STAR IDAZ
International Research Consortium on Animal Health

Annual state-of-the-art report on animal health research on IRC priorities

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Contents

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

Disclaimer:

The report is a presentation of the current initiatives and recent scientific literature, organised to identify and highlight trends and advances in research on animal health, with a focus on a selection of priority animal diseases at a global level. The report does not target initiatives aimed at implementing animal disease control strategies (e.g., roadmaps for the control or eradication of infectious diseases) or at improving animal health control infrastructures.

Since the information relating to advances in animal health research is based on published articles, a time lapse between scientific breakthroughs and their publication is inevitable and so the report may not fully capture information on ongoing, or recently concluded, studies. The information on projects collected by our members is provided voluntarily and may contain inaccuracies or errors. While we make efforts to ensure the accuracy and reliability of the information, we do not guarantee its completeness or correctness. Users should exercise their judgment and verify any information obtained through our platform before making decisions based on it.

The findings and conclusions in this report are those of the contributors, who are responsible for the contents, and do not necessarily represent the views of the European Commission. This report does not necessarily reflect the opinion of the STAR IDAZ IRC members, but is the result of an analysis, by the Scientific Secretariat of the STAR IDAZ IRC (SIRCAH), based on the collection of information from selected sources, including literature surveys. Therefore, no statement in this report should be construed as an official position of the European Commission or of any of STAR IDAZ IRC and SIRCAH members.

Executive summary

Background and aim

The STAR IDAZ International Research Consortium on Animal Health (STAR IDAZ IRC) was established in 2016 to coordinate research activities at the international level, to speed up the development of new and improved animal health strategies for priority diseases/infections/issues of animals. The goal of the initiative is to deliver improved control tools and strategies, including candidate vaccines, diagnostics, therapeutics and other animal health products and procedures and/or key scientific information and tools to support risk analysis and disease control for at least 30 priority diseases and cross-cutting issues .

The aim of this report is to provide STAR IDAZ IRC Members, as well as other animal health stakeholders, with an overview on selected priorities of the ongoing research activities and of the latest discoveries. Overall, this sharing of information will support the decisions of policy makers and research funders and facilitate collaboration avoiding duplication of efforts, thus accelerating coordinated development of control methods at the international level.

Methods

After a short update on the progress of STAR IDAZ IRC activities to identify research gaps and facilitate networking among members, a report on selected IRC priority diseases and cross-cutting issues is provided. In this report, the update focuses on animal genomics/genetics, aquaculture, specifically aquatic fish diseases, brucellosis, emerging issues, foot and mouth disease, helminths, mastitis, porcine reproductive and respiratory syndrome (PRRS) and porcine respiratory disease complex (PRDC), and poxviruses.

For each of the aforementioned themes, information about existing global research coordination networks is given together with a collection of the main information on identified research gaps, mainly derived from STAR IDAZ Executive Summaries and the DISCONTOOLS database. A selection of promising innovations or major research outcomes published in scientific journals between January 2023 and July 2024 were identified through a scan of the scientific literature in the **CAB Abstracts database**, using specific keywords for each of the priority diseases/issues.

Trends in published research associated with the keywords have been reported to show, whenever possible, the main statistics on each priority disease/issue for topics such as diagnostic, epidemiology, vaccination/vaccine development and therapeutics.

A graphical analysis of the estimated distribution of articles, based on country of first author, among the four STAR IDAZ Regional Networks (Americas, Africa and Middle East, Asia and Australasia, and Europe), is included. This has been supplemented with information on current research initiatives on the priority diseases and issues, collected from experts and research funders during STAR IDAZ IRC Executive Committee, Scientific Committee, and Regional Networks meetings and roadmap workshops.

A list of targeted initiatives taken to speed up research and development (R&D), to facilitate transnational R&D collaborations, and recent infrastructures and databases to facilitate R&D respectively can be found in the Annex and will soon be uploaded on our new website. Information was collected by scanning the web with relevant keywords or collecting information from our IRC partners.

Main acronyms

ACDP	Australian Centre for Disease Preparedness
ACIAR	Australian Centre for International Agricultural Research
AEI	Agencia Estatal de Investigación - Spanish National Research Agency
AfVANET	African Vaccinology Network
AFD	French Development Agency
AFS-FHS	Fish Health Section of the American Fisheries Society
AMR	AntiMicrobial Resistance
AMU	AntiMicrobial Use
ANR	French National Research Agency
Anses	French Agency for Food, Environmental and Occupational Health & Safety
APHA	Animal and Plant Health Agency- UK
AREF	African Research Excellence Found
ARS	Agricultural Research Service -USDA
ASF	African Swine Fever
ATA	Alternatives To Antibiotics
AvCoV	Avian Coronavirus
BBSRC	Biotechnology and Biological Sciences Research Council
BMGF	Bill and Melinda Gates Foundation
BMZ	German Federal Ministry for Economic Cooperation and Development
bTB	Bovine Tuberculosis
CABI	Centre for Agriculture and Bioscience International
CIRAD	French Agricultural Research and Cooperation Organisation
CRDF	US Civilian Research & Development Foundation
CSIC	Agencia Estatal Consejo Superior de Investigaciones Cientificas
CBPP	Contagious Bovine PleuroPneumonia
CCPP	Contagious Caprine PleuroPneumonia
CIRAD	French Agricultural Research Centre for International Development
COHESA	Capacitating One Health in Eastern and Southern Africa
COST	EU COoperation in Science and Technology
CoVs	Coronaviruses
CSIC	Spanish National Research Council
CSIRO	Australian Centre for Disease Preparedness
CWG AHW	Collaborative Working Group on European Animal Health and Welfare Research
DAPP	French Public Policy Support Department
DDG	Deputy Director General
DEFRA	Department for Environment, Food & Rural Affairs (UK)
DISCONTOOLS	Disease Control Tools
DIVA	Differentiating Infected from Vaccinated Animals
EBLV-1	European bat lyssavirus 1
EC	European Commission
EMIDA ERA-NET	European Research Area Network on Emerging and Major Infectious Diseases of Livestock
EMPRES	Emergency Prevention System
ENEA	Italian National Agency for New Technologies, Energy, and Sustainable Economic Development

ERA-NET	European Research Area Network
ERINHA	European Research Infrastructure on Highly Pathogenic Agents
ERRAZE	Early Recognition and Rapid Action in Zoonotic Disease Preparedness
EUPAHW	European Partnership on Animal Health and Welfare
EVA	European Virus Archive
ExCo	STAR IDAZ Executive Committee
FAO	Food and Agriculture Organization of the United Nations
FLI	Friedrich-Loeffler-Institut - German Federal Research Institute for Animal Health
FMD	Foot-and-Mouth Disease
FP	Framework Programme
FPS	Belgium Federal Public Service
FWO	Research Foundation Flanders
GALVmed	Global Alliance for Livestock Veterinary Medicines
GARA	Global ASF Research Alliance
GCRF	Global Challenges Research Fund
GWAS	Genome-Wide Association study
GFRA	Global FMD Research Alliance
GLASS	Global Antimicrobial Resistance and Use Surveillance System
GLEWS	Global Information and Early Warning System on Food and Agriculture FAO
Global AMR R&D Hub	Global Antimicrobial Resistance Research and Development Hub
GloPID-R	Global Research Collaboration for Infectious Disease Preparedness
GOARN	Global Outbreak Alert and Response Network
GRAbTB	Global Research Alliance for Bovine Tuberculosis
GRET	French Research and Technological Exchange Group
HERA	Health Emergency Preparedness and Response Authority
HPAI	Highly Pathogenic Avian Influenza
IAEA	International Atomic Energy Agency
IBS	International Brucellosis Society
IBV	Infectious Bronchitis Virus
ICN	International Coronavirus Network
ICARS	International Centre for Antimicrobial Resistance Solutions
ICRAD	International Coordination of Research on Infectious Animal Diseases
IDRC	International Development Research Centre
IHI	Innovative Health Initiative
ILRI	International Livestock Research Institute
InnoVet- AMR	Innovative Veterinary Solutions for Antimicrobial Resistance
INIA	Spanish National Institute for Agricultural Research
INRAE	French National Research Institute for Agriculture, Food and Environment
IOM	Internation Organisation for Mycoplasmology
IRC	International Research Consortium
IRD	French National Research Institute for Sustainable Development
IRTA	Institute for Research and Agrofood Technology
ISAH	International Society for Animal Genetics
IVI	Institute Virology and Immunology
IVIS	International Veterinary Immunology Symposium
IVVN	International Veterinary Vaccinology Network
IZS	Italian Experimental Zooprofilactic Institute
KVI	Kimron Veterinary Institute
KALRO	Kenya Agricultural & Livestock Research Organisation

LA-MRSA	Livestock-Associated Methicillin-Resistant Staphylococcus
LiHRA	Livestock Helminth Research Alliance
LMICs	Low- and Middle-Income Countries
LVIF	Livestock Vaccine Innovation Fund
MAFF	Ministry of Agriculture, Forestry and Fisheries
MCID	Multidisciplinary Center for Infectious Diseases
MIN NLV	The Netherlands Ministry of Agriculture, Nature and Food Quality
MINSAL-IT	Italian Ministry of Health
NACA	Network of Aquaculture Centres in Asia-Pacific
NARO	National Agricultural Research Organisation
NIFA	National Institute of Food and Agriculture USDA
NGO	Non-Governmental Organization
NMC	National Mastitis Council
NVI	Norwegian Veterinary Institute
NSFC	National Natural Science Foundation of China
NVRI	Nigerian National Veterinary Research Insititute
OFFLU	WOAH/FAO Network of Expertise on Avian influenza
ONSSA	Office National de Sécurité Sanitaire des produits Alimentaires
PANDORA	Pan-African Network for Rapid Research, Response and Preparedness for Infectious Diseases
PCV	Porcine Circovirus
PREZODE	PREventing ZOonotic Diseases Emergence
PRDC	Porcine Respiratory Disease Complex
PRRS	Porcine Reproductive and Respiratory Syndrome
R&D	Research and Development
SARS-CoV-2	Severe Acute Respiratory Syndrome CoV 2
SC	Scientific Committee
SCAR	Standing Committee on Agricultural Research
SIRCAH	Secretariat of the International Research Consortium on Animal Health
SNP	Single Nucleotide Polymorphism
SRIA	Strategic Research & Innovation Agenda
STAR IDAZ Global Net	Global Strategic Alliances for the Coordination of Research on the Major Infectious Diseases of Animals and Zoonoses
SWG FISH	Strategic Working Group on Fish
STDF	Standards and Trade Development Facility
TADs	Transboundary Animal Diseases
UKCDR	United Kingdom Collaborative on Development Research
UK DFID	United Kingdom Department for International Development
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VBD	Vector-Borne Disease
VOM	National Research Institute of Nigeria
VTC	Vector Transmission Control
WAIHS	World Animal Health Information System
WBVR	Wageningen Bioveterinary Research
WG	Working Group
WHO	World Health Organanisation
WOAH	World Organisation for Animal Health (formerly known as OIE)
WUR	Wageningen University & Research
ZODIAC	Zoonotic Disease Integrated Action

I. STAR IDAZ IRC – International Research Consortium on Animal Health

Website: http://www.star-idaz.net/

STAR IDAZ International Research Consortium on Animal Health

35 **Partners**

23 **members countries**

Networking more than 55 countries

Budget
US$ +2.5 Billion

Start date:
2011

Overview

STAR IDAZ is the International Research Consortium (IRC) of research funders and programme owners on animal health. The IRC was built on an international forum of R&D programme owners/managers and international organisations established under a 4-year (2011-2015) European Commission FP7 project: "Global Strategic Alliances for the Coordination of Research on the Major Infectious Diseases of Animals and Zoonoses" (STAR IDAZ). The aim of the global network is to share information, improve collaboration on research activities and work towards common research agendas and coordinated research funding on the major animal diseases affecting livestock production and/or human health.

Since 2015, STAR IDAZ has moved forward as a self-sustaining network under an agreed Memorandum of Understanding with most partners signing up to a higher level of commitment in STAR IDAZ IRC. Since 2016 it has been supported by a Secretariat (SIRCAH) funded by the European Commission, with funding secured until 2027.

STAR IDAZ successfully established, through its global and regional activities, a network of organisations managing research budgets or programmes in more than 55 countries that are committed to working together. The aim includes coordination of research relevant to emerging and major infectious diseases of livestock, including fish and managed bees, and those infections of livestock that carry the risk of disease threat to human health. Diseases of wildlife are also considered where they were identified as reservoirs of infection with emerging and major infectious diseases of humans or production animals.

Aim and priorities

Aim: to coordinate research at the international level to contribute to new and improved animal health strategies for at least 30 priority diseases/ infections/issues.

Priorities: major animal diseases and cross-cutting health issues affecting livestock production, including zoonoses.

Objectives and activities

Objectives:

- Strengthen the linkages between and reduce the duplication of global research effort on high priority infectious diseases of animals (including zoonoses) to maximise the efficient use of expertise and resources and accelerate coordinated development of control methods
- Identify and co-ordinate the response to gaps in research activities for targeted diseases
- Create the necessary critical mass and capacity to address emerging infectious disease threats
- Improve the cost-effectiveness and added value to network partners of current research programmes
- Develop durable procedures for a better coordinated, rapid response to urgent research needs
- Identify unique regions with localised diseases and improve access to research in those areas
- Improve access to and the utility of research results across all partner organisations.

Activities:

Regional Network meetings and Executive Committee meetings are organised periodically to facilitate information sharing, identification of research priorities and opportunities for collaboration, respectively at regional or global levels. To identify research gaps on which to focus research on, **Working Groups** have been established on priority topics along with a **Scientific Committee** of 16 experts to advise the **Executive Committee** of the IRC partners. The Working Groups develop to facilitate focused funding and research efforts to identified research priorities. The roadmaps are based on 'Leads' which consider the: i) Research Questions ("What is the problem we are trying to solve?"); ii) Challenges ("What are the scientific and technological challenges or knowledge gaps that need to be address?"); iii) Solution Routes ("What approaches could and should be taken to address the Research Questions?"); iv) Dependencies ("What needs to be done before we can solve this?"); and v) State of the art, which includes the existing knowledge including the successes and failures.

News from the STAR IDAZ Network:

IRC Executive Committee

STAR IDAZ Executive Committee (ExCo), has 35 Members from 23 countries that oversee the direction of the consortium and agree its activities to facilitate the coordination of research on animal health. The Executive Committee have agreed to coordinate research funding strategies, promote support for STAR IDAZ IRC objectives, and share information between the members.

In the last year, four new partners have joined the IRC.

- Switzerland Regional Consortium, Switzerland
- KALRO - Kenya Agricultural & Livestock Research Organisation, Kenya
- NARO - National Agricultural Research Organisation, Uganda
- ONSSA - Office National de Sécurité Sanitaire des produits Alimentaires, Morocco
- IDRC- International Development Research Centre, Canada

Dr Maryam Muhammad, Director and Chief Executive of the National Research Institute (VOM) took over the role of Chairperson of STAR IDAZ IRC from Hong Yin who stepped down after 5 years in the position.

Moreover the following new Executive Committee representatives joined: Dr Karin Artursson (Swedish Veterinary Agency); Dr Debbie Eagles (CSIRO Australian Centre for Disease Preparedness); Dr Karin Troell (Norwegian Veterinary Institute); Dr Jagvinder Dhanda (Canadian Food Inspection Agency); Dr Siboniso Moyo (International Livestock Research Institute); Dr Roxann Motroni (USDA-Agricultural Research Service); Dr Renée Larocque (IDRC, Canada); Dr Katsuhiko Fukai (National Agriculture and Food Research Organization, Japan).

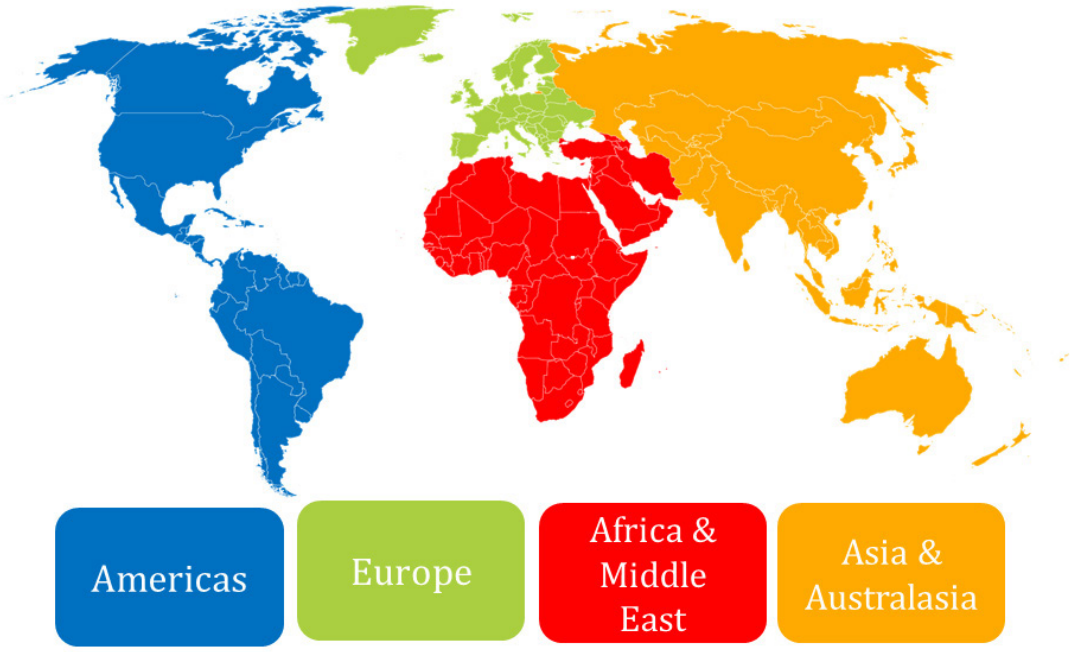
Since September 2023, the following IRC ExCo meetings were held:

- 31 January 2024 by webinar with an additional follow up meeting to present outputs of funded research and current research projects on 15 February 2024
- 19-20 June 2024 at the Rebouças Convention Centre, São Paulo, Brazil.

Regional Networks

The STAR IDAZ Regional Networks (for Africa & the Middle East, the Americas, Asia & Australasia, and Europe) facilitate regional cooperation and coordination among more than 55 countries around the globe, by identifying common research priorities in the regions, opportunities for sharing resources including access to samples, specialised facilities, and expertise, and international or regional funding opportunities.

Additional organisations interested in networking for animal health research are welcomed in Regional Network meetings, the designated representative for research organisation or funder can send an email expressing their interest to **Madeline.Newman@defra.gov.uk**.



Information on meetings dates and agendas are available in the table below per each RN:

Regional Network	Date & Location
Africa and Middle East	16 November 2023, Kruger National Park, South Africa / Alongside the 13th International Veterinary Immunology Symposium (IVIS 2023) 21 August 2024, Webinar
Americas	22 August 2023, Quito, Ecuador / Regional Workshop alongside the ALAM 2023 Congress 19 July 2024, Webinar
Asia and Australasia	9 October 2023, Webinar 16 July 2024, Webinar
Europe - CWG AHW	7 December 2023, Webinar 23 May 2024, Webinar

Scientific Committee and active Working Groups

The last Scientific Committee (SC) meetings were held:

- 4 December 2023 by webinar
- 18 June 2024 at the Rebouças Convention Centre, São Paulo, Brazil.

During these meetings, the SC reviewed the progress of all active Working Groups (WGs), agreed the required next steps to develop the research roadmaps and developed recommendations for research to the Executive Committee.

Regarding active WGs this year, experts continued their networking activities delivering outputs on the following areas:

African Swine Fever

The STAR IDAZ WG for African Swine Fever (ASF) operates through the Global African Swine Fever Research Alliance (GARA). As a result, three **ASF research roadmaps** have been published on the STAR IDAZ website, for the development of control strategies, diagnostic tests and candidate vaccines while the **2022 African Swine Fever Virus Research Review** was published in April 2022, in collaboration with USDA and GARA. On 5-7 December 2023, a GARA Asia workshop was held in the Philippines, to focus on critical knowledge and research gaps specific to Asia. The next GARA meeting, initially scheduled to take place in Rome at the FAO Headquarters 12-14 November 2024, has been postponed to March/ April 2025. SIRCAH and the SC lead will engage with GARA to explore if an executive summary of research needs can be developed based on recent gap-analysis results.

AMR and Alternatives to Antimicrobials

Roadmaps have been developed and published for the role of the microbiome and how it can be manipulated, immunomodulators, and phage technologies. An overarching roadmap was created to link together the three roadmaps (see report: **Research roadmaps development for alternative to antibiotics**). The document, produced in collaboration with the Canadian International Development Research Centre (IDRC), outlines the process, the participative methods and the research roadmaps developed. The research roadmaps are based on results from several workshops held since 2019, each one further progressing the previously agreed findings.

A world café workshop to present the roadmaps and discuss Americas regional perspective was held back-to-back to the **2023 ALAM congress, Quito, Ecuador**. The event was co-organised with the Tripartite AMR project and facilitated the networking of several Americas stakeholders on the AMR and ATA topic. Main gaps have been summarised in the **Executive Summary of priority research needs: Alternative to antibiotics (ATA)**. These roadmaps continue to be recognized as vital animal health research priorities. Montserrat Arroyo, WOAH DDG, highlighted their importance during a presentation of the One health priority research agenda for AMR the 28th of June 2023. The ATA roadmaps were also referenced in the Quadripartite **Implementing the global action plan on antimicrobial resistance** and **Global Leaders Group on Antimicrobial Resistance "Recommendations to address the antibiotic pipeline and access crisis in human health**" in 2024.

Aquaculture

The STAR IDAZ ExCo agreed to establish a WG on Aquaculture last year. Given that the sector is broad, a scoping exercise was conducted. SIRCAH has gathered background information on the main networks and strategic research agendas within the sector. Initial discussions with the SC have been conducted, agreeing an initial focus on aquatic fin fish diseases. Links have been established with WOAH and DISCONTOOLS for collaborative efforts to identify the highest priority diseases. Ongoing discussions are centred on the best methods for collaboration to identify priorities that will ensure long-term benefits for global management of aquatic diseases.

Bovine Tuberculosis

A STAR IDAZ bTB roadmap workshop was held on 28 February 2023 in Birmingham, UK - the objectives were to understand research and innovation needs, update the existing bTB roadmap and develop roadmaps for diagnostic tests and control strategies. A **report** of the STAR IDAZ bTB workshop is available on the STAR IDAZ website. The valuable insights gained from the workshop have informed the update of the **research roadmap** on the bTB candidate vaccine, and the development of two new roadmaps for **diagnostics and control strategies**. The **Executive Summary** of research gaps is available on the website.

Coronaviruses

SIRCAH2, in collaboration with the UK International Coronavirus Network (UK-ICN), is in the process of producing research roadmaps for Coronaviruses. In May 2023, a gap analysis workshop was organised alongside the International Conference on Livestock, Companion Animals, and Wildlife Coronaviruses. A workshop report can be found on the STAR IDAZ website **here.** The outcomes of these workshops served as a foundation for the drafting of research roadmaps focused on disease control strategies, diagnostics, and vaccine development. Additional workshops are foreseen in 2024 to finalise the research roadmaps and the executive summary of research needs.

Influenza

Research roadmaps for the development of **disease control strategies**, **diagnostics** test and **candidate vaccine** development were published on the website in April 2023. An **executive summary of identified research gaps** was published in April 2023 too. These were the results of three virtual **workshops** held in January and February 2023 to prioritise influenza research gaps and develop research roadmaps. The **IRC Animal Influenza Research Review** published in July 2021 and the result of the gap analysis workshop held in Iowa in 2022 provided elements for discussion during the workshops. Some recent research carried out by partners on HPAI in cattle have been recently compiled and disseminated in our STAR IDAZ **summer newsletter**.

Foot-and-Mouth Disease

A gap analysis workshop took place on 10 November, 2023, during the GFRA Scientific Conference in Uganda to update the Foot-and-Mouth Disease (FMD) roadmaps. The meeting had 51 participants from Africa, Europe, the Americas, and Asia. During the meeting, important subjects such as virus characteristics, host interactions, diagnostics, vaccines, and control strategies were discussed. The participants also addressed research gaps and proposed potential solutions. The SC members focusing on FMD reviewed the gap analysis report from the GFRA meeting in Argentina 2022 (published in 2023) and updated the STAR IDAZ FMD research roadmaps based on these documents. **The updated roadmaps** were reviewed by the SC, validated by the ExCo and subsequently published on the STAR IDAZ IRC website.

Mastitis

SIRCAH2 has convened an initial group of cattle mastitis experts online. A STAR IDAZ workshop on the topic was organized as a side-event of the National Mastitis Council held in Ghent, 14 August 2024 and included participants from over 37 countries. The **workshop** focused on alternatives to antimicrobials in mastitis management as well as mastitis vaccines. A report will be soon published on the STAR IDAZ website.

Mycoplasmas

Building on the **Veterinary Mycoplasmas Research Report** published in July 2023, a **gap analysis workshop** focused on the critical issue of contagious bovine pleuropneumonia (CBPP) was held in June 2023 in Cambridge. This workshop aimed to identify CBPP research gaps as a priority due to its severe impact on livestock in sub-Saharan Africa and the potential for spreading to other regions. The findings from this workshop were presented at the International Organization for Mycoplasmology Congress in Japan on 16-20 July 2023. In April 2024, a follow-up workshop was organised in Frankfurt, Germany, with the aim to develop better ways of defining protection against CBPP, a key research gap identified in the June 2023 workshop. STAR IDAZ ran this workshop in collaboration with USDA-ARS and ILRI. A report detailing the outcomes of the workshop will be published soon. Following the recommendations of the SC and approval by the ExC, SIRCAH2 will establish a dedicated working group for Mycoplasmas. This group will utilise the Research Report and workshop insights to shape future research roadmaps.

One Health

The One Health Working Group was set up in collaboration with **GloPID-R** (Global Research Collaboration for Infectious Disease Preparedness). WG members met for the inaugural meeting in March 2023 while in mid-2023, a survey was conducted to understand the current One Health research and funding landscape and the priority research gaps. Following this, SIRCAH2 and GloPID-R ran a workshop in December 2023 to discuss and identify opportunities for short- and long-term improvements to the current research funding landscape and potential challenges. A report summarising the current challenges and recommended improvements will be published this year. Draft recommendations were presented at the 'Paradigm shifts for Global One Health' event in Wageningen, The Netherlands in April 2024 to seek feedback from the research community.

Vaccinology

The STAR IDAZ review of vaccine platform technologies, titled '**Applications of Platform Technologies in Veterinary Vaccinology and the Benefits for One Health'** was published in *Vaccine* in April 2022. Building on this, a workshop titled 'Platform Technologies for Veterinary Vaccines Against Bacterial Diseases' was held on 17 November 2023 alongside the International Veterinary Immunology Symposium in South Africa. The main objective of the workshop was to identify gaps in veterinary vaccinology and explore opportunities in the application of novel vaccine platform technologies for the development of veterinary vaccines against bacteria. A peer-reviewed meeting report is in preparation for wider dissemination of the findings.

Vector Transmission Control

The Vector Transmission Control (VTC) research roadmap was presented in a poster presentation at the International Symposium of Tick and Tick-borne Diseases in March 2023. During the workshop organised back-to-back to the International Symposium, while discussing further the research roadmap, it was decided to focus on three key areas: targeting vector hosts, understanding vector biology, and managing vector habitats. As a result, the **VTC roadmap** was updated and has been refined and published on the STAR IDAZ website.

As the SC agreed there was a need to focus on anti-tick vaccines, a key area identified in the VTC research roadmap, a workshop titled 'Shaping the Future of Livestock Tick Vaccines' was organised. It was held immediately preceding the next in-person SC and ExCo meetings on 17 June, 2024 in Sao Paulo, Brazil, involving key actors from academia, research institutions and industry.

II. STATE-OF-THE-ART IN IRC PRIORITY DISEASES

Introduction

In the framework of the STAR IDAZ IRC, a list of priority diseases and cross-cutting issues was identified for which research coordination is required to make progress and deliver the necessary control tools. This preliminary list was further discussed during the meetings of the STAR IDAZ IRC Executive and Scientific Committees' meetings held between 2017 and 2023 and updated accordingly. The full list of the currently identified priorities is reported below.

1. African swine fever (ASF)
2. Animal genomics/genetics for animal health
3. Antimicrobial resistance (AMR) and the development of innovative alternatives to antimicrobials
4. Aquaculture: fish diseases
5. Bovine tuberculosis (bTB)
6. Brucellosis
7. Coronaviruses (CoVs)
8. Diagnostics (tools and technologies)
9. Emerging issues
10. Epidemiology
11. Foot-and-mouth disease (FMD)
12. Foresight
13. Helminths
14. Vaccinology
15. Influenza
16. Mastitis
17. Mycoplasmas (including contagious bovine pleuropneumonia - CBPP and contagious caprine pleuropneumonia - CCPP)
18. One Health
19. Porcine reproductive and respiratory syndrome (PRRS)
20. Porcine respiratory disease complex (PRDC)
21. Poxviruses
22. Vector transmission and control (VTC)

During the first STAR IDAZ IRC Executive Committee meeting held in Kenya (2017), the first six diseases/issues to be addressed were selected. These were: ASF, bTB, brucellosis, FMD, helminths, and PRRS. During the ExCo meeting held the following year (2018) in Spain, CoVs and VTC were selected as additional topics to be addressed. At the STAR IDAZ IRC ExCo meeting held in China in 2019, the scope of the work to be performed on VTC was better defined, and it was decided to start working on AMR and the development of innovative alternatives to antimicrobials. In the ExCo meetings held online during 2021, it was agreed mycoplasmas, mastitis and influenza should be addressed next. Other priorities discussed during the ExCo meetings included vaccinology, diagnostics, emerging diseases and One Health. Most recently in the ExCo meeting in Kenya (2023) it was decided to include a topic on aquaculture, with the focus and scope being better defined by the Scientific Committee in the coming months.

This report provides an overview of the state-of-the-art of research, at a global level, for selected diseases/syndromes/issues in accordance with discussion held in the last ExCo meeting such as: animal genomics/genetics, aquaculture, specifically fish diseases, brucellosis, emerging issues, FMD, helminths, mastitis, PRRS and PRDC, and poxviruses.

For each of topic, the report provides information on:

23. **Existing or planned global networks** aiming at guiding future research on the topic
24. **STAR IDAZ WG progress in identifying critical research** gaps schematic view of the current working stage (green- achieved, yellow- in progress, red- to be done)
25. Identified **research gaps on control tools** (diagnostics, vaccines, and pharmaceuticals), whenever possible extracted from STAR IDAZ research roadmaps or the DISCONTOOLS database
26. **Recent research advances**, providing an overview of a selection of highly relevant papers on the subject matter published within the last year
27. **Trends in published research**, showing estimated statistics extracted from the CAB Abstract database on the topics and the STAR IDAZ regions where relevant papers are published[1]
28. **Ongoing research**, presenting a non-exhaustive list of ongoing research projects reported by the STAR IDAZ IRC partners.

For each of its priority diseases/issues, STAR IDAZ IRC establish (or plan to) geographically balanced Working Groups (WGs) of experts to perform gap analyses and to produce research roadmaps on the selected diseases/issues. For diseases/issues where global networks dedicated to gap analyses already exist, these groups were/will be requested to support the STAR IDAZ IRC and act as WGs. Thus the 'global research networks' section describes the pre-existing global networks where collaboration is ongoing or is envisaged to bring forward further activities and when this is not present, the STAR IDAZ IRC newly established WG for each priority disease.

In the 'Recent research advances' sections, the selection of articles outlined resulted from a review of the literature published on the priority diseases from January 2023 to July 2024 and a selection of key articles presenting overviews of the current state of knowledge or providing significant advances in science. Because of the large volume of literature published on the selected diseases/issues, it was not feasible to include a comprehensive list of recent publications, instead only a selection of a few highly relevant ones are included, selected by SIRCAH with the support of the Scientific Committee.

'Trends in published research' associated with the keywords used in the CAB Abstracts search have also been also included to show, whenever possible, the main statistics on each priority disease/issue for topics such as diagnostic, epidemiology, vaccination/vaccine development and therapeutics. Moreover, a graphical analysis of the estimated distribution of articles, based on the country of first author, among the four STAR IDAZ Regional Networks (Americas, Africa and Middle East, Asia & Australasia and Europe), has been reported. These data represent only an estimation of the trend in published research based on data searched by keywords and depend on the keywords attributed by CAB Abstracts. Some articles may be counted under more than one topic when more than one keyword was attributed to the article. Furthermore, for some diseases/issues it was not possible to apply the standard topic search because of the peculiarities of the issue.

The 'Ongoing research' sections present lists of projects targeting the selected priority diseases, classified based on the country of origin and name of the funding body issuing the project. The lists only focus on projects issued by STAR IDAZ IRC and STAR IDAZ Network Members, and are non-exhaustive, being based on information provided by Members and extracted from the reports of the STAR IDAZ IRC Executive Committee meetings, from Regional Network meetings and Working Group activities. Nevertheless, in the view of the authors, such lists provide a valuable tool to support decision making by research funders, providing support in avoiding duplication of efforts and identifying potential synergies and collaborations.

1 Due to the complexity of key words, no data extraction was executed for general cross-cutting issues, such as emerging issue.

1. Animal genomics/genetics

Global network: International Society for Animal Genetics (ISAG)

Website: https://www.isag.us/

Partners ca.
N/A

Budget
N/A

Start date:
1954

Overview

The International Society for Animal Genetics (ISAG) is a global scientific organisation founded in 1954, dedicated to advancing knowledge in animal genetics. ISAG brings together researchers, academics, and industry professionals from around the world to collaborate, share knowledge, and set standards for genetic research and testing in animals. The society focuses on various species, including livestock, companion animals, and wildlife, with an emphasis on improving genetic understanding, enhancing breeding programmes, and supporting conservation efforts.

Aim and priorities

ISAG's primary aims and priorities are:

Advancing scientific knowledge: ISAG seeks to promote and facilitate the exchange of scientific knowledge in animal genetics, fostering innovation and the development of new genetic tools and technologies

Setting global standards: The society plays a crucial role in establishing international standards for genetic testing, including those for parentage verification, disease diagnostics, and genetic diversity assessment

Fostering global collaboration: ISAG aims to create a global network of researchers and professionals who can collaborate on research projects, share data, and contribute to the global understanding of animal genetics

Supporting education and professional development: ISAG prioritises the education and training of both established and early-career scientists, ensuring the continued growth and development of expertise in the field of animal genetics

Promoting ethical practices: The society emphasises the importance of ethical considerations in genetic research and the responsible use of genetic technologies in animal breeding and conservation.

Objectives and activities

To achieve its aims, ISAG undertakes a variety of activities, including:

Biennial conferences: ISAG organises international conferences every 2 years, bringing together leading researchers, academics, and industry professionals to discuss the latest advances in animal genetics. These conferences are a major event in the field, providing a platform for presenting research findings, networking, and collaborating on new projects

Workshops and committees: The society conducts specialised workshops and forms committees to address specific areas of interest, such as genetic markers, parentage testing, and disease resistance. These gatherings allow for in-depth discussion and the development of technical guidelines and standards

Publication and dissemination of research: ISAG supports the publication of research findings in scientific journals, reports, and other media. The society's publications are an essential resource for researchers and professionals working in animal genetics

Development and maintenance of genetic databases: ISAG plays a key role in the establishment and management of genetic databases that are crucial for research in areas like breed conservation, genetic diversity, and molecular genetics

Standards and guidelines: ISAG develops and updates guidelines for genetic testing, ensuring consistency and accuracy across the global community. These standards are widely adopted in genetic laboratories around the world

Educational programmes: The society offers training programmes, workshops, and mentorship opportunities to support the education of young scientists and professionals in the field.

News

ISAG regularly updates its members and the broader community with news on developments in the field of animal genetics, as well as the society's ongoing activities. To stay updated on the latest news, members and interested individuals can visit ISAG's official website **https://www.isag.us/**.

STAR IDAZ WG progress

Preliminary assessment/research review conducted	
Gap analysis performed	
Research roadmaps developed	

Identified research needs

Recent research in animal genetics has identified several key areas where further investigation and innovation are needed. These needs are critical for advancing the field and addressing pressing challenges in animal breeding, conservation, and health. Below contains eight of the most important research needs and recommendations that have emerged from recent studies:

- **Genetic diversity and conservation**: Preserve and enhance genetic diversity in animals to improve resilience against diseases and environmental changes
- **Disease resistance**: Identify genetic markers for disease resistance and use gene editing to develop healthier animals
- **Precision breeding**: Improve genomic selection accuracy with multi-omics data and AI, accelerating the breeding of animals with desirable traits
- **Climate change adaptation**: Breed animals with traits that enhance resilience to climate-related stressors, supporting sustainable agriculture
- **Ethical considerations**: Address ethical concerns in genetic research and engage the public to ensure responsible use of genetic technologies
- **Functional genomics**: Expand research on gene function and epigenetics to understand how environmental factors influence animal traits
- **Reproductive technologies**: Improve cryopreservation and assisted reproductive techniques to enhance reproductive efficiency and genetic outcomes
- **Multi-omics integration**: Develop platforms for integrating multi-omics data to gain a comprehensive understanding of animal biology.

Recent developments

Genetic variation in natural and induced antibody responses in layer chickens.[2]

This research aimed to identify genomic regions linked to natural and induced antibodies in chickens using low-pass sequencing and enzyme-linked immunosorbent assays. Particularly focused on innate antibodies binding KLH, OVA, and PHA, and adaptive antibodies binding IBD, IBV, NDV, and REO. GWAS was conducted on different chicken breeds such as White Leghorn, two White Plymouth Rock, and two Rhode Island Red, identifying significant genomic regions related to immune responses. Enrichment analysis revealed key immune-related pathways in Rhode Island Red and White Leghorn chickens, though White Plymouth Rock showed no significant enrichment. The findings enhance understanding of the genetics behind antibody responses in layer chickens.

Characterization of an African swine fever virus outbreak in India and comparative analysis of immune genes in infected and surviving crossbreed vs. indigenous Doom pigs.[3]

Since 2020, ASF outbreaks cause significant economic losses, with ASFV genotype II identified as the cause affecting all pig breeds in Northeast India, except the Doom pigs, a unique indigenous breed from Assam closely related to wild pigs. This study examined the expression of immune-related genes MYD88, LDHB, and IFIT1 in ASFV-infected Doom pigs, comparing them to healthy controls at different stages of infection. Doom pigs' disease tolerance and genetic similarity to wild pigs make them ideal for studying ASFV resistance. The findings offer key molecular insights into the regulation of ASFV tolerance genes.

2 Arango, J., Wolc, A., Owen, J., Weston, K., & Fulton, J. E. (2024). Genetic Variation in Natural and Induced Antibody Responses in Layer Chickens. Animals, 14(11), 1623. **https://doi.org/10.3390/ani14111623**

3 Das, P. J., Sonowal, J., Sengar, G. S., Pegu, S. R., Deb, R., Kumar, S., Banik, S., Rajkhowa, S., & Gupta, V. K. (2024). Characterization of an African swine fever virus outbreak in India and comparative analysis of immune genes in infected and surviving crossbreed vs. indigenous Doom pigs. Archives of virology, 169(7), 145. **https://doi.org/10.1007/s00705-024-06062-y**

Global status of gene edited animals for agricultural applications.[4]

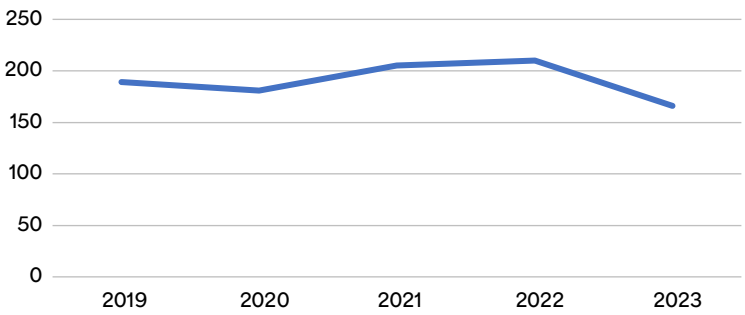
This review analysed 212 studies on agricultural animal Gene editing (GnEd), encompassing ruminants, monogastrics, avian species, aquatic species, and insects. GnEd utilises site-directed nucleases like CRISPR/Cas9 to create precise double-strand breaks (DSBs) in genomes, commonly resulting in knock-out mutations through insertions or deletions. The study shows that the primary traits targeted were yield (32%), reproduction (21%), and disease resistance (17%). Over half of these studies had Chinese first authors and some countries, like Argentina, Brazil, Japan and Colombia, classify certain GnEd-induced knock-outs as natural genetic variations, allowing some modified animals like fast-growing fish and disease-resistant pigs to be labelled non-GMO.

Transcriptomic changes and regulatory networks associated with resistance to mastitis in Xinjiang brown cattle.[5]

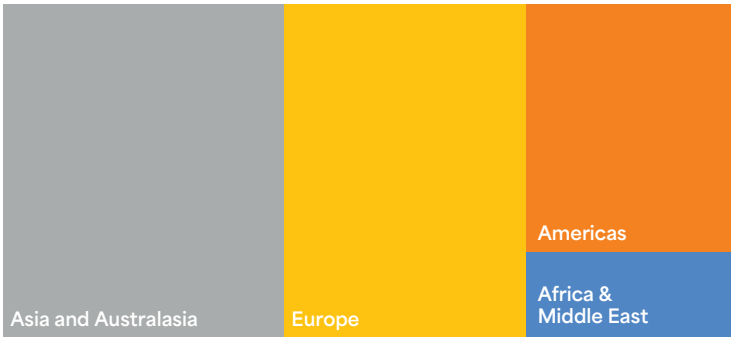
This study aimed to identify genes involved in mastitis resistance in cattle of the breed Xinjiang brown cattle, noted for their disease resistance and tolerance of roughage feeding. Cattle with high somatic cell counts (SCCs) showed higher level on cytokines IL-1β, IL-6, IL-10, TNF-α, and TGF-β. RNA-seq revealed 1632 differentially expressed mRNAs, 1757 lncRNAs, and 23 circRNAs, enriched in pathways such as PI3K/Akt, focal adhesion, and ECM-receptor interactions. ceRNA networks highlighted key genes enriched in pathways like PI3K-Akt, cholinergic synapses, cell adhesion, and cytokine receptor activity, suggesting their roles in bovine mastitis resistance.

Trends in published research

Total records & Main topics



Country/ Region of first Author (2019/2023)



4 Ledesma, A. V., & Van Eenennaam, A. L. (2024). Global status of gene edited animals for agricultural applications. Veterinary journal, 305, 106142. https://doi.org/10.1016/j.tvjl.2024.106142

5 Wang, D., Yang, H., Ma, S., Liu, T., Yan, M., Dong, M., Zhang, M., Zhang, T., Zhang, X., Xu, L., Huang, X., & Chen, H. (2024). Transcriptomic Changes and Regulatory Networks Associated with Resistance to Mastitis in Xinjiang Brown Cattle. Genes, 15(4), 465. https://doi.org/10.3390/genes15040465

Ongoing research

Non-exhaustive list of ongoing projects on genomics/genetics funded by STAR IDAZ IRC and STAR IDAZ Network Members reported in June 2024:

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
Australia	ACIAR	ILRI	A Platform for Testing, delivering, and Improving Chickens for Enhanced Livelihood Outcomes in South East Asia	2020	2024
Austria	IAEA	KALRO	Using Nuclear and Related Technologies in increasing utilization of locally adapted cattle and feed resources	2022	2025
China	NSFC	Anhui University	New explorations of the evolutionary mechanism of the male stag beetle maxillary luxury trait - based on comparative genomics and transcriptomics studies	2024	2027
China	NSFC	China Agricultural University	Population genomics and evolutionary mechanism of body colour adaptation in the short-headed bumblebee (Hymenoptera: Apidae)	2024	2027
China	NSFC	Fourth Military Medical University	Juvenile exercise enhances immune defence in adult mice through epigenetic modulation of hepatic piperidinic acid metabolism	2024	2026
China	NSFC	Fudan University	Cross-species analysis of mechanisms of evolutionary genetics of high-altitude adaptation in vertebrates	2023	
China	NSFC	Institute of Zoology-Chinese Academy of Sciences	Exploring the evolutionary relationship between spider construction behaviour and phenotype based on phylogenetic genomics	2023	
China	NSFC	Northwest A&F University	Phylogenetic genomics and taxonomic revision of the leafhopper family Cicadellidae	2024	2027
China	NSFC	Qinghai Normal University	Phylogenetic genomics and evolutionary history of goat-antelopes from the southeastern margin of the Qinghai-Tibetan Plateau.	2024	2026
China	NSFC	Sun Yat-sen University	Integrated conservation of the Chinese crested tern based on conservation genomics and ecological modelling	2023	
China	NSFC	The Second Military Medical University	Molecular classification, phylogeny and population genetics of malaria-transmitting mosquito vectors in the Lancang-Mekong River basin	2024	2027
China	NSFC	Xinjiang Agricultural University	Epigenetic analysis of the mechanisms regulating the performance of the Ili horse in the 5000 m speed race	2024	2026
EC	EU-PAHW (EU + INRAE in-kind)		Role of the immune system in farm animals	2024	

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
France	CGIAR	ILRI	Sustainable Animal Productivity for Livelihoods, Nutrition and Gender Inclusion (SAPLING) Initiative	2022	2024
India	ICAR	ILRI	Pangenome analysis and identification of selection signature for conservation of red jungle fowl	2023	2024
France		INRAE	Phylodynamics of animal diseases and livestock health	2021	2023
Italy	MINSAL-IT	IZS AM	AGATA-Artificial intelligence in genomics and pathogenesis: predictive medicine in Public Health	2021	2023
Italy	MINSAL-IT	IZS LER	Klebsiella pneumoniae–one of the most serious medical emergencies of our time–what is the role of animals? Comparative genetic analysis of the virulence and resistance of human and animal strains	2022	2024
Italy	MINSAL-IT	IZS LT	Development of analytical protocols for the detection and identification of genetically modified animals aimed at official control of unauthorized GMOs in the food chain	2021	2023
Italy	MINSAL-IT	IZS LT	Genomics of the Campylobacter zoonotic population in Italy in a One Health perspective, with particular regard to antibiotic-resistant Campylobacteriosis, and development of a prototype local surveillance network (Lazio Region)	2022	2024
Italy	MINSAL-IT	IZS ME	Epidemiological and genetic evaluation of the possible role of wild birds in the transmission of the parasite Toxoplasma gondii to humans. (FLYINGTOXO)	2022	2024
Italy	MINSAL-IT	IZS SA	Phylodynamic analysis of the genetic variability of the Bluetongue virus in Sardinia with insights into its origins and spread dynamics	2022	2024
Italy	MINSAL-IT	IZS SI	De novo sequencing of the genome of Leishmania infantum isolated from dogs: a new reference strain in the Mediterranean basin. Phylogenetic analysis and epidemiological studies (NGS/MCAN)	2021	2023
Italy	MINSAL-IT	IZS SI	Innovative methods (metagenomics, immunohistochemistry, and in situ hybridization) applied to the epidemiology of endemic and exotic vector risks (Ixodidae and Argasidae) for the study and surveillance of pathogens in Mediterranean multi-host ecosystems	2023	2025

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
Italy	MINSAL-IT	IZS SI	Whole genome sequencing of Leishmania spp. strains isolated from animal and human populations in Italy: comparative genomic characterization and One Health molecular epidemiology approaches to a re-emerging zoonosis (Epi-Leish)	2023	2025
Italy	MINSAL-IT	IZS UM	The role of genetics in disease control in aquaculture	2023	2025
Italy	MINSAL-IT	IZS VE	Study of the direct genetic component and hereditary social effects in the prevalence of tail biting for the definition of new genetic improvement plans for pig lines (GeneTail)	2022	2024
NL	TKI Agri&Food	WUR	Breed4Food	2021	2025
SPAIN	AEI	IRTA	Deciphering campylobacter coli host interactions for the development of effective control tools in poultry farming	2022	2025
SPAIN	AEI	UNIVERSIDAD DE LLEIDA	Identification and validation of genetic markers associated with resilience to infectious diseases in pigs	2022	2025
UK	Defra	Cefas	Underpinning research to support Defra policy and Cefas core research and diagnostic capability in aquatic animal disease.	2023	2026
UK	Defra	Cefas	Review and enhance disease risk-ranking models for the aquaculture industry in England & Wales	2024	2025
UK	Defra	Cefas	Establish an Official Statistics Publication for UK Aquaculture Statistics	2024	2025
UK	Defra	Cefas	Development of microbial indicators to measure environmental and climate change impact on aquatic animals	2024	2025
UK	Defra	Cefas	Development of a readily-deployable systems-based toolkit for holistic understanding of aquatic animal health	2024	2025
USA	BMGF	ILRI	Centre for Tropical Livestock Genetics and Health - Phase 2 - Genetics and Reproductive Technologies	2022	2027
USA	BMGF	ILRI	Centre for Tropical Livestock Genetics and Health - Phase 2 - East Coast Fever	2022	2027
USA	BMGF	ILRI	Tropical Poultry Genetics Solutions (TPGS)	2022	2025
USA	BMGF	ILRI	African Asian Dairy Genetic Gains (AADGG)	2022	2025
USA	UNWomen	ILRI	Introduction and evaluation of tropically adapted chicken strains in selected districts of South Sudan	2023	2025

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
USA	USDA NIFA	ARS	Integrating functional genomics, behavior, and health measures to mitigate the cumulative effects of in utero heat stress on swine welfare	2021	2025
USA	USDA NIFA	BOARD OF REGENTS OF THE UNIVERSITY OF NEBRASKA	Improving robustness and climatic resilience in US sheep populations through genomics	2022	2025
USA	USDA NIFA	IOWA STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY	Comprehensive mining of the blood cell transcriptome for improved phenomics in swine	2022	2025
USA	USDA NIFA	OKLAHOMA STATE UNIVERSITY	Impact of prenatal stress on microbiome signature on immune and welfare status of the progeny	2023	2027
USA	USDA NIFA	PURDUE UNIVERSITY	DSFAS: Integrating multiomics and high-throughput phenotypic datasets through machine learning to improve animal resilience and welfare	2022	2026
USA	USDA NIFA	PURDUE UNIVERSITY	Environmental and Genetic Strategies for Improving Bone Health and Walking Ability of Commercial Turkeys	2022	2025
USA	USDA NIFA	PURDUE UNIVERSITY	PARTNERSHIP: Using genomics and individual animal protective factors to combat ectoparasitic mites and improve laying hen welfare	2023	2027
USA	USDA NIFA	REGENTS OF THE UNIVERSITY OF MINNESOTA	Using genetic predictive models to improve the health and performance of Standardbred racehorses	2023	2025
USA	USDA NIFA	RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY	Using genomics to mitigate the threat of the invasive longhorned tick, *Haemaphysalis longicornis*	2021	2024
USA	USDA NIFA	UNIVERSITY OF CALIFORNIA, DAVIS	Leveraging High-Throughput Phenotypes and Biological Information into Genome-enabled Analysis and Prediction	2021	2024
USA	USDA NIFA	UNIVERSITY OF MARYLAND, COLLEGE PARK	Incorporating Functional Genomics Data in Cattle GWAS and Genomic Selection	2021	2024
USA	USDA NIFA	UNIVERSITY OF MISSOURI SYSTEM	High Throughput Phenotyping of Polygenic Heritable Sperm Defects	2023	2027
USA	USDA NIFA	UNIVERSITY OF WISCONSIN SYSTEM	The Resilient Cow: Next-Generation Selection using High-Frequency Phenotypes to Achieve Predictable Performance in Unpredictable Conditions	2023	2027
USA	USDA NIFA	UNIVERSITY OF WISCONSIN SYSTEM	Integrating Enviromics, Genomics, and Machine Learning for Precision Breeding of Resilient Beef Cattle	2023	2027

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
USA	USDA NIFA	UNIVERSITY SYSTEM OF NEW HAMPSHIRE	PARTNERSHIP: Comparative microbial genomics of mastitis pathogens and the dairy environment	2021	2025
USA	USDA NIFA	WASHINGTON STATE UNIVERSITY	Genomically optimized organic dairy (GOOD): genome selection against uterine diseases to improve fertility and longevity in cattle	2022	2026
USA	USDA NIFA	WASHINGTON STATE UNIVERSITY	Validation and Characterization of Loci Associated with Fetal Loss in Dairy Cattle	2023	2026
USA	USDA NIFA	WESTERN UNIVERSITY OF HEALTH SCIENCES	Characterizing the spatial expression of the clustered homolog of immunoglobulin-like receptors (CHIR) in the chicken intestine after coccidiosis vaccine challenge	2023	2025
USA	USDA	ILRI	Generation of a Transposon Mutant Library of Mycoplasma Mycoides Subspecies Mycoides	2022	2028

2. Aquaculture: Fish Diseases

Global network:

No global research network has been identified on Aquaculture focusing on fish diseases. STAR IDAZ is planning to convey a global working group to identify the highest research priorities for aquatic fish diseases, including some prominent global networks such as:

- **Reference Centres Network** for Aquatic diseases of the World Organisation for Animal Health (WOAH). They provide guidelines, coordinate research, and facilitate information sharing among the 183 WOAH Member countries to control and prevent the spread of fish diseases.
- **WorldFish** of CGIAR, an international non-profit research organisation present in 37 countries that focuses on the sustainable development and management of fisheries and aquaculture. It has work areas related to fish diseases as part of its broader mandate to improve aquaculture productivity and sustainability. Their research often includes studying fish health, disease management, and biosecurity measures to prevent the spread of diseases in aquaculture systems.

Additionally, some regional networks are also active in the field such as the:

- Network of **Aquaculture Centres in Asia-Pacific** (NACA), which works on fish health and disease management among other things. This network collaborates with various international and regional organisations to monitor, manage, and prevent fish diseases.**SCAR FISH**, a policy-driven strategic group having the objectives of providing the European Commission and its Member States with research and innovation policy advice on issues such as fisheries and aquaculture.
- **Fish Health Section** of the American Fisheries Society (AFS-FHS), which focus on fish disease research, diagnostics, and management within North America.

STAR IDAZ WG progress

Preliminary assessment/research review conducted	
Gap analysis performed	
Research roadmaps developed	

Identified research needs

In the last decades, different groups of researchers with expertise in fish health, worked to identify research gaps and developed strategic research and innovation agendas. Some examples are:

- CWG AHW/SWG FISH: **Disease prevention in farmed fish: new developments and research needs** [2019];
- CWG AHW/SWG FISH: **Strengthening fish welfare research through a gap analysis study** [2018];
- SWG Fish: SRA on Fresh water fish: **Evaluation of the freshwater aquaculture research needs in Europe** [2020]
- Australian Department of Agriculture, Fisheries and Forestry: **Aquaplan 2022-2027** [2022]
- WorldFish: Priority actions 3.2: Ensure aquatic food are safe and healthy for human consumption- **Research and innovation strategy 2030**

Nevertheless, there is a need for a global coordinated approach and a continuous updating of research needs to steer the funding towards impactful research activities, avoiding duplication of efforts and enhance synergies. STAR IDAZ is working to convene a group of international experts on fish diseases to identify gaps of knowledge over high-priority areas.

Recent developments

Most of the escaped farmed salmon entering a river during a 5-year period were infected with one or more viruses.[6]

This study examined almost 600 farmed Atlantic salmon escapees over 5 years, revealing that over 90% were infected with one or more viruses. The salmon tested were infected by viruses such as piscine orthoreovirus (PRV-1) at 75.7%, followed by salmonid alphavirus (SAV) at 43.6%, and piscine myocarditis virus (PMCV) at 31.2%. The authors highlight that farmed fish escapees could pose a significant risk of transmitting infectious agents to wild salmon populations.

Rapid detection of fish with SVC symptoms based on machine vision combined with a NAM-YOLO v7 hybrid model.[7]

This study developed a machine vision-based detection method using a hybrid NAM-YOLO v7 deep learning model to identify fish infected with spring viraemia of carp virus (SVCV). After training of the model, NAM-YOLO v7 achieved over 95% accuracy in detecting infected fish, while the time for detection for each image only takes 0.18 s. This novel technique has the potential to offer a rapid, efficient, and practical tool for early detection and disease surveillance in small aquaculture farms.

Preparation and evaluation of microencapsulated delivery system of recombinant interferon alpha protein from rainbow trout.[8]

The research focused on developing and evaluating a microencapsulated delivery system for recombinant interferon alpha (IFN-α) emulsion using resistant starch and carboxymethyl chitosan. By using the Box-Behnken design (BBD) response surface technique, the system was optimised to enhance the survival rate of rainbow trout and carp infected with viral diseases. The findings shows that rainbow trout infected with infectious hematopoietic necrosis virus (IHNV) and common carp infected with spring viraemia of carp virus (SVCV) have a relative survival rate (RPS) of 65 % and 60 % after treated with IFN microcapsules. This suggests that the microencapsulated IFN-α has significant potential as an antiviral treatment in aquaculture.

6 Madhun, A. S., Karlsbakk, E., Skaala, Ø., Solberg, M. F., Wennevik, V., Harvey, A., Meier, S., Fjeldheim, P. T., Andersen, K. C., & Glover, K. A. (2024). Most of the escaped farmed salmon entering a river during a 5-year period were infected with one or more viruses. Journal of fish diseases, 47(7), e13950. https://doi.org/10.1111/jfd.13950

7 Cai YaoYi; Yao ZeKai; Jiang HaiBo; Qin Wei; Xiao Jun; Huang XiuXiang; Pan JiaJi; Feng Hao (2024). Rapid detection of fish with SVC symptoms based on machine vision combined with a NAM-YOLO v7 hybrid model. Aquaculture, Vol. 582, 740558, **https://doi.org/10.1016/j.aquaculture.2024.740558**

8 Ouyang, P., Li, Y., Wei, W., Li, Q., Liu, J., MaYang, Li, S., Zhou, Y., Chen, D., Geng, Y., & Huang, X. (2024). Preparation and evaluation of microencapsulated delivery system of recombinant interferon alpha protein from rainbow trout. International journal of biological macromolecules, 273(Pt 1), 132872. **https://doi.org/10.1016/j.ijbiomac.2024.132872**

Self-assembling ferritin nanoplatform for the development of infectious hematopoietic necrosis virus vaccine.[9]

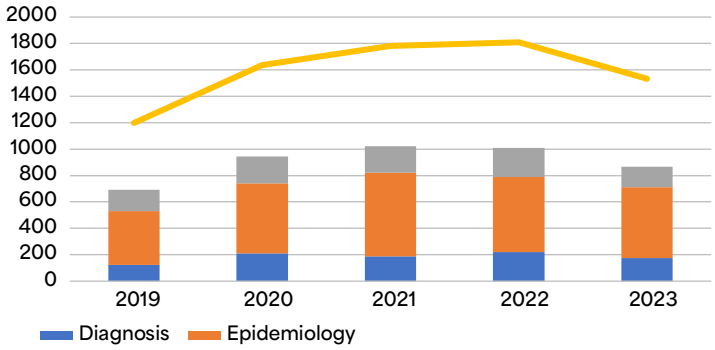
This study introduced a novel self-assembling ferritin-based nanoparticle vaccine platform to improve stability and immunogenicity of a safe subunit vaccine for the Infectious hematopoietic necrosis virus (IHNV). Researchers genetically fused the virus glycoprotein to the *H. pylori* ferritin as a scaffold, constructing a self-assembling IHNV nanovaccine (FerritVac). Despite the introduction of an exogenous fragment, the FerritVac NP vaccine showed promising stability, no cytotoxicity, and induced a strong immune response in fish, making it a viable candidate for preventing IHNV in aquaculture.

Combining phage display technology with in silico-designed epitope vaccine to elicit robust antibody responses against emerging pathogen tilapia lake virus.[10]

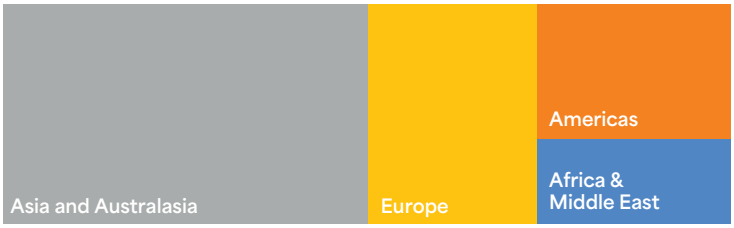
This study combined phage display technology with computational epitope design to develop a vaccine against the tilapia lake virus (TiLV), an emerging virus with unknown protein functions. By using a phage library and identifying a mimotope (Pep3)a vaccine was developed. Further analysis identified a protective antigenic site (S1399-410), leading to a vaccine that elicited a strong immune response in tilapia, with a survival rate of 81.8% after challenge. This research offers a promising approach for epitope vaccine development against emerging viral diseases and achieved a significant immune response and protection rate in tilapia.

Trends in published research[11]

Total records & Main topics



Country/ Region of first Author (2019/2023)



9 Ahmadivand, S., Krpetic, Z., Martínez, M. M., Garcia-Ordoñez, M., Roher, N., & Palić, D. (2024). Self-assembling ferritin nanoplatform for the development of infectious hematopoietic necrosis virus vaccine. Frontiers in immunology, 15, 1346512. https://doi.org/10.3389/fimmu.2024.1346512

10 Gong, Y. M., Wei, X. F., Zheng, Y. Y., Li, Y., Yu, Q., Li, P. F., & Zhu, B. (2023). Combining Phage Display Technology with In Silico-Designed Epitope Vaccine to Elicit Robust Antibody Responses against Emerging Pathogen Tilapia Lake Virus. Journal of virology, 97(4), e0005023. https://doi.org/10.1128/jvi.00050-23

11 Search for infectious diseases of cultured finfish

Ongoing research

Non-exhaustive list of ongoing projects on aquaculture funded by STAR IDAZ IRC and STAR IDAZ Network Members reported in June 2024:

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
Canada	IDRC	The Network of Aquaculture Centres in Asia-Pacific TH	**Knowledge brokering for nature-based solutions in aquaculture transformation in Asia-Pacific**: support to the Aquaculture Innovation and Investment Hub		
Canada	IDRC	Chiang May University	**Nature-based practices and aquaculture adaptation to climate change in Thailand and Vietnam**		
China	NSFC	East China University of Science and Technology	Molecular mechanism of T3SS-mediated Parthanatos programmed death of Edwardsiella inhibitor cells to promote fish infection	2024	2027
China	NSFC	Guangdong Academy of Agricultural Sciences––Rice Research Institute	Nitrogen transport strategies for coordinating high-yield rice cultivation and healthy fish farming in a rice-fish symbiosis system	2024	2026
China	NSFC	Huazhong Agricultural University	SOCS family members regulate the node molecules of TLR5 immune signaling pathway, which has both anti-viral and anti-bacterial functions, and its mechanism in *Cyprinus carpio* - A case study of grass carp (*Ctenopharyngodon idellus*)	2023	
China	NSFC	Institute of Hydrobiology, Chinese Academy of Sciences	Drivers of Fish Extinction Debt in the Upper Yangtze River	2023	
China	NSFC	Institute of Hydrobiology, Chinese Academy of Sciences	Study on Parasite Species and Invasion Risk of Exotic Freshwater Fish in China	2023	
China	NSFC	Ocean University of China	Mechanism of differential regulation of glycolipid metabolism in fish by fatty acids with different saturations	2023	
China	NSFC	Yuxi Normal University	Effects of endocrine disruptors on the embryonic development of fish from lakes in the central Yunnan plateau	2024	2026
EU	EC	Utrecht University	**DECIDE** - Data-driven control and prioritisation of non-EU-regulated contagious animal diseases	2021	2026
France	ANR	UMR VIM	LipoFishVac - Liponanoparticular mRNA and DNA fish vaccines with immunomodulator adjuvants	2021	2024
France	ANR	UMR VIM	CELL2FISH - The function of Interferon Regulatory Factor 3/7 in fish	2023	2028

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
France	ANR	UMR VIM	ThermoFish - Emergence of viral diseases endangering the sustainable development of aquaculture: adaptation of Novirhabdovirus to climate change	2025	
Italy	MINSAL-IT	IZS LT	Development of molecular methods for the early detection of intracellular parasites in fish	2022	2024
Italy	MINSAL-IT	IZS LT	Development of innovative protocols based on ozone therapy for the control of gill and skin diseases in freshwater fish. Contribution to environmental sustainability and reduction of the health impact of the aquaculture sector	2022	2024
Italy	MINSAL-IT	IZS SA	Multidisciplinary study aimed at histomolecular characterization of the main pathogens and associated lesions of the oyster (Crassostrea gigas) farmed in Sardinia	2021	2023
Italy	MINSAL-IT	IZS UM	The role of genetics in disease control in aquaculture.	2023	2025
Japan	MAFF		Development of a vaccination method for Yellowtail Lactococcosis to increase vaccine efficacy		
Japan	MAFF		Development of an Iridovirus vaccine for bluefin tuna		
Japan	MAFF		Genetic variation of White Spot Syndrome Virus (WSSV) based on the full genome analysis		
Japan	MAFF	Japan Fisheries Research and Education Agency	Upgrading techniques to reduce outbreaks of red sea bream iridovirus (RSIV)		
SPAIN	AEI	CSIC- INIA	Oral vaccines against IPNV in trout based on *B. subtilis* spores and flagellin microparticles	2023	2026
SPAIN	AEI	CSIC/ INSTITUTO DE ACUICULTURA DE TORRE DE LA SAL	Identification and characterization of prophylactic and therapeutic targets for the management of hematophagous monogeneans in mediterranean aquaculture	2023	2027
SPAIN	AEI	UNIVERSIDAD AUTÓNOMA DE BARCELONA	Production and complete functional and structural characterization of nanostructured antigens (NPS) of IHNV and SAV2: from an injectable platform to one of oral administration	2022	2025
SPAIN	AEI	UNIVERSIDAD DE MURCIA	Nodavirus-fish cell interactions. application of antimicrobial peptides as antiviral agents in aquaculture	2023	2026
SPAIN	AEI	UNIVERSIDAD DE VIGO	Deciphering new molecular signatures of vaccine efficacy against *Tenacibaculum Maritimum* in turbot (*Scophthalmus Maxima*)	2023	2026

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
SPAIN	AEI	UNIVERSIDAD MIGUEL HERNÁNDEZ	Novel chlamydomonas-encapsulated recombinant protein oral vaccines for ihnv and sav. antiviral efficacy compared to injectable nanopellet (nps) vaccination	2022	2025
SPAIN	AEI	UNIVERSIDADE DE SANTIAGO DE COMPOSTELA	Design of novel vaccines to prevent the impact of photobacteriosis disease caused by Photobacterium *Damselae ssp. piscicida* in marine fish aquaculture	2023	2026
SPAIN	AEI	UNIVERSIDADE DE SANTIAGO DE COMPOSTELA	Effect of climate change on the spatio-temporal distribution dynamics of viral risk agents in aquaculture - adaptation mechanisms to the increase in temperature of two viruses used as model	2023	2027
USA	USDA NIFA	AMULET, INC.	A rapid, field-portable sensor for detecting histamine in food	2023	2025
USA	USDA NIFA	AUBURN UNIVERSITY	Growth Carcass Traits and Disease Resistance of Myostatin Gene-Edited Channel Catfish and Hybrid Catfish	2022	2024
USA	USDA NIFA	AUBURN UNIVERSITY	Rapid validation of immunogenic targets from hypervirulent Aeromonas hydrophila for development of a recombinant protein vaccine against vMAS in channel catfish (*Ictalurus punctatus*)	2022	2024
USA	USDA NIFA	AUBURN UNIVERSITY	Investigation of vaccination and disease susceptibility of largemouth bass fry during the early rearing stages	2023	2025
USA	USDA NIFA	AUBURN UNIVERSITY	Physiological, transcriptomic and epigenetic assessment of fresh and cryopreserved sperm quality to improve hybrid catfish fry production	2023	2026
USA	USDA NIFA	AUBURN UNIVERSITY	Evaluation of a Recombinant Flavobacterium covae Vaccine in Conjunction with a Dietary Probiotic in Channel Catfish (Ictalurus punctatus)	2023	2026
USA	USDA NIFA	AUBURN UNIVERSITY	Multiple Â¿-3 Fatty Acid Transgene Insertions with MC4R Knockout to Enhance Â¿-3 Fatty Acid Levels, Growth and Reproductive Control in Catfish	2024	2029
USA	USDA NIFA	CLEMSON UNIVERSITY	The Application of MicroRNA to Impact Muscle Growth in Rainbow Trout with Climate Change Implications	2023	2026
USA	USDA NIFA	EmergingDx Inc.	Low-cost Diagnostic Platform for Aquaculture	2023	2025

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
USA	USDA NIFA	FLORIDA A & M UNIVERSITY	Microbial Hazard Assessment and Capacity Building in AI-enabled Biosensing for Contamination Detection in Hydroponic and Aquaponic System	2024	2027
USA	USDA NIFA	FLORIDA STATE UNIVERSITY	Aptamer-Antibody Based Immunoassay for the Detection of Crustacean Shellfish Allergens	2021	2024
USA	USDA NIFA	FRONTLINE BIOTECHNOLOGIES INC.	A Sorbent Technology for eDNA Collection and Concentration for Aquaculture Pathogen Detection	2022	2024
USA	USDA NIFA	KENTUCKY STATE UNIVERSITY	Engaging Secondary School Students in Real-World Investigations in the High School Classroom to Increase their Interest in STEM Subjects and Careers and Enhancement of Leadership	2023	2026
USA	USDA NIFA	MASSACHUSETTS INSTITUTE OF TECHNOLOGY	Underwater Vaccination Using Biopolymeric Microneedles	2024	2026
USA	USDA NIFA	MISSISSIPPI STATE UNIVERSITY	Transfer and Persistence of Multi-drug Resistance Plasmids in the Intestinal Microbiota of Catfish	2021	2024
USA	USDA NIFA	MISSISSIPPI STATE UNIVERSITY	Management Of Fish-Borne Trematodes In Pond-Raised Ictalurid Catfish	2021	2024
USA	USDA NIFA	MISSISSIPPI STATE UNIVERSITY	Functional elucidation of virulence associated proteins encoded by *Flavobacterium columnare*, an important fish pathogen	2021	2025
USA	USDA NIFA	MISSISSIPPI STATE UNIVERSITY	The Role Of The Tight Adherence Operon Genes Of Epidemic *Aeromonas Hydrophila*-Caused Disease In Channel Catfish And Use To Develop Vaccines	2021	2024
USA	USDA NIFA	MISSISSIPPI STATE UNIVERSITY	Trans-cinnamaldehyde as an antimicrobial feed additive to control and prevent enteric septicemia of catfish	2022	2025
USA	USDA NIFA	MISSISSIPPI STATE UNIVERSITY	Direct binding of non-specific cytotoxic cells (NCCs) to bacteria is an important innate immune mechanism in catfish	2022	2024
USA	USDA NIFA	MOTE MARINE LABORATORY, INC.	Novel tech for development of a rapid in-situ seawater and shellfish red tide toxin biosensor and testing feasibility of using land-based recirculation depuration as a red tide mitigation strategy	2021	2025
USA	USDA NIFA	MOTE MARINE LABORATORY, INC.	An In-situ Biosensor for Rapid Sex Determination: A Critical Tool for Economic Growth and Profitability of Sturgeon Caviar Production	2023	2025

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
USA	USDA NIFA	Northwest Indian College	Using molecular methods to determine the role of phytoplankton in West Coast shellfish die-offs	2023	2025
USA	USDA NIFA	Northwest Indian College	Contemporary and Historical Importance of Traditional Plants and Foods	2023	2025
USA	USDA NIFA	NORTHWEST INDIAN COLLEGE FOUNDATION	Testing Reality: The validation of passive sampling methods and real-world monitoring for Paralytic Shellfish Toxins	2021	2024
USA	USDA NIFA	OCEAN ERA, INC.	Precocious puberty in *Seriola rivoliana*: induction of early maturation to accelerate selective breeding outcomes in high-value finfish	2022	2024
USA	USDA NIFA	RADMANTIS LLC	Advanced imaging transforms RAS via individualized tracking of salmon growth and welfare	2024	2025
USA	USDA NIFA	REGENTS OF THE UNIVERSITY OF IDAHO	Efficacy and immunomodulatory property of probiotic C6-6 for early life stage management of coldwater and columnaris disease and coinfection	2022	2025
USA	USDA NIFA	REGENTS OF THE UNIVERSITY OF IDAHO	Ontogeny of lymphoid organs and immunoglobulin producing cells in burbot (*Lota lota*).	2024	2025
USA	USDA NIFA	SAES - AUBURN UNIVERSITY	Increasing Colonization of Stem Cells and Early Detection of Xenogenesis in Catfish with Long Term Reproductive Performance	2023	2027
USA	USDA NIFA	SHERLOCK BIOSCIENCES, INC.	Field-deployable CRISPR-based diagnostics for improved biosecurity in aquaculture	2023	2025
USA	USDA NIFA	TENNESSEE TECHNOLOGICAL UNIVERSITY	Understanding Hybrid Incompatibility and Reproductive Isolation of Channel Catfish and Blue Catfish	2024	2026
USA	USDA NIFA	TEXAS A&M AGRILIFE RESEARCH	Impact Of Dietary Glutamate On The Development Of Gut Mucosal Immunity In Hybrid Striped Bass	2021	2025
USA	USDA NIFA	TEXAS A&M UNIVERSITY-CORPUS CHRISTI	Building foundations for genetic improvement of Eastern oyster in Texas	2021	2024
USA	USDA NIFA	TEXAS STATE UNIVERSITY	Development Of Nasal And Gut Probiotics To Protect Intensive Catfish Culture Against *Edwardsiella Ictaluri* Infections	2021	2024
USA	USDA NIFA	TEXAS STATE UNIVERSITY	Elucidating the metal cell biology of *Saprolegnia parasitica*	2022	2024
USA	USDA NIFA	TRIPLE N OYSTER FARM LLC	Inland production of oyster seed utilizing an artificial seawater closed recirculating aquaculture system	2023	2025

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
USA	USDA NIFA	TRUSTEES OF THE UNIVERSITY OF PENNSYLVANIA, THE	Induction of immune responses in newly found semi-organized lymphoid structures of teleost fish	2021	2024
USA	USDA NIFA	TRUSTEES OF THE UNIVERSITY OF PENNSYLVANIA, THE	Discovery of novel IgT-inducing immunibiotics and their protective effects against fish mucosal pathogens	2022	2024
USA	USDA NIFA	UNIVERSITY OF ALABAMA AT BIRMINGHAM	Just Keep Gilling: Dietary and genetic strategies to improve hypoxia tolerance in rainbow trout	2023	2028
USA	USDA NIFA	UNIVERSITY OF ARIZONA	A viral vector for an oral delivery of RNAi-based therapeutics in shrimp	2022	2024
USA	USDA NIFA	UNIVERSITY OF ARIZONA	Development of PCR-based diagnostic assays in support of disease free attestations of formulated aquafeed.	2022	2025
USA	USDA NIFA	UNIVERSITY OF ARKANSAS SYSTEM	Elucidating the fate of intra- and extracellular antibiotic resistance genes in agricultural reuse water	2021	2024
USA	USDA NIFA	UNIVERSITY OF ARKANSAS SYSTEM	Seed Grant: Phage endolysins, Alternative antimicrobials for Streptococcus iniae	2021	2024
USA	USDA NIFA	UNIVERSITY OF ARKANSAS SYSTEM	Phage Endolysins as Alternatives to Antibiotics for Treating Systemic Infections of Streptococcus iniae in Fish	2021	2025
USA	USDA NIFA	UNIVERSITY OF ARKANSAS SYSTEM	Functional significance of Rhesus glycoproteins in mitigating toxic ammonia build-up in catfish challenged with elevated environmental ammonia and water borne iron in aquaculture practices	2023	2026
USA	USDA NIFA	UNIVERSITY OF CALIFORNIA, DAVIS	Impact of OsHV-1 Microvariants on *Cassostrea virginica* family lines	2021	2024
USA	USDA NIFA	UNIVERSITY OF CONNECTICUT	Evaluation of Genomic Selection for Acute Hepatopancreatic Necrosis Disease Survival and Resistance in White Pacific Shrimp: Genomic Prediction and Genome-Wide Association Study	2022	2025
USA	USDA NIFA	UNIVERSITY OF FLORIDA	Self-Destructing Edwardsiella Piscicida: DNA Vaccine And Antigen Delivery Vector System To Prevent Tilapia Lake Virus (TiLV) Infection	2022	2024
USA	USDA NIFA	UNIVERSITY OF FLORIDA	One-pot RT-LAMP CRISPR/Cas12b platform for rapid detection of tilapia lake virus	2023	2025
USA	USDA NIFA	UNIVERSITY OF MAINE SYSTEM	Cellulose nanomaterials: A novel adjuvant and delivery system for aquatic vaccines	2021	2024

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
USA	USDA NIFA	UNIVERSITY OF MARYLAND BALTIMORE COUNTY	Production of all-female Atlantic salmon without using steroids	2022	2026
USA	USDA NIFA	UNIVERSITY OF MARYLAND BALTIMORE COUNTY	A targeted field survey of parasites on oyster aquaculture farms in the context of the natural environment	2024	2026
USA	USDA NIFA	UNIVERSITY OF MARYLAND EASTERN SHORE	Pathogenic Vibrios and Microbiome in On-bottom and Off-bottom Oyster Culture as Affected by Weather Events and Environmental Conditions	2021	2025
USA	USDA NIFA	UNIVERSITY OF MARYLAND, COLLEGE PARK	Whole-Genome Analyses/Selection to Increase Muscle Yield and Reduce Fillet Downgrading In Rainbow Trout	2021	2024
USA	USDA NIFA	UNIVERSITY OF MARYLAND, COLLEGE PARK	Integrated genomics and metagenomics predictions and modulation of the gut microbiota muscle axis to improve fillet yield in Rainbow trout	2023	2026
USA	USDA NIFA	UNIVERSITY OF NEW MEXICO, THE	Elucidating the role of beta defensins in stress response in Rainbow trout	2021	2024
USA	USDA NIFA	UNIVERSITY OF RHODE ISLAND	Microbial solutions to improving larval resilience in shellfish hatcheries	2022	2024
USA	USDA NIFA	UNIVERSITY OF TEXAS RIO GRANDE VALLEY, THE	Freshwater Prawn Production: Solving the National Problem of Prawn Postlarvae (Seed) Availability through Engineering and Automation	2022	2024
USA	USDA NIFA	UNIVERSITY OF WASHINGTON	Improved climate resilience in oysters through optimization of hatchery-based environmental conditioning practices	2022	2024
USA	USDA NIFA	VIRGINIA INSTITUTE OF MARINE SCIENCE	Rethinking Selective Breeding For Health: Reduced Pathogen Shedding As A Novel Component Of Multi-Trait Enhancement In Salmonid Aquaculture	2023	2025
USA	USDA NIFA	WASHINGTON STATE UNIVERSITY	Decoding the Salmonid Genome Project: A national resource for the large-scale functional characterization of genomic elements using gene edited rainbow trout	2023	2028

3. Brucellosis

Global network: Brucellosis International Society

Website: https://brucellosissociety.org/

Partners ca.
N/A

Budget
N/A

Start date:
1948

Overview

The International Brucellosis Society provides a forum for education of its members and the public on brucellosis and related diseases. The Society is composed of scientists who meet once a year to exchange information on basic and applied mechanisms of animal and human disease research related to brucellosis and its impact worldwide. This multidisciplinary forum brings together basic biology, genomics, immunology, disease prevention, diagnostics and pathogenic mechanisms looking at the diverse areas of brucellosis research.

The International Brucellosis Society originated from the annual gathering of researchers, veterinarians, and regulatory agency officials in Chicago, USA, to exchange ideas and discuss research findings in dealing with brucellosis prevention and control. The first Brucellosis Research Conference was held at the Morrison Hotel in Chicago in November, 1948

Aim and priorities

Aim: sharing research findings, coordinating studies, and developing joint activities to combat brucellosis.

Objectives and activities

The International Brucellosis Society organises annual international conferences as an opportunity for sharing information among scientists, veterinary and medical professionals, and others interested in brucellosis, especially those from countries where the disease is endemic.

News

The 26th Annual Brucellosis Research Conference was held in Texas in May 2024.

STAR IDAZ IRC published a comprehensive roadmap for **Brucellosis vaccine development** on 31 March, 2018. This roadmap addresses critical challenges, including creating DIVA-compatible vaccines, enhancing safety, especially for pregnant animals and achieving long-lasting immunity. To bolster these efforts, STAR IDAZ is planning to connect with the International Brucellosis Society to conduct a survey to identify major research gaps and to plan future steps with the Brucellosis WG. This survey, aimed at brucellosis experts worldwide, will help determine if the current vaccine roadmap needs updating and if new roadmaps are required for diagnostics, therapeutics, or control tools. This strategic initiative ensures that STAR IDAZ's approach remains aligned with global research priorities and effectively targets the control and eventual eradication of brucellosis.

STAR IDAZ WG progress

Preliminary assessment/research review conducted	
Gap analysis performed	
Research roadmaps developed[12]	

Identified research needs

The DISCONTOOLS report on brucellosis identifies the following critical research needs for controlling and eradicating the disease:

Vaccine

- Develop new vaccines that are DIVA-compatible and safe for all livestock. Current vaccines (RB51 and S19) have limitations:
  - Variable efficacy
  - Inability to differentiate infected from vaccinated animals (DIVA)
  - Risks when used in pregnant animals, potentially causing abortions.

Diagnostic

- Improvement of diagnostic tools critical for accurate disease surveillance, early detection, and effective management of brucellosis outbreaks:
  - Need for standardised, sensitive, and specific diagnostic tests
  - Tests should be reliable across different animal species and regions, including resource-limited areas.

Control strategies

Understanding Brucella's virulence mechanisms and host-pathogen interactions. This will be important for developing new therapeutic strategies and enhancing existing control measures

Research into the socioeconomic impact of brucellosis, particularly in LMICs, including studying the cost-effectiveness of different control strategies and their impact on public health and livestock economies.

Epidemiology

- Additional knowledge on the epidemiology of brucellosis, especially in:
  - Mixed breeding systems
  - Wildlife reservoirs.

12 Roadmap on vaccine available online

Recent developments

Brucellosis and one health: Inherited and future challenges[13]

This article highlights the ongoing difficulties in managing brucellosis through the One Health approach, which integrates human, animal, and environmental health. It underscores the need for better collaboration between health sectors, improved diagnostic tools, and more effective vaccines, particularly in resource-limited regions where brucellosis remains endemic. The authors call for a coordinated global effort to address these challenges and enhance the implementation of One Health strategies.

Selection of *Brucella abortus* mimetic epitopes for fast diagnostic purposes in cattle.[14]

This study developed peptides that mimic regions of antigenic proteins of *Brucella abortus* that can be used for fast serological test for all epidemiological situations. Nine clones of phage displaying peptide binders to *B. abortus* were selected from phage display technologies and subsequently sequenced and translated. After molecular docking analysis, two peptides (Ba4 and Ba9) were selected for further analysis. The Ba9, tested by ELISAm showed a sensitivity of up to 97.5% for detection of antibodies circulating in animals with brucellosis. Finally, peptide Ba9 was incorporated onto a bioelectrode, showing promise for a fast test based on an electrochemical sensor using graphite modified with poly-3-hydroxyphenylacetic acid.

Bioinformatics approach for structure modelling, vaccine design, and molecular docking of Brucella candidate proteins BvrR, OMP25, and OMP31.[15]

This study focused on designing vaccines and treatments for brucellosis by modelling the structures of *Brucella* proteins (BvrR, OMP25, and OMP31) and predicting their epitopes. Based on a structural analysis, the best protein models were selected and used for motif and epitope identification. Virtual screening of the ZINC and DrugBank databases identified five promising compounds from the ZINC database that showed strong docking scores, favourable ADMET properties and no cytotoxicity, suggesting they could be potential inhibitors of *Brucella* proteins. These findings offer opportunities for developing new treatments and vaccines for brucellosis.

Immuno-profiling of *Brucella* proteins for developing improved vaccines and DIVA capable serodiagnostic assays for brucellosis.[16]

This research aimed to enhance brucellosis control by developing improved vaccines and DIVA capable serodiagnostic assays. Several serodominant proteins were identified by high-throughput immunoprofiling of *Brucella melitensis* proteins, using sera from brucellosis-positive humans and animals. Ten of these proteins were cloned, expressed, and evaluated for their potential in vaccine development and diagnostics. The protein Dps (BMEI1980) showed strong reactivity with brucellosis-positive sera but not with sera from vaccinated cattle, showing DIVA capability. A prototype lateral flow assay and ELISA based on Dps was developed and demonstrated high sensitivity, specificity, and DIVA capability, making it a promising candidate for next-generation brucellosis diagnostics and vaccines.

13 Moriyón, I., Blasco, J. M., Letesson, J. J., De Massis, F., & Moreno, E. (2023). Brucellosis and one health: Inherited and future challenges. Microorganisms, 11(8), 2070. **https://doi.org/10.3390/microorganisms11082070**

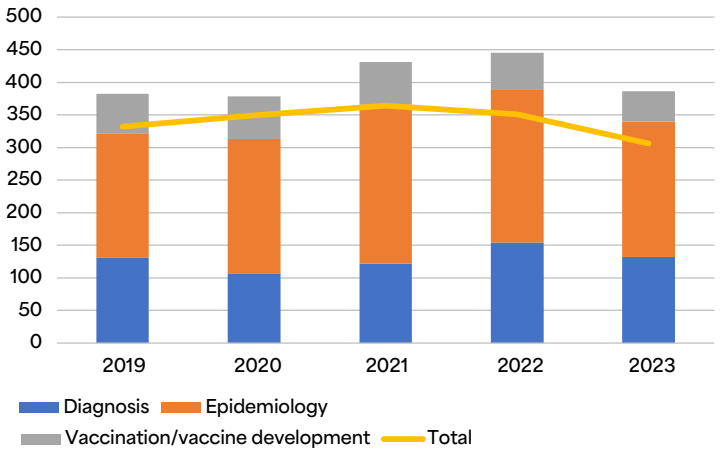
14 Santos, F. A. A., Fujimura, P. T., Vaz, E. R., de Castro, A. C. H., Brito-Madurro, A. G., Alonso-Goulart, V., Bastos, L. M., Fonseca, B. B., Lima, A. M. C., & Goulart, L. R. (2023). Selection of Brucella abortus mimetic epitopes for fast diagnostic purposes in cattle. Veterinary research communications, 47(2), 987-997. **https://doi.org/10.1007/s11259-022-10043-4**

15 Elrashedy, A., Nayel, M., Salama, A., Salama, M. M., & Hasan, M. E. (2024). Bioinformatics approach for structure modeling, vaccine design, and molecular docking of Brucella candidate proteins BvrR, OMP25, and OMP31. Scientific Reports, 14(1), 11951. **https://doi.org/10.1038/s41598-024-61991-7**

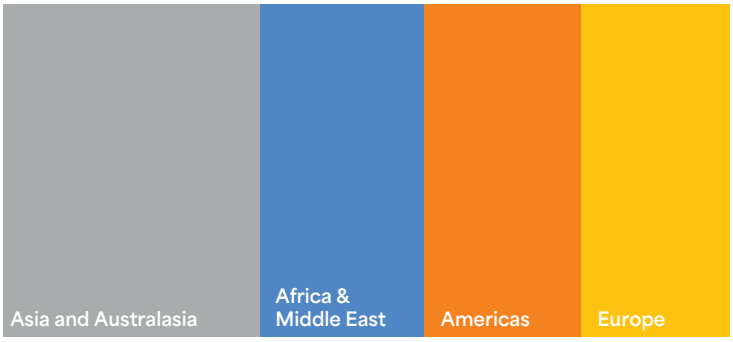
16 Nandini, P., Jakka, P., Murugan, S., Mazumdar, V., Kumar, D., Prakash, R., Barbuddhe, S. B., & Radhakrishnan, G. (2023). Immuno-profiling of Brucella proteins for developing improved vaccines and DIVA capable serodiagnostic assays for brucellosis. Frontiers in microbiology, 14, 1253349. **https://doi.org/10.3389/fmicb.2023.1253349**

Trends in published research

Total records & Main topics



Country/ Region of first Author (2019/2023)



Ongoing research

Non-exhaustive list of ongoing projects on brucellosis funded by STAR IDAZ IRC and STAR IDAZ Network Members reported in June 2024:

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
China	NSFC	Inner Mongolia Agricultural University	Characterization of spatial and temporal distribution of *Brucella abortus* and ticks in cattle and sheep in Inner Mongolia and the mechanism of panophilicity to tick cells	2024	2026
China	NSFC	Institute of Animal Sciences of Chinese Academy of Agricultural Sciences	Screening of Brucella dominant CTL antigenic epitopes and functional studies	2024	2026
China	NSFC	Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences	Molecular mechanism by which the Brucella effector protein BspJ targets the host RNA deconjugating enzyme DDX5 to suppress the inflammatory response	2024	2027
China	NSFC	Northwest A&F University	Mechanism of Brucella T4SS effector protein BtpB targeting NAD+-SIRTs to regulate host cell autophagy	2024	2027
China	NSFC	Shihezi University	Molecular mechanisms of *Brucella abortus* outer membrane vesicle regulation of the cytoskeleton affecting intracellular transport	2024	2027
China	NSFC	Xinjiang Medical University	Mechanism of Notch signalling through monocarboxylic acid transporter proteins regulating MDSC function in persistent Brucella infection	2024	2026
China	NSFC	Xinjiang Medical University	Mechanistic study on the promotion of macrophage M1 polarization in acute-phase *Brucella abortus*-infected hosts in vivo via activation of the TLR-4 pathway by clearing and tonifying formula danphenolic acid B	2024	2026
EU	EC	EC	REPRODIVAC: Next-generation vaccines and diagnostics to prevent livestock reproductive diseases of worldwide impact	2022	2027
Israel	Ministry of Agriculture and Rural Development	Hebrew University, KVI	The epidemiology of *Brucella melitensis* in dairy herds in Israel and the development of a risk based surveillance and control program for this disease.	2020	2024
Italy	MINSAL-IT	IZS AM	Canine brucellosis: development of diagnostic tools and management models for the control of *B. canis*.	2021	2023

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
Italy	MINSAL-IT	IZS AM	Proteomics of the brucellin antigen (Brucomica)	2023	2025
Italy	MINSAL-IT	IZS AM	Study of the efficacy of the Brucella abortus RB51 strain vaccine in pregnant buffaloes (*Bubalus bubalis*) subjected to challenge. (Bu&Bra)	2022	2024
Italy	MINSAL-IT	IZS ME	Study of the cell-mediated response during brucellosis and analysis of possible correlations with different genotypes of brucella in the Mediterranean buffalo (*Bubalus bubalis*)	2021	2023
Italy	MINSAL-IT	IZS ME	Innovative molecular methods in the diagnosis of buffalo brucellosis	2022	2024
Italy	MINSAL-IT	IZS SA	Monitoring the spread of Brucella Suis in domestic and wild pig populations in Sardinia	2021	2023
NL	MIN LNV	WBVR	Brucellose	2023	2027
SPAIN	AEI	UNIVERSITAT INTERNACIONAL DE CATALUNYA, FUNDACIO PRIVADA	Brucella placental pathogenesis and new vaccines development from a new molecular perspective	2023	2026
UK	Defra	APHA	Developing improved detection and control tools for brucellosis		
USA	USDA NIFA	IMMPORT THERAPEUTICS, INC.	Identification of improved diagnostic markers for *Brucella suis* via screening with a Brucella pan-proteome microarray and ELISA prototypes for USDA	2022	2025

4. Emerging issues

Global network:

No unique global network for research on animal emerging diseases has been recognised, however, there are many regional or topic specific networks working in this area. To enhance networking and collaborations, STAR IDAZ IRC ran a mapping exercise to identify these different initiatives, projects and networks working on animal health emerging issue and brought several of them together during a series of webinars. PREZODE, one of the relevant global networks for preventing zoonotic disease emergence, is detailed below.

Website: https://prezode.org

PREZODE

Partners ca.
>240

Budget
N/A

Start date:
2021

Overview

PREventing ZOonotic Diseases Emergence (PREZODE) is an international network that aims to prevent the spread of zoonotic diseases through research, advocacy, and collaboration and support emergence risk reduction strategies for zoonotic infectious diseases. It aims to help coordinate regional, national and international projects and programmes concerning the emergence of zoonotic infectious diseases and implement innovative methods to improve prevention and mitigate emergence risks.

PREZODE consists of more than 240 members from scientific, academic and associative backgrounds, including governments from 27 member countries.

Aim and priorities

Aim: to strengthen and integrate knowledge, innovation, capacity building and operational actions to reduce risk and rapidly detect the emergence of zoonotic diseases in countries and globally.

Priorities: emergence of zoonotic infectious diseases and implementation of innovative methods to improve prevention and mitigate emerging risks.

Objectives and activities

The ojective is to develop:

A framework for the international coordination of research and innovation projects and programmes, of One Health monitoring networks, and participatory projects with stakeholders

A platform for sharing knowledge brought by past, current and future projects and capitalising on experimentations across world regions

An online resource centre for decision-makers to enable public policies supporting emergence risk reduction strategies for zoonotic infectious diseases.

The **PREZODE Strategic Agenda** was published in December 2022 and will serve as a research and operational roadmap for members over the next 10 years.

News

On 7 June 2024, PREZODE hosted an online panel discussion to combine information and analyses regarding the recent spread of Highly Pathogen Avian Influenza (HPAI). A **summary and recording of the panel discussion** is available on the PREZODE website.

PREZODE regularly updates its members and the broader community with news and its ongoing activities through its website and regular newsletters. More information can be found on the PREZODE website **https://prezode.org/**

STAR IDAZ WG progress

Preliminary assessment/research review conducted	
Gap analysis performed[17]	
Research roadmaps developed[18]	

STAR IDAZ hosted the global 'PANDEMIC! A One Health View of Emerging Infectious Diseases. What veterinary sciences can contribute' webinar, in collaboration with the Collaborative Working Group on Animal Health and Welfare Research (CWG-AHW), in June 2020. The webinar presented lessons learned from the COVID-19 pandemic and aimed to investigate the role of veterinary sciences in coping with and preventing future animal and zoonotic pandemics. Over 500 expert participants discussed how research on animal infectious diseases can contribute to prevent and control future human and animal pandemics and how strategic research agendas in animal health can be improved to respond to emerging animal diseases. The **webinar report** summarises the meeting outcomes, outlining identified research needs and policy recommendations.

Following a mapping exercise to identify different initiatives, projects and networks working on emerging issues, STAR IDAZ IRC ran a series of webinars from June 2021 with those initiatives with an international focus and veterinary research component. The webinars aimed to better understand existing collaborations and discuss how STAR IDAZ IRC can assist in encouraging further coordination and collaboration in this area. STAR IDAZ will engage with PREZODE further to discuss opportunities for collaboration to identify and tackle research needs for emerging diseases with zoonotic potential.

Identified research needs

The STAR IDAZ IRC and CWG-AHW **'PANDEMIC! A One Health View of Emerging Infectious Diseases. What Veterinary Sciences can Contribute' webinar report** (2020) details research and policy recommendations around One Health, biosecurity, preparedness, control tools and research management.

The **PREZODE Strategic Agenda** (2022) details the knowledge gaps in research to be filled and the operational activities to be targeted by PREZODE members in the medium and long term over the next 10 years. Knowledge and research gaps have been identified under the five pillars utilised by PREZODE:

- Understand the zoonotic risk and risk activities
- Co-design solutions to reduce the zoonotic risk
- Strengthen early warning systems to detect zoonotic risks
- Prototype a global information system for surveillance and early detection
- [Cross cutting] Engage stakeholders and co-design One Health networks and policies

17 Not applicable for this WG

18 Not applicable for this WG

Recent developments

Rapid detection of high consequence and emerging viral pathogens in pigs.[19]

In this study, the authors developed a sample processing and analysis pipeline to identify DNA and RNA viruses and bacterial pathogens from clinical samples utilising enrichment techniques coupled with Oxford Nanopore Technologies MinION™ sequencing platform. The sample processing and analysis pipeline developed allows the identification of both DNA and RNA viruses and bacterial pathogens simultaneously from a single tissue sample and provides results in less than 12 hours. Based on preliminary evaluation of this method using clinical samples from animals with unknown disease causality, the authors demonstrate that this method could be used to simultaneously detect pathogens from multiple domains of life simultaneously with high confidence.

Emerging zoonotic diseases in Southeast Asia in the period 2011-2022: a systematic literature review.[20]

This systematic review investigated the prevalence of emerging zoonotic diseases over 11 years from 2011 to 2022 in Southeast Asia to understand the status of emerging zoonotic diseases, as well as to provide necessary actions for disease control and prevention in the region. The review was performed on 26 studies of pigs, 6 studies of poultry, 21 studies of ruminants, 28 studies of companion animals and 25 studies of wildlife in Southeast Asia carried out between 2011-2022, which provide a snapshot of the prevalence of the emerging zoonotic disease across the country. The findings from the review showed that emerging zoonotic diseases were prevalent across the region and identified a few zoonotic diseases associated with poultry, mainly stemming from Cambodia and Vietnam, as high priority in Southeast Asia.

Molecular epidemiology of underreported emerging zoonotic pathogen Streptococcus suis in Europe.[21]

Streptococcus suis, is a zoonotic bacterial pathogen detected in swine; infections in humans are not notifiable in most countries, so its incidence is likely underestimated. This study aimed to increase insight into the molecular epidemiology of human *S. suis* infections in Europe. Seven reference laboratories were surveyed, and a systematic review of the scientific literature carried out. The authors then performed whole-genome sequencing to type 46 zoonotic *S. suis* isolates and combined them with 28 publicly available genomes in a core-genome phylogeny. Clonal complex (CC) 1 isolates accounted for 87% of typed human infections; CC20, CC25, CC87, and CC94 also caused infections. The emergence of diverse zoonotic clades and notable severity of illness in humans support classifying *S. suis* infection as a notifiable condition.

A scoping review of zoonotic parasites and pathogens associated with abattoirs in Eastern Africa and recommendations for abattoirs as disease surveillance sites.[22]

Abattoir workers' exposure to animals and animal products increases their risk of infection from zoonotic pathogens. Backyard abattoirs and slaughter slabs have the highest risk of pathogen transmission because of substandard hygiene practices and minimal infrastructure. To assess further the risk of pathogen transmission from abattoirs, the authors conducted a scoping review of parasites and pathogens among livestock and human workers in abattoirs across 13 Eastern African countries, which are hotspots for zoonoses. The results (n = 104 articles) showed the presence of bacteria, viruses, fungi, and macroparasites (nematodes, cestodes, etc.) in cattle, goats, sheep, pigs, camels,

19 Neujahr, A. C., Loy, D. S., Loy, J. D., Brodersen, B. W., & Fernando, S. C. (2024). Rapid detection of high consequence and emerging viral pathogens in pigs. Frontiers in veterinary science, 11, 1341783. **https://doi.org/10.3389/fvets.2024.1341783**

20 Nguyen, T. T., Mai, T. N., Dang-Xuan, S., Nguyen-Viet, H., Unger, F., & Lee, H. S. (2024). Emerging zoonotic diseases in Southeast Asia in the period 2011-2022: a systematic literature review. Veterinary quarterly, 44(1), 1-15. **https://doi.org/10.1080/01652176.2023.2300965**

21 Brizuela, J., Roodsant, T. J., Hasnoe, Q., van der Putten, B. C. L., Kozakova, J., Slotved, H. C., van der Linden, M., de Beer-Schuurman, I. G. A., Sadowy, E., Sáez-Nieto, J. A., Chalker, V. J., van der Ark, K. C. H., & Schultsz, C. (2024). Molecular Epidemiology of Underreported Emerging Zoonotic Pathogen Streptococcus suis in Europe. Emerging infectious diseases, 30(3), 413-422. **https://doi.org/10.3201/eid3003.230348**

22 Rodarte, K. A., Fair, J. M., Bett, B. K., Kerfua, S. D., Fasina, F. O., & Bartlow, A. W. (2023). A scoping review of zoonotic parasites and pathogens associated with abattoirs in Eastern Africa and recommendations for abattoirs as disease surveillance sites. Frontiers in public health, 11, 1194964. https://doi.org/10.3389/fpubh.2023.1194964

and poultry. Most articles reported results from cattle, and the most frequent pathogen detected was *Mycobacterium bovis*, which causes bovine tuberculosis. Based on these findings, the authors discuss ways to improve abattoir biosafety and increase biosurveillance for disease control and mitigation, proposing a regional approach to biosurveillance and highlighting that next generation sequencing will be key in identifying a wide range of pathogens, rather than a targeted approach.

Trends in published research

Due to the broader scope of this topic it was not possible to provide stats on trends in published research.

Ongoing research

Non-exhaustive list of ongoing projects on emerging issues funded by STAR IDAZ IRC and STAR IDAZ Network Members reported in June 2024:

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
Australia and UK	ACIAR, FCD	ILRI	ILRI involved in 5 Innovation packages: Agrochemicals, Climate change, Biodiversity, TAD, Food system	2023	2024
Belgium	EC	ILRI	Capacitating One Health in Eastern and Southern Africa (COHESA)	2021	2025
Belgium	EU through a consortium	ILRI	Towards commercialization of an attenuated vaccine against African swine fever	2024	2027
Belgium	FWO	Ghent University	Cultured stem cells for customized meat design	2020	2024
CGIAR	CGIAR	ILRI	Improving Human Health through a One Health approach (One Health Initiative)	2022	2024
CGIAR	CGIAR	ILRI	Resilient Cities through Sustainable Urban and Peri-urban Agrifood Systems Initiative	2022	2024
CGIAR	CGIAR	ILRI	Sustainable Animal Productivity for Livelihoods, Nutrition and Gender Inclusion Initiative	2022	2024
Denmark	ICARS	ILRI	Antimicrobial Susceptibility Testing Centre of Excellence for serving countries in Africa, covering pathogens in humans, livestock and Aquaculture	2021	2024
Europe	EC	CIRAD	**BCOMING Biodiversity Conservation to Mitigate the risks of emerging infectious diseases**	2022	2026
EU	EC	Universidad complutense de Madrid -ILRI	**A Safe DIVA Vaccine for African Swine Fever Control and Eradication** - (VACDIVA)	2019	2024
EU		INRAE UMR754 IVPC	Innovating to protect biodiversity and prevent future pandemics	2022	2026
EU		INRAE UMR754 IVPC	Coronavirus lead discovery: identification of broad-spectrum antivirals (TNA ISID_8172)	2022	2025
France	ANR	INRAE UMR VIM	Virulence mechanisms of the African Swine Fever virus	2025	
France	ANR	INRAE UMR Virologie	Integrative pathoBiology of Tick-borNe encephalitis vIrus in humans and tiCks	2025	2028

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
France	ANR	INRAE UMR754 IVPC	Generate a physiological and complex lung tissue through 3D bioprinting for the study of host-pathogen interactions	2025	
France	DAPP INRAE	INRAE UMR754 IVPC	Entomological surveillance network and early detection of arboviruses in support of public policies	2022	2024
France	Fondation pour la Recherche Médicale	INRAE UMR754 IVPC	Rift Valley fever virus and its protein NSs as a novel model for studying amyloid aggregation	2024	2027
France	GRET	ILRI	Agro-ecology and Safe food System Transitions (ASSET) in Southeast Asia	2020	2025
France	INRAE	INRAE UMR754 IVPC	Modelling and inference of intra-vector infection dynamics from experimental data	2022	2024
France	The Ministry of Europe and Foreign Affairs	ILRI	Antimicrobial resistance with One Health approach in Uganda, Kenya, Ethiopia and Tanzania	2024	2026
Germany	BMZ	ILRI	One Health Research, Education and Outreach Centre for Africa (OHRECA)	2020	2025
Germany	University of Bonn	ILRI	Implementation and Arboviral Disease in Kenya Within the Context of Collaborative Research Centre 228 Future Rural Africa	2018	2026
India	India-Assam Rural Infrastructure & Agricultural Services Society	ILRI	Assam Agribusiness & Rural Transformation Project (APART)	2018	2024
Italy	MINSAL-IT	IZS AM	OneCoV: emerging animal coronaviruses and their impact on Public Health	2022	2024
Italy	MINSAL-IT	IZS AM	ORBIVAX: development and evaluation of the efficacy of inactivated vaccines against two emerging Orbiviruses in the Mediterranean basin	2022	2024
Italy	MINSAL-IT	IZS LER	Identification of emerging lineages and virulence determinants associated with the resurgence of *Salmonella enterica serovar Enteritidis* infections in Europe in humans	2021	2023
Italy	MINSAL-IT	IZS LER	Emerging tick-borne zoonoses	2022	2024
Italy	MINSAL-IT	IZS LER	Neuroinvasive strains of Astrovirus in pigs, emerging pathogens with zoonotic potential. Clinical, epidemiological aspects, surveillance systems, and early detection	2022	2024
Italy	MINSAL-IT	IZS LER	Evaluation of emerging hazards in meat substitutes. (MicrobioPrepVeg)	2023	2025
Italy	MINSAL-IT	IZS LER	Study of the spread and characterization of emerging hepatotropic viruses in carnivores and lagomorphs in Lombardy	2023	2025
Italy	MINSAL-IT	IZS PB	SARS-CoV-2: Study of an emerging zoonosis through new diagnostic protocols (SAZODIA)	2021	2023

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
Italy	MINSAL-IT	IZS PLV	An innovative integrated surveillance model as an early detection tool for some emerging zoonoses	2021	2023
Italy	MINSAL-IT	IZS PLV	Aquatic biodiversity in the era of "climate change": emerging pathogens and persistent organic contaminants	2021	2023
Italy	MINSAL-IT	IZS PLV	Emerging allergens and food safety: analytical and epidemiological pathway between present and future food allergens	2022	2024
Italy	MINSAL-IT	IZS SA	Identification of emerging pathogens causing significant reproductive disorders in the sheep population of Sardinia	2021	2023
Italy	MINSAL-IT	IZS SA	Identification and quantification of microbial communities, pathogens, and emerging microorganisms present in the processing environments of sheep dairies in Sardinia through DNA metabarcoding	2021	2023
Italy	MINSAL-IT	IZS SA	Research and characterization of new emerging viral pathogens in pig farms and of African Swine Fever strains with reduced virulence	2021	2023
Italy	MINSAL-IT	IZS SI	Innovative methods for the evaluation of endemic, emerging (AMR), and chemical infectious risks in rural areas with livestock farming: human-livestock-wildlife interaction	2021	2023
Italy	MINSAL-IT	IZS SI	Implementation of rapid alert systems and evaluation of the spread of new arboviruses for the reduction of associated health risks	2021	2023
Italy	MINSAL-IT	IZS SI	Characterization and risk assessment of *Toxoplasma gondii* and other emerging and non-emerging pathogens in plant and animal-based food products	2021	2023
Italy	MINSAL-IT	IZS SI	Development of organic electrochemical transistor tests for real-time quantification of neutralizing antibodies against emerging and re-emerging Orthopoxviruses	2022	2024
Italy	MINSAL-IT	IZS SI	Development of organic electrochemical transistor tests for real-time quantification of neutralizing antibodies against emerging and re-emerging Orthopoxviruses	2022	2024
Italy	MINSAL-IT	IZS SI	Evaluation of the spread of the Epizootic Haemorrhagic Disease Virus (EHDV) in Sicily and the role played by vectors aimed at implementing early detection systems	2023	2025
Italy	MINSAL-IT	IZS SI	Whole genome sequencing of Leishmania spp. strains isolated from animal and human populations in Italy: comparative genomic characterization and One Health molecular epidemiology approaches to a re-emerging zoonosis (Epi-Leish)	2023	2025

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
Italy	MINSAL-IT	IZS SI	Impact of plastics on the modulation of intestinal microbiota and on the introduction and spread of emerging diseases in *Caretta caretta* turtles	2023	2025
Italy	MINSAL-IT	IZS VE	Etiopathogenesis and epidemiology of emerging pathogens in the poultry sector: persistence and adaptation of emerging clones of *Salmonella Infantis* and new biocontrol strategies	2023	2025
Italy	MINSAL-IT	IZS VE	Development of a reverse genetics system for early identification of the main pathogenic mediators of emerging lyssaviruses (PathoGenMark - pathogenicity genetic markers)	2023	2025
Italy	MINSAL-IT	IZS VE	Xenobiotics and bee health status: evaluation of the effects of emerging contaminants, PFAS, on the bee microbiota and transcriptome (PFApiS)	2023	2025
Italy	MINSAL-IT	IZS VE	Role of small rodents in the local-scale distribution and epidemiology of emerging zoonoses: *Echinococcus multilocularis* and Hantavirus (RodiZoon)	2023	2025
Kenya	African Population Health & Research Center	ILRI	MAD-tech-AMR- Management of animal diseases and antimicrobial use by information and communication technology to control AMR in East Africa	2021	2024
Kenya	African Population Health & Research Center	ILRI	Selecting Efficient Farm-level Antimicrobial Stewardship Interventions from a One Health perspective (SEFASI)	2022	2025
Netherlands	Wageningen University	ILRI	Support to the International Alliance against Health Risks in Wildlife Trade	2022	2024
NL	MIN LNV	WBVR	Preparing for Emerging Pathogens		
South Africa	Stellenbosch University	ILRI	Accelerating genomics surveillance for COVID-19 response in Africa	2021	2024
South Africa	Stellenbosch University	ILRI	Genomic Surveillance to Control Pathogen Infections In Africa	2023	2027
South Korea	Korea-RDA-Rural Development Administration	ILRI	Analysis of African swine fever virus spread model and immune response to warthog against viral infection	2021	2024
Spain	AEI	UNIVERSIDAD DE BARCELONA	Emerging viruses of concern in the livestock industry, food safety and public health: preparedness, early warning and risk assessment tools in the one-health era	2022	2025
Switzerland	Biovision	ILRI	Scaling agroforestry to benefit the welfare of animals and their owners in Ethiopia (SAWA-Ethiopia)	2022	2024
Switzerland	MCID	IVI	Role of sheep and rodent reservoirs for Wesselsbron, a neglected zoonotic flavivirus	2022	2025

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
Switzerland	MCID	IVI	Confronting the rising epidemic of the zoonotic tick-borne encephalitis virus	2022	2025
Switzerland	SERI (EU-Horizon)	IVI	PANVIRPREP Developing broad-spectrum antiviral drugs for pandemic preparedness	2024	2026
Switzerland	Swiss Agency for Cooperation and Development	ILRI	One Health for Humans, Environment, Animals & Livelihoods	2020	2024
UK	Defra and BBSRC		Usutu virus risk to the UK: Determining local vector competence and modelling climate suitability		
UK	Defra and BBSRC		Genomics for animal and plant disease centre		
UK	Defra		Development of improved tools and approaches for control of zoonotic arthropod-borne diseases of animals and their vectors		
UK	Defra		Coronavirus Prevalence in GB Bats (Active and Passive Surveillance)		
UK	Defra		EBLV-1 Prevalence in Serotine Bats in England & Wales (Active Surveillance)		
UK	Defra		Coronavirus detection, characterisation and pathogen investigation in animals		
UK	Defra		Pathogenesis, immunity, and control of coronaviruses in a large natural host animal, the pig		
UK	Defra		Are overwintering female mosquitoes an effective mechanism for West Nile virus persistence in temperate areas?		
UK	Defra		Development of diagnostic tools for Seneca Valley virus		
UK	LSHTM-London School of Hygiene & Tropical Medicine	ILRI	GCRF Action Against Stunting Hub	2019	2024
UK	Mott MacDonald	ILRI	Regional Grants Phase II Set 2 - Antimicrobial Resistance and One Health, Including Animal Health, the Environment and Practitioner Engagement (AMROH)	2024	2025
USA	US Dept of Defense	ILRI	Mitigating the Risk of Vector-Borne Disease in Northern Kenya	2023	2025

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
USA	BMGF	ILRI	CGIAR Livestock Partnership with the following components: 1) evaluation and improvement of quality control for CBPP vaccines in Africa; 2) development and testing of a novel integrated disease control model for CBPP; 3) establishment and standardization of a challenge model for CBPP; and 4) establishment and standardization of challenge models multiple genotypes of African swine fever	2022	2025
USA	CRDF	ILRI	Title Analysis of the cross protective response induced by ASFV recombinant vaccine ASFV-G-DI177L	2023	2024
USA	National Institutes of Health - Fogarty International Center, USA	KALRO	Support for Vector Biology Training for Sustainable Control of Vector Borne diseases in East Africa	2023	2029
USA	National Institutes of Health - National Institute of Allergy and Infectious Diseases, USA	KALRO	Expanding toolbox for tsetse control in Kenya	2022	2027
USA	National Institutes of Health - National Institute of Allergy and Infectious Diseases, USA	KALRO	Endosymbiont-mediated chitin catabolism in the tsetse fly gut impacts trypanosome transmission	2023	2024
USA	Swedish International Development Cooperation Agency, Bioinnovate Africa Program	KALRO	Upscaling Novel Bio-Rational Products for Controlling Tungiasis in Eastern Africa	2023	2025
USA	University of Florida	ILRI	POULTRY LOSSES AND ONE HEALTH (POLOH): Reducing losses and zoonotic risks along the poultry value chain through a One Health approach	2022	2025
USA	University of Missouri	ILRI	Animal Health Systems Facilitating Trade	2022	2024
USA	USAID	ILRI	Operational Research to Improve Policies and Practices on the Use of the Rift Valley Fever Vaccinations in East Africa	2019	2024
USA	USAID	ILRI	Evaluation of Livestock Emergencies (ELE)-Vaccination and Disease Surveillance	2022	2024

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
USA	USDA	NaLIRRI	One health holistic bio-surveillance: examining livestock and arthropods to unmask the source for re-emerging and/or emerging zoonotic viral human diseases in Uganda	2022	2024
USA	USDA	ILRI	Analysis of the cross protective response induced by ASFV recombinant vaccine ASFV-G-DI177L	2021	2024
USA	USDA	ILRI	Investigation of Arboviral Infection Rates and Blood Meal Sources of Various Mosquito Species in Rift Valley Fever Endemic Areas in Kenya	2022	2024
USA	Washington State University	ILRI	Feed the Future Innovation Lab For Animal Health (Animal Health Innovation Lab); and developing Novel CRISPR-Cas-Powered Diagnostics for ECF	2020	2025
WTO	STDF	KALRO	Promoting live animal trade and export in Eastern Africa	2024	2025

5. Foot-and-Mouth Disease

Global network: Global Foot-and-Mouth Disease Research Alliance

Website: https://www.ars.usda.gov/gfra/

Partners ca.
N/A

Budget
N/A

Start date:
2023

Overview

The Global Foot-and-Mouth Disease Research Alliance (GFRA) is a global network established in 2003. Its main focus is on collaborative research, control, and eradication of foot-and-mouth disease (FMD). It operates as the WG for FMD within the STAR IDAZ IRC. By uniting scientists and research organisations worldwide, GFRA aims to advance the understanding of FMD, develop innovative control measures, and inform global policies. The alliance specifically targets strategic research, improving vaccines and diagnostics, and evaluating the socio-economic impacts of FMD to achieve progressive disease control and eradication.

Aim and priorities

The primary goal of the GFRA is to promote global collaboration in researching and developing strategies to control and ultimately eradicate FMD. GFRA focuses on key priorities, including enhancing international research collaborations, developing advanced vaccines and diagnostics, understanding FMD epidemiology, and evaluating the socio-economic impacts of control measures. Additionally, GFRA aims to provide robust scientific evidence to support the formulation of policies that promote safe trade practices in FMD-endemic regions. Through these efforts, GFRA aims to maximise global resources and expertise to ensure that FMD research is strategic, impactful, and leads to disease eradication.

Objectives and activities

GFRA is dedicated to achieving several specific objectives and carrying out activities to advance the fight against FMD.

Objectives:

- Promote international collaboration: GFRA aims to enhance global partnerships in FMD research by connecting scientists and institutions from different regions. This fosters a culture of knowledge sharing and collaborative efforts
- Conduct targeted research: the alliance prioritises research that deepens our understanding of FMD. This includes studying virus evolution, transmission patterns, and effective containment strategies
- Innovate in control measures: a core objective is the development and refinement of vaccines, diagnostics, and other control tools to improve prevention and response capabilities
- Assess socio-economic impact: evaluating the economic and social effects of FMD and its control measures is crucial for informing effective and sustainable strategies
- Support policy formation: GFRA provides scientific insights that inform policies for managing FMD, particularly in regions where the disease is prevalent. These policies are based on the latest research.

Activities:

- Organising scientific events: GFRA hosts international meetings, webinars, and workshops to share research findings and promote dialogue within the global FMD research community
- Engaging in collaborative research: through joint projects, GFRA addresses key research gaps, such as vaccine development and disease modelling, to enhance global FMD control efforts
- Conducting gap analyses: the alliance identifies critical areas requiring research focus through gap analysis exercises. This guides strategic planning and resource allocation
- Providing training and capacity building: GFRA also focuses on building capacity by offering training programmes that equip researchers and practitioners with the latest knowledge and skills in FMD control.

News

GFRA recently organised scientific meetings and webinars to foster research collaboration and share the latest findings on FMD control. For instance, the 2023 GFRA Scientific Meeting in Kampala, Uganda, brought together researchers to discuss advancements in vaccine development, epidemiological studies, and region-specific control strategies.

To stay updated on GFRA news and activities, you can visit the official GFRA website at **https://www.ars.usda.gov/gfra/**. This site provides the latest updates, access to newsletters, information on upcoming events, and other resources related to FMD research.

STAR IDAZ WG progress

Preliminary assessment/research review conducted	
Gap analysis performed	
Research roadmaps developed	

Identified research needs

The main research needs identified in the GFRA Gap Analysis Report produced from the gap analysis meeting in Buenos Aires, Argentina, December 2022, highlight several critical areas including:

Epidemiology:

- Inadequate understanding of FMD transmission networks in endemic regions
- Need for region-specific data to improve epidemiological models
- Insufficient data collection methods affecting model reliability.

Diagnostics:

- Lack of robust validation for existing diagnostic tools
- Need for reliable and accurate diagnostics across different regions and conditions.
- Vaccines and biotherapeutics:
- Inconsistent vaccine effectiveness and coverage, particularly in resource-limited regions
- Need for more effective vaccines and better understanding of biotherapeutic options.

Immunology:

- Gaps in understanding immune responses to FMD in different species
- Need for research on immunological bases of protection and cross-protection
- Development of novel immunological approaches is required.

Virology:

- Incomplete understanding of FMDV molecular biology, including virus-host interactions
- Need for studies on viral replication, transmission, and persistence.

Pathogenesis:

- Gaps in knowledge of FMDV pathogenesis, particularly transmission dynamics and chronic carriers
- More research needed on the impact of viral genetic diversity on disease outcomes.

Recent developments

Development and planning of measures to reduce the risk of the foot-and-mouth disease virus spread (case of the Republic of Kazakhstan[23]

This study examined the prevention of FMD in Kazakhstan, revealing a 25.3% sero-positivity in cattle in 2021 and a 2022 FMD case in a non-vaccination zone. The research found that post-vaccination immunity lasts about 3 months. The authors recommend a comprehensive approach combining biosecurity, surveillance, and international cooperation to control FMD spread.

Epidemiological and genetic analysis of foot-and-mouth disease virus O/ME-SA/Ind-2001 in China between 2017 and 2021.[24]

The O/ME-SA/Ind-2001 lineage of foot-and-mouth disease virus (FMDV) caused 19 outbreaks across 8 provinces in China between 2017 and 2021. Whole genome sequencing of representative isolates revealed three distinct viral clades, with decreasing nucleotide identity over time, indicating rapid evolution. Analysis of the VP1 epitope suggests potential risks to current vaccine effectiveness. The study emphasises the need for enhanced FMD surveillance and monitoring of viral evolution to inform control strategies in China and Asia.

23 Turgenbayev, K., Abdybekova, A., Borsynbayeva, A., Kirpichenko, V., Karabassova, A., Ospanov, Y., ... & Tulepov, B. (2023). Development and planning of measures to reduce the risk of the foot-and-mouth disease virus spread (case of the Republic of Kazakhstan). Caspian Journal of Environmental Sciences, 21(3), 561-573

24 Zhang, X., Ma, W., Yang, F., Yang, Y., Lv, L., Wu, J., ... & He, J. (2023). Epidemiological and Genetic Analysis of Foot-and-Mouth Disease Virus O/ME-SA/Ind-2001 in China between 2017 and 2021. Transboundary and Emerging Diseases, 2023(1), 3761703. https://doi.org/10.1155/2023/3761703

Potent immune responses against thermostable foot-and-mouth disease virus VP1 nanovaccine adjuvanted with polymeric thermostable scaffold[25]

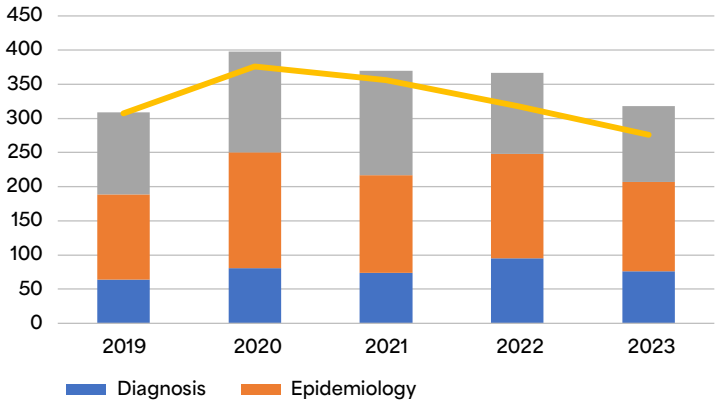
This study aimed to develop nanovaccines against FMD by conjugating recombinant VP1 proteins from serotype A and O FMD virus to thermostable scaffolds using the SpyTag/SpyCatcher system. Authors report that developed nanovaccines induced potent and long-lasting antibody responses in mice, with antibody titres approximately 100 times higher than those from monomer antigens. The nanovaccine using *Quasibacillus thermotolerans* encapsulin (QtEnc) generated higher antibody titres than the one using lumazine synthase. Additionally, both vaccines promoted higher levels of neutralizing antibodies and Th1-biased immune responses. Results indicated that FMDV nanovaccines generated by conjugating VP1 with a thermostable scaffold are highly immunogenic and promising candidates for FMDV control.

Evaluation of Potential In Vitro Recombination Events in Codon Deoptimized FMDV Strains.[26]

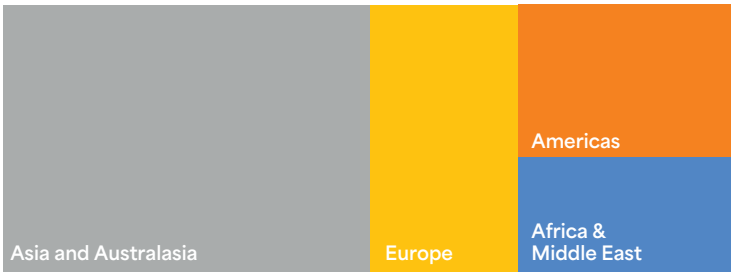
This study explored the potential risks of using codon deoptimization (CD) to create foot-and-mouth disease (FMD) live-attenuated vaccines (LAV) with DIVA markers, particularly focusing on the possibility of reversion to virulence through recombination with wild-type (WT) strains. An in vitro assay was developed to quantify recombination between a WT strain and a partially deoptimized LAV candidate. Results showed that recombination could occur, especially within non-deoptimized regions of the viral genome and lead to the emergence of WT sequences. However, if some recombinants evolved back to WT after further passage, those with extensive CD or DIVA markers were less fit than WT viruses. Results indicate that the developed assay could prove a powerful tool to evaluate the recombination of FMDV genomes in vitro and should contribute to the improved design of FMDV codon deoptimized LAV candidates.

Trends in published research

Total records & Main topics



Country/ Region of first Author (2019/2023)



25 Peng, Y., Yan, H., Zhang, J., Peng, R., Feng, X., Su, J., Yi, H., Lu, Y., & Chen, Z. (2024). Potent immune responses against thermostable Foot-and-Mouth disease virus VP1 nanovaccine adjuvanted with polymeric thermostable scaffold. Vaccine, 42(4), 732-737. https://doi.org/10.1016/j.vaccine.2023.12.079

26 Spinard, E., Fish, I., Azzinaro, P. A., Rodriguez-Calzada, M., Hartwig, E. J., Smoliga, G. R., Mogulothu, A., Arzt, J., de Los Santos, T., & Medina, G. N. (2023). Evaluation of Potential In Vitro Recombination Events in Codon Deoptimized FMDV Strains. Viruses, 15(3), 670. https://doi.org/10.3390/v15030670

Ongoing research

Non-exhaustive list of ongoing projects on FMD funded by STAR IDAZ IRC and STAR IDAZ Network Members reported in June 2024:

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
China	NSFC	Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences	Mechanisms of tropic mutation of foot-and-mouth disease virus from cattle-to-pig adaptation	2023	
China	NSFC	Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences	The molecular mechanism by which the foot-and-mouth disease virus uses prolyl oligopeptidase (POP) to promote its own replication	2024	2027
China	NSFC	Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences	Study on the response mechanism and induction strategy of cross-protective antibody to foot and mouth disease virus type O	2024	2027
China	NSFC	Lanzhou Veterinary Research Institute, Chinese Academy of Agricultural Sciences	Molecular mechanism by which VP1 targets p53 to promote persistent intracellular infection of foot-and-mouth disease virus	2024	2026
China	NSFC	Shandong University	Molecular design of foot-and-mouth disease virus crossover vaccine and its immunogenicity and immunoprotective studies	2024	2026
EC	EC	EC	SPIDVAC: Improved control of priority animal diseases: Novel vaccines and companion diagnostic tests for African horse sickness, peste des petits ruminants and foot-and-mouth disease	2022	2025
Israel	Ministry of Agriculture and Rural Development, Chief Scientist	Kimron Veterinary Institute	Detection of Foot-and-Mouth Disease virus and anti-viral antibodies in milk as a tool for improving monitoring and control of the disease	2021	2024
Israel	Ministry of Agriculture and Rural Development, Chief Scientist	Kimron Veterinary Institute	Improving the production of emergency vaccines against emerging strains of FMD Virus	2024	2027
Japan	MAFF		Strengthen measures for the control of FMD	2023	2027
Uganda	Government of Uganda	NaLIRRI	GOU FMD Project: Development of vaccine for control of FMD in uganda	2019	2024
UK	Defra		New and improved diagnostic tools for FMD and other vesicular diseases		

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
UK	Defra		Understanding environmental and airborne transmission to improve control and surveillance of foot-and mouth disease outbreaks		
UK	Defra		A heterologous FMD vaccine potency test for a field virus from the emerging SAT2/XIV lineage		
UK	Defra		Antiviral restriction factors: Understanding determinants of host range and barriers to species-jumping in livestock viral		
UK	Defra		FMDV sequencing: development of new tools to understand risks and to help control outbreaks		
UK	University of Liverpool	ILRI	GBADs: Global Burden of Animal Diseases	2021	2024
USA	USDA NIFA	COLORADO STATE UNIVERSITY	Multi-species modeling of animal movements and transboundary animal disease outbreaks in the U.S.	2022	2025
USA	USDA NIFA	OREGON STATE UNIVERSITY	US-UK Collab: Long-Distance Dispersal and Disease Spread Under Increased Ecological Complexity	2022	2026
USA	USDA NIFA	UNIVERSITY OF VERMONT & STATE AGRICULTURAL COLLEGE	Predicting Livestock Disease Transmission Dynamics under Alternate Biosecurity Risk Management Interventions and Behavioral Responses of Livestock Producers	2021	2026
USA	USDA NIFA	UNIVERSITY OF VERMONT & STATE AGRICULTURAL COLLEGE	A systems approach to securing the New England milk supply in the event of a foot-and-mouth disease outbreak	2022	2025

6. Helminths

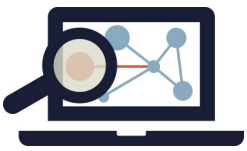
Global network: Livestock Helminth Research Alliance

Website: www.lihra.eu

Partners ca.
30

Budget
N/A

Start date:
2014



Overview

Infections with helminthic parasites are a major threat to animal health, welfare, and production. If uncontrolled, they have worldwide a serious negative impact on the income of farmers, the viability of livestock industries, and the sustainable development of rural areas, as well as some zoonotic potential in some cases. The control of these infections is complicated because of climate change and the expansion of anthelmintic resistance (AR).

The Livestock Helminth Research Alliance (LiHRA) is a global network of researchers, founded in 2014, that brings together, expands and optimises skills and expertise in different disciplines within livestock helminth research. LiHRA grew out of EU-funded research projects addressing challenges in the control of gastrointestinal nematodes and liver fluke in ruminants under global change, and related projects investigating alternative control approaches for livestock parasites.

LiHRA engages with international experts and partner organisations around the globe and coordinates the activities of the STAR IDAZ IRC Helminth Working Group.

LiHRA members meet annually to review current challenges, recent results, research gaps and future opportunities for collaborative research. Discussions within LiHRA give rise to opinion papers and have underpinned the initiation of various research and networking projects.

Aim and priorities

Aim: to improve the health, welfare and productivity of livestock by providing sustainable helminth control options, and develop sustainable effective helminth control strategies and promote their implementation by the livestock industry.

Objectives and activities

- To generate a globally leading research alliance in the field of livestock helminth infections
- To stimulate collaborative research by enabling exchange of ideas and mobility of young researchers and by promoting mutual research projects
- To initiate/foster research initiatives by promoting helminth research at international and national funding authorities
- To facilitate knowledge exchange with the livestock industry to respond to their needs and constraints and identify areas for future research
- To have the ability to respond to global changes that impact on livestock, farming practices and helminth infections
- To establish a network of standardised diagnostic parasitology labs and to standardize field trial and monitoring approaches throughout Europe

News

The next LiHRA meeting will take place on 22-23 October 2024 in Cordoba, Spain.

STAR IDAZ WG progress

Preliminary assessment/research review conducted	
Gap analysis performed	
Research roadmaps developed	

Identified research needs

DISCONTOOLS reports the following research gaps:

Nematodes:

- Improved diagnostic tools:
  - Validated sampling strategies
  - Molecular tests for detecting anthelmintic resistance against all major drug classes in the helminth species of importance
  - Pen-side tests
  - Decision support systems that inform on the level of infection and morbidity.
- Improved therapeutic responses:
  - Improving therapeutic responses for existing anthelmintics via enhancing drug exposure, drug combinations and use of bio-active forages
  - Novel active pharmaceutical/phytochemical ingredients with alternative mode of action and/or expanded therapeutic response.
- Vaccines:
  - Improved knowledge of the immune mechanisms associated with natural and vaccine-induced protection
  - Flexible, modifiable expression systems for various antigen conformations and secondary modifications.

- Integrated parasite control:
  - Establishment of regional/national/international centres of expertise
  - Improved risk assessments, modelling and decision support tools
  - Working out integrated control approaches making smart, combined use of a 'Basket of control options' and reducing reliance on anthelmintic drugs.

Liver fluke:

- Development of integrated control programmes that are no longer reliant on the exclusive use of anthelmintic
- The impact of fluke on its host's immune system to underpin development of vaccines as well as to understand the increasing susceptibility to other pathogens leading to altered disease course and diagnosis of some infections such as bovine TB
- Development of sensitive and specific, fully evaluated diagnostics for sheep, cattle and humans
- Development of drugs that are effective against the young immature stages of the parasite
- Development of vaccines targeting all stages and suitable for any host species
- Genome mapping to: aid in identification of drug resistant isolates, mechanisms and improving our understanding of drug resistance to different flukicides; develop tools for diagnosis; and differentiating between species and identifying hybrid species.

Taenia solium:

- Advocacy and financial support for implementation of existing, proven effective disease control and elimination measures
- Implementation studies
- Highly performing diagnostic tools
- Monitoring and surveillance systems
- Distribution and delivery of oxfendazole and vaccine
- One Health uptake, building One Health systems, engaging different sectors
- Economic benefits and cost sharing.

Echinococcus:

- Cystic echinococcosis:
  - Manufacture and registration of the EG95 vaccine for livestock and political will and funding to undertake control programmes
  - Well-designed, integrated control programmes based on deworming of dogs and vaccination of lambs over the long-term.
- *Echinococcus multilocularis:*
  - Development of improved diagnostic tests to use in monitoring of control programmes and for the individual fast diagnosis in dogs
  - Improved methods to control the infection in wildlife.

Recent developments

Exploring the utility of circulating miRNAs as diagnostic biomarkers of fasciolosis.[27]

Authors explored the potential of improving diagnostic methods for *Fasciola hepatica* infection in sheep utilising circulating microRNAs (miRNAs) as early diagnostic biomarkers. Using miRNA sequencing analysis, researchers identified specific miRNA profiles during different infection stages, including both sheep-derived and parasite-derived miRNAs. Two sheep miRNAs (oar-miR-133-5p and oar-miR-3957-5p) revealed promising, detecting infection as early as 7 days post-infection. The study suggested the possible use of miRNAs as biomarkers for early detection of fasciolosis in livestock.

27 Chowdhury, S., Ricafrente, A., Cwiklinski, K., Sais, D., Dalton, J. P., Tran, N., & Donnelly, S. (2024). Exploring the utility of circulating miRNAs as diagnostic biomarkers of fasciolosis. Scientific reports, 14(1), 7431. **https://doi.org/10.1038/s41598-024-57704-9**

Genomic regions associated with resistance to gastrointestinal nematode parasites in sheep-a review.[28]

This review highlighted the challenges posed by gastrointestinal nematode (GIN) infections in sheep, including symptoms like weight loss and anaemia, and the issue of GIN resistance as a result of overuse of anthelmintics. Resistance to GIN can be measured by multiples traits including faecal egg count (FEC), Faffa Malan Chart scores, haematocrit, packed cell volume, eosinophilia, immunoglobulin (Ig), and dagginess scores. The importance of genetic variation in sheep resistance to GINs is also recognised. Key genes like CFI and MUC15, and overlapping quantitative trait loci (QTLs) associated with GIN resistance, were identified. Understanding these genomic regions can enhance breeding programmes and provide insights into the genetic mechanisms of GIN resistance in sheep.

Next-generation sequencing technologies for helminth diagnostics and surveillance in ruminants: shifting diagnostic barriers.[29]

This review looked at advances in next-generation sequencing (NGS) technologies that increase understanding of AR's genetic basis, enabling the development of molecular diagnostics that can simultaneously detect multiple drug resistances and species in a single assay. These advancements hold significant potential transforming helminth diagnostics and surveillance in ruminants for sustainable livestock management.

Multi-omics data elucidate parasite-host-microbiota interactions and resistance to *Haemonchus contortus* in sheep.[30]

Authors reported the use of multi-omics data to explore the complex interactions between sheep, the parasite *Haemonchus contortus*, and the gut microbiota, aiming to understand the genetic basis of parasite resistance. It was found that certain genes and genomic regions are associated with resistance, immune response, and adaptation in sheep. Microbiota components linked to resistance, and parasite genes that were more active in susceptible sheep were also identified. These results can support breeding strategies for parasite-resistant sheep and inform new approaches for managing *H. contortus* infections.

Fasciola hepatica infection modifies IgG1 specific immune response to foot-and-mouth disease virus induced by vaccination.[31]

Authors investigated the impact of *Fasciola hepatica* infection on the immune response to foot-and-mouth disease virus (FMDV) vaccination in cattle. Findings show that overall IgG levels and antibody avidity did not differ significantly between infected and non-infected groups, however *F. hepatica* infection led to a significant decrease in FMDV-specific IgG1 levels and antibody avidity at 28 days post-infection. This suggests that *F. hepatica* infection could alter the immune response to FMDV vaccination, specifically affecting IgG1.

28 Cunha, S. M. F., Lam, S., Mallard, B., Karrow, N. A., & Cánovas, Á. (2024). Genomic Regions Associated with Resistance to Gastrointestinal Nematode Parasites in Sheep-A Review. Genes, 15(2), 187. **https://doi.org/10.3390/genes15020187**

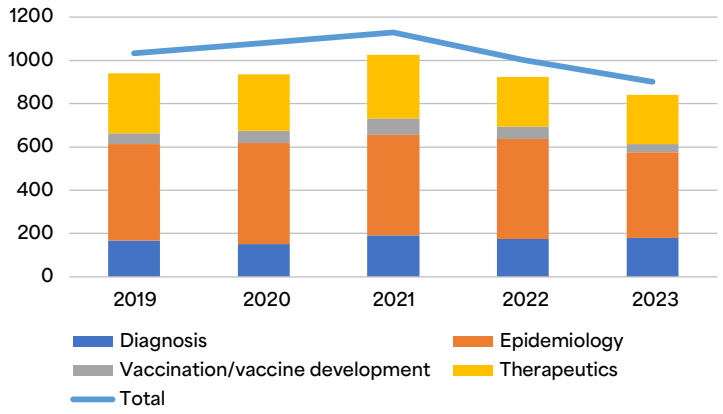
29 Antonopoulos, A., Gilleard, J. S., & Charlier, J. (2024). Next-generation sequencing technologies for helminth diagnostics and surveillance in ruminants: shifting diagnostic barriers. Trends in parasitology, 40(6), 511-526. **https://doi.org/10.1016/j.pt.2024.04.013**

30 Niciura, S. C. M., Cardoso, T. F., Ibelli, A. M. G., Okino, C. H., Andrade, B. G., Benavides, M. V., Chagas, A. C. S., Esteves, S. N., Minho, A. P., Regitano, L. C. A., & Gondro, C. (2024). Multi-omics data elucidate parasite-host-microbiota interactions and resistance to Haemonchus contortus in sheep. Parasites & vectors, 17(1), 102. **https://doi.org/10.1186/s13071-024-06205-9**

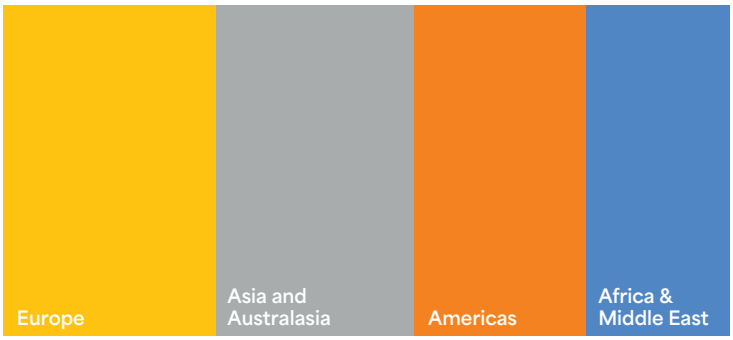
31 Costa, M., Mansilla, F., Manuel Sala, J., Saravia, A., Ubios, D., Lores, P., Capozzo, A. V., & Freire, T. (2024). Fasciola hepatica infection modifies IgG1 specific immune response to foot-and-mouth disease virus induced by vaccination. Vaccine, 42(3), 541-547. **https://doi.org/10.1016/j.vaccine.2023.12.067**

Trends in published research

Total records & Main topics



Country/ Region of first Author (2019/2023)



Ongoing research

Non-exhaustive list of ongoing projects on helminths funded by STAR IDAZ IRC and STAR IDAZ Network Members reported in June 2024:

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
	NSFC				
Belgium	SPF Public Health	International Coordination of Research on infectious Animal Diseases	MAP TCBZR - Mapping resistance loci and interrogating mechanisms of triclabendazole resistance in European isolates of Fasciola hepatica	2024	2027
Belgium	vlaio	Ghent University	Wormtool - Implementeren en valideren van een niet-invasieve beslissingsondersteunende tool voor duurzame wormbestrijding bij jongvee	2023	2027
China	NSFC	Institute of Hydrobiology, Chinese Academy of Sciences	Research on the species and invasion risk of alien freshwater fish parasites in China	2023	
China	NSFC	Institute of Urban Environment, Chinese Academy of Sciences	Research on the mechanism of urbanization on soil animal host-parasite relationship	2024	2026
China	NSFC	Northeast Forestry University	Correlation between moose parasitic infection and MHC gene polymorphisms under the background of climate warming	2024	2026

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
EC	EC	EIGEN VERMOGEN VAN HET INSTITUUT VOOR LANDBOUW- EN VISSERIJONDERZOEK	**SPARC**: Sustainable Parasite Control in Grazing Ruminants	2024	2027
EU	EC	Ghent University	**Envirant** - Environmental impact of anthelmintics in livestock and alternatives to minimize their use		
EU	ERA-NET ICRAD (FR, PL, UK)	INRAE	**HARTEMIS** - Haemonchus Anthelmintic Resistance–Evolution Mechanisms and Innovative Solutions	2024	2027
EU	ERA-NET ICRAD (FR, BE, IE, TR, UK)	INRAE	**ANTHELMOGRAM** - The next generation decision-making tool for anthelmintic resistance management in Europe.	2024	2027
EU	ERA-NET ICRAD (PL, EE, FR, LV, UK)	Warsaw University of Life Sciences	**METBOL-AR** - An application of metabolomics to the detection of anthelmintic resistance of gastrointestinal nematodes in goat	2024	2027
EU	ERA-NET ICRAD (UK, BE,IE,TR)	Liverpool University	**MAP-TCBZR** - Mapping resistance loci and interrogating mechanisms of triclabendazole resistance in European isolates of Fasciola hepatica	2024	2027
Israel	Israeli Ministry of Environmental Protection	Tel Hai college & Kimron Veterinary Institute	Life cycles of Cystic Echinococcosis in the Jordan Basin and the Golan Heights	2023	2025
Italy	MINSAL-IT	IZS LT	Application of biomolecular methods for the screening and in-depth characterization of zoonotic parasites in livestock, companion animals, and wildlife in passive surveillance activities in the Lazio and Tuscany regions	2021	2023
Italy	MINSAL-IT	IZS LT	Gastrointestinal strongyles (SGI) of small ruminants: efficacy of anthelmintics and drug resistance in a central Italian area	2022	2024
Italy	MINSAL-IT	IZS LT	Development of molecular methods for the early detection of intracellular parasites in fish	2022	2024
Italy	MINSAL-IT	IZS ME	Epidemiological and genetic evaluation of the possible role of wild birds in the transmission of the parasite Toxoplasma gondii to humans (FLYINGTOXO)	2022	2024
Italy	MINSAL-IT	IZS ME	Risk categorization of antimicrobial and anthelmintic consumption in Italian Mediterranean Buffalo breeding	2022	2024
Italy	MINSAL-IT	IZS PLV	Safer raw meat and fish: evaluation of innovative strategies for parasite reduction	2023	2025

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
Italy	MINSAL-IT	IZS SI	Study on the efficacy of innovative and traditional fish product transformation techniques in devitalizing Anisakis larvae	2022	2024
Italy	MINSAL-IT	IZS VE	Survey on the prevalence and distribution of tick-borne pathogens in goat farms and risk assessment related to the presence of the Tick Borne Encephalitis Virus (TBEV) in raw milk and derived products (IXORISK)	2021	2023
NL	TKI Agri&Food	WUR	Development of a sustainable approach to worm control in laying poultry	2022	2024
NL	TKI Agri&Food	WUR	Wise with worms ruminants	2023	2027
SPAIN	AEI	UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	Immunization with recombinant proteins against *Haemonchus contortus* in small ruminants based on proteomic analysis of thiol-sepahrose purified extracts	2023	2026
SPAIN	AEI	UNIVERSIDAD DE SALAMANCA	Hybrids of tubulin inhibitors and deacetylases for the treatment and control of trematodes and nematodes	2022	2026
SPAIN	AEI	UNIVERSIDAD DE SALAMANCA	Innovative vaccine approaches based on mRNA, lipid nanoparticles and multiple protective t-cell epitopes against fascioliasis	2023	2026
UK	Royal Society of Tropical Medicine and Hygiene	NaLIRRI	Prevalemnce of (Black fly) *Simulium damnosum* in areas with fast moving water in Northern Uganda	2023	2024
UK	Roslin Institute, University of Edinburgh, UK	ILRI	Building a Reference Quality Annotated Genome Assembly for Red Maasai Sheep as a Resource to Understand Complex Traits such as Susceptibility to GI Helminth Infection	2024	2026
USA	USDA NIFA	THE PENNSYLVANIA STATE UNIVERSITY	Economic consequence of parasite loads and selection opportunities for parasite resistance in organic dairy cattle	2023	

7. Mastitis

Global network: National Mastitis Council

Website: www.nmconline.org

Partners ca.
110

Budget
N/A

Start date:
1961

Overview

The National Mastitis Council is a not-for-profit professional organisation devoted to reducing mastitis and enhancing milk quality. The NMC promotes research and provides information to the dairy industry on udder health, milking management, milk quality, and milk safety. Founded in 1961, NMC now has about 1,100 members in more than 40 countries throughout the world. NMC membership is open to anyone with an interest in udder health, milking management, and milk quality. The NMC is headquartered in Minnesota, USA.

Aim and priorities

Aim: to reduce mastitis and enhance milk quality.

Objectives and activities

- Provides a forum for the international exchange of information relating to mastitis control and milk quality
- Develops and publishes educational materials including books, brochures and audio visuals on udder health, milking management and milk quality
- Establishes guidelines for mastitis control methods
- Develops protocols for determining effectiveness of mastitis control products
- Monitors changes in technology relating to udder health and milk quality
- Holds meetings and provides continuing education opportunities.

News

The last **NMC Regional Meeting** was held 12-14 August in Ghent, Belgium.

The first **STAR IDAZ Workshop on mastitis** 'Bridging Research Gaps in Bovine Mastitis' was organised as a short course during NMC Regional Meeting in Ghent.

STAR IDAZ WG progress

Preliminary assessment/research review conducted	
Gap analysis performed	
Research roadmaps developed	

Identified research needs

DISCONTOOLS identified the following research gaps:

- Information on host-pathogens interactions: studies on these aspects are needed both to identify the most relevant virulent strains and to identify methods which will enable the udder to reduce its susceptibility, independently from the bacteria involved
- Improved understanding of the immunology of the mammary gland. Current lack of understanding of how strain-to-strain variations (bacterial genetics and virulence factors) and host-pathogen interactions lead to different clinical outcomes
- Global analysis of the capacity for transmission between different host species including humans and global analysis of the evolution and geographic spread of strains and the identification of new emerging strains, including LA-MRSA
- Improved diagnostics: cheap, fast, specific, sensitive, cow-side/in-line
- More information is needed on genetic basis for resistance or susceptibility to mastitis, with a view to identifying candidate markers or SNPs for selection
- Investing in antibacterial discovery programs to discover and develop new, more effective antibacterial agents for treatment.

Recent developments

Invited review: Selective treatment of clinical mastitis in dairy cattle.[32]

This review discussed how selective treatment of clinical mastitis (CM) in dairy cattle can reduce antimicrobial use (AMU) without compromising udder health or farm economics. By using rapid diagnostic tests and improved udder health practices, non-severe CM cases with high spontaneous cure rates or low bacteriological cure potential can be excluded from antimicrobial treatment, leading to a significant reduction in AMU on dairy farms.

Selective treatment of non-severe clinical mastitis does not adversely affect cure, somatic cell count, milk yield, recurrence, or culling: A systematic review and meta-analysis.[33]

This study found that selective treatment of non-severe clinical mastitis in dairy cattle does not harm udder health or farm productivity. Selective treatment protocols can effectively reduce antimicrobial use without compromising key outcomes such as bacteriological cure, somatic cell count, milk yield, recurrence, or culling rates.

32 de Jong, E., McCubbin, K. D., Speksnijder, D., Dufour, S., Middleton, J. R., Ruegg, P. L., Lam, T. J. G. M., Kelton, D. F., McDougall, S., Godden, S. M., Lago, A., Rajala-Schultz, P. J., Orsel, K., De Vliegher, S., Krömker, V., Nobrega, D. B., Kastelic, J. P., & Barkema, H. W. (2023). Invited review: Selective treatment of clinical mastitis in dairy cattle. Journal of Dairy Science, 106(6), 3761-3778. **https://doi.org/10.3168/jds.2022-22826**

33 de Jong, E., Creytens, L., De Vliegher, S., McCubbin, K. D., Baptiste, M., Leung, A. A., ... & Barkema, H. W. (2023). Selective treatment of nonsevere clinical mastitis does not adversely affect cure, somatic cell count, milk yield, recurrence, or culling: A systematic review and meta-analysis. Journal of Dairy Science, 106(2), 1267-1286. **https://doi.org/10.3168/jds.2022-22271**

The DRB3 gene of the bovine major histocompatibility complex: Discovery, diversity, and distribution of alleles in commercial breeds of cattle and applications for development of vaccines.[34]

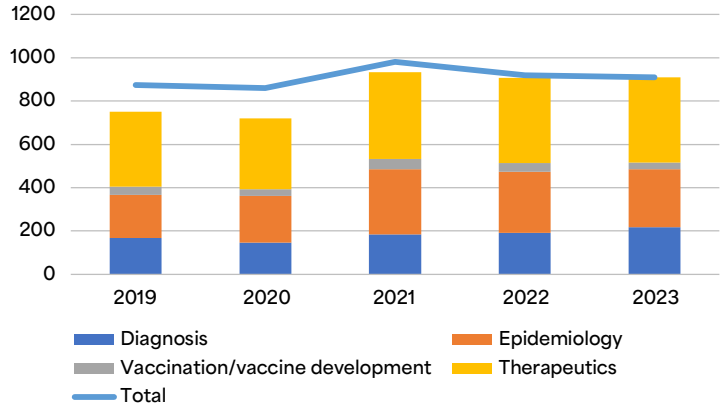
This review focused on the diverse alleles of the DRB3 gene in the bovine Major Histocompatibility Complex (BoLA), which have implications for cattle health, vaccine development, and breeding programmes. The study highlighted the importance of further research on new BoLA alleles to improve cattle productivity and disease resistance.

Underlying genetic architecture of resistance to mastitis in dairy cattle: A systematic review and gene prioritisation analysis of genome-wide association studies.[35]

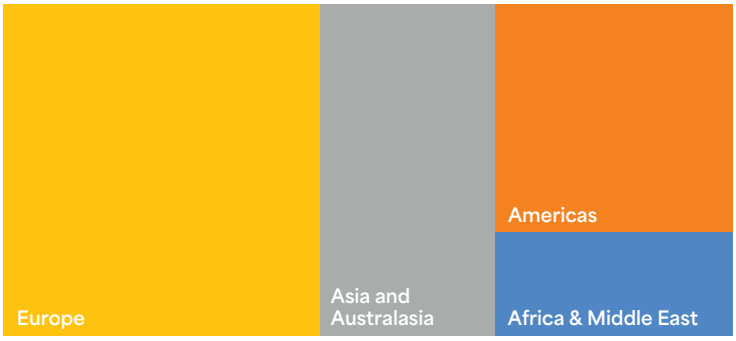
This review explored the genetic architecture underlying mastitis resistance in dairy cattle. By analysinggenome-wide association studies, potential candidate genes linked to mastitis resistance were identified. The findings highlighted the complex polygenic nature of mastitis resistance and the potential for enhanced genetic selection strategies in dairy cattle.

Trends in published research

Total records & Main topics



Country/ Region of first Author (2019/2023)



34 Andrade, T. E. G., Peña, M. S., Fiorotti, J., Bin, R. S., Caetano, A. R., Connelley, T., & Santos, I. K. F. M. (2024). The DRB3 gene of the bovine major histocompatibility complex: Discovery, diversity, and distribution of alleles in commercial breeds of cattle and applications for development of vaccines. Journal of Dairy Science. https://doi.org/10.3168/jds.2023-24628

35 Narayana, S. G., de Jong, E., Schenkel, F. S., Fonseca, P. A. S., Chud, T. C. S., Powell, D., ... & Barkema, H. W. (2023). Underlying genetic architecture of resistance to mastitis in dairy cattle: A systematic review and gene prioritization analysis of genome-wide association studies. Journal of Dairy Science, 106(1), 323-351. https://doi.org/10.3168/jds.2022-21923

Ongoing research

Non-exhaustive list of ongoing projects on mastitis funded by STAR IDAZ IRC and STAR IDAZ Network Members reported in June 2024:

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
CANADA	IDRC	ILRI	GO HEAL MASTITIS - Goat Health: Harnessing Bacteriophages for Mastitis Prevention in Kenya	2024	2026
China	NSFC	China Agricultural University	Key transposon in dairy cows as an enhancer element regulates the immune response of Staphylococcus aureus mastitis	2024	2026
China	NSFC	Guizhou University	Mechanism of anthocyanin targeted inhibition of NF-κB signaling pathway against Staphylococcus aureus mastitis in dairy goats	2024	2026
China	NSFC	Institute of Bast Fiber Crops, Chinese Academy of Agricultural Sciences	The action path of heat stress-induced mastitis in dairy cows and the intervention mechanism of flaxseed lignans	2023	
China	NSFC	Jilin University	Research on the pathological mechanism and prevention of “rumen mastitis” in dairy cows	2023	
China	NSFC	Jilin University	Role of MAMs in regulating mitophagy in staphylococcal bovine mastitis and its mechanism	2024	2027
China	NSFC	Nanjing Agricultural University	Mechanism of action of Knights/Efs/Cass-Sting in mastitis-induced by Aurius infection	2024	2026
China	NSFC	Nanjing Agricultural University	Mechanism of action of MDP/NAGK/NOD2 signalling axis in SARA-induced endogenous mastitis in ruminants	2024	2027
EU	EC	KALRO	AgriFI KCSAPP - Develop a Vaccine for Management of Mastitis in Camels	2020	2024
EU	EC	KALRO	AgriFI KCSAPP - Develop and Commercialize Pen-side Mastitis Diagnostic Kit	2020	2024
EU	EU-PAHW	INRAE	KNOW-PATH - Knowledge on priority pathogens, infectious diseases and their detection methods	2024	2026
EU	EU-PAHW	INRAE	Develop tools such as vaccine platforms and expression systems, immunological toolboxes and delivery systems	2024	2026
France	AAPG2021 JCJC - ANR	ANR	EcoSA-2021 - Ecosystem-based control of Staphylococcus aureus mastitis in dairy farms	2021	2024
France	ANR	INRAE	CelBoVax: Shaping cell-mediated immunity to produce effective vaccines for cattle	2021	2025

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
France	France	INRAE	OptYVAX: Optimization of a yeast-based vaccine against bovine mastitis.	2024 selected for final evaluation	2026
Israel	Israel Dairy Board	Kimron Vet. Inst.	Prevalence and typing of antibiotic-resistance bacteria in bulk tank milk in Israel	2022	2024
Israel	Ministry of Agriculture and Rural Development, Chief Scientist	KVI	Translation of basic research of mycoplasma mastitis to dairy cows to unveil novel therapeutics and vaccine targets	2023	2025
Israel	Ministry of Agriculture and Rural Development, Chief Scientist	Volkani Inst., KVI	Using symbiotic interactions between probiotic Bacilli to mitigate udder pathogens in dairy cows	2019	2024
Israel	Ministry of Agriculture and Rural Development, Chief Scientist	Volkani Inst., KVI	Early Mastitis Causative Pathogens Detection based on Optical Lab-on-Chip Device	2020	2024
Italy	MINSAL-IT	IZS LT	Regenerative Therapy: use of mesenchymal stem cells for the functional recovery of mammary tissue. The mastitis model in dairy sheep.	2022	2024
Italy	MINSAL-IT	IZS ME	Molecular characterization and antibiotic resistance (AMR) of Staphylococcus aureus strains isolated during buffalo mastitis in Campania.	2021	2023
Italy	MINSAL-IT	IZS PB	Metagenomic study and analysis of microbial diversity in the milk of healthy and mastitic cows.	2021	2023
UK	Defra and BBSRC	Nottingham University	Digital Platform For Sustainable Health: A Step Change In Reducing Endemic Disease In Dairy Cattle	2023	2026
UK	Defra and BBSRC	University of Bristol	AI to monitor changes in social behaviour for the early detection of disease in dairy cattle	2023	2026
USA	USDA NIFA	COLORADO STATE UNIVERSITY	Solutions for controlling mastitis and improving milk quality in organic dairy farms: An integrated approach	2022	2026
USA	USDA NIFA	CORNELL UNIVERSITY	Effects of Serine Palmitoyltransferase Inhibition on Insulin Sensitivity and Milk Production in Dairy Cows	2021	2024
USA	USDA NIFA	IOWA STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY	Improving antibiotic stewardship in dairy goats to assure food safety and milk quality	2021	2024

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
USA	USDA NIFA	IOWA STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY	Immune and metabolic response to local infection in early vs. late lactation dairy cows	2022	2024
USA	USDA NIFA	IOWA STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY	Evaluation of Cytochrome P450-derived Lipid Metabolites as Therapeutic Targets during Mastitis in Dairy Cattle	2023	2024
USA	USDA NIFA	IOWA STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY	Systems-based integrated approach to demonstrating, promoting and enhancing the sustainability of dairy goat production in the United States	2024	2029
USA	USDA NIFA	MICHIGAN STATE UNIVERSITY	Identification and Modulation of Oxidative Stress in Dairy Cows for a Successful Transition into Lactation	2022	2026
USA	USDA NIFA	OREGON STATE UNIVERSITY	Feeding spent hemp biomass to cattle: cannabinoid residuals, animal health, and product quality	2021	2024
USA	USDA NIFA	PENTAMER BIOLOGICS LLC	An intramammary subunit vaccine to prevent Staphylococcus aureus bovine mastitis	2023	2024
USA	USDA NIFA	REGENTS OF THE UNIVERSITY OF MINNESOTA	Effect of Mucosal Immune Stimulation on Mammary Gland Immune Responses During the Dry Period and Early Lactation Period in Dairy Cows	2021	2025
USA	USDA NIFA	TUSKEGEE UNIVERSITY	Impact of a combination of polyclonal chicken anti-SpA immunoglobulin Y (IgY), cholecalciferol, and peptide RP on Staphylococcus aureus mastitis using a mouse model	2022	2025
USA	USDA NIFA	UNIVERSITY OF MISSOURI SYSTEM	Partnership: Defining And Managing Staphylococcus Chromogenes Intramammary Infections In Primiparous Dairy Cows	2022	2027
USA	USDA NIFA	UNIVERSITY OF VERMONT & STATE AGRICULTURAL COLLEGE	Advancing knowledge of non-aureus Staphylococci epidemiology, the leading cause of dairy cattle mastitis: species and strain typing matters	2022	2024
USA	USDA NIFA	UNIVERSITY SYSTEM OF NEW HAMPSHIRE	PARTNERSHIP: Comparative microbial genomics of mastitis pathogens and the dairy environment	2021	2025
USA	USDA NIFA	VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY	The impact of prepartal liver glutathione on milk performance parameters and welfare of peripartal dairy cows	2022	0

8. Porcine Reproductive and Respiratory Syndrome (PRRS) and Porcine Respiratory Disease Complex (PRDC)

Global network: NC229 multi-station research consortium on emerging viral diseases of swine

Website: N/A

Partners ca.
N/A

Budget
N/A

Start date:
2003

Overview

The NC229 research consortium was created in 1999 in response to the emergence of porcine reproductive and respiratory syndrome virus (PRRSV). The North American/International PRRS Symposium (NAPRRS), now recognised by the community as a highly effective platform for the exchange of basic research findings and fundamental translational technology, is directly derived from the NC229 consortium. The NAPRRS Symposium has impacted swine virology by fostering global collaboration since 2003, showcasing innovation, and generating tangible outcomes that advance disease management, enhance swine health, and guide industry decision-making.

Aim and priorities

Aim: to address pivotal and timely cross-cutting research domains by

- Bringing together researchers, veterinary practitioners, and experts from around the world
- Facilitating a dynamic exchange of knowledge, ideas, and experiences
- Regularly sharing innovative strategies, interventions, and preventive measures to address the evolving challenges posed by swine viral diseases
- Fostering innovations in disease control and management, focusing on delivering cross-cutting knowledge to the end-user through extension and educational efforts.

Objectives and activities

- To shed new insights into swine viral diseases, including PRRS and other endemic and emerging pathogens
- To develop novel diagnostic tests and sampling strategies, collectively enhancing the timely detection and management of swine viral diseases
- To generate and test vaccine candidates, marked by enhanced safety and efficacy, making a substantial contribution to the successful control of crucial swine viral diseases
- Identify genetic factors associated with the host's resistance to viral diseases, propelling the use of gene-editing technologies in the development of a novel breed of pigs resistant to viruses.

News

The 2024 NAPRRS/NC229: International Conference of Swine Viral Diseases will be held on 8-9 December 2024 in Chicago, USA. **https://vetmed.illinois.edu/about-the-college/pathobiology/north-american-prrs-symposium/**

STAR IDAZ WG progress

Preliminary assessment/research review conducted	
Gap analysis performed	
Research roadmaps developed	

Identified research needs

DISCONTOOLS identified the following research gaps for PRRS:

Diagnostics:

- Current PCR and ELISA diagnostic tools may not detect all circulating PRRS virus isolates due to the virus's high mutation rate, requiring continuous validation and updates
- There is a need for ongoing monitoring of new PRRS virus strains through genetic sequencing to ensure diagnostics remain effective
- The absence of a pan- PRRS database hinders the comparison of virus isolates across countries, which is essential for studying the virus's evolution and genetic changes.

Vaccines:

- There is an urgent need for new vaccines that provide broader, more universal protection, and allow differentiation between vaccinated and infected animals (DIVA vaccines)
- Existing vaccines, particularly modified live vaccines (MLVs), offer only partial protection, with efficacy depending on both the genetic similarity to the field virus and the induction of cellular immunity
- Genome analysis is crucial for identifying viral elements associated with spread, pathogenicity, and immune evasion, which are key to developing more effective vaccines.

Pathogenesis and immune response:

- Significant gaps remain in understanding PRRS virus pathogenesis, particularly regarding virus-host interactions, immune evasion, and the mechanisms underlying virulence and persistence
- More research is needed on the virus's replication processes, including receptor interactions, transcription, translation, assembly, and release

Further study is required to comprehend how the PRRS virus interferes with the immune response, especially its impact on co-infections with other pathogens like PCV2 and bacteria.

The research needs for PRDC have not been identified yet, however research is needed to better understand the interactions among the multiple pathogens involved (e.g. PRRSV, swine influenza virus, *Mycoplasma Hyopneumonie*, PCV and other) and how they contribute to the overall disease complexity.

Recent developments

Current status of vaccines for porcine reproductive and respiratory syndrome: Interferon response, immunological overview, and future prospects.[36]

This review updated the current knowledge on PRRS vaccines' interactions with the host interferon system, and other immunological aspects, to assess their current status and evaluate advents in PRRSV vaccine development. It presented the strengths and weaknesses of both live attenuated and inactivated vaccines in the prevention and management of PRRS, aiming to inspire the development of innovative strategies and technologies for the next generation of PRRS vaccines.

Genetically modified pigs lacking CD163 PSTII-domain-coding exon 13 are completely resistant to PRRSV infection.[37]

Genomic editing of pigs to remove the entire CD163 or just the SRCR5 domain conferred resistance to infection with both PRRSV-1 and PRRSV-2 viruses. It was predicted that removal of exon 13 can produce gene-edited pigs fully resistant to PRRSV infection. This article described a study on pigs with a defined CD163 exon 13 deletion (ΔExon13 pigs), which looked at their susceptibility to viral infection. The modified pigs remained PCR and serologically negative for PRRSV throughout the study; in addition, the study showed that removal of exon 13 did not affect the main physiological function associated with CD163 in vivo.

The synergic role of emerging and endemic swine virus in the porcine respiratory disease complex: pathological and biomolecular analysis.[38]

This article described a study investigating the presence of PCV2 and PRRSV and emerging viruses (PCV3, TTSuV, and PPV2) in the lungs of swine of different ages using histopathology and real-time PCR. The detection of TTSuV, PCV3, and PPV2 in affected pigs, in addition to PCV2 and PRRSV, prioritises the need for comprehensive approaches in implementing appropriate control measures and minimising economic losses associated with PRDC.

Establishment and application of a quadruplex real-time reverse-transcription polymerase chain reaction assay for differentiation of porcine reproductive and respiratory syndrome virus, porcine circovirus type 2, porcine circovirus type 3, and *Streptococcus suis*.[39]

This article presented a study that conducted molecular bioinformatical analysis to concurrently detect and differentiate PRRSV, PCV2, PCV3 and *SS*. Specific primers and probes and a multiple TaqMan fluorescence quantitative PCR detection method were used. The research results demonstrated that the established multiple TaqMan fluorescence quantitative PCR detection method displayed exemplary specificity, with no instances of cross-reactivity with other pathogens. It is ideally suited to the clinical monitoring of PRRSV, PCV2, PCV3, and *SS*, and it carries significant importance in ongoing efforts to prevent and manage respiratory diseases in porcine populations.

36 Li, J.; Miller, L.C.; Sang, Y. Current Status of Vaccines for Porcine Reproductive and Respiratory Syndrome: Interferon Response, Immunological Overview, and Future Prospects. Vaccines 2024, 12, 606. **https://doi.org/10.3390/vaccines12060606**

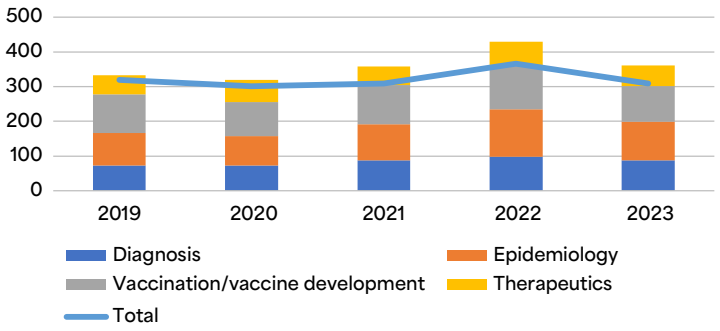
37 Salgado, B., Rivas, R. B., Pinto, D., Sonstegard, T. S., Carlson, D. F., Martins, K., Bostrom, J. R., Sinebo, Y., Rowland, R. R. R., & Brandariz-Nuñez, A. (2024). Genetically modified pigs lacking CD163 PSTII-domain-coding exon 13 are completely resistant to PRRSV infection. Antiviral research, 221, 105793. **https://doi.org/10.1016/j.antiviral.2024.105793**

38 Burrai, G.P.; Hawko, S.; Dei Giudici, S.; Polinas, M.; Angioi, P.P.; Mura, L.; Alberti, A.; Hosri, C.; Hassoun, G.; Oggiano, A.; et al. The Synergic Role of Emerging and Endemic Swine Virus in the Porcine Respiratory Disease Complex: Pathological and Biomolecular Analysis. Veterinary Sciences 2023, 10, 595. **https://doi.org/10.3390/vetsci10100595**

39 Wang, G.; Zhu, H.; Zhan, C.; Chen, P.; Wu, B.; Peng, Z.; Qian, P.; Cheng, G. Establishment and Application of a Quadruplex Real-Time Reverse-Transcription Polymerase Chain Reaction Assay for Differentiation of Porcine Reproductive and Respiratory Syndrome Virus, Porcine Circovirus Type 2, Porcine Circovirus Type 3, and Streptococcus suis. Microorganisms 2024, 12, 427. **https://doi.org/10.3390/microorganisms12030427**

Trends in published research on PRRSV

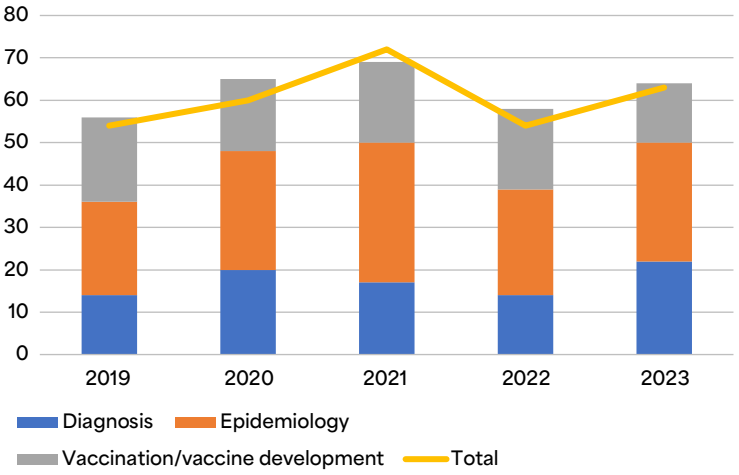
Total records & Main topics



Country/ Region of first Author (2019/2023)

Trends in published research on PRDC

Total records & Main topics



Country/ Region of first Author (2019/2023)

Ongoing research

Non-exhaustive list of ongoing projects on PRRS and PRDC funded by STAR IDAZ IRC and STAR IDAZ Network Members reported in June 2024:

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
Belgium	FPS	Ghent University	PigRReSist - Opportunities for genetic selection for resistance to PRRS infection in pigs in Belgium		
Belgium	FWO	Ghent University	New insights into the fusion process of porcine reproductive and respiratory syndrome virus (PRRSV) in macrophages show the way for the development of effective PRRS vaccines		
China	NSFC	China Agricultural University	Molecular Mechanisms of Porcine Reproductive and Respiratory Syndrome Virus Influencing T Cell Function	2023	2027
China	NSFC	China Agricultural University	Molecular mechanism of porcine reproductive and respiratory syndrome virus infection promoting mast cell activation	2023	2027
China	NSFC	China Agricultural University	Role and molecular mechanism of LncRNA LOC103222771 negatively regulating Claudin-4 in the pathogenesis of porcine reproductive and respiratory syndrome virus infection	2023	2026
EU	EC	ENEA	**REPRODIVAC:** Next-generation vaccines and diagnostics to prevent livestock reproductive diseases of worldwide impact	2022	2027
France	INRAE & Anses	INRAE & Anses	MOVISHOP - Modelling of Viral Interactions in a Structured Herd Organizational Pattern: Application to porcine reproductive and respiratory syndrome and hepatitis E viruses	2024	2027
Japan	MAFF		Strengthen measures for the control of PPRS	2023	2027
NL	MIN LNV	WBVR	ASF, Aujeszky and PRRS		
SPAIN	AEI	UNIVERSIDADE DE SANTIAGO DE COMPOSTELA	Optimization and evaluation of air sampling methods for detection and surveillance of porcine reproductive and respiratory swine virus in intensive swine farms	2023	2026
Uganda	Competitive Grant Scheme	NARO	Modulation of the Host Mucosal Immune Response to Porcine Respiratory Disease Complex using in-feed Probiotics	2021	2025
USA	USDA NIFA	IOWA STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY	Integrating data streams for causal inference and forecasting application to foster precision swine health	2022	2025

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
USA	USDA NIFA	NORTH CAROLINA STATE UNIVERSITY	Predict and Protect against PRRSV: Combine PRRSV forecasting technology with vaccine efficacy prediction to prevent PRRSV outbreaks	2022	2026
USA	USDA NIFA	NORTH DAKOTA STATE UNIVERSITY	Integrating vaccine efficacy and safety by directed suicidal replication	2021	2025
USA	USDA NIFA	REGENTS OF THE UNIVERSITY OF MINNESOTA	Utilization of computer vision as a means to understanding the etiology of tail biting outbreaks in growing-finishing pigs	2022	2024
USA	USDA NIFA	REGENTS OF THE UNIVERSITY OF MINNESOTA	Translating genetic data to antigenic phenotype for improved management of PRRSV in U.S. swine populations	2022	2024
USA	USDA NIFA	REGENTS OF THE UNIVERSITY OF MINNESOTA	Assessing The Microbiome As A Tool For The Mitigation Of Viral Disease In Nursery Pigs	2024	2025
USA	USDA NIFA	SOUTH DAKOTA STATE UNIVERSITY	Role of interferon-induced transmembrane protein 3 (IFITM3) and a zinc metalloprotease (ZMPSTE24) in PRRSV replication	2021	2024
USA	USDA NIFA	UNIVERSITY OF CONNECTICUT	Multivalent, Multiepitope Mosaic Vaccine: Towards Controlling PRRSV Heterogeneity	2021	2024
USA	USDA NIFA	UNIVERSITY OF CONNECTICUT	Identification Of Small Molecules To Prevent Porcine Reproductive And Respiratory Syndrome Virus (PRRSV)	2022	2025
USA	USDA NIFA	UNIVERSITY OF ILLINOIS	Preventing porcine reproductive and respiratory syndrome (PRRS) through modifications in the virus receptor, CD163	2021	2022
USA	USDA NIFA	UNIVERSITY OF ILLINOIS	Recombination-negative, immune-enhanced, and clinically-attenuated PRRSV as a vaccine platform	2023	2027
USA	USDA NIFA	VIRGINIA POLYTECHNIC INSTITUTE & STATE UNIVERSITY	Defining Amino Acid Metabolism in Disease Challenged Pigs	2024	2026

9. Poxviruses

Global network:

No global network for poxvirus research in animals has been identified, despite the fact that smallpox is the only virus to have been eradicated; eradication occurred through a human vaccination campaign. Poxviruses have been central to virology science development since its start, and there are still some poxviruses in animal with no adequate tools to control disease, and whose spread (e.g. LSD, salmon gill poxvirus) is of international concern and in some cases with zoonotic potential. STAR IDAZ IRC considers poxvirus research among its priorities and is planning to open an international working group that can identify research gaps to enhance research where it is most needed.

STAR IDAZ WG progress

Preliminary assessment/research review conducted	
Gap analysis performed	
Research roadmaps developed	

Identified research needs

DISCONTOOLS identified the following research gaps:

Lumpy skin disease (LSD)

- Control strategies:
  - Understanding and characterising the vector-borne transmission of LSDV
  - Understanding the fundamental immunology and pathology of LSDV to develop novel disease control tools.
- Diagnostics:
  - Developing improved immune-based diagnostic assays to support disease surveillance and eradication activities.
- Vaccine:
  - No vaccines other than live-attenuated vaccines available, which can result in trade restrictions and lack of DIVA capability, hampering disease surveillance and eradication.

Orthopoxviruses (OPX - vaccinia virus/buffalopox virus, cowpox virus, monkeypox virus)

- Control strategies:
  - Better understanding of the identity and distribution of reservoirs for OPXV-associated zoonotic agents.
- Diagnostics:
  - Currently, no robust or commercial antibody tests are in use, leading to potential misdiagnosis with other vesicular diseases in ruminants
  - Better understanding of protein and nucleic acid level differences between OPX viruses and within OPX species would allow for the development of rapid diagnostic tests
  - Development and validation of rapid pen-side diagnostic tests to distinguish between agents and identify viruses to strain type.
- Vaccine:
  - Need to improve vaccines as current vaccines are fully virulent live viruses that can themselves cause outbreaks.

Parapoxviruses (PPV - bovine papular stomatitis virus, pseudocowpox virus, orf virus)

- Control strategies:
  - Addressing the current uncertain understanding of the burden and distribution of zoonotic poxviruses globally
  - Improving knowledge about the disease caused by PPVs, especially regarding pathogenesis, immunology, epidemiology, and control.
- Diagnostics:
  - No routine diagnostic tests in use, leading to potential misdiagnosis.
- Vaccine:
  - Limited licensed vaccines available only for orf virus; current vaccines are fully virulent live viruses
  - Need for efficient and safe vaccines providing long-lasting immunity
  - No vaccines under development for specific use in animals.
  - Therapeutics:
  - No approved veterinary treatments available commercially.
  - Antivirals have been tested successfully in vitro, ex vivo, and in vivo experiments.

Sheep pox and goat pox (Capripoxviruses)

- Control strategies:
  - Emphasis on epidemiological and economic evaluation of prevention and control measures tailored to specific countries/regions
  - Developing efficient vaccination campaigns in LMIC.
- Diagnostics:
  - Commercial diagnostic tests are available.
- Vaccine:
  - Uncertainty in the understanding and knowledge in relation to pathogenesis, immunology, vaccinology
  - Several live-attenuated vaccines available, but the quality varies
  - Information on the effectiveness and efficacy of CPPV vaccines needed.
  - Recombinant capripox-based vaccines to control more than one small ruminant disease have been reported.

Recent developments

Lumpy skin disease: history, current understanding and research gaps in the context of recent geographic expansion.[40]

This review traced the history and epidemiology of lumpy skin disease (LSD). The authors highlighted the recent rapid expansion of LSD into new regions, including Europe and Asia, and discussed the need for enhanced surveillance and control measures. They also reported significant research gaps, particularly in understanding the virus's transmission dynamics, the role of wildlife reservoirs, and the development of effective vaccines. The review calls for coordinated international efforts to manage the spread of LSD and mitigate its economic impact on the livestock industry.

40 Mazloum A, Van Schalkwyk A, Babiuk S, Venter E, Wallace DB and Sprygin A (2023). Lumpy skin disease: history, current understanding and research gaps in the context of recent geographic expansion.
Front. Microbiol. 14:1266759. **https://doi.org/10.3389/fmicb.2023.1266759**

Phylogenetic and pathogenic characterization of lumpy skin disease virus circulating in China.[41]

This research provided a phylogenetic and pathogenic characterisation of the lumpy skin disease virus (LSDV) strains circulating in China. Thanks to this genetic sequences analysis of various LSDV strains, the study showed significant genetic diversity, which potentially may influence the virulence and spread of the virus. In addition, the authors investigated the pathogenic effects of these strains in cattle, providing valuable information on the disease's clinical presentation and severity in China. The findings can support for developing targeted vaccines and control strategies specific to the strains prevalent in the region.

Development of the isothermal recombinase polymerase amplification assays for rapid detection of the genus Capripoxvirus.[42]

This study developed a rapid and sensitive diagnostic tool for detecting capripoxviruses, including lumpy skin disease virus (LSDV), using isothermal recombinase polymerase amplification (RPA) assays, combined with real-time fluorescence (real-time RPA) and naked-eye visible lateral flow strip (LFS RPA). This essay allows for user friendly quick identification of the virus without the need for sophisticated laboratory equipment, making it particularly useful in field conditions and low-resource settings. The study demonstrated the assay's high sensitivity and specificity and thus could represent an alternative method for diagnostic to enhance early detection and control of outbreaks, limiting the spread of the disease in affected regions.

Lumpy skin disease virus ORF127 protein suppresses type I interferon responses by inhibiting K63-linked ubiquitination of tank binding kinase 1.[43]

This research elucidated the molecular mechanisms by which lumpy skin disease virus (LSDV) evades the host immune response. Specifically, the research identified the ORF127 protein one of the strongest inhibitory effectors on the expression of IFN-β and ISGs, while the 1-43 aa of N-terminal of ORF127 was noted to play a vital role in suppressing the expression of IFN-β. Increasing understanding on these mechanisms, the study provides insights into the virus's ability to persist and spread, which could prove helpful for the development of new antiviral therapies targeting this pathway.

Novel strategy for poxviridae prevention: thermostable combined subunit vaccine patch with intense immune response.[44]

This study developed an innovative thermostable subunit vaccine patch for poxvirus, utilising lumpy skin disease virus (LSDV) as model. The patch does not require cold-chain storage and virus remained stable for at least 4 months at room temperature, effectively addressing the storage and transportation challenges. The study's findings suggest that this vaccine strategy could results as an attractive option for use in remote or resource-limited areas, offering a practical and effective solution for large-scale immunisation programmes, particularly in regions prone to vaccine spoilage because of inadequate storage facilities.

41 Shanhui Ren, Haotai Chen, Lvfeng Yuan, Xue Yang, Tadele Berihun Afera, Zaib Ur Rehman, Huibao Wang, Xiangwei Wang, Chunling Ma, Yuguang Lin, Xusheng Qiu, Xiangping Yin, Yuefeng Sun (2023). Phylogenetic and pathogenic characterization of lumpy skin disease virus circulating in China. Virology Volume 585: 127-138, ISSN 0042-6822. **https://doi.org/10.1016/j.virol.2023.06.008**

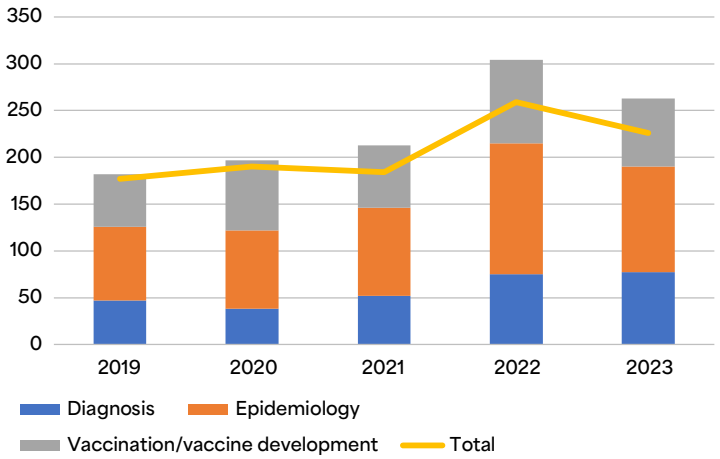
42 Libing Liu, Jinfeng Wang, Fuping Nie, Ruiwen Li, Yixiang Gao, Xiaoxia Sun, Wanzhe Yuan, Jianchang Wang (2023). Development of the isothermal recombinase polymerase amplification assays for rapid detection of the genus Capripoxvirus. Journal of Virological Methods 320: 114788, ISSN 0166-0934. **https://doi.org/10.1016/j.jviromet.2023.114788**

43 Liang Z, Wang S, Yao K, Ren S, Cheng P, Qu M, Ma X, Gao X, Yin X, Wang X, Sun Y (2024). Lumpy skin disease virus ORF127 protein suppresses type I interferon responses by inhibiting K63-linked ubiquitination of tank binding kinase 1. FASEB J. 15;38(3):e23467. PMID: 38329325. **https://faseb.onlinelibrary.wiley.com/doi/abs/10.1096/fj.202301987RR**

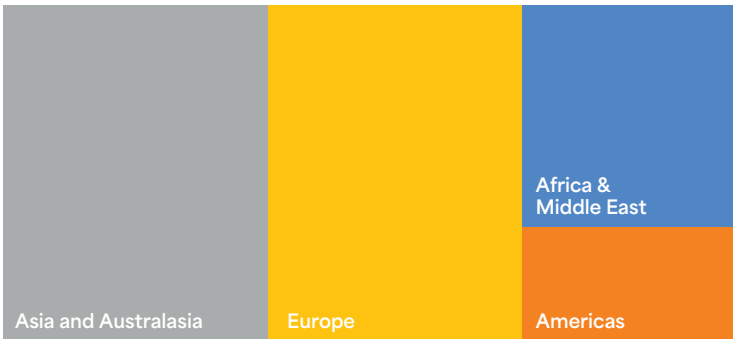
44 Wen, Y., Deng, S., Wang, T., Gao, M., Nan, W., Tang, F., Xue, Q., Ju, Y., Dai, J., Wei, Y., & Xue, F. (2024). Novel strategy for Poxviridae prevention: Thermostable combined subunit vaccine patch with intense immune response. Antiviral research, 228, 105943. Advance online publication. **https://doi.org/10.1016/j.antiviral.2024.105943**

Trends in published research

Total records & Main topics



Country/ Region of first Author (2019/2023)



Ongoing research

Non-exhaustive list of ongoing projects on poxviruses funded by STAR IDAZ IRC and STAR IDAZ Network Members reported in June 2024:

Funder Country	Funder Name	Main Research Institution	Research project	Start Year	End Year
China	NSFC	Fudan University	Research on the mechanism and application of human antibody response against monkeypox virus	2023	2027
China	NSFC	Gannan Medical College	Structural analysis of monkeypox virus F13L and I7L proteins and discovery and mechanism of action of targeted small molecule inhibitors	2023	2026
China	NSFC	Institute of Microbiology, Chinese Academy of Sciences (IMS)	Screening and functional studies of human antibodies against monkeypox virus	2023	2027
China	NSFC	Institute of Pharmaceutical Biotechnology, Chinese Academy of Medical Sciences	Optimisation of the electrophilic structure and identification of direct target proteins based on covalently bonded trinitrotoluene anti-poxvirus	2023	2027
China	NSFC	Nanchang University	Structural basis of monkeypox virus A41L and CrmB proteins' interaction with chemokines	2023	2026
China	NSFC	Shanghai Institute of Pharmaceutical Sciences, Chinese Academy of Sciences	Substrate Recognition Mechanism and Inhibitor Discovery of Monkeypox Virus I7L Protease	2023	2026
China	NSFC	Shenzhen University	Fibre-optic sensor based on CRISPR biotechnology and dual sensing effect and its ultra-sensitive detection of monkeypox virus genes	2023	2026
China	NSFC	South Medical University	Development of a multifunctional neutralising antibody against human orthopoxvirus and its antiviral mechanisms	2023	2027
Italy	MINSAL-IT	IZS SI	Development of organic electrochemical transistor tests for real-time quantification of neutralizing antibodies against emerging and re-emerging Orthopoxviruses.	2022	2024
Japan	MAFF		Strengthen measures for the control of LSD in livestock	2023	2027
NL	MIN LNV	WUR	Kennissynthese monkeypox-virus en mogelijke reservoirpopulaties in Europa - Knowledge synthesis about monkeypox virus and possible reservoir populations in Europe	2022	2022
UK Defra			Developing capability for detection of Monkeypox exposure in animals		

Annex

International Initiatives Accelerating Research and Development Beyond STAR IDAZ IRC

Research and development (R&D) are fundamental for developing effective disease prevention and control tools, utilising existing knowledge, and mitigating disease impacts. Several initiatives have been launched at both regional and global levels to accelerate research and deliver timely solutions for emerging issues.

This chapter aims to provide a list of key network initiatives, funding opportunities and regulatory easing measures. These initiatives are designed to accelerate the delivery of R&D relevant to the animal health sector.

AfVANET - African Vaccinology Network

AfVANET promotes collaboration among African scientists to advance vaccine research and development on the continent.

http://afvanet.org/

AgResults Brucellosis and FMD vaccine prizes

AgResults offers pay-for-results prize competitions to encourage innovative solutions for brucellosis control and foot-and-mouth disease through vaccination.

https://brucellosisvaccine.org/
https://www.galvmed.org/foot-and-mouth-project/

ANTI-VeC: Application of Novel Transgenic technology & inherited symbionts to Vector Control

Focused on innovative vector control technologies, ANTI-VeC network leverages transgenic methods to tackle vector-borne diseases.

http://www.anti-vec.net

AREF - African Research Excellence Fund

AREF supports African researchers in addressing health challenges through capacity building and funding opportunities.

https://www.africaresearchexcellencefund.org.uk/

CaribVET - Caribbean Animal Health Network

CaribVET enhances animal health in the Caribbean through collaborative surveillance, diagnostics and research activities.

Caribbean animal health network (caribvet.net)

CEPI - Coalition for Epidemic Preparedness Innovations

The Coalition for Epidemic Preparedness Innovations, is a global partnership working to accelerate the development of vaccines and other biologic countermeasures against epidemic and pandemic threats.

http://cepi.net/

CWG AHW - Collaborative Working Group on European Animal Health and Welfare Research

CWG AHW coordinates animal health and welfare research efforts across Europe, fostering collaboration and innovation. It acts as the STAR IDAZ European Union Regional Network.

http://www.scar-cwg-ahw.org/

ECOHEALTH ALLIANCE

A global organisation focused on the intersection of wildlife, ecosystems and human health. It conducts research and implements strategies to prevent pandemics and promote environmental health.

https://www.ecohealthalliance.org/programs

ERFAN - Enhancing Research for Africa Network

ERFAN strengthens veterinary and animal health research capacities in Africa through collaborative projects and training.

https://www.izs.it/IZS/Cooperazione_1/IZSAM_in_Africa/ERFAN_-_Enhancing_Research_For_Africa_Network

ERRAZE@WUR - Early Recognition and Rapid Action in Zoonotic Emergencies

The WUR initiative aims to improve early detection and response to zoonotic disease outbreaks through research and innovation.

https://www.wur.nl/en/Research-Results/Research-programmes/Cross-WUR-programmes/ERRAZE-at-WUR.htm

EUPAHW - European Partnership on Animal Health and Welfare

EUPAHW fosters collaboration among European stakeholders to enhance animal health and welfare through research and policy.

European Partnership on Animal Health and Welfare - Home (eupahw.eu)

FIND: Foundation for Innovative New Diagnostics

FIND works to accelerate the development and delivery of accurate and affordable diagnostic tests for diseases of poverty.

https://www.finddx.org/

GALVmed - Global Alliance for Livestock Veterinary Medicines

GALVmed focuses on developing and delivering vaccines and medicines for livestock diseases in LMICs.

https://www.galvmed.org/

GARA - Global African Swine Fever Research Alliance

GARA coordinates international research efforts to control and prevent African swine fever through scientific collaboration. **https://www.ars.usda.gov/GARA/**

GBADs- Global Burden of Animal Diseases

GBADS aims to quantify the global impact of animal diseases on economies, food security and public health to guide policy.

https://animalhealthmetrics.org/

GFRA - Global Foot-and-mouth Research Alliance

GFRA promotes international research collaboration to control and eradicate foot-and-mouth disease globally.

https://www.ars.usda.gov/gfra/

Global Vector Hub

A comprehensive platform for vector control and research collaboration

The Global Vector Hub provides resources, data, and networking opportunities for vector control professionals worldwide.

https://globalvectorhub.tghn.org/

GloPID-R - Global Research Collaboration for Infectious Disease Preparedness

GloPID-R coordinates research funding and activities to respond rapidly to infectious disease outbreaks worldwide.

https://www.glopid-r.org/

GOARN - Global Outbreak Alert and Response Network

GOARN unites institutions and networks to respond to disease outbreaks and public health emergencies globally.

https://goarn.who.int/

GRAbTB - Global Research Alliance for Bovine Tuberculosis

GRAbTB fosters international collaboration to advance research and control measures for bovine tuberculosis.

https://www.STAR IDAZ.net/global-research-alliance-for-bovine-tuberculosis-grabtb/

HERA Invest

HERA Invest supports the development and deployment of medical countermeasures for health emergencies in the EU.

https://health.ec.europa.eu/hera-invest_en

IHI - Innovative Health Initiative

IHI drives innovation in healthcare by funding collaborative projects that address major health challenges in Europe.

https://www.ihi.europa.eu/

InnoVet-AMR - Innovative Veterinary Solutions for Antimicrobial Resistance

InnoVet-AMR supports the development of novel veterinary solutions to combat antimicrobial resistance globally.

https://www.idrc.ca/en/initiative/innovet-amr-innovative-veterinary-solutions-antimicrobial-resistance

IOM - The International Organization for Mycoplasmology

IOM advances research on mycoplasmas, fostering scientific exchange and collaboration among researchers worldwide.

http://iom-online.org/

IVVN - International Veterinary Vaccinology Network

IVVN supports the development of vaccines for livestock and zoonotic diseases through international collaboration and funding.

http://intvetvaccnet.co.uk/

LVIF - Livestock Vaccine Innovation Fund

LVIF invests in the development and commercialisation of vaccines to improve livestock health and productivity.

https://www.idrc.ca/en/initiative/livestock-vaccine-innovation-fund

OFFLU - WOAH/FAO Network of Expertise on Animal Influenza

OFFLU enhances global coordination and expertise on animal influenza, contributing to pandemic preparedness and response.

https://www.offlu.org/

One Health AMR partnership

The co-funded European Partnership on One Health antimicrobial resistance should be implemented from 2025 through a joint programme of activities ranging from coordinating transnational research efforts to other activities such as coordination and networking activities, capacity building programmes, brokerage and mobility programmes, work on research infrastructures and resources, including training and dissemination activities.

https://www.horizon-europe.gouv.fr/european-partnership-one-health-anti-microbial-resistance-33829

One Health EJP- European Joint Programme Co-fund on One Health

One Health EJP integrates efforts across human, animal and environmental health to tackle zoonotic diseases in Europe.

https://onehealthejp.eu/

PANDORA - Pan-African Network for Rapid Research, Response and Preparedness for Infectious Diseases

PANDORA focuses on enhancing Africa's capacity for rapid response and research during infectious disease outbreaks.

https://www.pandora-id.net/

PREZODE - Preventing Zoonotic Disease Emergence

PREZODE aims to reduce the risk of zoonotic disease emergence through interdisciplinary research and international cooperation.

https://prezode.org/

UK-ICN: International Coronavirus Research and Innovation Network

UK-ICN fosters global collaboration on coronavirus research, aiming to accelerate the development of diagnostics, treatments and vaccines.

https://uk-icn.co.uk

VectorBite Research Coordination Network

A network for advancing vector biology research

VectorBite coordinates research efforts on vector biology, focusing on vector-host interactions and disease transmission dynamics.

https://vectorbite.org/about-rcn/

VectorNet: European network for sharing data on the geographic distribution of arthropod vectors, transmitting human and animal disease agents

European network for sharing data on the geographic distribution of arthropod vectors

VectorNet facilitates data exchange on arthropod vectors, enhancing the understanding and control of vector-borne diseases in Europe.

https://ecdc.europa.eu/en/about-us/partnerships-and-networks/disease-and-laboratory-networks/vector-net

VetLAB: International Atomic Energy Agency's veterinary laboratory network

VetLAB enhances veterinary diagnostics and disease control through a global network of laboratories and technology transfer.

https://www.iaea.org/services/networks/vetlab

WHO R&D Blueprint

The WHO R&D Blueprint aims to fast-track the availability of effective tests, vaccines and medicines during epidemics.

http://www.who.int/blueprint/en/

WOAH Reference Laboratories Network

This network supports global animal health through standardised diagnostics, proficiency testing and disease surveillance.

https://www.woah.org/en/what-we-offer/expertise-network/

ZODIAC - Zoonotic Disease Integrated Action

ZODIAC focuses on early detection and control of zoonotic diseases, leveraging nuclear and nuclear-derived techniques.

https://www.iaea.org/services/zodiac

Infrastructures and Databases to Facilitate Research and Development

Conducting scientific research requires significant research infrastructure, including facilities, resources and related services. The establishment of common databases, allowing for the sharing of knowledge and facilitating networking, is important to facilitate and accelerate R&D.

This section provides a list of significant infrastructures and databases relevant to the animal health sector.

ACDP - Australian Centre for Disease Preparedness

A high-containment animal research centre in Australia, part of the CSIRO, working globally to support animal and human health organizations and enhance biosecurity.

https://www.csiro.au/en/about/facilities-collections/acdp/acdps-global-role

ANIMUSE - ANImal antiMicrobial USE Enabling Data-Based Decision Making

WOAH's global database that tracks antibiotic use in animals, helping stakeholders report, access and analyse data to promote responsible antimicrobial use.

https://amu.woah.org/amu-system-portal/home

DA4A Database – List of Animal Health Diagnostics

D4A proposes an **open-access database** of approximately 3000 animal health diagnostics. It is possible to look for a kit via different methods: keyword, producer, disease, target species or by an overview of a **mapping** of diagnostics by diseases.

DISCONTOOLS - Disease Control Tools

An open-access database identifying research gaps in animal health, helping funders and researchers prioritise and plan future studies on over 50 infectious diseases.

http://www.DISCONTOOLS.eu/

EMPRES - Emergency Preventions System for Animal Health

An FAO web application supporting Veterinary Services by organising and accessing global disease data, aiming to control and eliminate serious livestock diseases.

https://empres-i.apps.fao.org/

ERINHA - European Research Infrastructure on Highly Pathogenic Agents

A pan-European infrastructure providing access to high containment facilities to accelerate research on high-risk pathogens and enhance outbreak preparedness.

https://erinha.eu/

EVAg - European Virus Archive global

A non-profit organisation offering a global collection of virus samples and reagents, facilitating scientific research, education and disease control.

https://www.european-virus-archive.com/

GLASS - GLobal Antimicrobial resistance and use Surveillance System

A WHO global database for surveillance of antibiotic use and antimicrobial resistance in human health, including environmental and food chain data.

https://www.who.int/initiatives/glass

GLEWS - FAO Global Information and Early Warning System on Food and Agriculture

Monitors global food security, issuing reports and warnings to help countries and development partners plan and respond to potential food crises.

http://www.fao.org/giews/en/

Global AMR R&D Hub - Global Antimicrobial Resistance Research and Development Hub

A collaboration hub for coordinating global antimicrobial research efforts, providing a dashboard with real-time data on AMR R&D initiatives and funding flows.

https://dashboard.globalamrhub.org/

ISIDORe - Integrated Services for Infectious Disease Outbreak Research

Offers an integrated portfolio of research services and resources to study epidemic-prone pathogens, enhancing Europe's capacity for controlling infectious diseases.

https://isidore-project.eu/

The Immunological Toolbox

A platform for veterinary researchers to find reagents and collaborate, aiming to facilitate veterinary vaccine development by providing a comprehensive resource database.

https://www.ed.ac.uk/roslin/facilities-resources/immunological-toolbox

US NADC - National Animal Disease Center

One of the largest animal health research centres in the world, conducting research on animal diseases and serving as a reference laboratory for diagnostics and vaccines.

https://www.ars.usda.gov/midwest-area/ames/nadc/

WAHIS - World Animal Health Information System

WOAH's global animal health database, reporting outbreaks of listed and emerging diseases, with interactive tools for data visualisation and extraction.

https://wahis.woah.org/#/home

STAR IDAZ

International Research Consortium on Animal Health