap analysis and other methods

Objective 1.3

Develop and maintain an active website to facilitate the mission of GFRA

Objective 1.4

Seek funding for GFRA collaborative research and coordination activities

GOAL 2 Conduct strategic research to better understand FMD

Objective 2.1

Understand host-pathogen interactions

Objective 2.2

Understand the mechanisms of viral persistence

Objective 2.3

Understand the ecology of FMD

GOAL 3 Development of the next generation of control measures and strategies for their application

Objective 3.1

Discover vaccines specifically designed for the control and eradication of the FMD virus

Objective 3.2

Establish improved diagnostics for surveillance, control of outbreaks and substantiation of freedom from disease

Objective 3.3

Discover biotherapeutics that will provide rapid protection

Objective 3.4

Determine scientific information to implement effective biosecurity measures

GOAL 4 Determine social and economic impacts of the new generation of improved FMD control measures

Objective 4.1

Identify collaborations that would deliver robust cost-benefit analysis to assess the impacts of the new generation of FMD control measures

Objective 4.2

Study social incentives to utilize control measures

Objective 4.3

Identify the product profile for new countermeasures and control strategies

GOAL 5 Provide evidence to inform development of policies for safe trade of animals and animal products in FMD-endemic areas

Objective 5.1

Provide evidence of FMD infectivity from infected animals

Objective 5.2

Provide evidence of infectivity or inactivation of the FMD virus in animal products

Objective 5.3

Provide evidence for the economic and technical feasibility of establishing FMD-free areas in endemic countries

Objective 5.4

Provide evidence for the safety of commodities emerging from FMD-free compartments in endemic countries



History of GFRA

2003. GFRA is launched with five founder members: Institute for Animal Health, Pirbright Laboratory (UK); Plum Island Animal Disease Center (USA); Australian Animal Health Laboratory; National Center for Foreign Animal Disease (Canada); and International Livestock Research Institute (Kenya).

April 2004. Inaugural GFRA meeting is held at U.S. Department of Agriculture, Washington, DC.

June 2005. Business plan developed and circulated among members. A five-year research program aims to develop a new generation of vaccines and other technologies to combat FMD.

November 2006. As a direct result of GFRA activities a meeting is held in Agra, India, to explore the needs of countries in FMD-endemic settings. A detailed gap analysis of the current worldwide FMD virus research effort is undertaken and potential new research programs are defined to address these gaps.

January 2007. Funding is secured from the United Kingdom Government (Department for Environment, Food and Rural Affairs) to facilitate elements of the GFRA research plan in collaboration with the Plum Island Animal Disease Center.

May 2008. A group of international animal health scientists meet at the Plum Island Animal Disease Center to develop a plan to expand the Alliance and make GFRA more inclusive and relevant to countries combating FMD worldwide. A vision and mission are defined, including three options for joining the Alliance, and strategic goals and objectives are set out.

October 2008. The first open GFRA meeting is held at the EU-FMD Conference, Erice, Sicily, to obtain input from stakeholders, share the goals and objectives of GFRA and invite organizations worldwide with a stake in the progressive control of FMD to join the Alliance.

May 2009. The second open GFRA meeting is held at the EPIZONE Conference, Antalya, Turkey, to continue the process of interacting and communicating with clients, partners and stakeholders worldwide.



Organizational structure of GFRA

Membership

Any organization interested in enabling the GFRA vision and mission is encouraged to join the Alliance. There are three membership options:

1. **GFRA member.** FMD research organization that has signed the GFRA memorandum of understanding
2. **GFRA collaborator.** Organization that collaborates on a research project with a GFRA member
3. **GFRA associate.** Organization that benefits from, shares or supports the GFRA mission

The **current members** of GFRA are:

- Australian Animal Health Laboratory, Commonwealth Scientific and Industrial Research Organisation, Australia
- Institute for Animal Health, Pirbright Laboratory, United Kingdom
- Plum Island Animal Disease Center, United States Department of Agriculture, USA
- National Centre for Foreign Animal Disease, Canadian Food Inspection Agency, Canada
- National Veterinary Institute, Technical University of Denmark, Lindholm, Denmark
- Wageningen University and Research Centre, the Netherlands
- International Livestock Research Institute, Nairobi, Kenya

For more information on membership and the current lists of members, visit

<http://www.ars.usda.gov/gfrah/membership.htm>

Executive Committee

An Executive Committee comprising GFRA members facilitates activities that advance the GFRA mission. Committee membership rotates, with one member being replaced each year. The chair also rotates among member institutions on a yearly basis.

Among the Executive Committee's tasks are approval of GFRA membership, identification of partnership and funding opportunities, expansion of the Alliance, organization of meetings and engagement of experts that can assist in achieving the GFRA goals.

GFRA programs and activities

Key issues

In developing programs and activities, GFRA and the wider FMD research community need to bear in mind a number of key issues:

- Great value is to be gained from working together
- The need to accelerate progress is clear
- A focus on deliverables should be maintained
- Increased resources are needed to achieve the overall GFRA goals
- Increased funding will accelerate delivery of products to manage the progressive control and eradication of FMD worldwide
- The different needs of FMD-free and FMD-endemic countries should be recognized but collaboration that adopts a global stance will be most effective in leveraging expertise and resources
- There is an implicit link between activities undertaken within the framework of GFRA and the OIE/FAO Global Framework for the Progressive Control of Transboundary Animal Diseases

Deliverables

The major deliverables emerging from the activities of GFRA will be as follows:

- **Diagnostics.** The harmonized approach advocated by GFRA will greatly assist surveillance and monitoring; initial diagnosis; managing an outbreak of FMD; and demonstrating freedom from the disease during the recovery phase or following eradication.
- **Vaccines and biotherapeutics.** Highly effective countermeasures will be developed, specifically designed to meet the needs of FMD-free countries and the specific needs of FMD-endemic countries.
- **Decision support system tools.** These will include logistics for FMD control; smart intervention strategies, such as the latest technology applications for FMD control and eradication in endemic countries (vaccines, companion diagnostics and disease assessment) and an increased understanding of their economic impacts; feedback into research programs regarding the impact and prioritization of potential attributes of vaccines and biotherapeutics; and comparison of the value of new technologies in various ongoing models.

All of the above will be supported by basic research in immunology, pathogenesis, epidemiology, virology, genomics and bioinformatics.

Research collaborations

Research collaborations lie at the very core of the GFRA philosophy – adding value to individual efforts through working together.

Current collaborators of GFRA include:

- Onderstepoort Veterinary Institute (OVI), South Africa
- All Russian Research Institute for Animal Health (ARRIAH), Russian Federation
- Instituto Nacional de Tecnología Agropecuaria (INTA), Argentina
- National Institute of Animal Health, Regional Reference Laboratory for Foot-and-Mouth Disease in South-East Asia (RRL), Thailand
- Center for Animal Disease Modeling and Surveillance (CADMS), University of California, Davis, United States
- National Agriculture and Food Research Organization (NARO), Japan
- Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA), Brazil
- Central Veterinary Research Laboratory (CVRL), Sudan
- Animal Health Research Institute (AHRI), Egypt

For more information on our collaborators, visit

<http://www.ars.usda.gov/gfra/collaborators.htm>.

GFRA aims to expand FMD research collaborations worldwide and maximize the use of resources and expertise to achieve its five strategic goals.

Several research programs are currently active in Europe, North America, South America, South-East Asia and Africa. GFRA programs will continue to expand the Alliance in these areas and will actively reach out to new areas of the world that have a stake in the progressive control and eradication of FMD.

The following pages present examples of current research collaborations in which certain GFRA members are involved.



Examples of Research collaborations

USDA-ARS Foreign Animal Disease Research Unit, Plum Island Animal Disease Center (PIADC), United States

Project: Mechanisms of early immune enhancement against FMD

This collaboration between PIADC and the Institute for Animal Health, Pirbright, UK, involves investigation of the role of dendritic cells in the immune response to the FMD virus following vaccination in swine and cattle, with the aim of developing an alternative platform for vaccination through T-cell mediated response.

Project: Characterization of local isolates of FMD virus and development of vector-based vaccines

Through carrying out a genomic evaluation of field isolates of the FMD virus, the project aims to establish and employ improved methods for virus detection and typing. The principal partner is the National Agricultural Research Center, Islamabad, Pakistan.

Institute for Animal Health (IAH), United Kingdom

Project: Structurally modified master seed viruses to enhance conventional FMD virus vaccine production

A collaborative agreement has been signed between OVI (South Africa), IAH, PIADC, Oxford University and commercial partners to develop improved master seed stocks of virus for incorporation into current FMD virus vaccine production systems.

Project: FMD and other OIE List A diseases in large domestic animals and their impacts

A China Partnering award between IAH and Lanzhou Veterinary Research Institute aims to foster exchange of scientific knowledge on FMD virus pathogenesis, epidemiology, diagnostics, vaccine and persistence and its impact on diagnosis and control; promote short-term visiting exchanges of personnel from the institutes to undertake bilateral technology transfer; and instigate funding proposals for international, cooperative scientific and technical projects.

Project: Study for inhibiting FMD virus infection and defining pathogenicity determinants

In a collaboration supported by the government of the Republic of Korea, IAH and the National Veterinary and Quarantine Service in Seoul aim to develop a strategy for inhibition of FMD virus infection by increasing local innate and adaptive immune responses, and to find out more about the viral determinants for porciphilic tropism and persistent infection.

National Centre for Foreign Animal Disease (NCFAD), Canadian Food Inspection Agency, Canada

Project: Harmonization of diagnostic tests in the North American Animal Health Laboratory Network (Canada, United States, Mexico)

Under the framework of the Security and Prosperity Partnership of North America, an agreement was established to enhance laboratory coordination and information sharing between Canada, the United States and Mexico. An effort to harmonize diagnostic tests in the animal health laboratories of the three countries is currently targeted at vesicular diseases (FMD), avian influenza and bovine tuberculosis.

Project: Improvement of FMD preparedness and response in South America

Canadian and Pan American Health Organization (PAHO) experts in veterinary public health have agreed to collaborate to enhance diagnostic capability in the countries of the Andean region of South America to facilitate rapid response to an outbreak of FMD. A computer simulation model is being applied to assess, predict and mitigate FMD outbreaks in the region. National laboratories in Bolivia, Colombia, Ecuador, Peru and Venezuela are taking part in the project.

Central Veterinary Institute, Wageningen University, Netherlands

Project: Quantification of key transmission parameters of FMD virus, swine vesicular disease virus and other important epizootic infections

Through collaboration with a range of partners in China, Denmark, Italy and the United Kingdom, the project aims to collect data on transmission of FMD virus in various animal experiments and to mathematically quantify the transmission. These estimates of transmission parameters can be used in animal disease models to quantify the effect of control measures.

Project: FMD-DISCONVAC: Development, enhancement and complementation of animal-sparing, FMD vaccine-based control strategies for free and endemic regions

This ambitious project, supported by the European Union, features over a dozen collaborators, partnering leading European FMD research groups and vaccine producers with their counterparts in Argentina, China, India and the Russian Federation, and representing the public, private and non-profit sectors. The project aims to improve the quality of existing FMD vaccines and diagnostics through refinement and replacement of in vivo FMD vaccine quality tests; application of cutting-edge technologies to develop a new generation of FMD vaccines and diagnostics; and enhancement of our knowledge on FMD virus spread and transmission following the use of high-potency monovalent or multivalent vaccines.



GFRA: Into the future

GFRA action plan

The recently agreed GFRA action plan aims to:

1. Identify partnership opportunities and promote collaborative research projects
2. Expand and coordinate the Alliance and organize further meetings
3. Bring together experts to analyse gaps and set research priorities
4. Identify and enable strategic public-private partnerships
5. Seek funding for further activities and the implementation of priority research projects
6. Develop a website and other outreach materials

Lasting solutions

GFRA will continue to build the Alliance by adding new members and reaching out to partners and stakeholders worldwide. It will hold at least one general meeting annually and will hold regular scientific meetings to advance its goals and objectives.

Ultimately, GFRA intends to build a virtual FMD laboratory to support the needs of the international animal health community dedicated to the progressive control and eradication of FMD within the OIE/FAO Global Framework for the Progressive Control of Transboundary Animal Diseases.

Want to know more?

For more information, contact:

GFRA Executive Committee

Email: ars-gfra@ars.usda.gov

Website: <http://www.ars.usda.gov/gfra/>



The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry, no matter how small, should be recorded to ensure the integrity of the financial statements. This includes not only sales and purchases but also expenses, income, and any other financial activity.

The second part of the document provides a detailed breakdown of the accounting cycle. It outlines the ten steps involved in the process, from identifying the accounting entity to preparing financial statements. Each step is explained in detail, with examples provided to illustrate the concepts.

The third part of the document focuses on the classification of accounts. It discusses the different types of accounts, such as assets, liabilities, equity, and income, and how they are used to record and summarize financial transactions. It also explains the relationship between these accounts and the accounting equation.

The fourth part of the document covers the process of journalizing and posting. It describes how transactions are recorded in the journal and then transferred to the ledger. It also discusses the importance of double-entry accounting and how it helps to ensure the accuracy of the financial records.

The fifth part of the document discusses the preparation of financial statements. It explains how the information from the ledger is used to create the balance sheet, income statement, and statement of owner's equity. It also discusses the importance of these statements for decision-making and financial analysis.

The sixth part of the document covers the process of adjusting entries. It explains how these entries are used to correct errors and ensure that the financial statements are accurate and complete. It also discusses the different types of adjusting entries, such as accruals and deferrals.

The seventh part of the document discusses the process of closing the books. It explains how the temporary accounts are closed to the permanent accounts, and how the ending balances are carried over to the next period. It also discusses the importance of this process for maintaining accurate financial records.

The eighth part of the document covers the process of auditing. It explains how an auditor reviews the financial records to ensure their accuracy and compliance with accounting standards. It also discusses the different types of audits and the role of the auditor in the financial reporting process.

The ninth part of the document discusses the importance of internal controls. It explains how these controls are used to prevent and detect errors and fraud, and how they help to ensure the reliability of the financial information. It also discusses the different types of internal controls and how they are implemented.

The tenth part of the document covers the process of financial reporting. It explains how the financial information is used to create reports for management and other stakeholders, and how these reports are used to make decisions and plan for the future. It also discusses the importance of transparency and accountability in financial reporting.

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