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

DELIVERABLE 4.9:
September 2023

STAR-IDAZ
International Research
Consortium on Animal Health

Contents

This document was produced by SIRCAH, the Secretariat of the STAR-IDAZ International Research Consortium on Animal Health (STAR-IDAZ IRC).

**Funded by
the European Union**

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 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. 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.

The aim of this report is to provide STAR-IDAZ IRC Members, as well as other animal health stakeholders, with an overview of the existing opportunities to speed up research, to boost collaboration in the sector, and to provide an overview of the latest discoveries on priority animal health diseases. Overall, this will support the decisions of policy makers and research funders, to accelerate coordinated development of control methods at the international level.

Methods

The first two Chapters of this report target 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. Information was collected by scanning the web with relevant keywords or collecting information from the IRC partners.

The third Chapter consists of a periodical report on recent research developments on some of the IRC priority diseases. In this report, the update focuses on African swine fever, bovine tuberculosis (bTB), coronaviruses, vector-borne diseases, antimicrobial resistance and alternatives to antibiotics, influenza, mycoplasmas, diagnostics, one health and vaccinology. For each of the aforementioned themes, information about existing global research coordination networks is provided, and a collection of the main information on identified research gaps was 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 2022 and July 2023 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, 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 Network meetings and roadmap workshops.

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.

Main acronyms

ACDP	Australian Centre for Disease Preparedness
ACIAR	Australian Centre for International Agricultural Research
AfVANET	African Vaccinology Network
AFD	French Development Agency
AFENET	African Field Epidemiology Network
AI	Avian Influenza
AMR	AntiMicrobial Resistance
ANIHWA ERA-NET	E uropean Research Area Network on Animal Health and Welfare
APHA	Animal and Plant Health Agency - UK
APHIS	Animal and Plant Health Inspection Service - USDA
AREF	Africa Research Excellence Fund
ARS	Agricultural Research Service - USDA
ASF	African Swine Fever
ATA	Alternatives To Antibiotics
AU	African Union
AU-IBAR	African Bureau of Animal Resources
AvCoV	Avian Coronavirus
BBSRC	Biotechnology and Biological Sciences Research Council
BMGF	Bill and Melinda Gates Foundation
BSL	BioSafety Level
bTB	Bovine Tuberculosis
CA	Contagious Agalactia
CABI	Centre for Agriculture and Bioscience International
CAHFSA	Caribbean Agricultural Health and Food Safety Agency
CDC	Centers for Disease Control and Prevention
CENSA	National Center for Animal and Plant Health - Cuba
CIRAD	French Agricultural Research and Cooperation Organisation
CRDF	US Civilian Research & Development Foundation
CRP	Coordinated Research Project
CSF	Classical Swine Fever
CBPP	Contagious Bovine PleuroPneumonia
CCHF	Crimean-Congo Haemorrhagic Fever
CEPI	Coalition for Epidemic Preparedness Innovations
CIRAD	French Agricultural Research Centre for International Development
COMBAR	COMBatting Anthelmintic resistance in Ruminants
COPA COGECA	Committee of Professional Agricultural Organisations-General Confederation of Agricultural Cooperatives
COST	EU COoperation in Science and Technology
CoVs	Coronaviruses
CRWAD	Conference of Research Workers in Animal Disease
CSIC	Spanish National Research Council
CWG AHW	Collaborative Working Group on European Animal Health and Welfare Research
DEFRA	Department for Environment, Food & Rural Affairs (UK)
DIAH	Discovery to Innovation in Animal Health
DISCONTOOLS	Disease Control Tools
DIVA	Differentiating Infected from Vaccinated Animals

Dpi	Day post infection
EAAP	European Federation of Animal Science
EC	European Commission
ECTAD	Emergency Centre for Transboundary Animal Diseases
EDCTP	European-Developing Countries Clinical Trial Partnership
EFSA	European Food Safety Authority
EFPIA	European Federation of Pharmaceutical Industries and Associations
EHD	Epizootic Haemorrhagic Disease
EHEC	Enterohaemorrhagic Escherichia coli
EIB	European Investment Bank
EJP One Health	European Joint Programme Co-fund on One Health
EMIDA ERA-NET	European Research Area Network on Emerging and Major Infectious Diseases of Livestock
EMPRES	Emergency Prevention System
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
FWO	Research Foundation Flanders
GALVmed	Global Alliance for Livestock Veterinary Medicines
GAMRIF	Global AMR Innovation Fund
GARA	Global ASF Research Alliance
GAVI	Global Alliance for Vaccine and Immunisation
GCRF	Global Challenges Research Fund
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
GMP	Good Manufacturing Practices
GOARN	Global Outbreak Alert and Response Network
GRAbTB	Global Research Alliance for Bovine Tuberculosis
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
ICRAD	International Coordination of Research on Infectious Animal Diseases
IDRC	International Development Research Centre
IHI	Innovative Health Initiative
IICA	Inter-American Institute for Cooperation in Agriculture
ILRI	International Livestock Research Institute
IMI	Innovative Medicines Initiative

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	International Organization for Mycoplasmology
IRC	International Research Consortium
IRD	French National Research Institute for Sustainable Development
IRPCM	International Research Program of Comparative Mycoplasmology
IRTA	Institute for Research and Agrofood Technology
ISTH	Irrua Specialist Teaching Hospital
IVIS	International Veterinary Immunology Symposium
IVVN	International Veterinary Vaccinology Network
IZS	Italian Experimental Zooprophylactic Institute
JRAs	Joint Research Activities
KVI	Kimron Veterinary Institute
LiHRA	Livestock Helminth Research Alliance
LMICs	Low- and Middle-Income Countries
LMR	Living Map Reviewer
LPAI	Low Pathogenic Avian influenza
LVIF	Livestock Vaccine Innovation Fund
MERS-CoV	Middle East Respiratory Syndrome CoV
MINSAL	Italian Ministry of Health
NAK	Hungary's National Agricultural Chamber
NGO	Non-Governmental Organisation
NIFA	National Institute of Food and Agriculture USDA
NVI	Norwegian Veterinary Institute
NVRI	Nigerian National Veterinary Research Institute
OFFLU	WOAH/FAO Network of Expertise on Avian influenza
PAHO	Pan American Health Organization - WHO
PANDORA	Pan-African Network for Rapid Research, Response and Preparedness for Infectious Diseases
PANVAC	African Union Pan-African Veterinary Vaccine Center
PCV-2	Porcine circovirus-2
PEAV	Porcine enteric alphacoronavirus
PED	Porcine epidemic diarrhoea virus
PHEIC	Public Health Emergency of International Concern
PREACTS	Prezode in Action in the Global South
PRDC	Porcine Respiratory Disease Complex
PRRS	Porcine Reproductive and Respiratory Syndrome
R&D	Research and Development
REA	Research Executive Agency
RVF	Rift Valley Fever
SADC	South African Development Community
SADS	Swine Acute Diarrhoea Syndrome
SARS-CoV-2	Severe acute respiratory syndrome CoV 2
SC	Scientific Committee
SCAR	Standing Committee on Agricultural Research
SDG	Sustainable Development Goals
SERIDA	Asturias Regional Service for Agri-Food Research and Development
SFU	Strategic Foresight Unit
SIRCAH	Secretariat of the International Research Consortium on Animal Health
SIV	Swine influenza virus
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
TADs	Transboundary Animal Diseases
TAHSSL	Transform animal health solutions and services in low- and middle-income countries
TGEv	Transmissible gastroenteritis virus
TNA	Transnational Access
TPPs	Target Product Profiles
TRANSVAC	European Network of Vaccine Research and Development
TSE	Transmissible Spongiform Encephalopathy
UGent	Ghent University
UNDP	United Nations Development Programme
UNICEF	United Nations International Emergency Children's Fund
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
VetBioNet	Veterinary Biocontained research facility Network
VTC	Vector Transmission Control
WAIHS	World Animal Health Information System
WG	Working Group
WGS	Whole Genome Sequence
WHO	World Health Organization
WOAH	World Organisation for Animal Health (formerly known as OIE)
WNV	West Nile virus
WUR	Wageningen University & Research
ZAPI	Zoonoses Anticipation and Preparedness Initiative
ZODIAC	Zoonotic Disease Integrated Action

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

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

30 **Partners**

20 **members countries**

Networking more than 55 countries

Budget
US$ 2.5 billion

Start date:
2011-2015
2016-2022
2022-2027
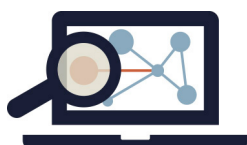
Overview

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.

STAR-IDAZ successfully established, through its global and regional activities, a network of organisations managing research budgets or programmes in more than 50 countries that are committed to working together. The scope of the project included 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 were also considered where they were identified as reservoirs of infection with emerging and major infectious diseases of humans or production animals.

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.

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 crosscutting health issues affecting livestock production, including zoonoses.

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 and
- Improve access to and the utility of research results across all partner organisations.

News from the STAR-IDAZ IRC Network:

IRC Executive Committee

STAR-IDAZ Executive Committee (ExCo) has 30 Members from 20 countries, 2 new Members have joined the IRC:

- USDA National Institute of Food and Agriculture (NIFA) – USA
- Norwegian Veterinary Institute (NVI) – Norway.

Since September 2022, the IRC ExCo meetings:

- 20 September 2022 by webinar
- 14 and 15 June 2023 at the International Livestock Research Institute (ILRI), Nairobi, Kenya.

In the last meeting, Members discussed how the IRC can improve its impact in advocating for STAR-IDAZ IRC and enlarge the network, particularly in underrepresented Regions.

Updates on the working groups activities were provided on: influenza, One Health, AMR and the alternative to antibiotics, ASF, Coronavirus, bTB, diagnostics, mycoplasmas, vaccinology, and vector biology & disease transmission (see below for updates).

Current priority topics remain important working areas for STAR-IDAZ IRC, moreover it was agreed to establish a WG on aquaculture. The focus of this WG should be identified by consultation with the STAR-IDAZ Scientific Committee, funders and experts in this field. Further engagement has also been agreed with GFRA and GARA.

To facilitate engagement with industry, it was agreed that STAR-IDAZ, through SIRCAH 2 funding, could support participation of two selected applicants for the innovation spotlight sessions **Discovery to Innovation in Animal Health (DIAH) Conference**. The event brings early developers (academia, research organisations, spin-offs/start-ups) and medium- to big-sized companies together to facilitate interaction and collaboration between them and thus stimulate innovation. The conference will be held on 6–8 February 2024, and focuses on innovation in animal health through collaboration in the phase of pre-development/discovery/ proof-of-concept. STAR-IDAZ roadmaps will be mentioned in the workshops as a guide together with technology readiness level (TRL) for use during early development.

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.
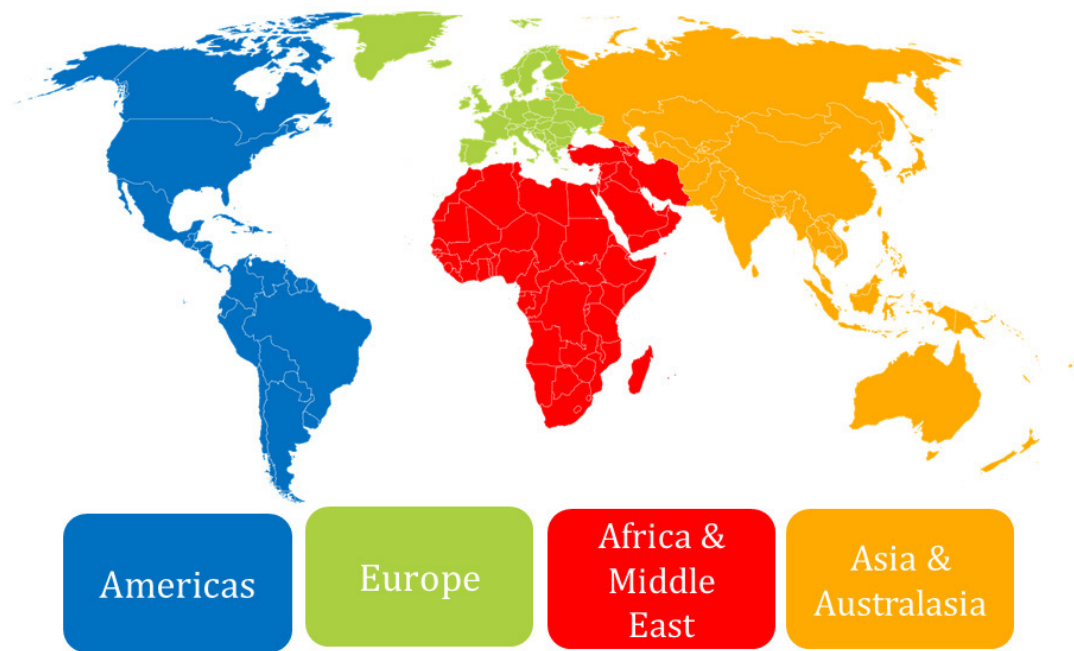
The Africa and Middle East Regional Network met by webinar:

- 16 January 2023;
- 1 August 2023.

The next meeting is planned as an in-person meeting alongside the 13th International Veterinary Immunology Symposium (**IVIS 2023**) in Kruger, South Africa on 16 November 2023.

The Americas Regional Network met:

17 March 2023 virtually;

22 August 2023 in Quito, Ecuador, with a focus on AMR and alternatives to antimicrobials.

The Asia and Australasia Regional Network met by webinar on 4 April 2023 and the next meeting will be held virtually on 9 October 2023.

The European Regional Network (operated through the SCAR CWG-AHW) met:

- 29 November 2022 in London, UK;
- 4-5 May 2023 in Vienna, Austria.

The next meeting will be held virtually as a webinar in Autumn 2023.

Scientific Committee and active Working Groups

The last Scientific Committee (SC) meetings were held:

- 23 February 2023 by webinar;
- 13 June 2023 at ILRI, Nairobi, Kenya.

At the meeting in February, the SC discussed and further developed the recommended operational procedures for research roadmap development. This document was developed to help guide the SC lead in each Working Group (WG). The process utilised by each WG will vary depending on the specific topic, existing alliances/networks and current research landscape. At the meeting in Nairobi, the SC discussed all active WGs' activities and relevant next steps.

The WGs and affiliated experts continued their networking activities delivering outputs on the following areas:

Influenza

Three virtual **workshops** were 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 workshop. 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 needs** was published in April 2023.

One Health

The One Health Working Group has been set up in collaboration with **GloPID-R** (Global Research Collaboration for Infectious Disease Preparedness). WG members met for the inaugural meeting in March 2023, where it was agreed further representation was required from the social and environmental sciences. A mapping exercise is being carried out to identify the existing and current initiatives and networks focused on One Health.

AMR and Alternatives to Antibiotics

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 developed to link together the three roadmaps (see report: **Research Roadmap Development for Alternatives to Antibiotics**). The document, developed 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 the 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 regional stakeholders on the AMR and ATA topic.

African Swine Fever

The STAR-IDAZ Working Group for African Swine Fever (ASF) operates through the Global African Swine Fever Research Alliance (GARA). Thanks to this, three ASF research roadmaps have been published on the STAR-IDAZ website, for the development of control strategies, diagnostic tests and candidate vaccines and the **2022 African Swine Fever Virus Research Review** was published in April 2022, in collaboration with USDA and GARA. The GARA Africa workshop was held in Kampala, Uganda on 7–9 February 2023 and identified critical knowledge and research gaps related to ASF which are specific to Africa. On 5–7 December 2023, a GARA Asia workshop will be held in the Philippines, to focus on critical knowledge and research gaps specific to Asia. SIRCAH and the SC lead will then engage with GARA to update the ASF roadmaps based on these gap analyses sessions.

Bovine Tuberculosis

A STAR-IDAZ bTB roadmap workshop was held on 28 February 2023 in Birmingham, UK, with the objectives 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 new roadmaps will be validated and published.

Coronaviruses

The International Coronavirus Network (ICN) Conference on Livestock, Companion Animals and Wildlife Coronaviruses was held in Belfast on 25-26 May 2023. STAR-IDAZ held a gap analysis session during the conference, with sessions on vaccines and therapeutics, diagnostics and surveillance, and epidemiology. A survey was circulated before the workshop and the results helped guide discussions at the workshop. A workshop report can be found on the STAR-IDAZ website **here** and draft research roadmaps will be developed based on the research gaps identified.

Diagnostics

A survey on 'Detection and Diagnostic Technology Development' was circulated to 60 experts from a wide range of different expertise (e.g., human health, data analysis, molecular biology, sensors, Artificial Intelligence, engineering) and from different organisations (e.g., universities, Government Institutes, start-ups). The first round of consultation was to detect new technologies that had potential to be utilised in animal disease diagnostics, the second round was carried out to identify specific research needs in those domains that could help to move new technologies forward. The results will be discussed in a workshop to identify main research needs.

Mycoplasmas

STAR-IDAZ, in collaboration with USDA-ARS, published the **IRC 2023 Veterinary Mycoplasmas Research Report** in June 2023. The review covers the research progress and development in contagious bovine pleuropneumonia (CBPP) and M. bovis since 2012 and other mycoplasmas since 2015. A CBPP gap analysis workshop was held on 26-28 June 2023, a gap analysis report will be published online to facilitate research collaborations.

Vaccinology

A 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, by Gary Entrican (SC member, University of Edinburgh) and Mike Francis (BioVacc Consulting). Gary Entrican presented on STAR-IDAZ, the research roadmaps and the influence of STAR-IDAZ on global vaccinology at the IVVN Early Career Researcher Event and at the **meeting of the WOAH Working group on Antimicrobial resistance** in March 2023

A 'Platform Technologies for Veterinary Vaccines against Bacterial Diseases' workshop will be held on 17 November 2023 as a session of the 13th International Veterinary Immunology Symposium (**IVIS 2023**). The objectives are to: i) review the current state-of-the-art of anti-bacterial veterinary vaccines with experts in a workshop setting; ii) promote discussion on the functionality and applicability of novel vaccine technologies for controlling bacterial pathogens; iii) create opportunities for novel collaborations; and iv) prepare a publication for dissemination of the outcomes of the workshop for researchers, funders, and industry.

Vector biology and disease transmission

A draft generic roadmap has been developed focusing on vector transmission control (VTC), through interventions on the vector host, vector biology and vector ecology. A roadmap workshop was held on 28 March 2023 in Weimar, Germany alongside the 15th International Ticks and Tick-borne Diseases Symposium (29-31 March 2023). Participants discussed and further developed the draft roadmap and lead summaries. Electronic engagement will be carried out to finalise and validate the lead summaries.

Helminths

Livestock Helminth Research Alliance (**LiHRA**) operates as the STAR-IDAZ Helminth WG and supported the development of the research roadmaps. The LiHRA General meeting was held in Peebles, UK on 29-30 November 2022 and the next meeting will be in Stockholm on 2-3 November 2023. The DISCONTOOLS **Nematode chapter** was published in May 2023, highlighting main critical research and knowledge gaps.

II. OTHER INTERNATIONAL INITIATIVES TO SPEED UP R&D

Research and development (R&D) are fundamental to ensure the development of adequate disease prevention and control tools, as well as to make better use of knowledge that is currently available, and for modelling disease impact. Several initiatives have been started, at a regional or at a global level, to speed up research in order to deliver timely solutions to emerging issues.

The aim of this chapter is to provide a list of the main funding and regulatory easing initiatives, and of the fast-track development pathways, which are designed to accelerate the delivery of R&D relevant to the animal health sector.

Global research networks on specific diseases

The sharing of information and scientific knowledge is of paramount importance to ensure disease preparedness. To this end, global research networks and alliances have been established on a number of infectious diseases to exchange and generate knowledge that would support the development of tools to successfully prevent, control or eradicate such diseases.

Although these networks present slightly different objectives, the identification of research needs and the coordination of research on priority issues are common activities.

Further details on the specific networks for the other STAR-IDAZ IRC priority diseases are provided in Chapter III.

AREF - African Research Excellence Fund

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

Partners ca. 16   **Budget** £4 million   **Start date:** 2015

Overview

The African Research Excellence Fund was established to support the next generation of research leaders in Africa and strive to improve health and save lives across the continent. To date it has raised £4 million from research funders, philanthropic foundations and individual donations, including GlaxoSmithKline, the Farrar Foundation, Medical Research Council (MRC), Medical Research Foundation, Robert Bosch Foundation, Vitol Foundation and Wellcome Trust.

In early 2021, AREF was officially registered as a charitable company, and established its own Board of Trustees.

Aim and priorities

Aim: to support the careers of the new generation of African researchers, giving them the stepping stones needed to become outstanding research leaders in their respective fields, ensuring that talent is retained in Africa to address the continent's unique health research needs.

Priorities: opportunities to develop research ideas, compete on an international level to win research funding, or access world-class research advisors and mentors.

Objectives & activities

- **Fellowships** aim to offer African researchers the invaluable experience of working with cutting-edge research methodologies in top-tier research environments. Through these fellowships, participants can expand their research networks, participate in workshops and conferences, and gain insights from leading figures in their respective fields

- **Grant-writing workshops** designed to empower African researchers with the confidence, knowledge, and essential support needed to secure competitive funding from international grant providers

- **Leadership programmes** tailored to equip African researchers with the necessary knowledge and expertise to become future leaders in their fields. They also focus on fostering equitable international collaborations and, ultimately, enabling participants to play a vital role in shaping the continent's healthcare priorities and research agenda.

News

AREF recently opened a call (Research Development Fellowship 2023/24) for a grant to support developing researcher skills for researchers in Africa who are emerging leaders and working on important challenges for human health, including veterinary aspects for One Health. The grant offers 3 to 9-month placements at a leading research institution in the UK, Europe or Africa, with additional support at a home institution before and after the placement. Up to £47,000 available in funding.

An essential grant writing skills programme was held in May and July 2022. Another will be dedicated to woman who are active in emerging/biomedical/health research in Africa, the course will be held the weeks of 18 September and 6 November 2023.

AfVANET - African Vaccinology Network

Website: http://afvanet.org/

AFRICAN VACCINOLOGY NETWORK

Partners ca.
NA

Budget
NA

Start date:
2019
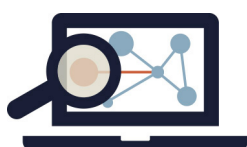
Overview

The African Vaccinology Network (AfVANET) is a network of African scientists, researchers, scholars and policymakers involved in vaccine research and development. AfVANET provides a forum for African scientists to take a greater part in establishing priorities for vaccine development for emerging and re-emerging human and veterinary diseases affecting the continent.

The concept of AfVANET was born during the Keystone symposium "New Approaches to Vaccines for Human and Veterinary Tropical Diseases" held in Cape Town, South Africa in May 2016. It was noted in the symposium that while African countries suffer the most from the infectious diseases discussed during the conference, the research and innovation used to tackle these diseases mostly come from outside the continent. The need for a better involvement of African scientists in finding solutions to infectious diseases that affect the health and wellbeing of people on the African continent was stressed. The network will collaborate with experts from the World Health Organization (WHO), the World Organisation for Animal Health (WOAH), the African Union Centre for Disease Control (AU CDC), the African Field Epidemiology Network (AFENET), the Global Alliance for Vaccine and Immunisation (GAVI) and the Global Alliance for Livestock Veterinary Medicine (GALVmed).

Aim and priorities

Aim: to promote and retain Africa's potential by fostering collaboration, innovation, training, and trust between vaccine Research & Development organisations and facilities for human and animal health in Africa.

Priorities: vaccines, genomics and transmission, clinical research, health systems research ethics, population health.

Objectives

- Bring together all stakeholders in vaccinology and related sciences in Africa
- Identify and prioritise vaccine gaps in Africa
- Promote vaccine research and development in Africa
- Promote sound ethics, biosafety and biosecurity in Africa.

News

The AfVANET committee is working towards making AfVANET recognised by African governments and the African Union (AU), stressing the idea of a new approach based on 'inside out' whereby African scientists will take a greater part in establishing the priorities and needs of the continent in place of the current 'outside in' approach.

AfVANET promotes teaching of immunology in Africa and encourages African scientist to participate in meetings on human and animal vaccinology, where they can learn more about new vaccination approaches for human and animal diseases. These will help African scientists toward an increase in the interactions between biologists, physicians and veterinarians at the African level.

AgResults Brucellosis vaccine prize

Website: https://brucellosisvaccine.org/

Partners ca.
6

Budget
US $30 million prize

Start date:
2016-2028

Overview

The Brucellosis Vaccine Challenge Project, a US $30 million prize competition, was launched in late 2016. This 'first of its kind' animal health initiative invites vaccine developers ('solvers') to develop a safer vaccine against *Brucella melitensis* in small ruminants that is as efficacious as the existing Rev1 vaccine and suitable for use in developing countries.

This global competition is funded by AgResults (a collaborative initiative between the governments of Australia, Canada, the UK and the USA, as well as the Gates Foundation), and implemented by the Global Alliance for Livestock Veterinary Medicines (GALVmed).

This novel 'pull funding mechanism' rewards research output rather than directly funding research input.

Aim and priorities

Aim: To develop a safe and efficacious vaccine for use against *Brucella melitensis* in small ruminants.

A key goal is to make a vaccine available that is safe for use in pregnant animals and which will be of greater use value in disease control strategies in developing countries.

Phases

The competition is open to any animal health vaccine development groups, in industry or academia in its early stages but requires a late-stage development/registration/commercialisation group to be part of the project post proof of principle.

It is structured in three phases:

- Phase 1 'Application Phase': Solvers were invited to submit their initial application to participate in the Competition (deadline November 18, 2017). The first milestone payment was a one-off payment of US $100,000, which could be awarded to a maximum of ten participants

- Phase 2 'Solving Phase': On acceptance into the Competition, Solvers work towards the demonstration of proof-of-principle safety and efficacy deliverables together with evidence of a scalable process (details of the requirements are outlined in the official Competition Rules document). Demonstration of proof of principle meeting the defined criteria leads to the potential award of milestone payment 2 (US $1,000,000; up to a max of 4 solvers).

- Phase 3 'Final Phase': Following a successful application for a Milestone 2 award, or a request to move into Phase 3 without a Milestone 2 payment for Solvers not wishing to share their data, Solvers will move into Phase 3 and will be required to take their vaccine candidates from proof-of-principle to a registered product. Registration of a vaccine which meets the Minimum Viable Product requirements, in defined countries, leads to the potential award of the Grand Prize (US $20,000,000 for a max of 1 Solver, the first) and/or Best in Class Prize (US $5,000,000 for a max of 1 Solver, same or different to the Grand Prize winner). The competition will close in May 2028.

The combination of technical vaccine development challenges, access to appropriate testing facilities and the pressure of pay-for-results funding have slowed progress. Recently an improved competitive grant funding call has been introduced to incentivise the timely completion of proof-of-principle data to maximise the probability of the successful registration of a vaccine within the timeframe of the Competition. Updated **Competition Rules** came into effect on 24 July 2023.

AgResults FMD Vaccine Challenge Project

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

Partners ca.
7

Budget
US$17.68 million prize competition

Start date:
2020
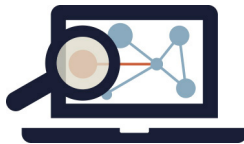
Overview

In January 2020, AgResults started the Foot-and-Mouth Disease (FMD) Vaccine Challenge Project, a new competition that encourages the development, registration and uptake of high-quality FMD vaccines that are tailored to meet the needs of Eastern Africa. The project is funded through the AgResults initiative by BMGF and the governments of Australia, United Kingdom, Canada, and USA. It is being implemented by GALVmed. The FMD Vaccine Challenge Project encourages animal health pharmaceutical companies around the world to participate. These companies will participate as 'competitors' to create vaccines that meet criteria established for the region.

Once the vaccines are registered in Eastern Africa and approved by the Project's Judging Panel, competitors will become eligible for the Project's cost-share benefit. The cost-share will reduce the cost-per-dose for buyers, enabling public and private sector actors to better combat FMD through access to more effective vaccines. In this way, the Project encourages the widespread use of prophylactic vaccination to improve animal health and farmer livelihoods.

To increase access to the high-quality vaccines, enhance existing public sector control efforts and build a stable market around FMD control, the Project encourages private sector participation in procurement and distribution of the vaccines, as well as in vaccination campaigns. The competition will conclude no later than July 2028.

Aim and priorities

Aim: develop, register, and commercialise effective vaccines for the control of FMD in Eastern Africa.

Priorities:
- Develop and register high-quality FMD vaccines, tailored to the needs of Eastern African
- Create greater market stability and affordability through increased production and purchase of FMD vaccines that are regionally relevant
- Build a private sector model for FMD vaccine purchase and distribution to complement public sector efforts.

Objectives

The competition has two phases:

- Development Phase: competitors must submit FMD vaccine dossiers (that they believe meet all of the elements of the AgResults Target Product Profile) to the regulatory authorities in at least one of the Project's target countries (Burundi, Ethiopia, Kenya, Rwanda, Uganda, Tanzania). Competitors will be eligible to submit an application to AgResults (via the online portal) upon receipt of full product registration in at least one target country

- Cost-Share Phase: structured in multiple sales periods, this phase will begin when the first FMD vaccine is registered in at least one target country and approved by the AgResults FMD Judging Panel. The cost-share support available to vaccine buyers through the competition is USD$15.8 million and will be paid directly to vaccine manufacturers to offset the cost of a target volume of vaccines. AgResults will fund a percentage of the vaccine price each sales period (e.g. 75% in the first sales period) up to a sale price of USD$2.00 per dose. If the vaccine has a sale price above USD$2.00, the buyer will pay the difference. To support the creation of a sustainable FMD vaccine market in the region, the level of cost-share support will gradually decrease each sales period in anticipation of the Project's completion.

Once the first vaccine has been approved by AgResults, other Competitors will still be eligible to submit applications (July 2027).

News

The Request for Applications document, containing full details of the Competition, was published in July 2020 (last updated in December 2022) and can be accessed at: **https://www.galvmed.org/wp-content/uploads/2023/03/FMD-Vaccine-Challenge-Project-RFA-rev6-131222.pdf**

The Project team facilitated the development of an annotated EAC Mutual Recognition Procedures Guideline 2 (GL2) to assist assessors with evaluation of vaccines against FMD (May 2021): **https://www.eac.int/documents/category/livestock**

The Project team developed a Public-Private Partnerships Framework that highlights the landscape, challenges, and opportunities of PPPs in the FMD vaccine value chain in Eastern Africa. Blog article: Full PPP Framework: **https://www.galvmed.org/wp-content/uploads/2021/09/PPP-Framework-FINAL-310821.pdf**

An article about the Project was published in the Viruses journal (September 2021): **https://www.mdpi.com/1999-4915/13/9/1830**

The Project team worked with the Secretariat of the East African Community to support National Regulatory Authorities in Eastern Africa to build capability in marketing authorisation of FMD and other vaccines: **https://www.galvmed.org/optimising-procedure-management-for-marketing-authorisation-of-veterinary-medicines-in-eastern-africa/**

CaribVET - Caribbean Animal Health Network

Website: Caribbean animal health network (caribvet.net)

	Partners ca. 34	**Budget** NA	**Start date:** 2006
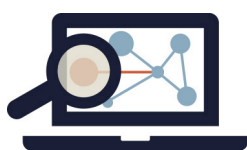
Overview

CaribVET is a collaborative network involving official veterinary services from 34 Caribbean countries/territories as well as research institutes (e.g. CIRAD, Guadeloupe and CENSA, Cuba), veterinary faculties (e.g. School Veterinary Medicine of the University of the West Indies, Trinidad and Tobago, University of Guyana, Ross University, Saint-Kitts-et-Nevis- and St. George's University, Grenada), CARICOM Secretariat and the Caribbean Agricultural Health and Food Safety Agency (CAHFSA), international organization (e.g. World Health Organization and Food and Agriculture Organization of the UN), regional organisations (e.g. US Department of Agriculture - USDA-APHIS-IS, Inter-American Institute for Cooperation in Agriculture -IICA and Pan American Health Organization- PAHO/WHO). CaribVET members are individuals or entities operating in the Caribbean including chief veterinary officers, national, regional and international organisations, universities and research institution, regional private sector groups and associations, regional non-governmental organisations, experts, etc.

Aim and priorities

Aim: to promote collaboration with national and regional animal and veterinary public health initiatives aimed at achieving food security/ stability and food safety in all the countries and/or the territories of the Caribbean.

Priorities: antimicrobial resistance, avian diseases, disaster risk reduction, epi and surveillance, laboratory, research/one health, swine diseases, tick-borne diseases, veterinary public health.

Objectives

- Support the development of a regional strategy on animal health which assist in improving the competitiveness in the livestock sub-sector in the Caribbean region
- Strengthen national capacities related to preparedness, surveillance, monitoring and management of animal and zoonotic diseases
- Assist in implementation of early warning, early detection and quick response mechanisms for animal and zoonotic diseases
- Improve and harmonise the surveillance and control of animal and zoonotic diseases
- Impart and expand the knowledge base of animal diseases including zoonoses and their distribution in the Caribbean
- Create and support the development of technical tools necessary for improving the region's technical and diagnostic capacity.

News

CaribVET has two ongoing projects focusing on One Health: CaribGREEN and AUSCAR.

The CaribGREEN project titled 'Caribbean One Health platform in research-innovation-education in agro-environmental and health for development' is a 2-year project, funded by the French agency for development (IRD). In its four components there is one focusing on the 'One Health approach' to foster and reinforce collaborations on agroecosystems health and implement global approach of health in the Caribbean, with the objective of providing a solid foundation for the long-term implementation of regional collaborative dynamics. Another 'CaribSURV' is focusing on health networks, and sanitary and phytosanitary emergency management, with the objective of reducing vulnerability of Caribbean countries and territories to emerging animal, plan and human health.

The AUSCAR/OSCAR project 'One Health Approach to Sanitary Risk Reduction in the Caribbean' will run for 1 year involving nine partners covering the Caribbean, Costa Rica and Colombia. The projects aims to build a community of practice around One Health in the region, warning systems and early and effective response and to identify areas, methods and tools to be used in the Caribbean and share methods to evaluate these surveillance systems.

On ASF, CaribVET, within the Inter-agency Training Group to Combat ASF in Latin America and the Caribbean, supported in delivering a series of webinars over the past 2 years available on the IICA website **here**.

CEPI - Coalition for Epidemic Preparedness Innovations

Website: http://cepi.net/

Partners ca.
35

Budget
US $3.5 billion/
5 years

Start date:
CEPI 2017-2021
CEPI 2.0 2022-2026

Overview

CEPI's coalition partners include global health organisations, vaccine developers and manufacturers, academic institutions, governments, philanthropies and civil society. At its start, it was founded by the governments of Norway and India, the BMGF, Wellcome, and the World Economic Forum. To date, CEPI has secured financial support from Australia, Austria, Belgium, the BMGF, Canada, Denmark, the European Commission, Ethiopia, Finland, Germany, Greece, Hungary, Iceland, Indonesia, Italy, Japan, Kuwait, Lithuania, Luxembourg, Malaysia, Mexico, Netherlands, New Zealand, Norway, Panama, Portugal, Philippines, Romania, Saudi Arabia, Senegal, Serbia, Singapore, Switzerland, Republic of Korea, United Kingdom, USA, and Wellcome. Additionally, in 2020 CEPI received support from private sector entities as well as public contributions through the UN Foundation COVID-19 Solidarity Response Fund. CEPI Secretariat is based in Oslo, Norway.

Aim and priorities

Aim: to finance and coordinate the development of new vaccines to prevent and contain infectious disease epidemics, also ensuring that the vaccines to be developed will be affordable and available to populations with the most need.

Priorities: CEPI initially focused on vaccines for known epidemic threats, selected on the priority list of pathogens outlined in the WHO R&D Blueprint. In the first years of activity, the targets have been Middle East Respiratory Syndrome coronavirus (MERS-CoV), Lassa virus, Nipah virus, Rift Valley fever, Chikungunya and the so-called 'Disease X' (i.e., a serious international epidemic caused by a pathogen currently unknown to cause human disease).

Although CEPI's focus is on human diseases, most of the diseases in the WHO R&D Blueprint are zoonoses, and, in some specific cases, CEPI would consider the development of animal vaccines, as this would represent an effective way for controlling the disease and preventing the development of human cases.

In 2020, CEPI activities mostly shifted toward COVID-19 response, and more specifically toward the development of human vaccines: nine partnerships to develop vaccines against COVID-19 were initiated. CEPI, GAVI and WHO co-lead the COVAX programme, with key delivery partner UNICEF, to accelerate the development and manufacture of COVID-19 vaccines, and to deliver fair and equitable access for every country in the world. COVAX is the vaccines pillar of the Access to COVID-19 Tools **(ACT) Accelerator**.

Objectives

- Stimulate, facilitate and finance the development of new vaccines against infections of epidemic potential, especially where pathways to regulatory approval and commercialisation are highly unpredictable

- Advance candidate vaccines through the development process, so safety and efficacy are proved in principle through human trials, before epidemics begin. This will enable rapid full trials or emergency deployment in outbreaks

- Establish the technical capabilities and processes necessary to accelerate research, development, manufacturing and clinical trials in the context of an outbreak

- Work with industry, regulators and other bodies to ensure any vaccines developed get licensed and reach the people who need them

- Support the long-term development of epidemic vaccine preparedness within the countries most at risk from epidemic threats.

News 2021

CEPI's 5-year plan (2022-2026) lays out a $3.5 billion roadmap to reduce vaccine development timelines to 100 days, develop a broadly protective vaccine against COVID-19 and other betacoronaviruses, and create a 'library' of vaccine candidates against selected viruses from the 25 viral families known to infect humans. The plan is available at **https://endpandemics.cepi.net**.

To date CEPI has made investments in 21 vaccine candidates against its priority pathogens (Lassa, MERS, Rift Valley Fever, Nipah, Chikungunya and Ebola), 14 COVID-19 vaccines, 13 broadly protective coronavirus vaccines, and an array of enabling science projects. The organisation has also invested in the development of rapid response platforms to develop vaccines against Disease X (the threat of an unknown virus).

In November 2022, CEPI partnered with University of California, Davis to support application of artificial intelligence (AI) to expand their 'SpillOver' platform to inform prioritisation of viral families with epidemic or pandemic risk.

In June 2023, CEPI partnered with the University of Leipzig to use the Rosetta Macromolecular Modelling platform to generate state-of-the-art immunogen designs and speed up development of future vaccines against novel viral threats.

Moreover, in July 2023, CEPI announced the support of $4.98 million to use AI for design of vaccines to fight diseases with pandemic potential. The project will design potential antigenic targets for up to 10 priority virus families with epidemic or pandemic potential. Laboratory-based tests will then be used to verify antigen designs for possible further development.

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

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

Partners ca.	Budget	Start date:
20	NA	205
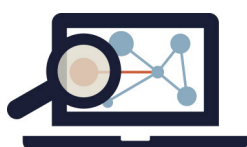
Overview

In 2005, in response to an initiative of the EU Standing Committee on Agricultural Research (SCAR), the Collaborative Working Group on European Animal Health and Welfare Research (CWG AHW) was established. The aims of this group, encompassing representatives of funding bodies from over 20 European countries, were the sharing of information, coordination of research activities, and the definition of a common research agenda.

Several actions have been initiated in the EU under the auspices of the CWG AHW, with the aim of improving transnational collaboration in research and to start a European coordination of research to define a coherent European Research Area (ERA). Building on this framework, networks between research funders on animal health were supported through four EU funded initiatives, the EMIDA ERA-NET (European Research Area Network on Emerging and Major Infectious Diseases of Livestock 2008 - 2011), the STAR IDAZ Global Net (Global Strategic Alliances for the Coordination of Research on the Major Infectious Diseases of Animals and Zoonoses, 2011 - 2015), the ANIHWA ERA-NET (European Research Area Network on Animal Health and Welfare, 2011-2015), and the ICRAD ERA-NET (International Coordination of Research on Infectious Animal Diseases, 2019 - 2023). Currently, the CWG also acts as European Regional Network for the STAR-IDAZ IRC.

Aim and priorities

Aim: to establish a durable and focused network of research funders from Member and Associated States of the EU – leading to improved collaboration on research prioritisation and procurement, creating the necessary critical mass and focus on animal health and welfare research needs.

Priorities: health, wellbeing and welfare of farmed production animals including fish and bees. Specifically, it includes welfare, infectious and non-infectious diseases including those conditions which pose a threat to human health, food safety issues relating to livestock products, and diseases of wildlife where they act as reservoirs of infection for humans or production animals.

Objectives & activities

- Share information on research projects
- Coordinate research activities
- Work towards a common research agenda
- Work towards mutual research funding activities, in the field of animal health, fish health and those conditions which pose a threat to human health.

Other activities include mapping the landscape in relation to provisions of research facilities, including expertise and microorganism collection.

News

The CWG AHW has continued to hold plenary biannual meetings since it was formed, with participation of the subgroups Strategy & Foresight Unit (SFU) and Animal Welfare, and two Management Board meetings. These meetings enable members to share information on ongoing research activities and options for collaboration, as well updates on emerging diseases and current animal health issues.

An additional meeting was held during 2022 as the CWG AHW is part of the core group for the preparation of a candidate European Partnership for Animal Health and Welfare (EUPAHW) under the cluster 6 of Horizon Europe (food, bioeconomy, natural resources, agriculture and environment). The partnership aims to deliver key knowledge, services and products to significantly improve the control of animal infectious disease and animal welfare in a coordinated way. The general objectives of the partnership will be to reinforce the preparedness of all actors involved in animal health and welfare against animal disease, to place animal welfare at the foreground of livestock production, to enhance cross-sector collaboration to prevent the spill-over from animals, food and the environment to humans. A new strategic research and innovation agenda was prepared for the partnership and can be found **here**.

Recently, the EUP AH&W proposal has been accepted for co-funding by the EC and the Grant Agreement negotiations will start in the autumn of 2023, aiming for the Partnership to begin early in 2024.

Moreover, the CWG AHW maintained and consolidated interaction with international organisations (EFSA, WOAH, COST), industry (COPA & COGECA, AnimalhealthEurope) and with large projects STAR-IDAZ IRC, ICRAD, One Health EJP and DISCONTOOLS.

In April 2023 the ERA-NET on International Coordination of Research on Infectious Animal Diseases (ICRAD) opened the 3rd transnational call on "Helminth infections and changing climate: tackling the challenges for animal health". The 2nd ICRAD call "One Health Approach to Zoonoses Research and Innovation" has been closed. Out of 40 project proposals, 10 international collaborative research projects have been funded. Further information on the projects covering research on prions, bacteria and viruses can be found **here**.

ECOHEALTH ALLIANCE

Website: https://www.ecohealthalliance.org/programs
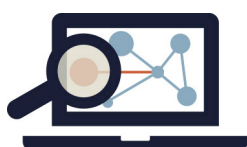
Partners ca. 30

Budget US $10 million

Start date: 2000

Overview

EcoHealth Alliance is a global environmental health non-profit organisation dedicated to a 'One Health' approach to protecting the health of people, animals and the environment from emerging infectious diseases. The organisation formed with the merger of two highly respected organisations, Wildlife Trust and the Consortium for Conservation Medicine. The concern for wildlife conservation and the health of our planet, led EcoHealth Alliance to become an environmental science and public health leader working to prevent pandemics in global hotspot regions across the globe and to promote conservation. It uses a multidisciplinary method to solve health challenges caused by global changes and human-animal interactions. It works with local governments, in-country scientists, and policymakers in more than 30 countries around the world to make critical on-the-ground changes for the prediction and prevention of infectious disease.

Aim and priorities

Aim: to protect wildlife and public health from the emergence of disease.

Priorities: impact on:

- Biosurveillance
- Deforestation
- One Health
- Pandemic prevention
- Wildlife conservation.

Activities

EcoHealth Alliance's programmes are funded on innovations in research, training, global partnerships, and policy initiatives. The strategic focus will be on:

- Pandemic prevention: understanding what causes diseases to emerge, designing better ways to track their origins, and designing pandemic prevention strategies based on good science.
- Policy and Health: influencing national and global policy on pandemic prevention, sustainable development, and conservation; co-design policy initiatives in the USA and globally, which promote the linkages between health and the environment and target pandemic prevention through sustainability.
- Conservation tackling:
  - Deforestation: Assessing the economic cost of emerging diseases linked to deforestation and using this to persuade policymakers, consumers, and industry to develop more sustainable approaches to land-use change.
  - Wildlife trade: Tracking the risk of disease emergence from the wildlife trade and the incentives that drive this trade to encourage alternative solutions and reduce species loss, ethical implications, and disease risk.

News

Among the current Featured Programme listing, where EcoHealth is partnering, there is an increasing number of topic of interest for animal health, such as:

- **Understanding the Risk of Bat Coronavirus Emergence**
- **Analyzing the Potential for Future Bat Coronavirus Emergence in Myanmar, Vietnam, and Laos**
- **Land Use Change and Zoonotic Spillover Risk**
- **Crimean-Congo Hemorrhagic Fever (CCHF)**
- **Conservation Works**
- **Emerging Infectious Diseases – South East Asia Research Collaboration Hub**
- **Establishing Biosurveillance Networks in Western Asia**
- **Rift Valley Fever**
- **PREDICT**
- **Infectious Disease Emergence and Economics of Altered Landscapes Project (IDEEAL)**
- **Health & Policy Initiatives**
- **Monitoring the Deadly Nipah Virus**
- **Emerging Disease Hotspots**

ERFAN - Enhancing Research For Africa Network

Website: https://www.izs.it/IZS/Cooperazione_1/IZSAM_in_Africa/ERFAN_-_Enhancing_ Research_For_Africa_Network

Partners ca. 36

Budget €1.5 million

Start date: 2018

Overview

ERFAN is an international scientific network to build fruitful collaborations for both African countries and Italian institutions, allowing a continuous and updated knowledge of animal and human health conditions in relation to the African continent. The Regional Representatives of the International Organisations such as SADC, European Union, WOAH (World Animal Health Organization), FAO (Food and Agriculture Organization of the United Nations), AU-IBAR (African Bureau of Animal Resources), IAEA (International Atomic Energy Agency) and delegates of the Italian Ministry of Foreign Affairs and International Cooperation and the veterinary institutions defined the organisational and operational structure of ERFAN.

Aim and priorities

Aim: to enhance research collaboration for Africa.

Priorities: Animal welfare, food hygiene, vector-borne diseases, in particular mosquitoes and culicoides; contagious bovine pleuropneumonia and small ruminants mycoplasmosis; brucellosis; anthrax; bovine Tuberculosis; TSE; project design for international cooperation.

Objectives & activities

- Improve veterinary laboratory performances of all veterinary institutions involved, through training, research and technology transfer
- Enhance collaborations among the partners of the network by exchanging resources, epidemiological data, technology and knowledge
- Identify research needs and gaps, in relation to One Health concept; animal-human-ecosystem health, food safety, epidemiological studies, animal welfare, etc.
- Improve cooperation, in veterinary science, between African and Italian partners.

News

The network provides opportunities for collaborations in order to achieve a continuous exchange of knowledge in the field of animal welfare and public health. The next ERFAN meeting for Northern Africa will be held in Tunis, Tunisia 3-5 October 2023, while the next ERFAN Regional meeting for Southern Africa will be held in Pretoria, South Africa 7-9 November 2023.

ERFAN has training available on digital platforms and funds small-scale research projects, Masters students and PhD students. Thanks to enhanced scientific cooperation, training and twinning projects, African veterinary institutes have attained a high scientific level in the diagnosis, study, and control of infectious animal diseases, offering services in accordance with ISO 17025.

The project will end in April 2024, but a second phase of the project has been submitted for funding.

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

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

Partners ca.	**Budget**	**Start date:**
NA	€8.2 million	2020-2024

Overview

ERRAZE is an initiative for an integrated global multi-stakeholder and One Health approach to the prevention and management of emerging zoonotic diseases that may have pandemic potential, to support policy makers and decision makers and thus society at large in preventing future pandemics and mitigating their impact. WUR brings together expertise in the areas of human, animal, plant and environmental health, the global agro-food system, economic and social developments, food safety and security, ethics and policy to find answers to the questions raised by new pandemic threats. ERRAZE is largely funded with WUR internal funds, and receives support from the Dutch national Government (the Ministry of Agriculture, Nature and Food Quality, and the Ministry of Health, Welfare and Sport).

Aim and priorities

Aim: to help build the knowledge base needed to prevent future zoonotic emergencies and to limit their impact, developing an integrated global multi-stakeholder approach.

Priorities:

- Pandemic preparedness
- Zoonotic diseases response management
- Emerging zoonoses prevention
- Recovery and learnings from pandemic.

Activities

- Develop maps with high-risk areas for pathogen re-emergence (hotspots)
- Further develop and describe evidence-based sustainable preventive interventions to the agri-food system
- Develop system models, linked to the risk maps, to simulate the effect of preventive measures in combination with human behaviour
- Continue to develop and use tools to identify stressors to the natural ecosystem and its species that could enhance pathogen shedding by reservoir hosts
- Surveillance and associated detection strategies and tools to enable early warning, rapid characterisation of novel pathogens, developing plug-and-play vaccines and therapeutics, and developing contingency plans
- Further develop agile, appropriate and scalable diagnostic and data collection tools
- Develop new scenarios for biosecurity and models to underpin and evaluate their efficacy and cost-benefit impacts
- Inform policy and institutional change towards contingency and recovery plans by use of sophisticated models for scenario analyses
- Develop insights and tools that help combine data-based evidence with expertise-based evidence
- Ensure that appropriate pandemic crisis feedback and learning mechanisms are completed, improving future pandemic prevention, preparedness and response
- Work towards governance systems and policies that enable further operationalisation of the One Health approach
- Global capacity building through a joint research prize in global One Health approaches to more safe and resilient food systems, with the FAO's World Food Forum.

News

Project showcases of the ERRAZE@WUR programme launched in July 2021 are available online at **ERRAZE@WUR: Showcases - WUR**. They focus on four strategic goals:

- **Automation and digitalisation in diagnostic capabilities; crisis response**
- Updating existing methods for (novel) pathogen detection, identification and characterisation; crisis preparedness
- Strengthen the FAIR (findable, accessible, interoperable, reusable) data infrastructure
- Creating the basis for novel diagnostic reagents and therapeutics for previously undescribed emerging zoonosis with a non-immune library of llama single-domain antibodies.

On May 25 2022 a One health event 'Working together to prevent, and mitigate a future zoonotic epidemics and pandemics' brought together researchers, policy makers, NGOs and other stakeholders. The event reinforced connections among participants and helped in the building of a scientific foundation to prevent future pandemics and to limit their impact. Presentations from the event can be downloaded here: **ERRAZE@WUR event: Working together to prevent, and mitigate future zoonotic epidemics and pandemics - WUR**

The award ceremony of the Transformative Research Challenge of the WFF was held in October 2023 in Rome.

A future international Global One Health oriented event will be organised in 2024

EUPAHW - European Partnership on Animal Health and Welfare

Website: NA

Partners ca.
NA

Budget
€20 million

Start date:
2024

Overview

The European partnership on Animal Health and Welfare will contribute to the objectives and targets of the new EU Common Agricultural Policy (CAP) and the EU Farm to Fork Strategy, for a transition to fair, healthy and resilient animal production systems, including the reduction of antimicrobial usage and improvement of animal welfare. It is a **Cofund Action of the HORIZON Europe Programme** that will support research and innovation to help policy makers, animal health industry and other relevant actors to prevent and control infectious animal diseases while improving animal welfare, thus contributing to sustainable animal farming and harvesting and the protection of public health and the environment. The expected outcomes of the partnership will also contribute to the Sustainable Development Goals (SDGs), in particular SDGs 2, 3, to the climate adaptation strategy, by fostering adaptation to climate change of livestock production and will sustain the One Health approach.

Aim: coordinate research programmes and activities on animal health and welfare between the EU and its Member States and Associated Countries and trigger combined action.

Priorities: animal health and welfare research for terrestrial livestock and aquatic animals. Wildlife and companion animals will be addressed when there is a potential threat to public health or health of production animals.

Aim and priorities

Activities

- To support transnational research and innovation activities, as defined in its Strategic Research and Innovation Agenda (SRIA).
- To facilitate the cooperation between all major actors on the monitoring, prevention and control of animal infectious diseases and on animal welfare issues. Actions will be undertaken to strengthen alignment of research and innovation programmes and joint integrative activities among research performing organisations and other actors and stakeholders to organise education and training activities, mobility schemes, networking; to optimise research infrastructures and resources, including networking.
- To boost research and to increase the evidence-base to develop products, indicators and tools for monitoring, control and improvement of animal health and animal welfare from farming to slaughtering, notably through joint research activities organised both among research performing organisations in the partnership and through launching open joint calls.
- To support surveillance, detection, risk assessment and alert communication, prevention, including selective breeding for relevant phenotypes and feeding supporting health and welfare, interventions including vaccines and treatments, socio-economic assessment on animal health and welfare.
- To enhance cross-sector cooperation and collaboration to prevent the spill-over of pathogens between animals, food, the environment and humans in a One Health perspective. The partnership will contribute to a multidisciplinary approach across sectors dealing with animal health and animal welfare, public health, food safety and the environment, including adaptation to climate change, in particular regarding zoonoses and antimicrobial resistance.
- To ensure general and targeted communication on the outputs of the partnership and dissemination of its deliverables to partners, policymakers, national and international stakeholders, and all other possible users, to stimulate their uptake and implementation.
- To regularly update the partnership vision and strategy, in particular to address new needs, for instance emergencies, policy implementation, stakeholders' interests, societal demands.

News

The EUPAHW should start its work in January 2024 after the finalisation of the grant agreement with the EC. **The strategic research agenda (SRIA) of the EUPAHW** has been developed through joint working of the EUPAHW, WP6 – ERA-Net co-fund ICRAD, STAR-IDAZ IRC and SFU - CWG AHW and extensive consultation with more than 300 key players to achieve a long-term common strategic vision and addresses the strategic objectives that will guide the activities of the partnership.

GALVmed - Global Alliance for Livestock Veterinary Medicines

Website: https://www.galvmed.org/

	Partners ca.	Budget	Start date:
	NA	$229 million	2008
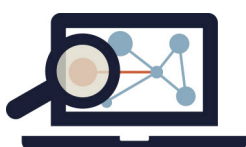
Overview

The Global Alliance for Livestock Veterinary Medicines (GALVmed) is a not-for-profit global alliance, registered as a charitable foundation, with headquarters in Edinburgh and offices in Nairobi and New Delhi.

GALVmed was formally established in 2005, with initial funding from the UK Government Department for International Development. By 2008, funding from BMGF and the UK Government enabled GALVmed to commence programmes of delivery. Since 2008, GALVmed has received over $229 million in donor funding for programmes in pursuit of its mission of making a difference to the livelihood of small-scale livestock producers by facilitating availability of animal health tools.

Aim and priorities

Aim: to reduce poverty and make a sustainable difference in access to veterinary medicines for small scale livestock farmers in sub-Saharan Africa and Asia.

Priorities: GALVmed funded programmes have targeted the development of new products (veterinary vaccines, pharmaceuticals, and diagnostics) and various product improvements (such as heat tolerance, production cost reductions, formulations for easy applications), as well as the development of sustainable access to these products.

Objectives

- Research and Development: to support R&D for animal health products on specific needs of small-scale livestock producers in Asia and sub-Saharan Africa. Currently, the main projects involve animal African trypanosomiasis, brucellosis, FMD, and smaller projects for cysticercosis, Newcastle Disease, and other diseases.

- Commercial development: to establish sustainable markets for improving marketing and distribution channels for animal health products to be used by small and medium scale producers in priority regions.

- Policy and Advocacy: current activities include advocating regulatory harmonisation in Africa, encouraging establishment of vaccine banks, supporting development of standards for veterinarians and veterinary paraprofessionals to improve access to veterinary services in LMICs, and strengthening veterinary product regulatory systems, including improving regulatory controls to help eliminate substandard or falsified products.

News

GALVmed projects focus on 17 neglected livestock diseases that have a large economic impact on small-scale livestock producers in Africa and South Asia: African swine fever, animal African trypanosomosis, brucellosis, *Chlamydia abortus*, contagious bovine pleuropneumonia, contagious caprine pleuropneumonia, East Cost Fever, FMD, fowlpox, Gumboro, lumpy skin disease, Newcastle Disease, peste des petits ruminants, porcine cysticercosis, Q fever, rift valley fever, sheep and goats pox.

GALVmed is also managing two competitions by offering prizes for successful completion of various milestones rather than offering up-front research grants. The goal is to incentivise development, registration, and commercialisation of new or improved vaccines against brucellosis and FMD.

Additional information about the two AgResults competitions can be found in the two dedicated sections in this Chapter.

GALVmed have established a partnership with the International Livestock Research Institute (ILRI) and Clinglobal. The aim is to launch a platform to transform animal health solutions and services in LMICs (TAHSSL). It will be a one-stop shop to conduct research on animal health product technologies that will generate robust proof-of-concept data to de-risk potential private sector entry into product development, registration and use.

On 3-5 July 2023, GALVmed coorganised the workshop "Harmonization of Standards for Registration of Veterinary Vaccines and Certification of Vaccine Manufacturing Facilities in Africa" with the African Union Pan-African Veterinary Vaccine Center (AU-PANVAC) and the Nigeria Veterinary Research Institute (NVRI) in Abuja, Nigeria. In the workshop technical requirements and standards for registration of veterinary vaccines in Africa were discussed. In addition, the challenges faced by regulatory authorities and vaccine manufacturers were identified with the purpose of building consensus on harmonisation of the standards for peste des petits ruminants vaccine registration across Africa. A major outcome of the meeting was the agreement that all regional economic communities and national veterinary drug registration authorities will use the harmonised technical documents developed under the **East African Community Mutual Recognition Procedure (EAC MRP)** project to register all peste des petit ruminants vaccines in Africa.

GBADS - Global Burden of Animal Diseases

Website: https://animalhealthmetrics.org/

Partners ca. NA	**Budget** NA	**Start date:** 2018

Overview

GBADs programme had its beginnings in 2016 by the mandate of WOAH Resolution no. 35/2016: 'development and testing of a methodology to determine the global burden of animal diseases in order to address deficiencies in economic information on national and world impact of animal diseases'. The launch of the programme took place in 2018, after a formal letter of intent between the University of Liverpool and WOAH which enabled the operationalisation of the project and to the subsequent roll-out thanks to funding from the BMGF, the UK Foreign, Commonwealth and Development Office, the European Union, Brooke, the Australian Centre for International Agricultural Research (ACIAR), and the University College Dublin. Then, eight additional partners actively committed to GBADs have formalised their engagement.

Aim

Aim: to assess the economic burden of animal diseases in standardised terms of production loss, expenditure, and trade impacts.

Objectives & activities

Develop a knowledge engine that will inform decision makers in the public and private sectors, drive policy change and strengthen strategies in order to improve animal health system performance and deliver progress on Sustainable Development Goals (SDGs).

- Activities include to:
- Generate case studies
- Establish guidelines to draw animal population estimates, production system classification and livestock production parameters
- Develop best practices for economic assessment of animal health
- Provide an analytics platform to support animal health decision-makers.

News

GBADs programme is currently developing methodologies and a prototype analytics platform. The GBADs is collecting existing data from a large variety of public- and private-sector sources by forming data alliances with multiple stakeholders. WOAH and Veterinary Services play a key role in data generation, reporting and validation. Targeted **case studies** across Europe, Africa and the Americas are being utilised to provide initial burden estimates and to identify priority areas for future method development and data acquisition. Ontologies and graph databases are being developed to connect data and improve their interoperability. **Dashboards**, **data portal API**, and a **documentation website**, containing a Data Governance Handbook explaining GBADs data, are now available online.

GFRA - Global Foot-and-mouth Research Alliance

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

	Partners ca. NA	Budget NA	Start date: 2018

Overview

The Global Foot-and-mouth Research Alliance (GFRA) was launched in 2003 with the aim of establishing and sustaining global research partnerships to generate scientific knowledge and discover the tools to successfully prevent, control, and eradicate FMD. The GFRA has, to date, 27 partners coming from all regions of the world and many stakeholders, including STAR-IDAZ.

The GFRA Members conducted research gap analyses on FMD diagnostics, vaccinology, epidemiology biotherapeutics and disinfectants, immunology, pathogenesis and molecular biology. These are now periodically updated during the groups' biannual meetings. These meetings also provide an opportunity for researchers to network and exchange new knowledge about the disease and the development of control tools.

Aim

Aim: to establish and sustain global research partnerships to generate scientific knowledge and discover the tools to successfully prevent, control and eradicate FMD.

Objectives & activities

- Facilitate research collaborations and serve as a communication gateway for the global FMD research community
- Conduct strategic research to better understand FMD
- Development of the next generation control measures and strategies for their application
- Determine social and economic impacts of the new generation of improved FMD control
- Provide evidence to inform development of policies for safe trade of animals and animal products in FMD-endemic areas.

News

GFRA and Civilian Research and Development Foundation (CRDF) Global organised a series of webinars in the last year and videos are collected online here.

A gap analysis event was held in collaboration with CRDF Global in Buenos Aires, Argentina, 5-6 December 2022 and a report will soon be available on the GFRA website. The 3rd GFRA/EuFMD Regional Virtual Workshop 'FMD in Africa' occurred in February 2022. The next GFRA scientific meeting to facilitate and coordinate information exchange and research collaborations on FMD will be held 8-10 November 2023 in Kampala, Uganda. The goal of the meeting will be to gain collectively insights of scientific efforts taking place in different parts of Africa and improve understanding on the emergence of new FMD strains in Africa and Asia.

GloPID-R - Global Research Collaboration for Infectious Disease Preparedness

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

Partners ca.
35

Budget
NA

Start date:
2015-2019
2020-2022
2023-2025

Overview

GloPID-R brings together worldwide funding bodies investing in research related to new or re-emerging infectious diseases. The GloPID-R Secretariat is a project which receives funding from the European Union's Horizon Europe. The World Health Organization, the Coalition for Epidemic Preparedness Innovations (CEPI) and the European & Developing Countries Clinical Trials Partnership (EDCTP), ESSENCE on Health research, GAVI and GOARN are also engaged in the network as observer. The need for the rapid development of essential diagnostics, vaccines and therapeutics at the outset of an emerging infectious disease outbreak was highlighted when Ebola struck in West Africa in 2014 and has been confirmed in the battle against COVID-19.

GloPID-R support readiness for upcoming outbreaks by analysing the current state of knowledge and preparedness and identifying gaps as possible areas for funding.

It identifies priority areas and creates working groups, develops videos and publications, and hosts workshops on these topics. GloPID-R is also actively involved in systemic preparedness, connecting clinical trial networks, building a framework for data sharing and improving the rapid delivery of research funding

---

Aim and priorities

Aim: to ensure that research capacity and capabilities are in place to support the rapid initiation of scientific research in case of an outbreak.

Priorities: GloPID-R has taken action in the following recent outbreaks:

COVID-19, Ebola, Plague, Yellow Fever, ZIKA, Chikungunya.

Their objectives are to:

- Facilitate the exchange of information
- Address scientific, legal, ethical and financial challenges
- Implement a 'One Health' approach with close cooperation between human and animal health researchers
- Establish a strategic agenda for research response
- Connect infectious disease research networks
- Involve developing countries.

The main working group activities of GloPID-R focus on:

- Clinical trial networks - reating links between clinical trial networks and addressing challenges in capacity building or trial implementation in the midst of a crisis
- Data sharing - building the first international framework to facilitate data sharing during public health emergencies
- Social science research - raising awareness about the vital role social science research plays in understanding infectious diseases
- Long-term research - identifying scientific gaps and addressing research challenges through a long-term research agenda
- Funding - working to improve the rapid delivery of funds to research projects when a crisis strikes
- One health - recognising the interdependence of human health, animal health and the environment.

Objectives & activities

News

In March 2023, a living mapping review (LMR) was developed for the **COVID-19 Research Project Tracker** (developed by UKCDR, GloPID-R & Covid CIRCLE) that provides a live database mapping funded research project connected with the three pillars and priorities outlined by the **UN Research Roadmap for the COVID-19 Recovery**. The LMR takes an in-depth look at the trends, opportunities, and remaining gaps in the long battle against COVID-19.

In 2021, GloPID-R started its Regional Hub strategy to facilitate the coordination of research on infectious diseases with pandemic potential on regional research priorities and capabilities. The African Regional Hub was launched on 23 August 2023, after the Asia Pacific Hub launched in 2021.

GloPID-R and STAR-IDAZ IRC have established a joint working group on One Health. The WG will define priority research needs in the One Health field utilising a participative multidisciplinary approach among human, veterinary and environmental fields (see further One Health section).

GOARN - Global Outbreak Alert and Response Network

Website: https://goarn.who.int/

Partners ca. 250	**Budget** NA	**Start date:** 2000
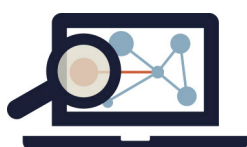
Overview

The Global Outbreak Alert and Response Network (GOARN) is a global technical partnership, established by the World Health Organization (WHO) as a key mechanism to engage the resources of technical agencies beyond the United Nations for rapid identification, confirmation and response to public health emergencies of international importance.

Aim and priorities

Aim: to improve global health security by coordinating and making available the resources of its partners (WHO Member States) to ensure preparedness for and appropriate responses to public health emergencies including disease outbreaks, food safety, chemical toxins, zoonosis, natural and manmade disasters etc.

Priorities: Public health emergency support and preparedness.

Objectives & activities

The Network delivers support to augment the overall WHO response to the public health emergency. Based on the varied and evolving needs of an emergency, this support could include:

- The deployment of technical experts to the affected countries, under the leadership of WHO
- Provision of technical advice through expert committees established during the emergency
- Provision of resources for the response efforts, such as laboratory and operational logistics, tools and equipment to reinforce field teams, etc.

Beyond providing direct assistance to public health emergency response, GOARN Partners may engage in the Network in several additional ways, including:

- Support for GOARN outbreak response training to strengthen the Network's capacity and performance
- Operational research and development of tools and technologies that support GOARN field teams in improving outbreak response interventions
- Networking among GOARN Partners to share information and establish opportunities for outbreak response collaboration.

An online survey for a global research agenda on public health and social measures during emergency run during 2022, led to the development of the network **strategy for 2022-2026**.

In May 2023, GOARN organised a webinar on operational research development and activities in SEAR.

A **COVID-19 Knowledge Hub**, curated by GOARN Partners including UN agencies, International and national NGOs, academic institutions and consortiums was launched to provide public access to the best resources available to support engagement in responding to this pandemic.

The Hub offered multidisciplinary information on COVID-19 for several stakeholders including policy makers, responders, researchers, educators, affected communities and the general public.

HERA Invest

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

Partners ca.
13

Budget
€100 million

Start date:
2023

Overview

HERA Invest is the European health investment fund dedicated to support innovative SME in the early and late phases of clinical trials of medical countermeasures and related technologies for tackling priority cross-border health threats. The European Investment Bank (EIB) and its partners together with the Commission's Health Emergency Preparedness and Response Authority (HERA), will invest up to 50% of project costs.

Companies must have already raised equity from professional investors, have a sustainable business model and business plan, and have a solid corporate governance in place. The EIB will typically invest between €15 and 30 million per project.

Aim

Aim:
• Promote R&D by European companies to ensure open strategic authonomy
• Leverage public funding to incentivise private investment in developing new protections against health threats
• Emphasise high-risk market areas where the need for financing is significant but the supply is low
• Reduce market failures.

Objectives & activities

Health threats to tackle:
• Pathogens with pandemic or epidemic potential
• Chemical, biological, radiological and nuclear (CBRN) threats originating from accidental or deliberate release
• Antimicrobial resistance (AMR).

Medical countermeasures to diagnose, prevent, protect from public health emergencies: vaccines, antibiotics, medical equipment, chemical antidotes, therapeutics, diagnostic tests, personal protective equipment.

News

The 5th meeting of the HERA advisory Forum was held on 20 June 2023. An update of current activities was provided and additional threats that may need to be prioritised, notably environmental health threats and biosecurity and potential dual use/misuse of emerging technologies, were discussed. In 2024, a 'Threat Assessment exercise' is planned that should take into consideration potential additional topics. The 2023 HERA Conference will take place on 5 December 2023.

IHI - Innovative Health Initiative

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

Partners ca.
6

Budget
€2.4 billion

Start date:
IHI 2021-2027
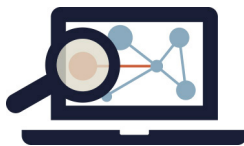
Overview

The new European partnership in health research and innovation, came into force on the 30 November 2021. IHI is a cross-sector, public-private partnership between the EC and the European life science industries, represented by COCIR, EFPIA, EuropaBio, MedTech Europe, and Vaccines Europe. IHI build on the successes and lessons learnt from IMI (2008-2013; 2014-2021), the Europe's largest public-private initiative in the medical research and innovation moving about €5.3 billion. As an IMI, the EU will provide 50% of the funding for IHI and the industry members will contribute the other 50%, primarily through 'in kind' contributions.

Like IMI, IHI work by bringing together diverse stakeholders (universities, companies large and small, and other health stakeholders) in collaborative projects that address disease areas where there is a high burden on patients and/or society. However, in IHI there will be a much greater focus on cross-sectoral projects involving the biopharmaceutical, biotechnology and medical technology sectors, including companies active in the digital area.

Aim and priorities

Aim: to translate health research and innovation into real benefits for patients and society.

Priorities: Innovations should be safe, effective, people-centred and cost-effective, and cover prevention, diagnostics, treatment and disease management. IHI will contribute to a number of European policies, most notably Horizon Europe, **Europe's Beating Cancer Plan**, the **new Industrial Strategy for Europe**, the **Pharmaceutical Strategy for Europe** and the **European health data Space**.

Objectives

- Turn health research and innovation into real benefits for patients and society
- Deliver safe, effective health innovations that cover the entire spectrum of care – from prevention to diagnosis and treatment – particularly in areas where there is an unmet public health need
- Make Europe's health industries globally competitive.

News

Since its start in 2021, IHI set up our three governance bodies – the **Governing Board**, the **States Representatives Group**, and (new in IHI) the **Science and Innovation Panel**. A **Strategic Research and Innovation Agenda** was finalised. The concept of co-creation of calls has been enhanced in IHI by the launch of the platform for **Ideas Incubator**.

IHI launched five calls for proposals. The last two currently open (RIA) could be of interest for some scientists of the animal health sector as well: call 4, **3Rs, patient-centric blood sample collection, clinical trials, and the environmental impacts of healthcare**, and call 5, **3Rs, theranostics, stroke management and synthetic data**.

InnoVet-AMR - Innovative Veterinary Solutions for Antimicrobial Resistance

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

| | **Partners ca.** | **Budget** | **Start date:** |
| | 2 | CA$30 million | 2018-2023 |
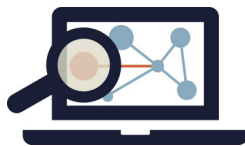
Overview

The Innovative Veterinary Solutions for Antimicrobial Resistance (InnoVet-AMR) is a 4-year CA$27.9 million partnership between IDRC and the UK Government's Global AMR Innovation Fund (GAMRIF), which is part of the Department of Health and Social Care.

Aim and priorities

Aim: to fund research that will develop innovative veterinary solutions focused on product development to reduce therapeutic and prevent non-therapeutic antimicrobial use in livestock and aquaculture production in low- and middle-income countries (LMICs).

Priorities: the programme specifically focuses on reducing AMR in swine, poultry, and aquaculture animals.

Objectives and activities:

- Support research that will identify innovative veterinary solutions, including vaccines and alternative solutions, to reduce the use of antimicrobials in livestock and aquaculture operations in LMICs
- Build effective partnerships to better coordinate discovery, development, and sustainable delivery of affordable innovative veterinary solutions to reduce the use of antimicrobials in livestock and aquaculture operations in LMICs.

News

12 projects are ongoing from the call 'Developing innovative veterinary solutions for the fight against antimicrobial resistance'. More information is available at: **https://www.idrc.ca/en/research-in-action/new-innovet-amr-projects**

LVIF - Livestock Vaccine Innovation Fund

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

	Partners ca. 3	Budget CA$57 million	Start date: 2015-2022

IDRC · CRDI
International Development Research Centre
Centre de recherches pour le développement international

Overview

The LVIF is a 5.5-year (2015-2020), CA$57 million, partnership between BMGF, Global Affairs Canada and Canada's International Development Research Centre (IDRC). The initiative supports research into vaccine solutions, through a series of global competitive calls. To facilitate the large-scale use of livestock vaccines, LVIF facilitate the development of vaccines that are accessible, affordable, available, and acceptable to livestock smallholders. The Fund targets key neglected livestock diseases that have the greatest impact on livestock smallholders.

Aim and priorities

Aim: to bring together vaccine researchers, manufacturers, and distributors, to accelerate the discovery of new vaccines and the improvement of existing solutions.

Priorities: the initiative concentrates on those animal diseases posing the greatest risk to subsistence livestock farmers/keepers in Sub-Saharan Africa, South and Southeast Asia, and targets transboundary diseases to achieve a lasting regional impact.

Objectives

- To accelerate the development of new vaccines against neglected livestock diseases by supporting innovation and leading-edge research
- To increase the efficacy, marketability and use of existing livestock vaccines
- To foster effective partnerships between vaccine researchers and public and private sector actors to more efficiently develop, register, commercialise, and deploy livestock vaccines.

News

To date 23 projects have been funded in the following fields: cutting-edge vaccine development, vaccine improvement and manufacturing, vaccine demand access and use. The latter is particularly focusing on: women's empowerment and benefits and scaling up products. More information on projects can be found at: https://idrc-crdi.ca/en/research-in-action/our-projects-targeting-neglected-diseases-through-partnerships

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

Website: https://onehealthejp.eu/

Partners ca.
44

Budget
€90 million

Start date:
2018-2023

Overview

The European Joint Programme (EJP) Co-fund on One Health (zoonoses – emerging threats) is an initiative aiming to create a European joint programme to deal with 'one health' issues, primarily targeting food-borne zoonoses and antimicrobial resistance, and, to a lesser extent, emerging zoonotic threats. The project Consortium, in order to ensure a One Health approach, includes a balanced number of human/public health and veterinary institutions.

Integration and alignment in research will be improved through funding of research projects. Three research calls have been launched, and a total of 29 projects have been funded. In addition to traditional research projects, the EJP funds integrative projects to develop common protocols or infrastructure that support collaborative processes (e.g., platforms for uploading, sharing, and analysing sequence data, experimental facilities or risk assessment structures), as well as PhD students, Summer Schools, and short-term Missions, and implemented numerous integrative activities.

Aim and priorities

Aim: to build a sustainable framework for an integrated community of research groups including reference laboratories in the fields of life sciences, medicine, veterinary medicine, animal sciences, food sciences and environmental sciences.

Priorities: One Health.

Activities

- Harmonise approaches across Europe for the assessment and management of food-borne zoonotic infections, antimicrobial resistance and emerging threats through collaboration between our food, veterinary and medical partners
- Improve the quality and compatibility of information using an interdisciplinary and integrative approach to One Health challenges
- Equip risk managers and policy makers with the best tools for intervention measures at the policy level
- Create a sustainable European One Health Network.

News

One Health EJP had its final meeting on **11 and 12 September 2023** in Paris.

One Health EJP has co-funded six joint integrative projects (JIPs), 24 joint research projects (JPRs) and 17 PhD projects, and the OHEJP SimEx Project. In 2022, the Continuing Professional Development Module, Final School, Annual Scientific Meeting, and Annual Scientific Meeting Satellite Workshop and other workshops were organised. In 2022, 10 Short Term Missions were also funded.

Achievements and policy briefs produced from the project can be found in the **Annual report 2022** and in the **policy brief addressing AMR of the project EU-JAMRAI**.

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

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

Partners ca. 22	Budget €11 million	Start date: NA

Overview

PANDORA-ID-NET is a multidisciplinary 'One Health' initiative that supports response to emerging infections in Africa. It is underpinned by a €11 million grant funded by the European and Developing Countries Clinical Trials Partnership. It has partners from 13 African countries and nine European Institutions. The network supports the development of robust 'ready to go within 48-72 hours' PANDORA-ID-NET trained outbreak rapid response teams that can appraise, evaluate and conduct public health research in each of the four African regions. These response teams will be multidisciplinary, including members from the clinical, veterinary, environmental and operational sides of disease research and linked to other regional and global networks on emerging infections.

Aim and priorities

Aim: to develop and strengthen effective outbreak response capacities across all geographical regions in sub-Saharan Africa, in partnership with national governments and other international stakeholders.

Priorities: rapid response, capacity developments, training.

Activities

- Epidemiological, surveillance, clinical and pathogenesis studies
- Zoonotic One Health interface studies
- Specific clinical trials on existing and sporadic zoonotic diseases
- Data collection, analyses, integration, sharing and reporting
- Engaging with policy makers, communities and overcoming ethical and regulatory obstacles
- Capacity building and training.

News

For World TB Day (24 March 2022), PANDORA collaborated with the Department of Community Medicine, Irrua Specialist Teaching Hospital (ISTH) and the Standing Committee on Public Health of the Ambrose Alli University Medical Students Association, Ekpoma, to organise a joint event and encourage more commitment to end TB.

In June 2022, PANDORA-ID-NET Consortium, in line with the mandate to raise the next generation of well-grown indigenous researchers, co-organised a 2 day training workshop with the Research and Grantsmanship Unit of the Department of Community Medicine, ISTH on research methods for early career researchers in Nigeria.

PREZODE - Preventing Zoonotic Disease Emergence

Website: https://prezode.org/

Partners ca.
216

Budget
NA

Start date:
2022
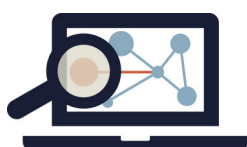
Overview

PREZODE is an international One Health initiative supporting emergence risk reduction strategies for zoonotic infectious diseases, following the recommendations of the forthcoming High-Level Expert Panel on One Health of the Tripartite. It will integrate research on animal, human and environmental health to better understand zoonotic emergence risks, co-design with stakeholders monitoring and early warning systems, and support science-based policies aiming at risk mitigation of zoonotic diseases emergence.

The Preparatory Committee is currently composed of the three research institutes that initiated PREZODE: Cirad, The French Agricultural Research Centre for International Development; INRAE, French National Research Institute for Agriculture, Food and Environment; IRD, French National Research Institute for Sustainable Development.

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

To develop:

- A scientific and operational framework to coordinate research projects, health networks and operational actions to strengthen the integrated approach and maximise the impact
- A platform for sharing knowledge acquired through past, current and future projects and capitalising on success stories and pilot actions in different regions of the world
- A resource centre available notably for the One Health High Level Expert Panel, to facilitate in particular the development of recommendations for decision makers by the latter.

News

The PREZODE strategic research agenda has been developed and it is composed of five pillars: understanding zoonotic risks and risk activities; co-design solutions to reduce zoonotic risks; strengthen early warning systems to detect zoonotic risks; prototype a global information system for surveillance and early detection; and engage stakeholders and co-design One Health network and policies. The agenda can be found online at: **https://prezode.org/What-we-do/Strategic-Agenda**.

In May 2023, PREZODE elected its first Steering Committee composed of 17 experts and its first meeting was held on July 2023.

The AfriCam project was launched on February 27. This is the first component of the PREACTS (Prezode in Action in the Global South), operational programme. AfriCam is an ambitious project aiming to strengthen surveillance and early detection systems in Cambodia and four African countries (Senegal, Cameroon, Guinea, and Madagascar). It will rely on innovative and participatory approaches, based on the mobilisation of local populations. The French Development Agency (AFD) allocates a total of €30 million to the overall programme funded by the AFD, CIRAD and IRD.

ANR will mobilise €9 million for a period of 3 to 5 years for a call for projects on PEPR PREZODE 'Global changes, human practices and emergence of zoonotic diseases'.

WHO R&D Blueprint

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

| | **Partners ca.** WHO Member States | **Budget** NA | **Start date:** 2016 |

Overview

A broad global coalition of experts from several medical, scientific, and regulatory backgrounds was convened by WHO to contribute to the Blueprint. The World Organisation for Animal Health (WOAH) serves as an observer in the Scientific Advisory Group of the initiative.

While the R&D Blueprint focuses on human diseases, most of the emerging human diseases are zoonoses, and thus the activity of this action could have positive impact on the control of animal diseases as well.

Aim and priorities

Aim: to accelerate the development and availability of effective tests, vaccines and medicines that can be used to save lives and avert large-scale crises through a global strategy and preparedness plan that allows the rapid activation of R&D activities during epidemics.

Priorities: One of the key components of the Blueprint is the delivery of R&D roadmaps to accelerate the development and implementation of effective medical countermeasures for WHO priority pathogens, aimed at reducing morbidity, mortality, and transmission. The current Blueprint priority pathogens are the following:

- COVID-19
- Crimean-Congo haemorrhagic fever (CCHF)
- Ebola virus disease and Marburg virus disease
- Lassa fever
- Middle East respiratory syndrome coronavirus (MERS-CoV) and severe acute respiratory syndrome (SARS)
- Nipah and henipaviral diseases
- Rift Valley fever (RVF);
- Zika
- 'Disease X'.

Disease X represents a hypothetical unknown pathogen that could cause a serious international epidemic, thus the R&D Blueprint explicitly seeks to enable cross-cutting R&D preparedness that is also relevant for an unknown 'Disease X as far as possible.

Objectives & activities	1. Improve coordination and foster an enabling environment. 2. Accelerate R&D processes. 3. Develop new norms and standards tailored to the epidemic context. 4. Streamline operational R&D response during outbreaks. Among other activities, the R&D Blueprint: • Define and refine a robust and transparent semi-quantitative prioritisation methodology for infectious diseases most likely to create epidemics • Provide annual update, using the prioritisation methodology described above, the list of diseases and pathogens to prioritise for research and development in public health emergency context • Develop a decision tree to assess the need for urgent R&D for potential emerging pathogens not yet included on the list • Develop R&D roadmaps and generic target product profiles (TPPs) for priority diseases, through broad and open consultations with leading experts and other stakeholders.
News	In the last year WHO R&D concentrated its activities on COVID-19 and monkeypox. As part of the response to COVID-19, the R&D Blueprint has improved the response to outbreaks by improving coordination, accelerating R&D and developing norms and standards. The **COVID-19 vaccine tracker and landscape** provides detailed information of COVID-19 vaccine candidates in development by closely monitoring their progress through the pipeline, the same tracker is available for Mpox **vaccine tracker** and **therapeutics tracker** in research and development. Ongoing activities include the development of a R&D roadmap for Rift Valley fever (RVF) under the tripartite FAO-WOAH-WHO Memorandum of Understanding (MoU). WHO R&D Blueprint has also been discussing with partners regarding the development of the roadmap for Disease X. Moreover, WHO R&D is currently working to update its list of diseases of great epidemic and pandemic threat, deriving from a prior prioritisation exercise held in 2018. A concept note of the prioritisation exercise can be found **here**. The prioritisation exercise will adopt a family virus approach to identify representative viruses within a viral family, thus improving capacity to respond to unforeseen strains in the same family. Moreover the prioritisation will consider also bacterial diseases.

ZODIAC - Zoonotic Disease Integrated Action

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

Partners ca.
IAEA Member
States

Budget
NA

Start date:
2020
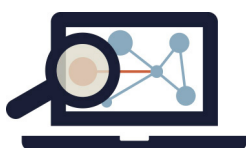
Overview

Zoonotic Disease Integrated Action (ZODIAC) is an IAEA (International Atomic Energy Agency) initiative established in June 2020 to help countries prevent pandemics caused by bacteria, parasites, fungi or viruses that originate in animals and can be transmitted to humans.

This initiative will benefit from the expertise of the joint laboratories of the IAEA and the Food and Agriculture Organization of the United Nations (FAO) and from cooperation with partners such as the World Health Organization (WHO) and the World Organisation for Animal Health (WOAH) under the One Health approach, collaboration between human health and animal health experts. Research, development and innovation will be at the centre of this initiative. The outcomes of the research and development activities undertaken by the IAEA in cooperation with its partners, using immunological, molecular, nuclear and isotopic techniques will be made immediately available to institutions participating in ZODIAC.

Aim and priorities

Aim: to support countries in the use of nuclear and nuclear-derived techniques for the timely detection and control of pathogens at the animal-human interface.

Priorities: it will help tackle a range of zoonotic diseases, such as the ones caused by coronaviruses, the Zika virus, avian influenza viruses as well as other pathogens yet unknown.

Objectives & activities

Under ZODIAC, veterinary and public health officials from Member States can benefit from joint research and development activities and from expert guidance as well as from the technical, scientific and laboratory support of the IAEA and its partners. Particularly for:

- Strengthening detection and diagnostic capabilities
- Developing and making novel technologies available for the detection of zoonotic diseases
- Making real-time decision-making support tools available for timely interventions
- Providing access to data on the impact of zoonotic diseases on human health
- Providing access to an IAEA coordinated response team in case of an outbreak.

News

ZODIAC and VETLAB Network organised several training courses for capacity building around the globe. ZODIAC is implementing coordinated research projects for 'Enhancing laboratory preparedness for the detection and control of emerging and re-emerging zoonotic diseases' in the Americas and the Caribbean, in Asia and the Pacific, in Europa and Central Asia and in Africa.

A first research coordination meeting on enhancing laboratory preparedness for the detection and control of emerging and reemerging zoonotic diseases was organised by ZODIAC in Asia and the Pacific from 7 to 11 August 2023 in Seoul, Republic of Korea, at the Korea Atomic Research Institute.

A second research coordination meeting focusing on the application of advanced molecular characterisation technologies was organised, through the Veterinary Diagnostic Laboratory (VETLAB) Network, on 21-25 August 2023 at IAEA headquarters in Vienna. The meeting was organised back-to back to the annual meeting of the Directors of the VETLAB Network laboratories in order to review their priorities.

A third research coordination meeting on improvement of diagnostic and vaccine tools for emerging and re-emerging animal health threats will take place virtually from 9 to 13 October 2023. The meeting will review the results from the development of irradiated vaccines, and discuss challenges encountered and future steps for the contract holders.

The first meeting of the new Coordinated Research Project (CRP) on innovative nuclear and related molecular approaches for detection and characterisation of antimicrobial resistance in an animal production environment is planned to take place at the IAEA Headquarters in Vienna, Austria, from the 30 October to 3 November 2023.

Additional information can be retrieved in their **Animal Production and Health Newsletter**.

III. RECENT INFRASTRUCTURES AND DATABASES TO FACILITATE R&D

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

The aim of this chapter is to provide a list of the main distributed infrastructure and databases relevant to the animal health sector.

ACDP - Australian Centre for Disease Preparedness

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

As one of only six high-containment animal research centres in the world, Commonwealth Scientific and Industrial Research Organisation's (CSIRO) Australian Centre for Disease Preparedness works with national and international human and animal health organisations as part of a global One Health network. This expertise is also used to assist countries in the Asia Pacific region to deal with animal disease issues contributing to regional food security and biosecurity. This support not only reduces the disease risks to the countries themselves but also assists the preparedness of Australian biosecurity through better threat assessment and preparedness.

ANIMUSE- ANImal antiMicrobial USE Enabling Data-Based Decision Making

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

ANIMUSE it is a global database held by WOAH, collecting data on the amounts of antibiotics used in animals since 2015. The platform is interactive allowing users to report, access, analyse and communicate data on antimicrobials intended for use in animals to different stakeholders. This information sharing is essential also to facilitate research and its application when needed and to help to reduce the overuse and misuse of antibiotics.

CWG AHW Project Database

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

The Collaborative Working Group on European Animal Health and Welfare Research (CWG) was established in 2005 to increase information sharing and research coordination in the European area. To meet these objectives, as one of the objectives of the EMIDA project, a database was established under the CWG to capture information on research projects funded on animal health. This database was further updated under the ANIHWA project, to also collect projects on animal welfare supported by CWG funding bodies. This was expanded under STAR-IDAZ to include project data from organisations outside of Europe.

The database represents a valuable tool to map current research on animal health, to allow research funders to identify areas where investments in research are lacking and to avoid duplications.

In 2020, the CWG conducted a survey to collect information about research projects being currently funded or planned on CoVs by the member organisations and funding bodies. The collected information was shared with the STAR-IDAZ IRC and CWG members and is now stored in the STAR-IDAZ IRC website, currently being update, complementing the information collected by the CWG project database in this area.

DISCONTOOLS - Disease Control Tools

http://www.discontools.eu/

DISCONTOOLS (DISease CONtrol TOOLS) is an open-access database to assist public and private funders of animal health research and researchers in identifying research gaps and planning future research. The database contains research gaps as well as a gap scoring and prioritisation models for more than 50 infectious diseases in animals. The data are provided by disease-specific expert groups, reviewed by a project management board and updated in a 5-year cycle. Users can select their topics of interest, compare the selected topics across diseases and prioritise the diseases according to a range of customisable criteria. By identifying the gaps in knowledge and available control tools, DISCONTOOLS helps to prioritise research and speed up the development of new diagnostics, vaccines and pharmaceuticals.

DISCONTOOLS is funded by a consortium of members from the European Collaborative Working Group on Animal Health and Welfare Research (CWG AHW), with industry providing secretariat support. The database has become an important resource for funders of animal health research and the research community to develop research agendas and evaluate research proposals. The website is planning a facelift in 2023 with new filtering capacities to more easily retrieve the required information. Recently updated diseases include ASF, EHEC, PCV-2, nematodes, coccidiosis, EHD, swine mycoplasmas, BVD and varroosis. New updates in the pipeline are CBPP, CSF and WNV.

EMPRES - Emergency Preventions System for Animal Health

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

EMPRES is a web-based application that has been designed by FAO's Emergency Prevention System (EMPRES) to support veterinary services facilitating the organisation and access to national, regional and global level disease data and information. The mission of the programme is to promote the effective containment and control of the most serious epidemic livestock diseases/transboundary animal diseases (TAD), as well as newly emerging diseases by progressive elimination on a regional and global basis through international cooperation involving early warning, early reaction, enabling research and coordination.

EVAg - European Virus Archive global

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

The European Virus Archive (EVA) project was funded under the European Commission FP7 (2009-2014) to create and mobilise a European network of high calibre centres with the appropriate expertise, to collect, amplify, characterise, standardise, authenticate, distribute, and track, mammalian and other exotic viruses. The network produced associated reagents on demand, to laboratories, mainly throughout Europe. In 2015, a new project was awarded funding under the Horizon 2020 Programme to enlarge the archive and make it global (EVAg, 2015-2019).

Currently, EVAg is a non-profit organisation dedicated to the characterisation, conservation, production, and distribution of biological materials in the field of virology. Its global virus collection is a valuable support tool for the organisation of scientific research, education, and disease control through human and veterinary health programmes, providing both essential resources as well as a platform for the continuation of project-derived products.

The EVAg consortium includes an international group of 38 laboratories and a number of Associated Partners, all sharing the common interest of creating an international virus collection. Currently EVAg has more than 2900 references in its catalogue with more than 1900 virus strains.

ERINHA -European Research Infrastructure on Highly Pathogenic Agents

https://erinha.eu/

European Research Infrastructure on Highly Pathogenic Agents (ERINHA) is a pan-European Research Infrastructure that brings together leading European Biosafety level 4 facilities and complementary (e.g. BSL3) facilities. It provides a coordinated transnational access to high containment and connecting facilities to enhance and accelerate research on risk group 4 and unknown emerging pathogens thus contributing to outbreak preparedness of Europe and globally.

GLASS- GLobal Antimicrobial resistance and use Surveillance System

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

GLASS it is the global database held by the WHO for surveillance on antibiotic use and AMR in human health. GLASS has been developed to progressively incorporate data from surveillance of AMR in humans, such as monitoring of resistance and the use of antimicrobial medicines, including AMR in the food chain and in the environment.

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

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

The Global Information and Early Warning System on Food and Agriculture (GLEWS) continuously monitors food supply and demand and other key indicators for assessing the overall food security situation in all countries of the world. It issues regular analytical and objective reports on prevailing conditions and provides early warnings of impending food crises at country or regional level. At the request of national authorities, GLEWS supports countries in gathering evidence for policy decisions, or planning by development partners, through its Crop and Food Security Assessment Missions (CFSAMs), fielded jointly with WFP.

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

https://dashboard.globalamrhub.org/

The Global Antimicrobial Resistance Research and Development Hub (Global AMR R&D Hub) was established in May 2018, in response to the Joint Statement of Intent of the G20 Focal Points of the G20 Health Working Group. It called for the setting-up of a new, international R&D collaboration hub in the field of antimicrobial research and product development aimed at maximising the impact of new and existing initiatives in basic and clinical antimicrobial research, as well as product development.

The main goal of the Global AMR R&D Hub is to promote high-level coordination among governments and upstream funders from different world regions, to better align national and international efforts in the fight against AMR. Its scope is embedded in a comprehensive One Health approach relating to R&D on AMR, comprising human and animal health as well as environmental aspects.

The central deliverable of the Global AMR R&D Hub is a near real-time Dynamic Dashboard providing information and analysis at a high level on current initiatives, funding flows and activities in the field of AMR R&D. The dashboard presents pre-analysed information, to inform policy makers in their decision making on strategic investments and actions in AMR R&D. While the Dashboard initially covered only

bacterial infections for humans, in 2020 it was enlarged to include information on AMR R&D related to animal health too. WOAH and the STAR-IDAZ IRC, along with other international experts, have supported the Hub in identifying animal health-specific categorisation fields for implementing this new feature of the Dynamic Dashboard. To date, the animal health part of the Hub already contains information on 1762 projects from 129 funders worldwide, for a total budget of over US $1.21 billion.

In 2020, the Global AMR R&D Hub entered a formal collaboration partnership with the STAR-IDAZ IRC, with the aim of cooperating on their common interest to strengthen global research efforts and reduce duplication of research on priority infectious diseases of animals relevant to AMR. This joint effort includes the exchange and dissemination of relevant AMR R&D expertise, information and data in animal health and supports more efficient use of international resources through the identification of gaps, overlaps and research coordination.

The Immunological Toolbox

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

The Immunology toolbox provides a platform for veterinary researchers to find resources and collaborate. The Toolbox aims to remove barriers to veterinary vaccine development by providing a central database of reagents and aiding information exchange. The website is home to the most up-to-date and comprehensive repository of antibodies and modified proteins available from commercial companies and academic institutes.

ISIDORe - Integrated Services for Infectious Disease Outbreak Research

https://isidore-project.eu/

ISIDORe provides an integrated portfolio of cutting-edge research services and resources to study epidemic-prone pathogens. It assembles the largest and most diverse research and service-providing instruments to study infectious diseases in Europe, with expertise from structural biology to clinical trials. It brings together under the same umbrella 17 major European life science research infrastructures and infectious disease networks (joining as partners also **VetBioNet** and **TRANSVAC2**) to accelerate the generation of new knowledge and intervention tools to enhance Europe's capacity for controlling (re) emerging and epidemic infectious diseases, starting with the COVID-19 pandemic.

US NADC – National Animal Disease Center

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

The National Animal Disease Center (NADC) in Iowa is one of the largest animal health research centers in the world that combines several research facilities into one location. It has around one million square feet of laboratory and research facilities, including BSL3. It is shared among two *US Department of Agriculture* (USDA) agencies:

Agricultural Research Service: the ARS' NADC conducts research concerning animal health and diseases with an agricultural impact; The main NADC ARS fields of research are: ruminant diseases and immunology research; virus and prion research; infectious bacterial diseases research.

Animal and Plant Health Inspection Service: the APHIS' National Veterinary Services Laboratories serves as a national and international reference laboratory and provides diagnostic services, reagents and training; while the APHIS' Center for Veterinary Biologics regulates vaccines, bacterins, antisera, diagnostic kits and other biological products for the diagnosis, prevention and treatment of animal diseases.

WAHIS- World Animal Health Information System

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

The World Animal Health Information System (WAHIS) is the global animal health database of WOAH. It collects and publishes animal disease information reported since 2005 by individual countries' veterinary services, including detailed country-specific information on outbreaks of diseases listed by WOAH including emerging diseases, in domestic animals and wildlife, and non-listed diseases in wildlife. The dataset is one of the most comprehensive in the world as 182 Members are obliged to report this information to WOAH in a timely manner. WAHIS includes interactive mapping tools and dashboards to support data consultation, visualisation and extraction of officially validated animal health data.

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

In the framework of the STAR-IDAZ IRC, a list of priority diseases and crosscutting issues for which research coordination is required to make progress and deliver the needed control tools was identified. This preliminary list was further discussed during 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 antibiotics
4. Aquaculture (recently identified)
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. Pox virus infections
22. Vector-borne diseases (VBD)

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 VBD 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 VBD was better defined, and it was decided to start working on antimicrobial resistance (AMR) and the development of innovative alternatives to antibiotics. 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:

- African swine fever (ASF)
- Antimicrobial resistance (AMR) and the development of innovative alternatives to antibiotics (ATA)
- Bovine tuberculosis (bTB)
- Coronaviruses (CoVs)
- Diagnostics (tools and technologies)
- Vaccinology
- Influenza
- Mycoplasmas -including contagious bovine pleuropneumonia (CBPP) and contagious caprine pleuropneumonia (CCPP)
- One Health
- Vector-borne diseases (VBD)

For each of topic, the report provides information on:

1. Existing or planned global networks aiming at guiding future research on the topic; additional Network with cross-cutting issues on research have also been reported to facilitate networking

2. 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)

3. Identified research gaps on control tools (diagnostics, vaccines, and pharmaceuticals), extracted from the DISCONTOOLS database

4. Recent research advances, providing an overview of a selection of highly relevant papers on the subject matter[1]

5. Trends in published research, showing estimated statistics extracted from the CABI Abstract database on the topics and the STAR-IDAZ regions where relevant papers are published[2]

6. Ongoing research, presenting a non-exhaustive list of ongoing research projects funded by the STAR-IDAZ IRC partners.

For each of its priority diseases/issues, STAR-IDAZ IRC is establishing geographically balanced Working Groups (WGs) of experts to perform gap analyses and to draw research roadmaps on the selected diseases/issues. For diseases/issues where global networks dedicated to gap analyses already exist, these groups were requested to support the STAR-IDAZ IRC and act as WGs. The 'Existing global research networks' sections describe the pre-existing global network or, when this is not present, the STAR-IDAZ IRC newly established WG for each priority disease.

For 'Recent research advances' sections, the selection of articles outlined resulted from a review of the literature published on the priority diseases from January 2022 to July 2023 and a selection of key articles presenting overview s of the current state of knowledge or providing significant advances in science. Due to 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, selected by SIRCAH with the support of the Scientific Committee.

---

1 Previous editions of the report contained a selection of scientific papers over a 3-year time period (i.e., the year of the report's publication and the two previous ones). Since the last report, it was decided to focus on more recent findings only (i.e., occurred over the past year), and to remove reference to older papers.

2 Due to the complexity of key words, no data extraction was executed for general cross-cutting issues as: diagnostic, One Health and vaccinology

'Trends in published research', associated with the keywords exploited in the literature search, have been shown whenever possible, including 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 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 trends 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 due to 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 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. African Swine Fever (ASF)

Global network: Global African Swine Fever Research Alliance (GARA)

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

Partners ca.
43

Budget
NA

Start date:
2013

Overview

The Global African Swine Fever Research Alliance (GARA) was launched with the aim of establishing and sustaining global research partnerships that will generate scientific knowledge and tools to contribute to the prevention, control and, where feasible, eradication of African swine fever (ASF).

The GARA has 43 partners coming from all regions of the world and several stakeholders, including STAR-IDAZ. In 2020, Alex Morrow, member of SIRCAH, was elected as Finance Director for the GARA (2020-2023) and joined its Advisory Board.

GARA Members conducted research gap analyses on ASF diagnostics, vaccinology, epidemiology and virology, which are now periodically updated during the group biannual meetings. These meetings also provide an opportunity for researchers to network and exchange new knowledge about the disease and the development of control tools.

Aim

Aim: To establish and sustain global research partnerships that will generate scientific knowledge and tools to contribute to the successful prevention, control and where feasible eradication of ASF.

Objectives & Activities:

- Identify research opportunities and facilitate collaborations within the Alliance
- Conduct strategic and multi-disciplinary research to better understand ASF
- Determine social and economic drivers and impact of ASF
- Develop novel and improved tools to support the prevention and control of ASF
- Determine the impact of ASF prevention and control tools
- Serve as a communication and technology sharing gateway for the global ASF research community and stakeholders.

News

In collaboration with STAR-IDAZ and the Agricultural Research Service of the United States Department of Agriculture (USDA-ARS), GARA published the **STAR-IDAZ IRC African Swine Fever Research Review** in March 2022. This comprehensive review highlights the significant progress made in ASF research since the 2018 gap analysis while addressing persisting research gaps. It provides a global overview of ongoing efforts, incorporating updates from engaged scientists.

GARA organises scientific meetings and workshops to foster collaboration and knowledge sharing. Notable events include the GARA Scientific Meeting in the Dominican Republic in May 2022, featuring discussions on gap analysis, and a regional coordination workshop in the Americas. The GARA Africa workshop held in Kampala, Uganda, in February 2023 identified critical knowledge gaps related to ASF in Africa.

Looking forward, GARA is preparing for an Asia workshop in the Philippines in December 2023. This workshop aims to identify and address crucial knowledge gaps specific to the Asian context. STAR-IDAZ continues to collaborate with GARA to update the ASF research roadmaps based on insights from these productive meetings.

STAR-IDAZ WG progress

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

DISCONTOOLS research needs

ASF remains a major problem for animal health worldwide, currently affecting four continents where most of the swine production takes place. Consequently, ASF is at the same time a global challenge for food safety. Despite great effort from the scientific community, industrial companies, and veterinary authorities over the years, there are still major gaps to contain and eradicate the disease. A safe and effective DIVA vaccine remains the most relevant gap for disease control, but further advances must also be made on diagnostics, epidemiology, biological and molecular characterisation, immunology and immune response.

R&D needs identified for ASF:

- Diagnostics validation in different host species and with virus genotypes and their variants
- Continuous validation of current antigen and antibody test in various epidemiological situations including various hosts
- In vitro assays that support vaccine research
- Non tests in vitro assays for evaluation of vaccine protection and cross protection
- Production of DIVA test for potential vaccine
- Robust tools to identify reversion to virulence of attenuated virus vaccines
- Mechanism for antibody dependent enhancement in some vaccine prototypes
- Reasons for adverse reactions following vaccinations
- Extensive technical approaches to document safety and genetic stability of vaccines
- Explore antivirus therapies
- Mode of actions of the antiviral molecules is unknown
- Effective waste control to pork products worldwide
- The control of food waste containing remains of pork products and making these remains inaccessible to the environment. It is therefore essential to have the help of the state administration, the local administration, Public Health and citizens: One Health.

Recent developments

Taking a Promising Vaccine Candidate Further: Efficacy of ASFV-G-ΔMGF after Intramuscular Vaccination of Domestic Pigs and Oral Vaccination of Wild Boar.[3]

The study by Deutschmann et al. (2022) focuses on the live attenuated vaccine candidate 'ASFV-G-ΔMGF' against African swine fever (ASF). The researchers conducted experiments on domestic pigs and wild boar, evaluating intramuscular and oral vaccination methods. Intramuscular immunisation induced strong immunity and full protection against challenge. Oral vaccination led to 50% seroconversion with complete protection in responders, but nonresponders showed ASF symptoms after challenge. The study highlights the potential of ASFV-G-ΔMGF for effective immunisation campaigns, while noting the lower efficacy of oral administration that should be considered in control strategies. Further research is needed to enhance oral efficiency and ensure safety.

Gaps in Viral Immune Evasion and Pathogenesis.[4]

Yu et al. (2023) discuss how African swine fever virus (ASFV) evades the host immune system. They identify gaps in understanding viral immune evasion mechanisms and pathogenesis. This review highlights the importance of filling these knowledge gaps to develop effective vaccines against ASF.

3 Deutschmann, P., Carrau, T., Sehl-Ewert, J., Forth, J. H., Viaplana, E., Mancera, J. C., Urniza, A., Beer, M., Blome, S. (2022). Taking a Promising Vaccine Candidate Further: Efficacy of ASFV-G-ΔMGF after Intramuscular Vaccination of Domestic Pigs and Oral Vaccination of Wild Boar. Pathogens, 11(9), 996. **https://doi.org/10.3390/pathogens11090996**

4 Yu, L., Zhu, Z., Deng, J., Tian, K., & Li, X. (2023). Gaps in Viral Immune Evasion and Pathogenesis. Viruses, 15(2), 574. **https://doi.org/10.3390/v15020574**

Viral Vector Vaccines Against ASF: Problems and Prospectives.[5]

Ravilov et al. (2022) review viral vector-based vaccines against African swine fever (ASF). They explore the potential of using viral vectors to deliver targeted ASF virus genes, inducing protective immune responses. The article discusses challenges, outcomes, safety considerations, and the potential for broader protection with these innovative vaccine strategies.

The Role of the Wild Boar Spreading African Swine Fever Virus in Asia: Another Underestimated Problem.[6]

This article explores the underestimated role of wild boars in the spread of African Swine Fever Virus (ASFV) in Asia. The study sheds light on the significant impact of wild boars as carriers and vectors of ASFV, emphasising the need for comprehensive surveillance, control strategies, and management of wild boar populations to curb the transmission of the virus.

Development of a Recombinase-aided Amplification Combined With Lateral Flow Dipstick Assay for the Rapid Detection of the African Swine Fever Virus.[7]

This study presents a novel diagnostic approach for the rapid detection of African swine fever virus (ASFV). The researchers developed a technique called Recombinase-aided Amplification combined with Lateral Flow Dipstick Assay (RAD-LFDA). This method provides a quick and efficient way to detect ASFV, which could significantly enhance early detection and control efforts in preventing the spread of the virus.

5 Ravilov, R. K., Rizvanov, A. A., Mingaleev, D. N., Galeeva, A. G., Zakirova, E. Y., Shuralev, E. A., Rutland, C. S., Khammadov, N. I., & Efimova, M. A. (2022). Viral Vector Vaccines Against ASF: Problems and Prospectives. Frontiers in Veterinary Science, 9, 830244. https://doi.org/10.3389/fvets.2022.830244

6 Cadenas-Fernández, E., Ito, S., Aguilar-Vega, C., Sánchez-Vizcaíno, J. M., & Bosch, J. (2022). The Role of the Wild Boar Spreading African Swine Fever Virus in Asia: Another Underestimated Problem. Frontiers in Veterinary Science, 9. https://doi.org/10.3389/fvets.2022.792277

7 Li, J. S., Hao, Y. Z., Hou, M. L., Zhang, X., Zhang, X. G., Cao, Y. X., ... & Zhou, Z. X. (2022). Development of a Recombinase-aided Amplification Combined With Lateral Flow Dipstick Assay for the Rapid Detection of the African Swine Fever Virus. Biomedical and Environmental Sciences, 35(2), 133-140. https://doi.org/10.3967/bes2022.018
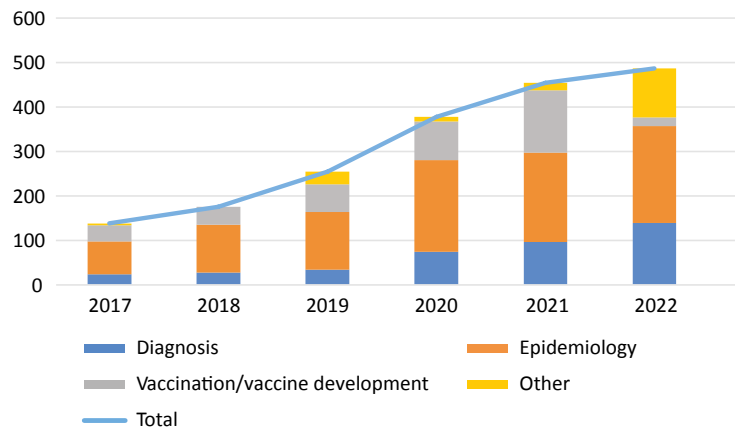
Trends in published research

Total records & Main topics

Legend:
- Diagnosis
- Epidemiology
- Vaccination/vaccine development
- Other
- Total

Country/ Region of first Author (2017/2022)

Regions: Europe, Americas, Asia and Australasia, Africa & Middle East

Ongoing research

Non-exhaustive list of ongoing projects on ASF funded by STAR-IDAZ IRC and STAR-IDAZ Network Members reported in June 2023:

Country/Funder	Main Research Institution	Research project	Start Year	End Year
Belgium/FPS Health, Food chain safety and Environment	Sciensano Ghent University	ASFIMMUNE - Study of the pathogenesis (role of host receptors) of African swine fever (ASF) and innate immune response in ASF virus infected domestic pigs	2020	2024
Canada/IDRC	JCVI/ILRI	Engineering of African swine fever virus using synthetic biology to accelerate vaccine development	2019	2023
China/Ministry of Science and Technology	Beijing Institute of Animal Science and Veterinary	Gene Deleted Vaccines against ASF	2021	2024
China/Ministry of Science and Technology	Harbin Veterinary Research Institute, CAAS	Development of Attenuated vaccines ASF	2021	2024
China/Ministry of Science and Technology	Lanzhou Veterinary Research Institute, CAAS	Development of subunit vaccine ASF	2021	2024
EU/EC	INRAE (coordinator), NVI	**WiLiMan** - Ecology of Wild-life, Livestock, huMan and Infectious Diseases in changing environments	2023	2028
EU/EC	Pirbright Institute, UK	**DEFEND** - Addressing the dual emerging threats of African Swine Fever and Lumpy Skin Disease in Europe	2018	2023
EU/EC	Universidad Complutense De Madrid	**VACDIVA** - A safe DIVA vaccine for African Swine Fever control and eradication	2019	2023
EU/ICRAD Joint Cofund call	Friedrich-Loeffler-Institut, UGent, WBVR	**ASF RASH** - African Swine Fever pathogenesis and immune responses in Resistant And Susceptible Hosts	2021	2024
EU/ICRAD Joint Cofund call	The Pirbright Institute, INRAE	**ASFVint** - Decoding a virus Achilles heel: the African swine fever virus interactome	2021	2024
Italy/Italian Ministry of Health	IZS PLV	African swine fever - study of innovative technologies in the field for the eradication of the disease	2022	2024
Italy/Italian Ministry of Health	IZS SA	ASF-SuSySens - Sensitivity estimation of the surveillance system for African swine fever: an app as a key tool to prevent the introduction of genotype 2	2022	2024
Italy/Italian Ministry of Health	IZS SA	Research and characterisation of new viral pathogens emerging in pig farms and strains of African swine fever with reduced virulence	2021	2023
Italy/Italian Ministry of Health	IZS UM	ASF-RESIST - African swine fever: role of environmental factors in the direct and indirect transmission of the disease (PSA-RESIST)	2022	2024
Italy/Italian Ministry of Health	IZS VE	African swine fever: survey on the perception of risk in the categories of stakeholders of the pig chain and the wildlife-hunting world to structure information interventions and institutional communication	2021	2023
Italy/Italian Ministry of Health	IZS VE	DEATHBOARS - Spatial and thanatological analysis for the development of protocols aimed at passive surveillance of African swine fever in wild boar	2022	2024

Country/Funder	Main Research Institution	Research project	Start Year	End Year
Japan/ Regulatory research projects for food safety, animal health and plant protection	National Institute of Animal Health, NARO	Regulatory research projects for food safety, animal health projects for food safety, animal health and plant protection	2020	2024
Kenya /TAHSSL	ILRI	ASF - Establishment of challenge models for defined ASFV genotypes	2022	2025
Netherlands/ Ministry LNV		ASF RASH - African Swine Fever pathogenesis and immune responses in Resistant And Susceptible Hosts	2022	2024
Norway/ Research Council of Norway	NVI	PreparePig - Preparing the Norwegian pig population for control of emerging and re-emerging diseases	2021	2025
Republic of South Korea/Rural Development Administration (RDA) of the Republic of Korea	ILRI	ASF - Analysis of African swine fever virus spread model and immune response to warthog against viral infection	2021	2024
Republic of South Korea/Rural Development Administration (RDA) of the Republic of Korea	ILRI	ASF - Analysis of African swine fever virus spread model and immune response to warthog against viral infection	2021	2024
Spain/ National Research Agency	Agencia Estatal Consejo Superior De Investigaciones Científicas (CSIC)- Centro De Biologia Molecular Severo Ochoa (CBM)	Modulation of innate immune response by African swine fever virus (ASFV), in view of vaccines development	2021	2024
Spain/ National Research Agency	Agencia Estatal Consejo Superior De Investigaciones Científicas (CSIC)- Instituto Nacional De Investigación y Tecnología Agraria y Alimentaria - Centro Nacional (INIA)	Molecular factors of restriction in the endocytic pathway and global interference of cellular systems by African swine fever virus	2022	2025

Country/Funder	Main Research Institution	Research project	Start Year	End Year
UK / International Veterinary Vaccinology Network (IVVN)	ILRI	ASF - Determination of African swine fever virus (ASFV) antigens that induce protective antibodies for inclusion in a subunit vaccine	2019	2022
UK/Defra	The Pirbright Institute	Vaccines, diagnosis and epidemiology for control and prevention of African swine fever	2020	2023
UK/GALVmed	ILRI	Towards a subunit vaccine for control of African swine fever	2018	2022
United States/ USDA-ARS	ILRI	ASF - Analysis of the cross-protective response induced by ASFV recombinant vaccine ASFV-G-DI177L	2023	2024
USA/USDA NIFA	American Association of Swine Veterinarians	ASF - Participant-Led Early-Career Swine Veterinarian Development Program	2022	2025
USA/USDA NIFA	Animal and Plant Health Inspection Service	ASF - Optimizing preparedness for an introduction of African swine fever virus in the USA	2022	2025
USA/USDA NIFA	Arizona State University	ASF - Nanotechnology for Agricultural and Food Systems PARTNERSHIP: Portable And Multiplexed Detection Of African Swine Fever With Metal Nanoparticles	2022	2026
USA/USDA NIFA	Biostone Animal Health Llc	ASF - Developing A Commercial Multi-Antigen Confirmatory ELISA To Detect Antibodies To African Swine Fever Virus Under Biosafety Level 2 Conditions	2023	2024
USA/USDA NIFA	Biostone Animal Health Llc	ASF - PARTNERSHIP: Developing Enzyme-Linked Immuno-Sorbent Assay (ELISA) Diagnostics to detect African Swine Fever Antibodies and to Differentiate Infected from Vaccinated Animals (DIVA)	2023	2026
USA/USDA NIFA	Kansas State University	ASF - Development and validation of novel diagnostic tools for rapid and early detection of emerging infection from ASFV variants	2022	2024
USA/USDA NIFA	Kansas State University	ASF - Stability and detection of African swine fever virus in soybean products fed to pigs	2022	2026
USA/USDA NIFA	Louisiana State University	ASF - PARTNERSHIP: Novel Pseudorabies Virus (PRV) Vectored Subunit Vaccine Against African Swine Fever	2023	2026
USA/USDA NIFA	Swine Health Information Center, Inc.	ASF - Stability and detection of African swine fever virus in soybean products fed to pigs	2022	2026
USA/USDA NIFA	University Of Illinois	ASF - PARTNERSHIP: Protective Antigens of African Swine Fever Virus Epidemic Strain Georgia-07	2023	2026

2. Bovine tuberculosis (bTB)

Global network: Global Research Alliance for Bovine Tuberculosis (GRAbTB)

Website: https://www.star-idaz.net/global-research-alliance-for-bovine-tuberculosis-grabtb/

GRAbTB	**Partners ca.** 15	**Budget** NA	**Start date:** 2014
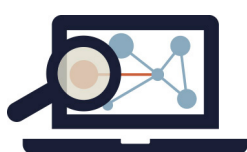
Overview

The Global Research Alliance for Bovine Tuberculosis (GRAbTB) was initiated under the STAR-IDAZ project to facilitate research cooperation and technical exchange on bovine tuberculosis (bTB). The GRAbTB currently has 15 partners from Asia and Australasia, the Americas and Europe, and is looking to expand the network.

GRAbTB performed research gap analyses on bTB epidemiology and control, diagnostics, vaccinology, and host-pathogen interaction in three workshops since 2014. In 2017, based on these gap analyses, three research roadmaps were drafted by SIRCAH, in collaboration with GRAbTB, on bTB vaccines, diagnostics, and epidemiology. These roadmaps were discussed by GRAbTB and other bTB experts at a workshop in Birmingham, UK in December 2017. After the meeting, SIRCAH and GRAbTB worked on the refining and finalising the roadmaps. The structure of generic roadmaps for diagnostic and disease control strategies were further discussed in a meeting of the GRAbTB Executive Committee, that was held in London, UK in July 2019. The discussion led to improvements to the diagnostics and disease control strategies roadmaps. In February 2023, an additional workshop was held in Birmingham, UK, focused on bTB diagnostics, vaccines, and control strategies.

Aims

Aim: to establish and sustain global research partnerships that will generate scientific knowledge and tools to contribute to the successful control and eradication of bovine TB.

Objectives & Activities:

- Identify research opportunities and facilitate collaborations within the Alliance
- Conduct strategic and multi-disciplinary research to better understand TB
- Develop and share novel and improved tools to control TB
- Serve as a communication and technology sharing gateway for the global bovine TB research community and stakeholders
- Promote collaboration with the human TB research community.

News

In February 2023, a productive workshop was held in Birmingham, UK, with support from STAR-IDAZ, UKRI-BBSRC and Defra UK. Esteemed experts from various regions of the world focused on bTB diagnostics, vaccines, and control strategies. They emphasised practical solutions benefiting farmers and families and prioritised ideas for the next 10-15 years. Insights from the workshop will guide future activities, aiming for a fairer future. As a result of the workshop, the bTB roadmaps have been updated and are currently undergoing validation by the Scientific Committee. The **report of the workshop** can be found on the STAR-IDAZ website.

STAR-IDAZ WG progress

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

DISCONTOOLS research needs

R&D needs identified for **bTB**:

- The development of defined skin test reagents based on specific *M. bovis* antigens to overcome the limitations of largely undefined and difficult to produce and standardise tuberculins

- Rapid, specific and simple diagnostic tests for live animals, particularly for cattle in developing countries, and for wildlife species

- Improved delivery systems for the application of vaccines in wildlife

- Further investigations into the host pathogen interactions and the immune response to support the development of new vaccines and better diagnostic tools

- A better understanding of the epidemiology of *M. bovis* infections in cattle and cattle herds to enable strategies for the use of new vaccines when available

- Information on infection by and pathogenesis of *M. bovis*, *M. caprae*, *M. pinnipedii* and even *M. tuberculosis* in other animal species.

Recent developments

SITVITBovis-a publicly available database and mapping tool to get an improved overview of animal and human cases caused by *Mycobacterium bovis*.[8]

In this study the researchers present the SITVITBovis database and mapping tool as a valuable resource for obtaining an enhanced overview of cases caused by *Mycobacterium bovis* in both animals and humans. The study addresses the need for a comprehensive platform that consolidates information related to *M. bovis* infections, facilitating a better understanding of the distribution and epidemiology of the pathogen. The database provides a publicly accessible repository of data, enabling researchers, clinicians, and public health officials to access and analyze *M. bovis*-related cases across species. The mapping tool complements the database by visualising the geographical distribution of these cases, aiding in the identification of patterns and trends. The SITVITBovis database and mapping tool serve as essential tools for surveillance, research, and policy-making related to *M. bovis* infections.

---

8 Couvin, D.; Cervera-Marzal, I.; David, A.; Reynaud, Y.; Rastogi, N. (2022). SITVITBovis-a publicly available database and mapping tool to get an improved overview of animal and human cases caused by Mycobacterium bovis. Database , 2022 , baab081

A novel phage-displayed MilA ELISA for detection of antibodies against Myc. bovis in bovine milk.[9]

In this study, Farzaneh et al. develop a novel phage-displayed MilA ELISA for detecting antibodies against *Mycobacterium bovis* (*M. bovis*) in bovine milk. The research focuses on creating an innovative method for identifying antibodies specific to *M. bovis* in bovine milk samples. Through their analysis, the study presents a phage-displayed MilA ELISA as a new approach to detecting *M. bovis*-specific antibodies in milk. The findings demonstrate the potential utility of this novel ELISA for diagnosing bovine tuberculosis (bTB) through milk testing, providing a sensitive and efficient means of identifying infected animals.

Replication and transmission features of two experimental vaccine candidates against bovine tuberculosis subcutaneously administrated in a murine model.[10]

In this work, the researchers investigate the replication and transmission characteristics of two experimental vaccine candidates against bovine tuberculosis (bTB) using a murine model. The study aims to assess the efficacy and potential of these vaccine candidates in preventing bTB infection and transmission. By examining the subcutaneous administration of these vaccines and their impact on replication and transmission dynamics, the researchers provide valuable insights into their effectiveness in the context of bTB control. The experimental approach helps elucidate the mechanisms underlying vaccine-induced immunity and their potential to interrupt the transmission chain of bTB.

Test performance data demonstrates utility of a cattle DIVA skin test reagent (DST-F) compatible with BCG vaccination.[11]

In their recent study, Jones et al. present test performance data that showcases the utility of a cattle DIVA skin test reagent (DST-F) compatible with BCG vaccination. The research focuses on evaluating the effectiveness of this test reagent in differentiating infected from vaccinated animals (DIVA) among cattle that have received BCG vaccination. Through their analysis, the study assesses the performance of the DST-F reagent in accurately identifying bTB infection in BCG-vaccinated cattle. The findings emphasise the potential of DST-F as a valuable tool for distinguishing infected animals from those that have been vaccinated, contributing to more precise and efficient disease surveillance and control strategies.

Protein Levels of Pro-Inflammatory Cytokines and Chemokines as Biomarkers of *Mycobacterium bovis* Infection and BCG Vaccination in Cattle.[12]

In their research, Khalid et al. investigate the protein levels of pro-inflammatory cytokines and chemokines as potential biomarkers of *Mycobacterium bovis* infection and BCG vaccination in cattle. The research aims to identify protein biomarkers that could serve as indicators of *M. bovis* infection and the immune response elicited by BCG vaccination in cattle. Through their analysis, the study examines the protein profiles of key immune molecules in relation to infection and vaccination status, shedding light on potential markers for disease diagnosis and monitoring.

9 Farzaneh, M., Derakhshandeh, A., Al-Farha, A. A. A., Petrovski, K., & Hemmatzadeh, F. (2022). A novel phage-displayed MilA ELISA for detection of antibodies against Myc. bovis in bovine milk. Journal of Applied Microbiology, 133(3), 1496–1505. **https://doi.org/10.1111/jam.15655**

10 Muñiz, X. F., García, E. A., Blanco, F. C., Bigi, F., Zumárraga, M. J., Cataldi, A. A., & Eirin, M. E. (2022). Replication and transmission features of two experimental vaccine candidates against bovine tuberculosis subcutaneously administrated in a murine model. Tuberculosis, 134, 102203. **https://doi.org/10.1016/j.tube.2022.102203**

11 Jones, G. J., Konold, T., Hurley, S., Holder, T., Steinbach, S., Coad, M., Neil Wedlock, D., Buddle, B. M., Singh, M., & Martin Vordermeier, H. (2022). Test performance data demonstrates utility of a cattle DIVA skin test reagent (DST-F) compatible with BCG vaccination. Scientific Reports, 12(1), 12052. https://doi.org/10.1038/s41598-022-16092-8

12 Khalid, H., van Hooij, A., Connelley, T. K., Geluk, A., & Hope, J. C. (2022). Protein Levels of Pro-Inflammatory Cytokines and Chemokines as Biomarkers of Mycobacterium bovis Infection and BCG Vaccination in Cattle. Pathogens, 11(7), 738. **https://doi.org/10.3390/pathogens11070738**

Direct detection of Mycobacterium bovis by a dry loop-mediated isothermal amplification assay in cattle samples collected during routine abattoir examination in Malawi.13

In this study, Kapalamula et al. employ a direct dry loop-mediated isothermal amplification assay to detect Mycobacterium bovis in cattle samples collected during routine abattoir examinations in Malawi. The research addresses the need for rapid and accessible diagnostic methods in resource-limited settings. Through their analysis, the study demonstrates the applicability of the assay for directly detecting M. bovis in cattle samples. The findings underscore the potential of this method for on-site diagnosis, which is crucial for timely disease management and control.

Trends in published research
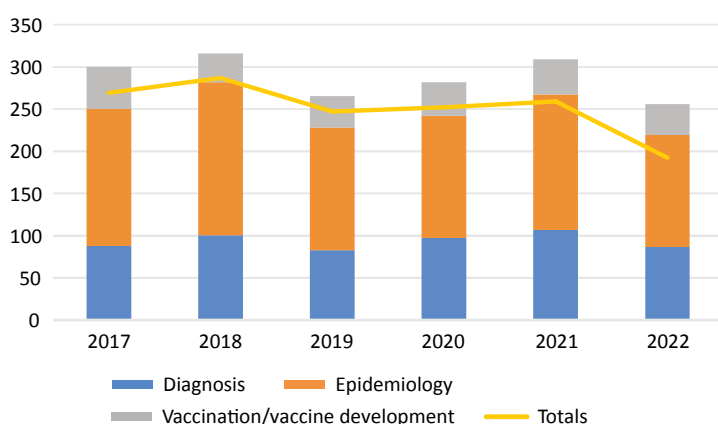
Total records & Main topics

Country/ Region of first Author (2017/2022)
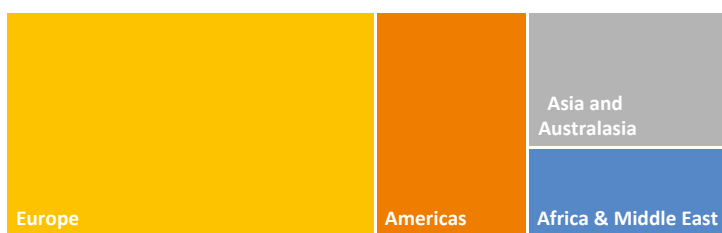
Ongoing research

Non-exhaustive list of ongoing projects on bTB funded by STAR-IDAZ IRC and STAR-IDAZ Network Members reported in June 2023:

Country/Funder	Main Research Institution	Research project	Start Year	End Year
Belgium/FPS Health, Food chain safety and Environment	KU Leuven Sciensano	ID4BT - Integrated Bovine Tuberculosis Diagnostics Approach: Bio-inspired Approaches	2020	2023

Country/Funder	Main Research Institution	Research project	Start Year	End Year
Belgium/FPS Health, Food chain safety and Environment	Sciensano ARSIA CER Groupe UCLouvain University of Liège DGZ Vlaanderen	DIBOTUB - Research and validation of new diagnostic methods for bovine tuberculosis	2019	2022
EU/ICRAD Joint Cofund call	The Royal Veterinary College	**AdapTB**- Defining the Molecular Determinants of Mycobacterial Adaptation and host:pathogen Interaction to inform bTB control	2023	2025
EU/ICRAD Joint Cofund call	Complutense University of Madrid	**imdiTBap** - Improving the diagnosis of tuberculosis in domestic ruminants through the use of new antigens and test platforms	2023	2025
Italy/Italian Ministry of Health	IZS LER	Update of the database of traditional genotypes of Mycobacterium tuberculosis complex (MTBC) with Whole Genome Sequence (WGS) and analysis of SNPs with particular reference to the most widespread profiles in Italy and transmission episodes	2021	2023
Italy/Italian Ministry of Health	IZS UM	MycomiRNA - Evaluation of the expression levels of microRNAs and their use as biomarkers in bovine paratuberculosis	2021	2023
Mexico/PAPIIT-UNAM	UNAM	bTB - Identification of natural disease resistance biomarkers to intracellular bacterial pathogens	2018	2020
Mexico/PAPIIT-UNAM	UNAM	bTB - Molecular and cellular components associated to Mycobacterium bovis control in granulomas of naturally infected cattle	2021	2023
Netherland/ Ministry LNV	WBVR	Projectcode: Whole proteome identificatie van peptides voor serodiagnostiek van tuberculose met ultra-high density peptide arrays (1600002154)	2020	2023
UK/Defra	APHA	Application of Enferplex (v3) and IDEXX antibody tests with the interferon-gamma test in selected cattle herds in Great Britain: is there evidence to support a change in supplementary TB testing	2022	2024
UK/Defra	APHA	CattleBCG - CattleBCG: Duration of immunity at minimum vaccine dose titre	2021	2023
UK/Defra	APHA	Development of a molecularly defined tuberculin	2021	2022
UK/Defra	APHA	Development of new serological tools for the identification of vaccinated and infected badgers for the control of bovine tuberculosis	2021	2024
UK/Defra	APHA	DST-F sensitivity study in naturally infected cattle	2021	2023
UK/Defra	APHA	Programme of work leading to licensing of a deployable CattleBCG vaccine and associated DIVA-skin test reagent (DST-F)	2020	2020
UK/Defra	APHA	Social Research: Farmer acceptability of the use of vaccines as a means to control bovine TB in cattle and wildlife	2022	2022
UK/Defra	University of Edinburgh	Applying machine learning tools to augment skin test interpretation	2022	2022

3. Coronaviruses

The coronaviruses (CoVs) of interest for the STAR-IDAZ IRC are infectious bronchitis virus (IBV), Middle East Respiratory Syndrome CoV (MERS-CoV), severe acute respiratory syndrome CoV 2 (SARS-CoV-2), and swine enteric CoVs, including porcine epidemic diarrhoea virus (PEDs), transmissible gastroenteritis virus (TGEv), and a new bat-HKU2-like porcine CoVs.

Global network: International Coronavirus research and innovation Network

Website: https://uk-icn.co.uk
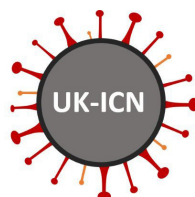
UK-ICN	**Members ca.** 347	**Budget** £500,000	**Start date:** 2021

Overview

The network is an open and inclusive Global Coronavirus Research and Innovation Network. It is based on the same concept of existing global research alliances in the animal health area (such as the Global ASF Research Alliance – GARA, and the Global FMD Research Alliance – GFRA), and this network has funding provided by Defra and BBSRC.

The UK-ICN members include representatives from academics, clinicians, veterinarians, governmental bodies, and industry parties with interests in a wide remit from basic science, vaccines and therapeutics, surveillance, pandemic preparedness and social science and policy.

UK-ICN utilises a network-of-network by partnering with existing likeminded networks, e.g. the Global Virus Network, STAR-IDAZ IRC, International Veterinary Vaccinology Network and BSL4ZNET, and expert members of the directorate and management board to fulfil its aims and objectives.

Aim and priorities

Aim: to establish and sustain global research and innovation partnerships to share knowledge, tools and intervention strategies for control of animal and human coronaviruses.

Priorities: animal and human coronavirus pathogen biology (including the seasonality, transmission, ecology and evolution of coronaviruses), host response and effective intervention strategies. UK-ICN activities focus on a One Health approach to understand coronavirus biology at the animal-human-environment interface. Network activities fall within five distinct themes; One Health and zoonoses; surveillance: detection and characterisation; countermeasures and interventions; behaviour and social policy; and SARS-CoV-3 and the future (pandemic preparedness).

Activities

- Facilitate research collaborations and serve as a communication gateway for global human and animal coronavirus research communities (particularly between the UK and international bodies)
- Creation of an interdisciplinary forum for data sharing and collaboration
- Dissemination and preservation of knowledge to better combat future emerging coronaviruses
- Co-ordination of interactions between members, especially at the animal-human-environment interface
- Providing face-to-face networking activities to encourage the cross-fertilisation of ideas, providing expert perspectives to identify knowledge gaps.

News

The network has been operational since September 2021 and will facilitate coordination of activities on coronaviruses with STAR-IDAZ, supporting in identifying research gaps and drafting research roadmaps on the topic.

To date, UK-ICN has held regional events in South Africa, the Middle East and India, and two international meetings in the UK with a heavy focus on One Health and therapeutics, as well as regular virtual seminar series featuring coronavirus speakers. Future activities will build on these to further solidify engagement in these under-represented geographical regions.

In collaboration with STAR-IDAZ IRC, the UK ICN co-organised a workshop aimed at identifying research gaps in coronaviruses. The workshop was held back-to-back to the **International Conference on Livestock, Companion Animals and Wildlife coronaviruses**. Before the workshops, a survey was circulated among the participants and the UK-ICN network, 56 respondents from 21 countries provided information on state-of-the-art research, challenges and possible solution routes. The findings of the survey fed the three gap analysis workshops focusing on: vaccines and therapeutics, diagnostics and surveillance, epidemiology. The **STAR-IDAZ-Report-of-the-workshops-on-Coronaviruses-gap-analysis** is available on the STAR-IDAZ website.

The results of the workshops will serve the development of STAR-IDAZ IRC coronavirus research roadmaps for disease control strategies, diagnostic tools and vaccine development. The research roadmaps will highlight the steps that need to be taken to address research efforts where it is most needed, to improve efficiency in response to future animal coronavirus outbreaks.

STAR-IDAZ WG progress

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

DISCONTOOLS research needs

Coronaviruses (CoVs) in pigs

CoVs infection in pigs can cause devastating disease in naïve populations. CoVs strains that can cause massive disease outbreaks are present in many pig populations in certain geographic areas. Trade and traffic can easily promote virus transmission and introduction in distant regions at any time. Control should rely on having appropriate diagnostic tools in place for routine surveillance and possibly also vaccines/or the ability to upscale existing vaccines in currently CoV free areas. Main critical gaps are:

Real time detection tool of various CoVs that is time sensitive and cost efficient

Readily available vaccine platforms based for example on virus/bacteria vector systems where genes of new strains can be inserted rapidly and which can be expanded rapidly if needed

Development of oral live vector vaccines that are not composed of whole live CoVs.

Avian Coronaviruses (AvCoVs)

AvCoVs, continue to cause severe losses to the poultry industry despite (in the case of IBV) the use of different vaccines and vaccine programmes over the last 70 years. AvCoVs seem to have a strong capacity for rapid evolution and perhaps therefore they continue to cause problems. However, fundamental studies (epidemiological and experimental) unravelling how and why AvCoVs, especially IBV, can create such diversity are lacking. Thus, more AvCoV studies are required that focus on genomic evolution, its dynamics and the driving factors involved (environmental, physical etc) so that better control measures can be conceived. Main critical gaps are:

- Inactivated vaccines for IBV that are capable of inducing protective immune responses equal to that of current live attenuated IBV vaccines
- What is the basis of cross-protection for IBV
- Rationally designed live attenuated marker vaccines for IBV that induce broad range protection
- Cost effective, reliable molecular tests for full S1 genotyping of IBV
- IBV strain specific ELISAs
- Knowledge on the host range of the different AvCoVs
- Turkey CoV Guinea-Fowl CoV specific ELISA tests are required to perform prevalence studies on these viruses
- Koch's postulates need addressing for Turkey CoV and Guinea-Fowl CoV
- Relevance of IBV-like viruses in wild birds for poultry.

Recent developments

Efficacy of two vaccination strategies against infectious bronchitis in laying hens.[14]

In this paper two vaccination strategies were evaluated against challenge with the Massachusetts (Mass) infectious bronchitis virus (IBV) strain that was linked to egg production. One strategy included live attenuated IB vaccines only, and the other used both inactivated and live attenuated IB vaccines. Both vaccination strategies showed protection against clinical signs compared to the mock-vaccinated challenged group. However, the study suggests a better performance for using live attenuated and inactivated IB vaccines in combination as only the birds that received live attenuated plus inactivated IB vaccines had significantly lower IBV genome loads in cloacal swabs at 7 dpi, as well as decreased histopathological lesion scores and IBV genome loads in magnum compared to the mock-vaccinated challenged group.

Generation of APN-chimeric gene-edited pigs by CRISPR/Cas9-mediated knock-in strategy.[15]

This study is the first to report the generation of APN-chimeric pigs, which may provide a natural host animal for characterising porcine enteric coronaviruses (PEC) infection with porcine aminopeptidase N (APN) and help in the development of antiviral solutions. The aim was to further optimise the porcine aminopeptidase N (pAPN) gene editing strategy, that could help to generate gene-edited pigs to explore individual antiviral properties and the biological functions of pAPN in pigs. APN-chimeric gene-edited pigs were produced through a CRISPR/Cas9-mediated knock-in strategy and reproductive tests showed normal pregnancy rates and viability of these gene-edited pigs. In vitro viral challenge assays further demonstrated that porcine kidney epithelial cells isolated from F1-generation gene-edited pigs could effectively inhibit transmissible gastroenteritis virus (TGEV) infection.

Zooanthroponotic transmission of SARS-CoV-2 and host-specific viral mutations revealed by genome-wide phylogenetic analysis.[16]

This article uses publicly available viral genome sequences and phylogenetic analysis to systematically investigate the transmission of SARS-CoV-2 between human and non-human species and to identify mutations associated with each species. The authors found the highest frequency of animal-to-human transmission from mink, while lower transmission from other sampled species (cat, dog, and deer) was observed. Using genome-wide association studies, the authors identified three single nucleotide variants (SNVs) statistically associated with mink and 26 with deer: ~⅔ were reasonably introduced into these animal species from local human populations, while the remaining ~⅓ were probably derived in animal populations. Those are retained top candidates for experimental studies of species-specific adaptation.

14 Ali, A., Hassan, M. S. H., Najimudeen, S. M., Farooq, M., Shany, S., El-Safty, M. M., Shalaby, A. A., & Abdul-Careem, M. F. (2023). Efficacy of two vaccination strategies against infectious bronchitis in laying hens. Vaccines, 11(2), 338. **https://doi.org/10.3390/vaccines11020338**

15 Liu, Z., Zhang, M., Huang, P., Ji, Z., Qi, C., Jiao, S., Zhao, D., Jiang, Y., Chen, X., Lv, D., Pang, D., Zhang, X., Feng, L., Xie, Z., & Ouyang, H. (2023). Generation of APN-chimeric gene-edited pigs by CRISPR/Cas9-mediated knock-in strategy. Gene, 851, 147007. https://doi.org/10.1016/j.gene.2022.147007

16 Naderi, S., Chen, P. E., Murall, C. L., Poujol, R., Kraemer, S., Pickering, B. S., Sagan, S. M., & Shapiro, B. J. (2023). Zooanthroponotic transmission of SARS-CoV-2 and host-specific viral mutations revealed by genome-wide phylogenetic analysis. eLife, 12, e83685. **https://doi.org/10.7554/eLife.83685**

SARS-CoV-2 in animals: susceptibility of animal species, risk for animal and public health, monitoring, prevention and control.[17]

EFSA conducted a study of the current epidemiology situation in EU of animal species known to transmit SARS-CoV-2 such as American mink, raccoon dog, cat, ferret, hamster, house mouse, Egyptian fruit bat, deer mouse and white-tailed deer. Among farmed animals, American mink have the highest probability to become infected from humans or animals and transmit SARS-CoV-2. A decreasing outbreaks trend was observed in the EU, when 44 outbreaks were reported in 2021 in mink farms in seven MSs and six in 2022 in two MSs. The genomic analysis of SARS-CoV-2 showed mink-specific clusters with a potential to spill back into the human population. Among companion animals, cats, ferrets and hamsters are at highest risk of SARS-CoV-2 infection, which most likely originates from an infected human, and which has low impact on virus circulation in the human population. Among wild animals (including zoo animals), mostly carnivores, great apes and white-tailed deer have been naturally infected by SARS-CoV-2, but no cases were reported in the EU. EFSA advises proper disposal of human waste is advised to reduce the risks of spill-over of SARS-CoV-2 to wildlife and minimise contact with wildlife, especially if sick or dead. Bats should be monitored as a natural host of many coronaviruses but no other specific monitoring for wildlife is recommended, except from testing hunter-harvested animals with clinical signs or found-dead.

Comparative susceptibility of SARS-CoV-2, SARS-CoV, and MERS-CoV across mammals.[18]

The authors performed a comparative in vitro infection analysis on 83 cell cultures derived from 55 mammalian species using pseudotyped viruses bearing S proteins from SARS-CoV-2, SARS-CoV, and MERS-CoV. The study revealed that cell cultures from Thomas's horseshoe bats, king horseshoe bats, green monkeys, and ferrets were highly susceptible to SARS-CoV-2, SARS-CoV, and MERS-CoV pseudotyped viruses. In addition, five variants (del69-70, D80Y, S98F, T572I, and Q675H) can significantly alter the host tropism of SARS-CoV-2. Moreover, examining the phylogenetic signals of transduction rates, it was noted that closely related taxa usually have similar susceptibility to MERS-CoV but not to SARS-CoV and SARS-CoV-2 pseudotyped viruses. Finally expression of 95 genes, e.g., PZDK1 and APOBEC3, were found commonly associated with the transduction rates of SARS-CoV, MERS-CoV, and SARS-CoV-2 pseudotyped viruses. This study provides basic knowledge of the susceptibility, variants, and molecules that underlie the cross-species transmission of these coronaviruses, critical for the long-term control and prediction of future pandemics.

Potent pan huACE2-dependent sarbecovirus neutralizing monoclonal antibodies isolated from a BNT162b2-vaccinated SARS survivor.[19]

The study reports the isolation and characterisation of highly potent monoclonal antibodies (mAbs) targeting the receptor binding domain (RBD) of huACE2-dependent sarbecovirus from a SARS-CoV survivor vaccinated with BNT162b2. E7, among the six mAbs identified, showed the best huACE2-dependent sarbecovirus neutralizing potency and breadth than any other mAbs reported to date. Studies of mutagenesis and cryo–electron microscopy showed that these mAbs have a unique RBD contact footprint and that E7 binds to a quaternary structure–dependent epitope.

---

17 EFSA Panel on Animal Health and Welfare (AHAW), Nielsen, S. S., Alvarez, J., Bicout, D. J., Calistri, P., Canali, E., Drewe, J. A., Garin-Bastuji, B., Gonzales Rojas, J. L., Gortázar, C., Herskin, M., Michel, V., Miranda Chueca, M. Á., Padalino, B., Pasquali, P., Roberts, H. C., Spoolder, H., Velarde, A., Viltrop, A., Winckler, C., … Ståhl, K. (2023). SARS-CoV-2 in animals: susceptibility of animal species, risk for animal and public health, monitoring, prevention and control. EFSA journal. European Food Safety Authority, 21(2), e07822. https://doi.org/10.2903/j.efsa.2023.7822

18 Li, M., Du, J., Liu, W., Li, Z., Lv, F., Hu, C., Dai, Y., Zhang, X., Zhang, Z., Liu, G., Pan, Q., Yu, Y., Wang, X., Zhu, P., Tan, X., Garber, P. A., & Zhou, X. (2023). Comparative susceptibility of SARS-CoV-2, SARS-CoV, and MERS-CoV across mammals. The ISME journal, 17(4), 549–560. https://doi.org/10.1038/s41396-023-01368-2

19 Wan Ni Chia, Chee Wah Tan, Aaron Wai Kit Tan, Barnaby Young, Tyler N. Starr, Ester Lopez, Guntur Fibriansah, Jennifer Barr, Samuel Cheng, Aileen Ying-Yan Yeoh, Wee Chee Yap, Beng Lee Lim, Thiam-Seng Ng, Wan Rong Sia, Feng Zhu, Shiwei Chen, Jinyan Zhang, Madeline Sheng Si Kwek, Allison J. Greaney5, Mark Chen, Gough G. Au, Prasad N. Paradkar, Malik Peiris, Amy W. Chung, Jesse D. Bloom5, David Lye, Sheemei Lok, Lin-Fa Wang (2023). Potent pan huACE2-dependent sarbecovirus neutralizing monoclonal antibodies isolated from a BNT162b2-vaccinated SARS survivor. Science Advances 28;9(30):eade3470. https://www.science.org/doi/10.1126/sciadv.ade3470

Thus, the findings of this study will be useful in supporting the development of future pan-sarbecovirus therapeutic antibodies and vaccines, critical not only for mitigating the current COVID-19 pandemic but also for prevention and response to future coronavirus outbreaks.

Efficient Direct and Limited Environmental Transmission of SARS-CoV-2 Lineage B.1.22 in Domestic Cats.[20]

The authors studied the characterisation of the transmission of SARS-CoV-2 between cats, through both direct and indirect contact. The study estimated the transmission rate parameter and the decay parameter for infectivity in the environment. Statistical analysis of the transmission data gives a reproduction number R0 of 2.18 (95% CI = 0.92 to 4.08), a transmission rate parameter β of 0.23 day-1 (95% CI = 0.06 to 0.54), and a virus decay rate parameter μ of 2.73 day-1 (95% CI = 0.77 to 15.82). Thus, transmission between cats was retained efficient and can be sustained (R0 > 1), while it was noted that the infectiousness of a contaminated environment decays rapidly (mean 1/2.73 days). Besides providing data for risk assessment from zoonotic spillover of SARS-CoV-2 from cats, the mathematical models utilised can be applied to evaluate transmission of others pathogens.

Trends in published research

Total records & Main topics
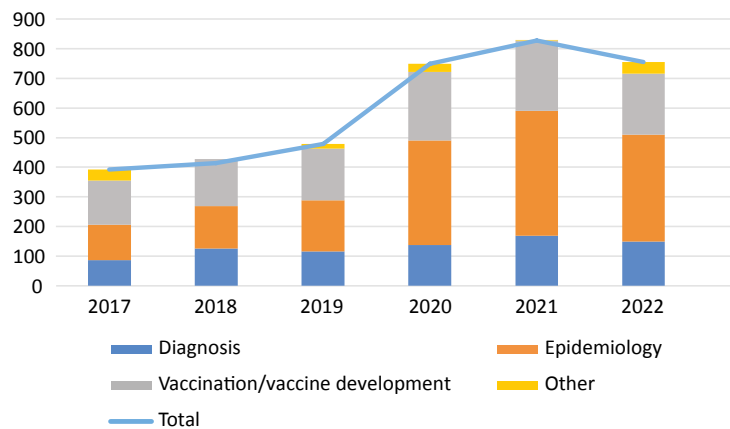
Country/ Region of first Author (2017/2022)
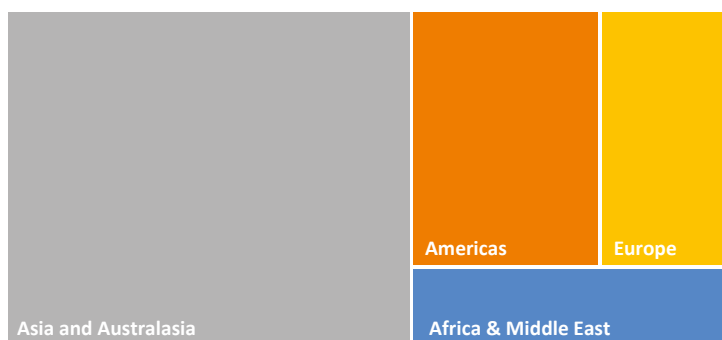
20 Gerhards NM, Gonzales JL, Vreman S, Ravesloot L, van den Brand JMA, Doekes HP, Egberink HF, Stegeman A, Oreshkova N, van der Poel WHM, de Jong MCM. (2023) Efficient Direct and Limited Environmental Transmission of SARS-CoV-2 Lineage B.1.22 in Domestic Cats. Microbiol Spectr. 11(3):e0255322. doi:10.1128/spectrum.02553-22.

Ongoing research

Non-exhaustive list of ongoing projects on CoVs funded by STAR-IDAZ IRC and STAR-IDAZ Network Members:

Country/Funder	Main Research Institution	Research project	Start Year	End Year
Belgium/FPS Health	UGent	CORUVA - Surveillance of coronaviruses in cattle and pigs with emphasis on the zoonotic risk	2021	2024
Belgium/ UGent IOF	UGent	VetCoVac - Introducing mRNA vaccination in chicken: first steps towards a commercial mRNA vaccine against a leading viral infection in chicken	2022	2024
China/ Ministry of Science and Technology	Huazhong Agricultural University	Genetics, pathogenesis	2021	2024
CRP	ILRI	Surveillance of immune responses to SARS-CoV2 and vaccination using serology	2020	2021
EU/EC	Norwegian University of Life Sciences (NMBU; coordinator), NVI	PANDASIA - **Pandemic literacy and viral zoonotic spillover risk at the frontline of disease emergence in Southeast Asia to improve pandemic preparedness**	2022	2027
EU/EJP One Health	German Federal Institute for Risk Assessment (BfR; coordinator), NVI	EJP COVRIN - **One Health EJP response to COVID-19: Joint Integrative Project**	2021	2023
EU/ICRAD Joint Cofund call	Erasmus MC	ConVErgence project: ERAnet ICRAD project 1ste call - Assessing swine as potential hosts for emerging Coronaviruses	2021	2024
EU/ICRAD Joint Cofund call	French Agency for Food, Environmental and Occupational Health & Safety	**MUSECoV** - Multi-scale Eco-evolution of Coronaviruses: from surveillance toward emergence prediction	2021	2024
France/ANR	INRAE	SARS2BlockEntry - Construction de nano-ligands pour bloquer l'entrée du SARS-CoV-2		
France/ANR	INRAE	Versatile - Emerging SARS-CoV-2 variants: intersection of entry routes and antiviral responses	2022	2027
France/ANR COVID	Université de Tours/INRAE	Nanovaccin 1 - Validation en modèle murin K18-hACE2 d'un candidat vaccin muqueux anti- SARS-Cov2 en terme de réponses immunitaires et de protection	2021	2022
France/ Région	Université de Tours/INRAE	Mucovid - Validation en modèle de référence hamster doré d'un nouveau candidat vaccin muqueux anti-SARS-CoV-2	2021	2022
Italy/Italian Ministry of Health	IZS AM	OneCoV - Emerging animal coronaviruses and their impact on public health	2022	2024
Italy/Italian Ministry of Health	IZS AM	PanCo - Pathogenesis and epidemiology of human to animal COronaviruses	2020	2022
Italy/Italian Ministry of Health	IZS LER	Animal coronaviruses in humans: knowing them to prepare for new pandemics	2021	2023

Country/Funder	Main Research Institution	Research project	Start Year	End Year
Italy/Italian Ministry of Health	IZS LT	Acquisition of scientific and epidemiological field evidence on the susceptibility of animals to SARS-CoV-2 and other coronaviruses from a One Health perspective	2020	2022
Italy/Italian Ministry of Health	IZS ME	Coronavirus in domestic ruminants in southern Italy; description of cases of inverse zoonotic infections	2022	2024
Italy/Italian Ministry of Health	IZS ME	Study of endogenous viral elements integrated into the genome (EVE) of domestic and wild species and their significance in the course of coronavirus infection. Epidemiological investigations on domestic and wild animals for the search for specific antibodies	2020	2022
Italy/Italian Ministry of Health	IZS VE e IZS Network	Susceptibility of mammals to SARS-COV-2: risks of reverse zoonosis and possibilities in translational medicine. (network project)	2020	2022
Nethererlands/ Ministry LNV	WBVR	Projectcode: WOT-01-003-069 en KB-37-003-003 - Preparing for emerging pathogens (PREP4EP) (1600001033)	2015	2024
UK/Defra	APHA	BBSRC-DEFRA Global Coronavirus Research Network Call	2021	2025
UK/Defra	APHA	Covid in wildlife	2022	2023
UK/Defra	APHA	SARS-CoV-2 Research Integration and preparedness (COVID19JIP) COVRIN. One Health research integration on SARS-CoV-2 emergence, risk assessment and preparedness	2021	2021
UK/Defra	APHA	UKRI: SARS-Cov-2 infection at the animal-human interface: longevity and re-infection dynamics with virus evolution	2021	2023
USA/USDA NIFA	Oklahoma State University	CoVs - **Defining Antagonism Hierarchy of Porcine Epidemic Diarrhea Virus for Live Vaccines Design**	2023	2027
USA/USDA NIFA	Virginia Polytechnic Institute And State University	CoVs - **Nanoparticle-based swine vaccine**	2022	2025

4. Vector-borne diseases (VBD)

Due to the breadth of the topic, which involves many diseases affecting different animal species and humans (e.g. Rift Valley fever), the scope of the STAR-IDAZ IRC Working Group (WG) focuses on vectors (i.e. insects and ticks) in particular on research for controlling vector transmission, rather than on specific vector-borne diseases.

Working Group members were identified through nominations by the STAR-IDAZ IRC Executive and Scientific Committees. It was agreed a generic roadmap focusing on vector transmission control would be developed, this includes direct vector control and controlling how the vector transmits the pathogen. The STAR-IDAZ Scientific Committee lead, supported by SIRCAH, drafted a research roadmap titled 'Vector transmission control'. The draft roadmap was presented at the virtual UK Vector Borne Disease Conference, held on 23 November 2020. Following participant feedback and comments, the roadmap was simplified and lead summaries were developed. A roadmap workshop was held on 28 March 2023 in Weimar, Germany, alongside the 15th International Ticks and Tick-borne Disease Symposium. A small group of experts was convened to discuss and edit the draft roadmap, with most experts specialising in tick-borne diseases. The roadmap and lead summaries were then modified further by the Scientific Committee lead, supported by SIRCAH. To ensure a range of vectors are considered in the roadmap, the next step will be to consult a wider group of experts on the roadmap and lead summaries through electronic consultation and a virtual workshop if necessary.

Global network

No global research network on vector-borne diseases affecting animal health has been established yet. However, there are several relevant networks (see below) to encourage collection and consolidation of key data, and to encourage development of analytical tools to better understand the role of vector behavior in transmission ecology.

Additional networks

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

www.anti-vec.net

A major goal for the scientific community working on vector-borne diseases is to develop novel strategies and tools for effective vector control. ANTI-Vec is a research project focused on developing novel strategies to combat mosquito-borne diseases, primarily targeting the *Aedes* species of mosquito which is responsible for diseases such as dengue, Zika, and chikungunya. The project explores innovative approaches, including genetic modification and biotechnology, to reduce mosquito populations or make them less effective disease vectors. By disrupting the mosquito's ability to transmit diseases, ANTI-Vec aims to contribute to the global effort to control and eventually eliminate these debilitating diseases, ultimately improving public health in affected regions.

Global Vector Hub

https://globalvectorhub.tghn.org/

The Global Vector Hub (GVH) is an open access, interactive resource for vector control interventions, focused on public health aiming to combat vector-borne diseases by serving as a central hub for knowledge sharing and collaboration. Its key objectives include facilitating data exchange and analysis related to vectors such as mosquitoes and ticks, fostering interdisciplinary research, promoting innovation in vector control methods, and enhancing global capacity to address vector-borne diseases. Ultimately, the GVH seeks to reduce the burden of diseases such as malaria, dengue, Zika, and Lyme disease by connecting researchers, policymakers, and organisations to collectively tackle these health challenges.

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

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

It is a joint initiative of the European Food Safety Authority (EFSA) and the European Centre for Disease Prevention and Control (ECDC). VectorNet supports the collection of data on vectors and pathogens in vectors related to both animal and human health.

VectorBite Research Coordination Network

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

The goal of the Vector Behaviour in Transmission Ecology Research Coordination Network (VectorBiTE RCN) is to increase interaction between researchers in the diverse fields studying VBDs, to encourage collection and consolidation of key data, and to encourage development of analytical tools to better understand the role of vector behaviour in transmission ecology.

STAR-IDAZ WG progress

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

DISCONTOOLS research needs

The database contains information about several VBD (i.e., **African horse sickness**, **African trypanosomiasis**, **bluetongue**, **Crimean-Congo hemorrhagic fever**, **Rift Valley fever**, **theileriosis**, **West Nile virus**). In 2020, the research needs were summarized in the **DISCONTOOLS e-book.** More recent updates are available at the disease specific links above.

Recent developments

Interaction between anti-tick vaccine and a macrocyclic lactone improves acaricidal efficacy against *Rhipicephalus (Boophilus) microplus* (Canestrini) (Acari: Ixodidae) in experimentally infested cattle.[21]

The southern cattle fever tick (SCFT) *Rhipicephalus (Boophilus) microplus*, is associated with high financial losses and, in many parts of the world, SCFT has evolved resistance to all market-available pesticides thus driving development of new control technologies. Vaccination against ticks using the tick gut protein Bm86 has been shown to be effective against acaricide-resistant ticks. This technique has been successfully implemented in Puerto Rico for the control of acaricide-resistant *R. microplus* on dairy and beef cattle. In this project, controlled animal studies were completed directly comparing efficacy of anti-tick vaccination with and without systemic acaricide. The results show that the Bm86 anti-tick vaccine in combination with the macrocyclic lactone, moxidectin, expressed a synergistic interaction, providing greater and longer efficacy than either treatment alone.

---

21 Arocho Rosario, C.M., Miller, R.J., Klafke, G.M. et al. (2022) Interaction between anti-tick vaccine and a macrocyclic lactone improves acaricidal efficacy against Rhipicephalus (Boophilus) microplus (Canestrini) (Acari: Ixodidae) in experimentally infested cattle. Vaccine. 8; 40(47):6795-6801. **https://doi.org/10.1016/j.vaccine.2022.10.001**

Host preference of bluetongue virus vectors, *Culicoides* species associated with livestock in West Bengal, India: Potential relevance on bluetongue epidemiology.[22]

Researchers investigated host preference of livestock associated *Culicoides* midges, by mouth aspirating seven *Culicoides* species from three bluetounge virus (BTV) hosts - cattle, sheep and goats. All midge species, except for *C. fulvus* Sen & Das Gupta, preferred cattle over other mammalian hosts. The study also identified species prevalence on different body areas of host. *C. oxystoma* Kieffer, the subgenus Trithecoides Wirth & Hubert and *C. actoni* Smith, predominated on the ventral region (belly/flank) of the cattle. DNA-based blood meal analysis revealed human blood from the midges trapped in UV-LED light traps, this is the first evidence that *C. similis* Carter, Ingram & Macfie, *C. fulvus* and *C. palpifer* Das Gupta & Ghosh, feed on humans.

Microbiota perturbation by anti-microbiota vaccine reduces the colonization of *Borrelia afzelii* in *Ixodes Ricinus*.[23]

In this study, authors characterised the Ixodes ricinus microbiota modulation in response to *Borrelia afzelii* infection and found that the pathogen induces changes in the microbiota composition, its beta diversity and structure of bacterial community assembly. Tick microbiota perturbation by anti-microbiota antibodies or addition of novel commensal bacteria into tick midguts causes departures from the *B. afzelii*-induced modulation of tick microbiota which resulted in a lower load of the pathogen in *I. ricinus*. These findings suggest *Borrelia* is highly sensitive to tick microbiota perturbations and anti-microbiota vaccines can be used as a tool for microbiota perturbation and control of important vector-borne pathogens.

Gamma-radiation of *Glossina palpalis gambiensis* revisited: effect on fertility and mating competitiveness.[24]

Researchers evaluated the effect of irradiation on the fecundity of *Glossina palpalis gambiensis* to identify the optimal dose to induce maximum sterility while maintaining biological performance. The results showed that pupal production and emergence rates were higher in batches of females that had mated with fertile males than in those that had mated with irradiated males with any experimental dose. An optimal radiation dose of 120 Gy was found to induce 97-99% sterility when administered to male flies when mated with virgin females. For semi-field cage experiments, males irradiated with 120 Gy showed good sexual competitiveness as compared to fertile males and those irradiated with 140 Gy, considering the level of filling of spermatheca and the number of pairs formed. The optimal dose of 120 Gy found in this study is slightly different from the traditional dose of 110 Gy that has been used in several eradication programmes in the past.

22 Kar, S., Mondal, B., Ghosh, J. et al. (2022) Host preference of bluetongue virus vectors, Culicoides species associated with livestock in West Bengal, India: Potential relevance on bluetongue epidemiology. Acta Tropica 235, 106648. **https://doi.org/10.1016/j.actatropica.2022.106648**.

23 Wu-Chuang, A., Mateos-Hernandez, L., Maitre, A. et al. (2023) Microbiota perturbation by anti-microbiota vaccine reduces the colonization of Borrelia afzelii in Ixodes ricinus. Microbiome 11, 151. **https://doi.org/10.1186/s40168-023-01599-7**

24 Pagabeleguem, S., Koughuindida, O., Salou, E. W. et al. (2023). Gamma-radiation of Glossina palpalis gambiensis revisited: effect on fertility and mating competitiveness. Parasite, 30, 8. **https://doi.org/10.1051/parasite/2023009**
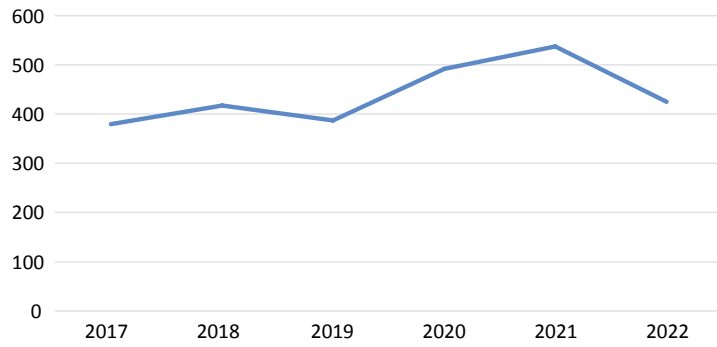
Trends in published research

Total records & Main topics

Year	Value
2017	~380
2018	~415
2019	~390
2020	~490
2021	~535
2022	~425

Country/ Region of first Author (2017/2022)

Europe

Asia and Australasia

Africa & Middle East

Americas
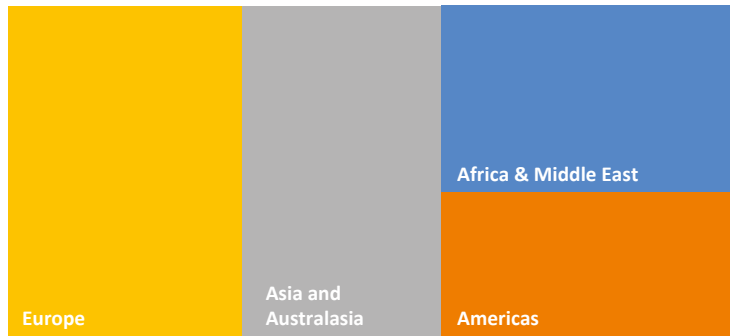
Ongoing research

Non-exhaustive list of ongoing projects on vector-borne diseases funded by STAR-IDAZ IRC and STAR-IDAZ Network Members:

Country/Funder	Main Research Institution	Research project	Start Year	End Year
Belgium/ FPS Health, Food chain safety and Environment	Sciensano University of Liège DGZ Flanders	TIBOPATH - Prevalence of animal pathogens transmitted to ruminants by ticks in Belgium	2020	2022
EU/EC	CIRAD (French Agricultural Research and Cooperation Organisation)	**COMBAT** - COntrolling and progressively Minimizing the Burden of Animal Trypanosomosis	2021	2025
EU/EC	CIRAD (French Agricultural Research and Cooperation Organisation)	**MOOD** - MOnitoring Outbreak events for Disease surveillance in a data science context	2020	2023
EU/EC	Friedrich Loeffler Institute, Germany (Coordinator)	SPIDVAC - Development of vaccines against African Horse sickness virus, peste des petits ruminants and foot-and-mouth diseases	2022	2025
EU/EC	Spiru Haret University, Romania	**CANLEISH** - Non-invasive volatiles test for canine leishmaniasis diagnosis	2021	2025
EU/EC	University of Copenhagen, Denmark (Coordinator)	**PREPARE4VBD** - A Cross-Disciplinary Alliance to Identify, PREdict and prePARe for Emerging Vector-Borne Diseases	2021	2025
EU/EC	INRAE	**Wiliman-ID** - Wild-life, livestock and human infectious diseases in changing environments –	2023	2028
France/AMI CLIMAE, INRA, INRAE	INRAE	Futuratick, Climatick - Caractérisation et adaptation au futur risque dans le cadre du changement climatique et de son atténuation	2023	2025
France/ANR	ANSES + EnvA	Labex IBEID_Coinfection - New insights regarding tick co-infections.	2021	2024
France/ANR	CIRAD	ArchR - Architecture génétique de la résistance aux insecticides : des données génomiques à la capacité vectorielle	2021	2024
France/ANR	CNRS	Heniphase - Séparations et transitions de phase par les protéines V et W des Henipavirus: mécanismes moléculaires et implications pour leurs fonctions et pour la pathogenèse	2021	2024
France/ANR	CNRS	SERIOUS - Social and Environmental RIsk factors in the emergence of mOsquito-borne diseases in Urban areaS	2022	2026
France/ANR	INRAE	AxoTick - Cholinergic receptors-mediated activities of peptidergic neurons innervating salivary glands of the tick Ixodes ricinus	2021	2025
France/ANR	INRAE	hIPsTER - Integrative Pathobiology of Tick-borne Flaviviruses	2020	2023

Country/Funder	Main Research Institution	Research project	Start Year	End Year
France/INRAE	VetAgroSup + INRAE	RESEDAPP - Réseau de Surveillance Entomologique et Détection précoce d'Arbovirus en appui aux Politiques Publiques	2022	2025
France/INRAE MP DIGIT-BIO	INRAE	MIDIIVEC - Modélisation de la dynamique de transmission des arbovirus par leur vecteur et prédiction du risque d'émergence et de propagation arbovirale	2022	2024
France/INRAE-SA	INRAE	NanoMos - Utilisation de nanoparticules biodégradables de polyacide lactique chez les moustiques pour lutter contre les arboviroses	2023	2024
France/RIVOC region occitanie	INRAE	HolisTique	2022	2025
French/INRAE	INRAE	MosquiCells - Establishment of novel mosquito cell lines for deciphering host-pathogen interactions during arbovirus infection	2022	2023
Italy/ Italian Ministry of Health	IZS AM	ARBoV - Arboviruses transmitted by ticks and mosquitoes: patterns of introduction, spread and control strategies	2022	2024
Italy/ Italian Ministry of Health	IZS LER	Emerging tick-borne zoonoses	2022	2024
Italy/ Italian Ministry of Health	IZS LER	Trial of One Health monitoring techniques on TBE and other tick-borne diseases	2021	2023
Italy/ Italian Ministry of Health	IZS ME	Biomolecular panel for the research of infectious agents for the fight against diseases transmitted by arthropod vectors (TBD) of zoonotic interest in southern Italy	2022	2024
Italy/ Italian Ministry of Health	IZS PLV	Tick-borne diseases: risk assessment related to climate change, human effects and dynamic multi-host ecosystems	2022	2024
Italy/ Italian Ministry of Health	IZS SA	Survey on tick infestation and the spread of the main arthropod-borne zoonoses in Sardinian sheep and goats, associated with prevention activities for the protection of human and animal health	2022	2024
Italy/ Italian Ministry of Health	IZS SI	Uncontrolled growth of wild ungulates in Sicily: is the environment-ticks-zoonotic pathogens balance still guaranteed?	2023	2026
Italy/ Italian Ministry of Health	IZS VE	Calli4Tracing - Experimental model for the evaluation of insects belonging to the *Calliphoridae* family as potential vectors or reservoirs of epizootic and zoonotic pathogens	2022	2024
Italy/ Italian Ministry of Health	IZS VE	IXORISK - investigation on the prevalence and distribution of tick-borne pathogens in goat herds and risk assessment related to the presence of Tick-Borne Encephalitis virus in raw milk and dairy products	2021	2023
Italy/ Italian Ministry of Health	IZS VE	KORVIRUS - Evaluation of the vector competence of the invasive mosquito species *Aedes koreicus* for dengue and West Nile viruses	2021	2023
Japan/ National Agricultural and Food Research Organisation	National Institute of Animal Health (NIAH)	Information gathering and optimisation of control and preventive strategy for arbovirus infections	2018	2023

Country/Funder	Main Research Institution	Research project	Start Year	End Year
Kenya/ TAHSSL	ILRI	Develop a novel assay to support vaccine research for TAHSSL target diseases (including East Coast fever, anaplasmosis, heartwater and babesiosis. *Theileria parva* sporozoite seroneutralization assay	2019	2021
Netherlands/ Dutch Research Council (NWO)	Netherlands Centre for One Health	**One Health PACT** (Predicting arboviruses Climate Tipping Points)	-	-
Norway/ FRAM	NVI	**ePod** - Slugs and snails and brainworm tales - an Arctic gastropod mystery	2023	2023
Norway/ Research Council of Norway	NVI	**TimeLyme** - Timing of host-vector-pathogen activity and emergence of Lyme disease under climate change	2021	2024
Spain/ National Research Agency	IRTA	Determination of the Role of Mosquito Vectors and Other Factors on West Nile Virus Transmission	2021	2024
Spain/ National Research Agency	National Institute for Agricultural and Food Research and Technology (INIA), Spanish National Research Council (CSIC)	Engineering Flavivirus Biosensors: New Tools for the Diagnosis and Study of Viral Pathogenesis	2021	2024
Spain/ National Research Agency	National Institute for Agricultural and Food Research and Technology (INIA), Spanish National Research Council (CSIC)	Newly Emerging West Nile Virus Strains: Analysis of the Infection in Vertebrate Hosts and Their Geographic Spread	2021	2024
Spain/ National Research Agency	The Autonomous University of Barcelona, Spain	West Nile Virus in Equids in Spain	2021	2024
Sweden/ National Veterinary Institute (SVA)	SVA	Preparedness against emerging mosquito-borne viral threats	2021	2024
UK/ Defra	Animal and Plant Health Agency, UK	VBD ticks and modelling	2022	2022
UK/ Defra	The Pirbright Institute, UK	Advanced genetic analysis, molecular and serological diagnostics of bluetongue	2019	2022
UK/ Defra	The Pirbright Institute, UK	Application of molecular and immunological diagnostics to the prevention and control of bluetongue virus and related orbiviruses	2022	2025
UK/ Defra and BBSRC	Animal and Plant Health Agency	TickTools: development of tools to monitor and control tick-borne diseases of humans and livestock	2023	2026
UK/ Defra and BBSRC	Animal and Plant Health Agency	Vector-borne RADAR (real-time arbovirus detection and response)	2023	2026

STAR-IDAZ – Annual state-of-the-art report on animal health research on IRC priorities – September 2023

Country/Funder	Main Research Institution	Research project	Start Year	End Year
UK/ Defra and BBSRC	Liverpool School of Tropical Medicine	Understanding, forecasting and mitigating zoonotic mosquito-borne viral disease in the UK	2023	2026
UK/ Defra and BBSRC	London School of Hygiene and Tropical Medicine	GenES_VBD network: Genomic epidemiology tools for the surveillance of vector-borne diseases network: applied to tick species, reservoirs and pathogens	2023	2026
UK/ Defra and BBSRC	UK Centre for Ecology and Hydrology	OpTick: One health surveillance and management of tick-borne disease threats in a changing environment	2023	2026
UK/ Defra and BBSRC	University of Glasgow, UK	Assessing the risk of mosquito vector-borne diseases in Scotland and their response to environmental change	2023	2026
UK/ Defra and BBSRC	University of Greenwich, UK	RCG One Health approach to tick-borne disease control through manipulation of reservoir host communities at landscape scale	2023	2026
UK/ Defra and BBSRC	University of Liverpool, UK	RCG Culex distribution, vector competence and threat of transmission of arboviruses to humans and animals in the UK	2023	2026
UK/ Natural Environment Research Council (NERC)	Tanzania Veterinary Laboratory Agency	Identifying inter-epizootic transmission routes of Rift Valley fever virus in Tanzania to inform targeted control strategies for outbreak response.	2022	2024
USA/ USAID	ILRI	Improvement of the sub-unit vaccines, Anti-sporozoite antibody-mediated vaccine solutions	2020	2025
USA/ USAID	Washington State University	AHIL - Animal Health Innovation Lab for East Coast fever control. Component: Generation of a live attenuated vaccine	2020	2025
USA/NSF-USDA-NIH Ecology and Evolution of Infectious Disease (EEID) program	Cirad	NIFNAF - Unravelling the Effect of Contact Networks & Socio-Economic Factors in the Emergence of Infectious Diseases at the Wild-Domestic Interface	2019	2024

5. Antimicrobial resistance – Alternative to Antibiotics (ATA)

Global network

Antimicrobial resistance was identified as one of the priority issues by the STAR-IDAZ IRC, and it was decided an international Working Group (WG) would be established to identify research gaps on this issue. Nevertheless, the topic is extremely broad and multifaceted, and many other initiatives already exist in this area (see below).

In order to ensure progress and avoid duplications, it was decided that the STAR-IDAZ IRC WG should focus on the development of alternatives to antibiotics (ATA), where R&D was still a major need for animal and one health, and global coordination was lacking.

The STAR-IDAZ IRC WG was established in 2019 to identify research needs to support the development of alternatives to antibiotics and the reduction/rationalisation of the use of antimicrobials in livestock. This will ultimately help in the development of new non-antibiotic-based antimicrobial products and approaches for controlling infections and enhancing productivity, while maximising the life of existing and new therapeutics.

The first physical meeting of the WG was held in Bangkok, Thailand in December 2019, back-to-back with the 3rd International Symposium on ATA. Participants completed a questionnaire beforehand, which formed the basis of discussion at the workshop. The questionnaire covered the research needs on four main areas:

1. Alternatives to antibiotics acting directly on the pathogen, including establishing their mode of action (focusing on phages)

2. Agents/compounds for their ability to enhance the hosts resistance to disease, including establishing their mode of action (focusing on immunomodulators)

3. Mode of action of antibiotics as growth promoters

4. Role of microbiome in the maintenance of health and how it might be manipulated.

For each topic, experts were asked to identify the main research questions, research needs, possible solution routes, and dependencies. Following the first workshop, the WG was divided into four subgroups focusing on: i) phages; ii) immunomodulators; iii) mode of action of antibiotics as growth promoters; and iv) the microbiota. Some experts are involved in multiple subgroups. A gap analysis and research roadmap workshop was planned alongside the annual meeting of the European Federation of Animal Science (EAAP) in Porto, Portugal in September 2020. However, when this was postponed and rescheduled as a virtual meeting, the STAR-IDAZ IRC decided to advance the work of the WG independently. Thus, three webinars were held in early October 2020 to progress the gap analysis and develop the draft roadmaps on microbiota, immunomodulators, and phages. To validate the roadmaps and open the discussions on how antibiotics function as growth promoters and how the marketability of ATA could be enhanced, STAR-IDAZ organised, in collaboration with the International Development research Centre (IDRC), five webinars that took place during October/November 2021:

- Alternatives to antibiotics acting directly on the pathogen, including establishing their mode of action (with a focus on phage technologies)

- Agents and compounds for their ability to enhance the host's resistance to disease, including establishing their mode of action, with a focus on immunomodulators

- The role of the microbiome in the maintenance of health, and how it can be manipulated

- How antibiotics work as growth promoters

- Taking new alternatives to antibiotics to market and the associated challenges.

Research 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 developed to link together the three roadmaps (see report: '**Research roadmaps development for alternative to Antibiotics'**). The document, outlines the process, the participative methods and the research roadmaps developed. A world café workshop to present the roadmaps and discuss American regional perspective was held back-to-back to the **2023 ALAM congress, Quito, Ecuador**. The event was co-organised with the **Tripartite EU-Americas AMR project**.

Additional initiatives

Some of the initiatives borne at international level to improve surveillance, foster behavioral change, research, education/awareness and steer political agendas are listed below.

AMR One Health quadripartite research agenda

The Quadripartite organisations have developed the **One Health Priority Research Agenda for AMR report**, this is a joint initiative to assist in directing and catalysing scientific interest and financial investments for the priority research agenda. The research agenda also serves as a guide to mitigate One Health AMR helping policymakers, researchers, and a multidisciplinary scientific community to work together on solutions to prevent and mitigate AMR within the One Health approach.

The research agenda focus on five pillars:

• Transmission

• Integrated surveillance

• Interventions

• Behavioural insights and change

• Economics and policy.

At the quadripartite agenda presentation, WOAH mentioned the STAR-IDAZ research roadmaps on ATA as an important complementary global research agenda for the animal health research sector.

Quadripartite Technical Group on Integrated Surveillance on Antimicrobial use and resistance

The Quadripartite organisations, made up of the Food and Agriculture Organization of the United Nations (FAO), United Nations Environment Programme (UNEP), World Health Organization (WHO), and the World Organisation for Animal Health (WOAH), have established the Quadripartite Technical Group on Integrated Surveillance on antimicrobial use and resistance.

Analysis of antimicrobial consumption and resistance ('JIACRA' reports)

The European Medicines Agency (EMA) with the European Food Safety Authority (EFSA) and the European Centre for Disease Prevention and Control (ECDC) joint forces to analyse the potential relationship between the consumption of antimicrobials by humans and animals and the occurrence of antimicrobial resistance. Annual **JIACRA reports** are delivered to better understand the occurrence of antimicrobial resistance across Europe and any trends occurring, providing valuable insights for policy-makers across the EU.

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.

STAR-IDAZ WG progress

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

DISCONTOOLS research needs

DISCONTOOLS does not cover antimicrobial resistance or alternatives to antibiotics as a separate topic, but disease specific information on effectiveness of control tools can be retrieved via targeted search in the **database**.

Recent developments

In situ, in vivo, and in vitro approaches for studying AMR plasmid conjugation in the gut microbiome.[25]

This article discusses the global threat of antimicrobial resistance (AMR) often driven by the transfer of antimicrobial resistance genes (ARGs) between bacteria, particularly via conjugative plasmids. The human gut microbiome, known as a hub for plasmid conjugation, plays a role in this spread. The article emphasises three approaches for studying plasmid transfer in the human gut: observing events in hospitalized patients; modeling the gut microbiome in rodents; and using in vitro models. Each approach offers unique insights into understanding plasmid transfer in the gut. The article concludes that utilising and advancing these methods, either individually or in combination, is crucial for gaining a better grasp of the importance, prevalence, and control of horizontal gene transfer in the gut microbiome.

Biosynthetic gene clusters from swine gut microbiome.[26]

Natural products from biosynthetic gene clusters (BGCs) represent promising therapeutic agents for animal and human health and have attracted interest from researchers due to their ability to participate in biofilm inhibition, stress resistance, and the killing of competitors. In this study, authors detected the presence of diverse secondary metabolite genes in porcine intestines through sequence alignment in the antiSMASH database. After comparing variations in microbial BGCs' composition between the ileum and the colon, it was found that the abundance of the resorcinol gene cluster was elevated in the ileal microbiome, whereas the gene cluster of arylpolyene was enriched in the colonic microbiome. The investigation of BGCs' diversity and composition differences between the ileal and colonic microbiomes provided novel insights into further utilising BGCs in livestock for swine health.

Polyphenolic phytochemicals as natural feed additives to control bacterial pathogens in the chicken gut.[27]

This article explores the potential of phytochemicals as alternatives to antibiotics for combating antibiotic resistance in poultry. The focus is on polyphenolic phytochemicals, including carvacrol oil, thymol oil, oregano oil, and tannins oil, which are used as feed additives. The paper examines how these compounds work to improve avian gut health and control the spread of antibiotic-resistant bacteria in poultry, particularly within *Escherichia coli, Salmonella, Campylobacter, Clostridium perfringens*.

---

25 Kessler, C., Hou J, Neo O., Buckner MM. (2023). In situ, in vivo, and in vitro approaches for studying AMR plasmid conjugation in the gut microbiome. Fems Microbiology Reviews 47(1). **https://doi.org/10.1093/femsre/fuac044**

26 Wang, L., Zhang, Y., Xu, J., Wang, C., Yin, L., Tu, Q., Yang, H., & Yin, J. (2023). Biosynthetic Gene Clusters from Swine Gut Microbiome. Microorganisms, 11(2), 434. **https://doi.org/10.3390/microorganisms11020434**

27 Al-Mnaser, A., Dakheel, M., Alkandari, F., & Woodward, M. (2022). Polyphenolic phytochemicals as natural feed additives to control bacterial pathogens in the chicken gut. Archives of Microbiology, 204(5), 253. **https://doi.org/10.1007/s00203-022-02862-5**

An overview of the use of bacteriophages in the poultry industry: successes, challenges, and possibilities for overcoming breakdowns.[28]

This review discusses the advantages, difficulties, and current constraints of bacteriophage applications in the poultry industry. Bacteriophages are being explored as an alternative to antibiotics in the poultry sector. Their high specificity enables them to target specific bacterial pathogens in infected animals. Combining different bacteriophages could enhance their effectiveness against multiple clinical strains. Bacteriophages can reduce bacterial contamination in animals and serve as safe disinfectants in industrial settings on surfaces and poultry carcasses. However, challenges related to resistance, safety, specificity, and stability need to be addressed before bacteriophage therapies can be widely adopted.

Probiotic *Bacillus* strains enhance T Cell responses in chicken.[29]

Researchers used a previously established in vitro system using peripheral blood mononuclear cells (PBMCs) to study the effects of immune-modulating feed additives. They evaluated how two probiotic *Bacillus* strains, *B. subtilis* DSM 32315 (BS) and *B. amyloliquefaciens* CECT 5940 (BA), affect immune responses. In the case of vital BS, the count of T-helper cells and activated T-helper cells increased after treatment (CD4+: $p<0.05$; CD4+CD25+: $p<0.01$) in a 1:3 ratio (PBMCs: Bacillus). Moreover, Vital BS also enhanced the proliferation and activation of cytotoxic T cells (CD8+: $p<0.05$; CD8+CD25+: $p<0.05$). Cell-free culture supernatants of BS increased the count of activated T-helper cells (CD4+CD25+: $p<0.1$). UV-inactivated BS significantly increased the proportion of cytotoxic T cells (CD8+: $p<0.01$), suggesting surface contact stimulation. However, no effect on B cells was observed after BS treatment. For vital BA, treatment in a 1:3 ratio (PBMCs: *Bacillus*) led to an increase in T-helper cells and activated T-helper cells (CD4+: $p<0.01$; CD4+CD25+: $p<0.05$). Cell-free culture supernatants and UV-inactivated BA had no effect on T cell proliferation and activation, nor on B cells. In conclusion, both *Bacillus* strains (BS and BA) enhanced T cell activation and proliferation in the studied in vitro model, indicating an immune-modulating effect on chicken immune cells.

Highly different effects of phage therapy and antibiotic therapy on immunological responses of chickens infected with *Salmonella enterica serovar Typhimurium*.[30]

This study aimed to compare the effects of bacteriophages and commonly used antibiotics (enrofloxacin and colistin) on immune functions in chickens infected with *Salmonella enterica serovar Typhimurium*. Thus, chickens were infected with *S. Typhimurium* and treated with a phage cocktail (14 days), enrofloxacin (5 days), or colistin (5 days). Various immune parameters were measured, including pro-inflammatory cytokine levels (IL-1β, IL-6, IFN-γ, IL-8, and IL-12), anti-inflammatory cytokines (IL-10 and IL-4), lymphocyte percentages, and stress hormone levels (corticosterone and cortisol). The phage cocktail showed anti-inflammatory effects when administered either 1 day after infection or 2 days after detecting *S. Typhimurium* in faeces. This was evidenced by reduced levels of pro-inflammatory markers and increased levels of anti-inflammatory cytokines after phage therapy. Additionally, phages did not negatively impact key immune cell subpopulations' numbers and activity.

28 Abd-El Wahab, A., Basiouni, S., El-Seedi, H. R., Ahmed, M. F. E., Bielke, L. R., Hargis, B., Tellez-Isaias, G., Eisenreich, W., Lehnherr, H., Kittler, S., Shehata, A. A., & Visscher, C. (2023). An overview of the use of bacteriophages in the poultry industry: Successes, challenges, and possibilities for overcoming breakdowns. Frontiers in microbiology, 14, 1136638. **https://doi.org/10.3389/fmicb.2023.1136638**

29 Larsberg, F., Sprechert, M., Hesse, D., Loh, G., Brockmann, G. A., & Kreuzer-Redmer, S. (2023). Probiotic Bacillus Strains Enhance T Cell Responses in Chicken. Microorganisms, 11(2), 269. **https://doi.org/10.3390/microorganisms11020269**

30 Grabowski, Ł., Węgrzyn, G., Węgrzyn, A., & Podlacha, M. (2022). Highly different effects of phage therapy and antibiotic therapy on immunological responses of chickens infected with Salmonella enterica serovar Typhimurium. Frontiers in immunology, 13, 956833. **https://doi.org/10.3389/fimmu.2022.956833**
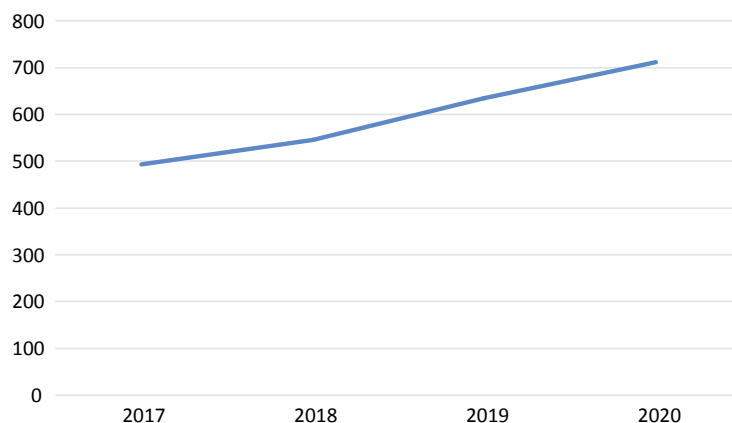
Trends in published research

Total records &
Main topics

Country/ Region of first
Author (2017/2022)

Asia and Australasia | Europe | Americas | Africa & Middle East
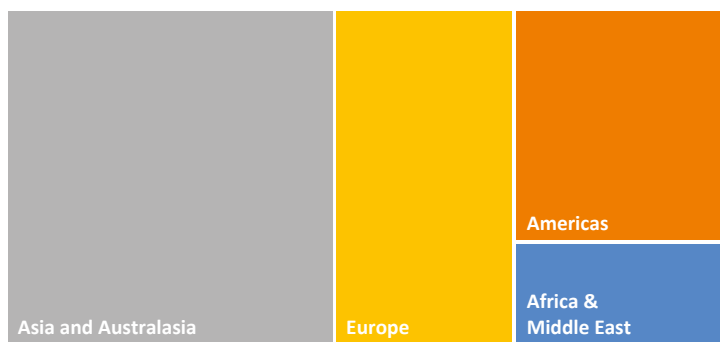
Ongoing research

Non-exhaustive list of ongoing projects on AMR & ATA funded by STAR-IDAZ IRC and STAR-IDAZ Network Members:

Country/ Funder	Main Research Institution	Research project	Start Year	End Year
Argentina/ FONCYT	INTA	PICT-2021-GRF-TII-00416 - Characterisation of a peptidoglycan hydrolase enzyme and evaluation of its possible bacteriolytic activity against pathogens of veterinary interest	2023	2027
Argentina/INTA	INTA	2023-PD-L06-I115 - Antimicrobial resistance and development of alternatives that minimise the use of antibiotics and antiparasitics for a more sustainable animal production	2023	2027
Belgium/BOF	UGent	BOF.DCV.2022.0016.02 - Bacteriophages and probiotic *Bacillus spp.* strains against *Aeromonas hydrophila* in Tilapia in Uganda	2023	2025
Belgium/FOD	UGent	ChlapeControl - Research towards the prophylaxis of *Chlamydia psittaci* and avian pathogenic *Escherichia coli* in poultry	2022	2025
Belgium/FOD	UGent	LactoPigHealth - PigHealth: control of weaning diarrhoea in piglets and reduction of antibiotic use	2017	2021

Country/ Funder	Main Research Institution	Research project	Start Year	End Year
Belgium/FPS Health, Food chain safety and Environment	ILVO UCLouvain	AMRESMAN - Antibiotic residues, antibiotic resistant bacteria and antibiotic resistance genes in manure, soil and plant and the possible human exposure	2017	2021
Belgium/FPS Health, Food chain safety and Environment	KU Leuven UGent University of Liège Sciensano	SalmiPIG - Salmonella biofilm formation in chronic carrier pigs: impact on gut colonization, genetic markers for functional diagnostics and potential as target for non-antibiotic therapy	2021	2025
Belgium/FPS Health, Food chain safety and Environment	Sciensano UGent University of Liège	PET-AMR – 'One Health' implications of the use of antibacterial agents in pet animals	2021	2024
Belgium/FPS Health, Food chain safety and Environment	UGent	GROUPMEDIPOUL - On-farm homogeneity, stability, interactions and cross-contamination of antimicrobial drugs mixed in drinking water for group treatment of poultry, and relation with plasma concentrations	2021	2023
Belgium/FPS Health, Food chain safety and Environment	UGent	LactoPigHealth - The use of lactoferrin to combat post-weaning diarrhoea in pigs and reduce antibiotic usage	2018	2021
Belgium/FPS Health, Food chain safety and Environment	UGent	RATIOSEP - Rationalising the use of antimicrobial agents of critical importance for treating sepsis in domestic animals using predictive models, biomarkers and rapid microbial identification with MALDI-TOF MS	2021	2024
Belgium/FPS Health, Food chain safety and Environment	UGent Sciensano	FLUPOUL - Researching the causes of the high prevalence of fluoroquinolone resistance in broilers	2019	2023
Belgium/FPS Health, Food chain safety and Environment	UGent Sciensano	MALDIRESP - Rapid antimicrobial susceptibility testing using MBT-ASTRA in bacterial pathogens from lung and udder in cattle	2017	2021
Belgium/FPS Health, Food chain safety and Environment	UGent Sciensano DGZ Vlaanderen Poulpharm AMCRA DIALAB University of Liège Arsia	AB-changeR - Effect of altered antimicrobial use in food-producing animals on antimicrobial resistance in selected animal and human pathogens: looking back to go further (lessons learned, challenges remaining)	2022	2024
Belgium/FPS Health, Food chain safety and Environment	UGent University of Liège	NASPROTECT - Probiotic protection against mastitis in dairy cows by bovine-associated non-aureus staphylococci	2023	2027
Belgium/FPS Health, Food chain safety and Environment	University of Liège ARSIA	RU-BLA-ESBL-CPE - Emergence or decline of classical beta-lactamases (BLAC), of cephalosporinases (BLAAmpC), of extended spectrum beta-lactamases (BLAESBL), and of carbapenemases (BLACPE) amongst coliform enterobacteria from bovines: encoding gene identification and antibody neutralisation	2017	2021

Country/ Funder	Main Research Institution	Research project	Start Year	End Year
Belgium/FWO	UGent	FWO PDO156-18 - Innate immune memory in shrimp and epigenetic regulation	2018	2022
Belgium/UGent IOF	UGent	CLEVERNAS - Clever use of non-aureus staphylococci in prevention and control of bovine mastitis	2021	2024
Belgium/UGent IOF	UGent	F2020/IOF-ConcTT/045 - Use of noval anti-microbial compounds against microbial infections in crustaceans	2020	2022
Canada/IDRC	ILRI	Using Phages for the replacement of antibiotics, and reduction of drug resistant nontyphoidal Salmonella, in poultry farms in Kenya	2019	2023
Canada/IDRC	ILRI	Using Phages for the replacement of antibiotics, and reduction of drug resistant nontyphoidal Salmonella, in poultry farms in Kenya	2019	2023
EU/ ICRAD Joint Cofund call	Teagasc	**BM-FARM**- Biomarkers and Microbiome in Farms for Antimicrobial Resistance Management	2021	2024
France/ Allemagne/ANR France -ANR Allemagne	INP Greifswald / Université d'Orléans	PLASFECT - Medical Gas Plasma Technology Against Antibiotic-resistant Bacteria infecting Wounds	2021	2024
France/ANR	INRAE	EcoSA-2021 - Ecosystem-based control of *Staphylococcus aureus* mastitis in dairy farms	2021	2024
Global/CRP	ILRI	AMR - Comparative analysis of wild and domestic pig microbiome and possible implications in animal health	2021	2022
Italy/Italian Ministry of Health	IZS AM	DeARM-WATER - DEvelopment of an optimised Antimicrobial Resistance Monitoring strategy for wastewaters	2023	2026
Italy/Italian Ministry of Health	IZS ME	APACHE - Use of antimicrobial peptides in ready-to-eat foods: a 'green' approach to counter the risks of microbiological contamination and to reduce its impact on public health	2022	2024
Italy/Italian Ministry of Health	IZS ME	Molecular characterisation and antibiotic resistance (AMR) of *Staphylococcus aureus* strains isolated during buffalo mastitis in Campania	2021	2023
Italy/Italian Ministry of Health	IZS PB	Environmental monitoring of antibiotic resistance through the isolation of AMR bacteria in the microbiota of wild animals	2022	2024
Italy/Italian Ministry of Health	IZS PB	Study of virulence and antibiotic resistance genes of *Bacillus anthracis* strains by Whole Genome Sequencing (WGS)	2022	2024
Italy/Italian Ministry of Health	IZS SA	Comparison between conventional and organic pig breeding in drug management and prevention techniques for the spread of pathogenic and antimicrobial resistant bacteria	2022	2024
Italy/Italian Ministry of Health	IZS SA	Development, set up and validation of a multiclass/ multiresidue confirmation method, using the UPLCHRMS technique, for the determination of antibiotic residues in milk	2021	2023
Italy/Italian Ministry of Health	IZS SA	Implementation of a surveillance system of antimicrobial resistance (AMR) in bacteria of veterinary origin with particular attention to zoonotic ones	2021	2023

Country/ Funder	Main Research Institution	Research project	Start Year	End Year
Italy/Italian Ministry of Health	IZS SI	Innovative methods for the assessment of endemic, emerging (AMR) and chemical infectious risks in rural areas with a livestock vocation: human-zootechnical-wildlife interaction	2021	2023
Italy/Italian Ministry of Health	IZS UM	Persistence of antibiotic-resistant and potentially toxigenic *Staphylococcus aureus* in the sheep and goats supply chain in the Umbria-Marche area: an integrated approach from a 'One Health' perspective	2022	2024
Italy/Italian Ministry of Health	IZS UM	Reduction and control of antimicrobial resistance (AMR) through the development, fine-tuning and validation of new bacterial, viral, protozoal and fungal veterinary vaccines (BVPF); mono and multi-valent formulated with innovative adjuvants	2022	2024
Italy/Italian Ministry of Health	IZS UM	Study, development and validation of new veterinary vaccines developed with innovative immunomodulatory molecules of natural and synthetic origin in order to reduce the use of antibiotics and effectively combat the phenomenon of antimicrobial resistance (AMR)	2021	2023
Italy/Italian Ministry of Health	IZS UM	WildSENTINEL-2021 - Use of wildlife as an environmental sentinel: monitoring of antimicrobial resistance and environmental contamination in the territories of Campania, Umbria and Marche	2021	2023
Netherland/ Ministry LNV	WBVR	Projectcode: KB-37-003-054. - Projectcode: KB-37-003-054 AMR analyse	2022	2024
Norway/ Norwegian Agency for Development Cooperation (NORAD)	NVI	Malawi-Ethiopia-OneHealth - One Health – controlling zoonotic diseases and AMR in the milk value chain in Ethiopia and Malawi	2022	2026
Norway/ Research Council of Norway	Institute for Rural and Regional Research (Ruralis; coordinator), NVI	LIMBO - Evaluating emerging AMR threats and future capacity for action in Norwegian livestock agriculture	2021	2024
Norway/ Research Council of Norway	NVI	ICONIC - Ionophore coccidiostats: risk of CO-selectioN of antImicrobial resistance - Clinical impact and intervention strategies	2021	2025
Norway/ Research Council of Norway	NVI	Navazole - Navigating the threat of azole resistance development in human, plant and animal pathogens in Norway	2021	2026
Norway/ Research Council of Norway	NVI	PHAGE-EX - Use of phage applications to combat MRSA at the sow-piglet interface to reduce exposure of staff and contamination of the environment	2022	2025
Spain/ National Research Agency	Agencia Estatal Consejo Superior de Investigaciones científicas (CSIC)-Centro Nacional de Biotecnologia (CNB)	Physiological and evolution-based approaches for tackling antibiotic resistance	2021	2024

Country/ Funder	Main Research Institution	Research project	Start Year	End Year
Spain/ National Research Agency	Agencia Estatal Consejo Superior de Investigaciones científicas (CSIC)- Centro de Investigaciones Biologicas Margarita Salas (CIB)	Structural and functional analysis of macromolecular switches involved in horizontal gene transfer and antibiotic resistance dissemination	2021	2024
Spain/ National Research Agency	Agencia Estatal Consejo Superior de Investigaciones científicas (CSIC)- Instituto de Quimica Fisica Rocasolano (IQFR)	Structure, dynamics and regulation of bacterial cell wall. Implications in antibiotics resistance	2021	2024
Spain/ National Research Agency	Fundacion Universitaria San Pablo CEU.- Facultad de Veterinaria	Evaluation of the use of probiotics and bioactive peptides against genital tract and mammary gland infections caused by *Mycoplasma agalactiae*	2021	2024
Spain/ National Research Agency	IRTA	Fecal microbiota transplantation as an alternative to antimicrobials for the prevention of enteric diseases caused by *Escherichia coli* and salmonella in pigs	2022	2025
Spain/ National Research Agency	Universidad Complutense De Madrid (UCM).-VISAVET	Dynamics of transmission of antimicrobial resistance at the human-animal interface: delimiting the risk due to epidemic plasmids	2022	2025
Spain/ National Research Agency	Universidad de Extremadura.-Facultad de Verinaria	Reducing antimicrobial resistance in zoonotic enterobacteria	2021	2024
Spain/ National Research Agency	Universidad de Sevilla. Facultad de Farmacia	Antibiotic resistance mediated by non-genetic mechanisms in *Enterobacteriaceae*	2021	2024
UK/Defra	APHA	Phage Therapy to Reduce AMR Enterobacteria Spread from a One Health Perspective	2022	2025
UK/Defra	APHA	Study of the effect of livestock industry biosecurity and hygiene measures on the occurrence and control of antimicrobial resistance	2021	2025
UK/Defra	The Food and Environment Research Agency (FERA)	Antimicrobials in Poultry Faeces	2023	2023
USA/USDA NIFA	Board of Regents of the University of Nebraska	AMR - Identifying AMR gene reservoirs and bacterial host-AMR gene associations to identify bacterial host range of AMR genes in swine production systems	2023	2027
USA/USDA NIFA	Cornell University	AMR - Assessment Of Resistance To Colicinogenic Synthetic Phage Antimicrobial System	2022	2023

Country/Funder	Main Research Institution	Research project	Start Year	End Year
USA/USDA NIFA	Iowa State University of Science and Technology	AMR - CAMRADES Connecting AntiMicrobial Resistance, Agricultural Decisions, and Environmental Systems	2022	2027
USA/USDA NIFA	Iowa State University of Science and Technology	AMR - Improving Antimicrobial Resistance Science Communication Education for Veterinary Students	2022	2025
USA/USDA NIFA	Iowa State University of Science and Technology	AMR - Promoting Interprofessional One Health Education as a means of mitigating antimicrobial resistance across the food chain	2022	2022
USA/USDA NIFA	Iowa State University of Science and Technology	AMR - Role of Dietary Short Chain Fatty Acids On Inhibition of Antimicrobial Resistance Transfer In The Gut of Poultry	2022	2024
USA/USDA NIFA	Kansas State University	AMR - BATTLE: BAlancing Therapeutic efficacy with anTimicrobial resistance in feedLot cattlE	2023	2026
USA/USDA NIFA	Mississippi State University	AMR - Trans-cinnamaldehyde as an antimicrobial feed additive to control and prevent enteric septicemia of catfish	2022	2025
USA/USDA NIFA	Ohio State University, the	AMR - Deciphering the Environmental Sources and Genetic Basis of Antifungal Resistant *Aspergillus fumigatus*	2022	2025
USA/USDA NIFA	Ohio State University, the	AMR - Mitigating Antimicrobial Resistance in the Male Dairy Calf Production System	2022	2026
USA/USDA NIFA	Pennsylvania State University, the	AMR - Mitigating Antimicrobial Resistance In The Puerto Rico Dairy Chain Through Research, And Training Of Farmers And Next-Generation Scientists	2023	2027
USA/USDA NIFA	Pennsylvania State University, the	AMR - rhAMR: A comprehensive and cost-effective method refined and applied to understand the impact of feed additives on antimicrobial resistance	2023	2028
USA/USDA NIFA	University of Chicago, the	AMR - The Economic Disamenities and Health Impacts of Animal Feeding Operation Practices in the United States	2022	2025
USA/USDA NIFA	University of Connecticut	AMR - Reducing antimicrobial resistance dissemination in broiler chickens using phytochemicals	2022	2022
USA/USDA NIFA	University of Florida	AMR - Integrated Weed Management Programs For Tomato Using AI Machine Vision And Georeferenced Weed Mapping To Reduce Herbicide Inputs	2022	2024
USA/USDA NIFA	Virginia State University	AMR - AMR in Small Ruminant Agro-systems	2022	2025

6. Influenza

In May 2023, STAR-IDAZ IRC published research roadmaps on influenza for **control strategies**, **diagnostic** and **vaccine** development. Moreover an **executive summary of research gaps** is available on STAR-IDAZ website.

Around 60 international experts supported the development of research roadmaps for control strategies, diagnostics and vaccine development for influenza. In particular, **three workshops** were held online the 30th and 31st of January and 1st of February 2023 to finalise the research roadmaps highlighting the steps that need to be taken to focus the research efforts where it is most needed to improve efficiency in response to future outbreaks. The roadmaps are based on research gaps identified during 2022 and 2021.

In 2021, STAR-IDAZ IRC, in collaboration with USDA-ARS, commissioned an **influenza review on Animal influenza** that reports what has been achieved by global research since the previous gap analysis and related activities carried out by USDA in 2013, OFFLU in 2014, by the EC in 2015 and by WHO in 2016 and 2017. The review includes information on avian, swine, equine and other influenza viruses of veterinary interest. By incorporating research updates and input from leading scientists in the field, the influenza research review report represents a picture of animal influenza research around the world, enriched by the first-hand knowledge of those working at its cutting edge. The findings of the report fed into a gap analysis workshop held on the 14-15th of June 2022 at the National Animal Disease Centre in Ames, Iowa, organised by USDA in collaboration with STAR-IDAZ IRC. Expert opinions and the review of recent and current research and control measures, alongside knowledge of on-the-ground countermeasures (both in use and under development) and their efficacy, were used in identifying the critical knowledge gaps fundamental to the development of research roadmaps.

Global network: OFFLU

Website: https://www.offlu.org/

	Partners ca.	**Budget** NA	**Start date:** 2006
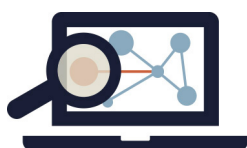
Overview

OFFLU is the joint WOAH-FAO global network of expertise on animal influenzas. It was established in 2006, initially to support the global effort to control H5N1 highly pathogenic avian influenza. Now OFFLU is a strong and functional network of world leading experts from WOAH and FAO Reference Laboratories and Collaborating Centres, and from other institutes with leading expertise in diagnostics, epidemiology, bioinformatics, vaccinology, and animal production.

To date, technical activities of OFFLU have delivered guidance on diagnostic protocols, antigenic matching of vaccine strains with circulating field viruses, minimum biosafety guidelines for laboratory workers, and strategic guidance on animal influenza surveillance.

Aims

Aim: to reduce negative impacts of animal **influenza viruses** by promoting effective collaboration between **animal health** experts and with the human health sector.

Objectives & Activities:	• To share and offer technical advice, training and veterinary expertise to international organisations and Member Countries to assist in the prevention, diagnosis, surveillance and control of animal influenza
	• • To exchange scientific data and biological materials (including virus strains) within the network, to analyse such data, and to share such information with the wider scientific community
	• • To collaborate with the WHO on issues relating to the animal-human interface, including pandemic preparedness for early preparation of human vaccine
	• • To highlight influenza surveillance and research needs, promote their development and ensure co-ordination.

News	The OFFLU Steering and Executive Committee met virtually in October 2022 to review the progress in the work plan of OFFLU technical activities, focusing on avian, swine, equine and wildlife influenza, proficiency testing, influenza real time antigenic characteristics, vaccine composition, One Health activities,
	The OFFLU annual report 2022 with details on the activities listed above can be found **here**, while the last update (June 2023) on global AIV with zoonotic potential can be found here.
	Some OFFLU experts participated in the **STAR-IDAZ workshops** for developing research roadmaps and in the **WOAH Animal Health Forum** held during WOAH's recent 90th General session. One of the approved resolution of the 90th WOAH GS **(18/2023 Resolution)** states: 'WOAH, its Members and the private sector support research alliances and global research coordination mechanisms (e.g. STAR-IDAZ, WHO Public Health Research Agenda, OFFLU) to generate scientific knowledge using interdisciplinary approaches and tools, including the development, testing, production and approval of effective vaccines to contribute to the successful control of HPAI.'

STAR-IDAZ WG progress

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

DISCONTOOLS research needs

Avian Influenza

Avian influenza (AI) is caused by infection of birds with avian influenza type A viruses (AIV). These viruses occur naturally among wild aquatic birds worldwide and can infect domestic poultry and other bird and animal species. Wild aquatic birds can be infected with AI A viruses in their intestines and respiratory tract, but usually do not get sick. AI viruses are classified into low (LPAI) and highly pathogenic (HPAI) phenotypes. HPAI viruses have been eradicated from domesticated poultry in many countries but eradication of HPAIV on a global scale is not expected as pockets of endemic infection continue to exist. LPAI virus strains are found worldwide, whilst AI infections are widely distributed in aquatic wild bird populations. The majority of infections are acute and asymptomatic. Faecal-oral transmission chains dominate. The environment (surface water, sediments) probably acts as an important factor of virus perpetuation. Incidence of infection is cyclic in the natural hosts and peak values correlate with autumn migration of aquatic wild birds in the northern hemisphere. Main critical research needs include:

- Research to fill gaps in relation to pathogenesis, immunology, vaccinology, epidemiology and control
- Cheap, stable and sensitive tests which allow high-throughput generic and subtype-specific multiplex serological screening
- Rapid and sensitive methods of assessing infectious status of flocks
- Easy to apply, single dose, cheap, marker vaccines that induce clinical broad protection and bring virus shedding to a minimum. Further development of recombinant vaccines is required.

Recent developments

Highly pathogenic avian influenza A(H5N1) virus infection in farmed minks, Spain, October 2022.[31]

This article reports the first outbreak of clade 2.3.4.4b HPAI H5N1 virus infection of minks farmed for their fur in Europe, occurred in Spain in October 2022. Some weeks before the outbreak, several cases of HPAI H5N1 were reported in wild birds found sick or dead (25 common gannets -*Morus bassanus*- and two gulls -*Larus michaelis*) along the nearby coasts in Galicia. The identified virus in the minks presents the highest similarity with strains of the A/gull/France/22P015977/2022-like genotype. The increasing number of sick animals after the identification of the outbreak suggests also an onward mink transmission in the farm. Moreover, an uncommon mutation on the amino acid 271A of PB2 gene was found that could have a potential public health implications.

Evaluation of three hemagglutinin-based vaccines for the experimental control of a panzootic clade 2.3.4.4b a(H5N8) high pathogenicity avian influenza virus in mule ducks.[32]

During winter 2016-2017, 487 outbreaks of clade 2.3.4.4b H5N8 subtype high pathogenicity (HP) avian influenza A virus (AIV) infections were detected in poultry and captive birds in France. To investigate how to possibly protect mule ducks against HPAIV A/decoy duck/France/161105a/2016 (H5N8), three vaccines were evaluated in controlled conditions. The first experimental vaccine was derived from the haemagglutinin gene of another clade 2.3.4.4b A(H5N8) HPAIV (Vac1), the second vaccine (Vac2) was a commercial bivalent adjuvanted vaccine containing an expressed haemagglutinin modified from a clade 2.3.2 A(H5N1) HPAIV, the third experimental vaccine (Vac3) also incorporated a homologous 2.3.4.4b H5 HA gene. Post-challenge virus excretion was monitored in vaccinated and control birds every 2-3 days for 2 weeks using real-time reverse-transcription polymerase chain reaction and serological analyses (haemagglutination inhibition test against H5N8, H5 ELISA and AIV ELISA) were performed. Vac1 abolished oropharyngeal and cloacal shedding to almost undetectable levels, whereas Vac3 abolished cloacal shedding only (while partially reducing respiratory shedding) and Vac2 only partly reduced the respiratory and intestinal excretion of the challenge virus. The study provided relevant insights in the immunogenicity of recombinant H5 vaccines in mule ducks, that has played a critical role in the recent H5 HPAI epizootics in France.

31 Agüero, M., Monne, I., Sánchez, A., Zecchin, B., Fusaro, A., Ruano, M. J., Del Valle Arrojo, M., Fernández-Antonio, R., Souto, A. M., Tordable, P., Cañás, J., Bonfante, F., Giussani, E., Terregino, C., & Orejas, J. J. (2023). Highly pathogenic avian influenza A(H5N1) virus infection in farmed minks, Spain, October 2022. Eurosurveillance, 28(3), 2300001. **https://doi.org/10.2807/1560-7917.ES.2023.28.3.2300001**

32 Niqueux, É.; Flodrops, M.; Allée, C.; Lebras, M. O.; Pierre, I.; Louboutin, K.; Guillemoto, C.; Prioux, A. le; Bouquin-Leneveu, S. le; Keïta, A.; Amelot, M.; Martenot, C.; Massin, P.; Cherbonnel-Pansart, M.; Briand, F. X.; Schmitz, A.; Cazaban, C.; Dauphin, G.; Delquigny, T.; Lemière, S.; Watier, J. M.; Mogler, M.; Tarpey, I.; Grasland, B.; Eterradossi, N. (2023) Evaluation of three hemagglutinin-based vaccines for the experimental control of a panzootic clade 2.3.4.4b a(H5N8) high pathogenicity avian influenza virus in mule ducks. Vaccine, Vol. 41, No. 1, pp. 145-158

Generation of an avian influenza DIVA vaccine with a H3-peptide replacement located at HA2 against both highly and low pathogenic H7N9 virus.[33]

This study reports the development of a promising differentiating infected from vaccinated animals (DIVA) vaccine. A DIVA vaccine strain, named rGD4HALo-mH3-TX, was successfully developed against both high and low pathogenic H7N9 subtype AIV, based on a substituted 12 peptide of H3 virus located at HA2. The multi-basic amino acid located at the HA cleavage site was modified, and six inner viral genes from a H9N2 AIV TX strain were introduced respectively to meet safety requirement and for increasing viral production. In immunised chickens, rGD4HALo-mH3-TX induced a similar antibody level with rGD4 and provided 100% clinical protection and 90% shedding protection against highly pathogenic virus challenge. Moreover, rGD4HALo-mH3-TX strain also showed good cross-protection against low pathogenic AIV JD/17. Serological DIVA characteristics were also developed by the successful establishment of a competitive inhibition ELISA based on a 3G10 monoclonal antibody, and the results showed a strong reactivity with antisera of chickens vaccinated with H7 subtype strains but not rGD4HALo-mH3-TX.

Human immunity and susceptibility to Influenza A(H3) Viruses of avian, equine, and swine origin.[34]

Authors selected four avian, one equine, and three swine influenza A viruses (IAVs) representing major H3 lineages to determine human risk. Human immunity against these virus could be limited IAVs of subtype H3 that infect humans are antigenically divergent from those of birds, horses, and swine. Thus authors tested serum collected during 2017-2018 from 286 persons in Belgium for haemagglutination inhibiting antibodies and virus neutralising antibodies against animal-origin IAVs. Moreover they tested replication in human airway epithelia. Seroprevalence rates for circulating IAVs from swine in North America were >51%, swine in Europe 7-37%, and birds and equids ≤12%, and a replication efficiency for cluster IV-A IAVs from swine in North America and IAVs from swine in Europe, intermediate for IAVs from horses and poultry, and absent for IAVs from wild birds and a novel human-like swine IAV in North America, authors concluded that the public health risk may be highest for swine H3 IAVs.

Has epizootic become enzootic? Evidence for a fundamental change in the infection dynamics of highly pathogenic avian influenza in Europe, 2021.[35]

The article discusses the emergence of highly pathogenic avian influenza (HPAI) virus subtype H5N1, clade 2.3.4.4b, observed in European wild birds and poultry since October 2021. The phylogenetic evidence suggests the presence of at least two distinct reservoirs for the virus. Two hypotheses are proposed for the emergence: (i) resident viruses have been maintained in northern Europe throughout summer 2021, contributing to the autumn/winter 2021 epizootic; or (ii) virus variants were reintroduced by migratory birds, leading to the reemergence. These sources of reintroduction are distinguished by their haemagglutinin genes (sublineages B1 and B2) and internal gene compositions. The circulation of enzootic HPAI viruses during summer 2021, suggests a potential shift in HPAI epidemiology in Europe. The article also discusses the genetic diversity and distribution of the H5N1 virus sublineages in various bird species and regions.

33 Li Gang; Feng Juan; Quan KeJi; Sun ZhiHao; Yin YunCong; Yin YinYan; Chen SuJuan; Qin Tao; Peng DaXin; Liu XiuFan ; 2022. Generation of an avian influenza DIVA vaccine with a H3-peptide replacement located at HA2 against both highly and low pathogenic H7N9 virus. Virulence , Vol. 13 , No. 1 , pp. 530-541. https://doi.org/**10.1080/21505594.2022.2040190**

34 Vandoorn, E., Stadejek, W., Leroux-Roels, I., Leroux-Roels, G., Parys, A., & Van Reeth, K. (2023). Human Immunity and Susceptibility to Influenza A(H3) Viruses of Avian, Equine, and Swine Origin. Emerging infectious diseases, 29(1), 98–109. **https://doi.org/10.3201/eid2901.220943**

35 Pohlmann, A.; King, J.; Fusaro, A.; Zecchin, B.; Banyard, A. C.; Brown, I. H.; Byrne, A. M. P.; Beerens, N.; Liang Yuan; Heutink, R.; Harders, F.; James, J.; Reid, S. M.; Hansen, R. D. E.; Lewis, N. S.; Hjulsager, C.; Larsen, L. E.; Zohari, S.; Anderson, K.; Bröjer, C.; Nagy, A.; Savič, V.; Borm, S. van; Steensels, M.; Briand, F. X.; Swieton, E.; Smietanka, K.; Grund, C.; Beer, M.; Harder, T., 2022. Has epizootic become enzootic? Evidence for a fundamental change in the infection dynamics of highly pathogenic avian influenza in Europe, 2021. mBio , 13(4), e0060922. **https://doi.org/10.1128/mbio.00609-22**

RT-LAMP as diagnostic tool for influenza-A virus detection in swine.[36]

This study describes the use of a reverse transcription loop-mediated isothermal amplification (RT-LAMP) for detecting the influenza A virus in swine. Researchers designed specific LAMP primers based on the virus' matrix (M) gene sequences. The assay detected the M gene with a limit of detection of 20 gene copies for direct LAMP, 100 copies using extraction kits, and 1000 copies in cell culture samples. A sensitivity of 94.3% and a specificity of 94.9% were demonstrated. Authors conclude that RT-LAMP assay has potential as a cost-effective and rapid diagnostic tool for influenza A virus detection in swine, suitable for farm or clinical settings.

Trends in published research

Total records & Main topics
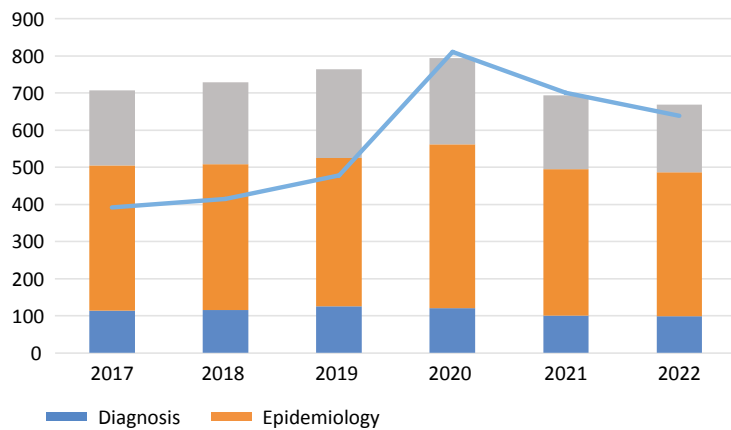
Country/ Region of first Author (2017/2022)

36 Storms, S. M., Shisler, J., Nguyen, T. H., Zuckermann, F. A., & Lowe, J. F. (2023). RT-LAMP as Diagnostic Tool for Influenza-A Virus Detection in Swine. Veterinary sciences, 10(3), 220. https://doi.org/10.3390/vetsci10030220

Ongoing research

Non-exhaustive list of ongoing projects on influenza funded by STAR-IDAZ IRC and STAR-IDAZ Network Members:

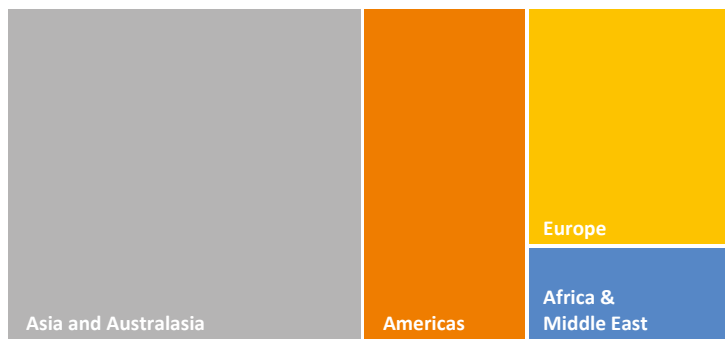| Country/Funder	Main Research Institution	Research project	Start Year	End Year
Belgium/FPS Health, Food chain safety and Environment	Sciensano	EMERDIA-H5 II - Development of experimental models to better understand the biology of recent highly pathogenic avian influenza (HPAI) H5Nx viruses and to improve their detection and control	2019	2022
Belgium/FPS Health, Food chain safety and Environment	Sciensano ULB	FLUCART - New mapping of sensitive natural areas in Belgium and dynamics of exposure of industrial and hobby poultry farms to low and highly pathogenic influenza viruses (AIv)	2023	2025
Belgium/FPS Health, Food chain safety and Environment	UGent	mRNAVIFLUE - Design and in vivo evaluation of a self-amplifying mRNA vaccine against influenza A virus in poultry	2023	2027
China/Ministry of Science and Technology	Harbin Veterinary Research Institute, CAAS	Epidemiology and trasmission of Influenza of animal	2021	2025
EU/EC	FLI (Germany) as coordinator UGent	**DELTAFLU** - Dynamics of avian influenza in a changing world	2017	2022
EU/EC	Friedrich Loeffler Institut	**KAPPA-FLU** - Ecology and biology of HPAIV H5	2023	2027
EU/EC	Norwegian Institute of Public Health (NIPH; coordinator), NVI	**UNITED4S** - Union and National Capacity Building 4 IntegraTED Surveillance	2023	2024
EU/ICRAD Joint Cofund call	French Agency for Food, Environmental and Occupational Health & Safety	**PIGIE** - Understanding the dynamics and evolution of swine influenza viruses in Europe: relevance for improved intervention and sustainable pig production	2021	2024
EU/ICRAD Joint Cofund call	INRAE / University of Liège	**PREVENTER** - Deciphering the role of influenza D virus in bovine and human respiratory diseases in Europe	2021	2024
EU/ICRAD Joint Cofund call	Danish technical University	**POC4AIV** - Preventing zoonoses by screening Avian Influenza Virus (AIV) in wildlife birds and poultry using a novel rapid point of care system	2023	2025
EU/ICRAD Joint Cofund call	Royal GD	**ICRAD-FluNuance** - Virulent Non-Notifiable Avian Influenza; Determinants of virulence of emerging viruses	2021	2024
EU/ICRAD Joint Cofund call	INRAE-Utrecht Institute for Pharmaceutical Science	EICRAD-**FLU-SWITCH** - Identification of factors driving the emergence and spread of avian influenza viruses with zoonotic potential	2023	2026
EU/ICRAD Joint cofund call	Royal GD	**FluNuance** - Virulent Non-Notifiable Avian Influenza; Determinants of virulence of emerging viruses	2021	2024
EU/ICRAD Joint cofund call	UGent	**EPICVIR** - Emerging porcine influenza and coronaviruses	2023	2026

Country/Funder	Main Research Institution	Research project	Start Year	End Year
EU/ICRAD Joint Cofund call	UGhent	**EPICVIR**- Emerging porcine influenza and Coronavirus	2023	2026
Europe/ VetBionet	Reproductive Biotechnology, Technical University of Munich	Analysis of the role of the duck RIG-I gene in transgenic chickens during infection with influenza virus - Susceptibility of genetically engineered chickens to the infection with highly pathogenic influenza viruses (H7N1)	2022	2023
France/ANR	INRAE	RISKEVOL - Identification of factors driving the emergence and spread of avian influenza viruses with zoonotic potential	2023	2026
France/ANR	Inserm	XI-TOLL-BFLU - Exploring the dynamics of X-linked gene expression in female B cells: implication in humoral immunity to influenza virus	2020	2024
France/F2E carnot	INRAE	PIGFLU - PigFlu: boosting immunity to fight swine influenza infection	2023	2024
France/INRAE	INRAE	Mouse flu - Study of the involvement of PB1-F2 (virulence factor) in the pathogenicity of avian influenza viruses in the mouse model	2022	2024
France/INRAE TSARA	INRAE	TSARA-Mali - Improvement of surveillance systems for avian influenza viruses in Mali	2022	2024
Italy/Italian Ministry of Health	IZS VE	Development of innovative substrates and phenotyping assays aimed at the in vitro fitness characterization of avian influenza viruses in poultry and wild species	2022	2024
Italy/Italian Ministry of Health	IZS VE	Evaluation of the role of galliformes and ducks as reservoirs of avian influenza viruses of subtype H1 and H3 with pre-pandemic potential	2021	2023
Netherlands/ Ministry LNV	WBVR	Risk of HPAI virus selection on LPAI-infected poultry farms - Risk of HPAI virus selection on LPAI-infected poultry farms (1600002776)	2022	2024
Spain/ National Research Agency	IRTA	Unravelling the molecular mechanisms of avian influenza virus infection outcome in the avian host by using a multi-omic approach	2021	2024
Spain/ National Research Agency	Neiker-Instituto Vasco De Investigacion Y Desarrollo Agrario Sa	Study of the virome and bacteriome of wild birds naturally infected with avian influenza virus	2021	2024
Spain/ National Research Agency	Universidad de Castilla-la Mancha. Instituto de Investigacion en Recursos Cinegeticos	Experimental approach to the interaction of the intestinal and respiratory microbiome composition with avian influenza virus infection in domestic and free-living birds	2021	2024
UK/Defra	APHA	Understanding the dynamics and evolution of swine influenza viruses in Europe – relevance for improved intervention and sustainable pig production	2021	2024
UK/Defra	The Food and Environment Research Agency (FERA)	Economic cost of HPAI outbreaks	2022	2022
UK/Defra and BBSRC	APHA-led UK consortium	Understanding animal health threats from emerging H5 high pathogenicity avian influenza viruses	2022	2023

Country/Funder	Main Research Institution	Research project	Start Year	End Year
USA/USDA NIFA	Biostone animal health llc	Influenza - An Enzyme-Linked Immunosorbent Assay To Detect Antibodies Against Avian Influenza Virus (AIV) Subtype H5 And H7 In Commercial Poultry	2023	2024
USA/USDA NIFA	Board of Regents of the University of Nebraska	Influenza - Survey of Intraspecific Variation within Swine ANP32A/B and Effects on Host Permissiveness to Avian Influenza Virus	2023	2025
USA/USDA NIFA	Colorado State University	Influenza - Multi-species modeling of animal movements and transboundary animal disease outbreaks in the U.S.	2022	2024
USA/USDA NIFA	Cornell University	Influenza - Novel Broadly Protective Swine Influenza Vaccine Platforms	2022	2024
USA/USDA NIFA	Genvax Technologies inc	Influenza - Surveillance and prediction of Swine Influenza A Virus haemagglutinin gene sequences for the rapid development of saRNA-nanoparticle vaccines	2023	2024
USA/USDA NIFA	Pennsylvania State University	Influenza - Functional identification of avian influenza resistance host factors through genome-wide CRISPR/Cas9 knockout screening in chickens	2023	2025
USA/USDA NIFA	Regents of the University of Minnesota	Influenza - Investigations into factors that drive the emergence of novel influenza reassortants in pigs under field conditions	2022	2025
USA/USDA NIFA	Tennessee State University	Influenza - Screening and Identification of Potential Cyanobacterial Crude Extracts/Compounds against Highly Infectious Poultry Viruses and Bacteria	2023	2026
USA/USDA NIFA	University of California, Davis	Influenza - Molecular mechanisms of enhanced resistance to avian influenza in two genetically distinct, highly inbred chicken lines	2023	2025
USA/USDA NIFA	University of Georgia Research Foundation, inc.	Influenza - Safe And Broadly Cross-Protective Live Attenuated Influenza Virus Vaccines For Use In Swine	2022	2025
USA/USDA NIFA	University of Missouri system	Influenza - The role of innate-like T cells in influenza immunity	2022	2024
USA/USDA NIFA	University of Texas medical branch at Galveston	Influenza - PARTNERSHIP: Rapid Detection of Incursions of SARS-CoV-2 and Novel Coronaviruses on Texas Meat and Dairy Farms	2023	2028
USA/USDA NIFA	University of Wisconsin	Influenza - PARTNERSHIP: Nanoparticle Vaccines Against Emerging Poultry Infections	2023	2026

7. Mycoplasma

In June 2023 STAR-IDAZ, in collaboration with USDA-ARS, published the **IRC 2023 Veterinary Mycoplasmas Research Report**. The review covers the research progress and developments in contagious bovine pleuropneumonia (CBPP) and *M. bovis* since 2012 and other mycoplasmas since 2015. A CBPP gap analysis workshop was held on 26-28 June 2023, a gap analysis report will be published online to facilitate research collaborations. These activities will lead to the identification of main research gaps to develop research roadmaps.

Global networks: The International Organization for Mycoplasmology (IOM)

Website: http://iom-online.org/

	Members ca. 500	**Budget**	**Start date:** 1976

Overview

The International Organization for Mycoplasmology (IOM) was founded in 1976 as a nonprofit organisation to promote the cooperative international study of mycoplasmas (Mollicutes) and mycoplasmal diseases and to disseminate knowledge about their characteristics, effects, transmission, and control.

IOM comprises around 500 professionals including human, animal, plant, and insect microbiologists involved or devoted to the study of the Mollicutes.

The International Research Program of Comparative Mycoplasmology (IRPCM) (previously a consultative group sponsored by WHO and FAO) is currently a permanent standing committee of the IOM. It is composed of specific interest working-teams that regularly analyse and summarise recent developments in their respective interest areas, such as mycoplasma arthritis, avian mycoplasmas, cell culture mycoplasmas, molecular genetics, phytoplasmas, ureaplasmas.

Members of the IOM also constitute the International Committee on Systematic Bacteriology Subcommittee on the Taxonomy of Mollicutes, the body that makes recommendations on minimum standards for the description of the class Mollicutes via the International Code of Nomenclature of Bacteria.

Aim

Aim: to promote the cooperative international study of mycoplasmas (Mollicutes) and mycoplasmal diseases and to disseminate knowledge about their characteristics, effects, transmission, and control.

	• Promote a cooperative study of mycoplasmas (Mollicutes) and mycoplasma diseases
	• Advance and disseminate knowledge on all aspects of mycoplasmas (IRPCM):
Objectives	• Developing a more complete understanding of the cellular and molecular biology of mycoplasmas, including those features that may be unique in the prokaryotic world to mycoplasmas
	• Elucidation of the diversity of mycoplasmas
	• Defining virulence factors of mycoplasmas pathogenic to humans, domestic and wild animals, and plants
	• Identifying more effective means of diagnosis, prevention, and control of mycoplasma infections and disease
	• Disseminate knowledge.

| | The 24th Congress of the International Organization for Mycoplasmology was held on July 16-20 2023, in Osaka, Japan. |
| News | More information regarding activities of Working teams can be found **here**. |

STAR-IDAZ WG progress

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

DISCONTOOLS research needs

Mycoplasma bovis

M. bovis associated infections are a major constraint on intensive production (both intensive beef production particularly in feed lots and milk production in high yielding herds). They have a significant negative economic impact on cattle rearing worldwide. The following factors summarise the problems: i) No effective vaccines available; ii) Insidious infection not always easily diagnosed; iii) Difficulty in eliminating the disease from a herd; iv) Difficulty in assessing the contribution of *M. bovis* in the bovine respiratory disease complex when a number of other pathogens are also involved; and finally v) Development of antibiotic resistance to most of the antibiotics currently in use. Lack of an understanding of the epidemiology of the disease at the herd level hampers the development of therapeutic preventive measures. Currently the most widely used preventive measure is chemotherapy but test and slaughter is a crude and less economical strategy to help control this disease. The disease in its chronic form should be considered also for its consequences on animal welfare (raising awareness).

Main critical research gaps are:

- A better understanding of the immune response against *M. bovis* for vaccine development

- Data about routes of transmission (including through the environment and potential biofilms, semen, etc.) and infection doses per route to improve herd management practices

- Experimental models for reproducing the disease in relation to development of complex cellular models

- Clarification about the pathophysiology of *M. bovis* infection that could hint towards new therapeutic development

- Interlaboratory trials to validate diagnostics methods and commercial kits. Ultimately transfer to accurate in-field tests would be most useful

- Clinical interpretation criteria for AMR to translate MIC results in vitro into resistant, intermediary or susceptible.

- Quicker diagnostics tools including antimicrobial susceptibility testing.

Swine Mycoplasmas

Mycoplasmosis is a term frequently used to denote enzootic pneumonia of pigs, but could in fact refer to disease caused by three species of *Mycoplasma*, i.e. *M. hyopneumoniae*, *M.hyorhinis* and *M. hyosynoviae*. All of these are pleomorphic microorganisms that lack a rigid cell wall, have very small genomes and limited biosynthetic capabilities. They have adapted to the parasitic mode of life and have pig respiratory tract as a natural habitat. They can be cultivated in artificial media but are fastidious and require complex media for growth in vitro. Among the three species, *M. hyopneumoniae* is economically the most important and the most studied.

Critical research gaps are:

- Increased identification of virulence factors of all three mycoplasmas

- Knowledge on the real prevalence and economic impact of arthritis and polyserositis due to *M. hyorhinis* and *M. hyosynoviae*

- Better understanding of genetics to improve vaccines, diagnostics and control strategies.

New vaccines and appropriate routes of administration.

Contagious Agalactia (CA)

- Knowledge of the true incidence, contribution of the different causative agents in goats and the economic cost of CA disease

- Still lack of awareness of the disease. Good practice guidelines for disease prevention and outbreak management are needed

- Paucity of rapid, affordable, screening tests with improved sensitivity for asymptomatic carrier animal

- Lack of affordable standardised tests, with regular quality controls/ring trials

- Updated regulation in countries where severity of restrictions constrains outbreak reporting

- Improved knowledge on the factors associated with reactivation of *Mycoplasma*, pathogenicity mechanisms, including the contribution of the host immune response to lesion development, to unusual clinical signs and to absence of disease in some young animals

- Further work on the transmission mechanisms: the role of pneumonia, significance of germplasm and aerosol transmission, role of biting insects and ticks, excreta and the environment

- Contribution of horizontal transfer of genetic material demonstrated in *M. agalactiae* to observed strain diversity, global disease epidemiology and reduced susceptibility to therapeutic antimicrobials

- Lack of globally accepted, effective and independently trialled vaccines. A marker vaccine together with a suitable diagnostic means of distinguishing between vaccinated and infected animals is needed. Newly developed engineering tools for development of synthetically constructed attenuated strains and trialled with the *M. mycoides* subsp. *capri* genome show early promise for future mycoplasma vaccinology

- Standardised in vitro testing of antibiotics and monitoring of antibiotic effectiveness/resistance. Antibiotics with increased efficacy/distribution that could prevent the continued excretion of mycoplasma. Screening and in vivo assessment, using standardised evaluation procedures, of novel chemicals and plant extracts.

Contagious Bovine Pleuropneumonia (CBPP)

- Research on the establishment of infection (pathogenicity factors, immunopathology, virulence factors, genomics) and the persistence of infection in chronically affected animals (e.g. reservoirs)

- A pen side test capable of detecting both acute and chronic infections

- A safer, more effective and better characterised vaccine to allow more effective disease control strategies to be implemented. DIVA technology is a critical gap in CBPP prevention and control tools. There is a debate regarding either the development of a new generation of potent CBPP vaccines/subunits or to rely on improvements in the current vaccines with regards to the biology of the vaccine strains and /or adjuvants and pH adjustments

- An experimental animal model for CBPP disease.

Recent developments

Characteristics of *Mycoplasma bovis, Mycoplasma arginini*, and *Mycoplasma californicum* on immunological response of bovine synovial cells.[37]

In this study the authors examined the characteristics of immune responses to *M. bovis, M. arginini,* and *M. californicum* in synovial cells. They suggest that *M. bovis* invaded and inhibited apoptosis of synovial cells to evade host immunity, which led to long-term survival in joints; in contrast *M. arginini* and *M. californicum* had low abilities to induce inflammation in joints and therefore do not cause severe pathology. This demonstrates the variations in synovial cell immune responses to *M. bovis, M. arginini,* and *M. californicum*, which are thought to be related to the pathogenicity of arthritis.

Mannheimia haemolytica increases *Mycoplasma bovis* disease in a bovine experimental model of BRD.[38]

In this work, the authors identified several M. bovis proteases and lipases whose expression was modulated by *M. haemolytica* products in vitro. Co-infection animal challenges were performed to develop a model to test vaccine protection. A prior exposure to BHV-1 followed by infection with *M. bovis* and *M. haemolytica* resulted in severe pathology and the BHV-1 infection was abandoned. When M. bovis and *M. haemolytica* were introduced into the lungs by bronchoscopy, the authors found that *M. haemolytica* resulted in worsening of the respiratory disease caused by *M. bovis*. The authors then performed a proof-of-concept trial where animals were immunised with the *M. bovis* proteins identified in this study and challenged with both pathogens. Despite detecting significant humoral immune responses to the antigens, the experimental vaccine failed to protect against *M. bovis* disease.

37 Nishi, K., Okada, J., Iwasaki, T., Gondaira, S., & Higuchi, H. (2023). Characteristics of Mycoplasma bovis, Mycoplasma arginini, and Mycoplasma californicum on immunological response of bovine synovial cells. Veterinary immunology and immunopathology, 260, 110608. **https://doi.org/10.1016/j.vetimm.2023.110608**

38 Prysliak, T., Vulikh, K., Caswell, J. L., & Perez-Casal, J. (2023). *Mannheimia haemolytica* increases Mycoplasma bovis disease in a bovine experimental model of BRD. Veterinary microbiology, 283, 109793. Advance online publication. **https://doi.org/10.1016/j. vetmic.2023.109793**

Diagnostic investigation of *Mycoplasma hyorhinis* as a potential pathogen associated with neurological clinical signs and central nervous system lesions in pigs.[39]

This study evaluated the role of *M. hyorhinis* as a potential pathogen associated with neurological clinical signs and central nervous system lesions in pigs. The presence of *M. hyorhinis* was evaluated in a clinical outbreak and a 6-year retrospective study by qPCR detection, bacteriological culture, in situ hybridisation (RNAscope®), and phylogenetic analysis and with immunohistochemistry characterisation of the inflammatory response associated with its infection. *M. hyorhinis* was confirmed by bacteriological culture and within central nervous system lesions by in situ hybridisation on animals with neurological signs during the clinical outbreak. The isolates from the brain had close genetic similarities from those previously reported and isolated from eye, lung, or fibrin. Nevertheless, the retrospective study confirmed by qPCR the presence of *M. hyorhinis* in 9.9% of cases reported with neurological clinical signs and histological lesions of encephalitis or meningoencephalitis of unknown etiology. *M. hyorhinis* mRNA was confirmed within cerebrum, cerebellum, and choroid plexus lesions by in situ hybridisation (RNAscope®) with a positive rate of 72.7%. *M. hyorhinis* should be included as a differential etiology in pigs with neurological signs and central nervous system inflammatory lesions.

Genome Editing of Veterinary Relevant Mycoplasmas Using a CRISPR-Cas Base Editor System.[40]

In this study the authors demonstrated the adaptation of an efficient Cas9-Base Editor system to introduce targeted mutations into three major pathogenic species that span the phylogenetic diversity of these bacteria: the avian pathogen *Mycoplasma gallisepticum* and the two most important bovine mycoplasmas, *Mycoplasma bovis* and *Mycoplasma mycoides* subsp. *mycoides*. As a proof of concept, they used an inducible SpdCas9-pmcDA1 cytosine deaminase system to disrupt several major virulence factors in these pathogens. The optimised system was able to disrupt 54 of 55 insertion sequence transposases in a single experiment. Whole-genome sequencing of the edited strains showed that off-target mutations were limited, suggesting that most variations detected in the edited genomes are Cas9-independent. This effective, rapid, and easy-to-use genetic tool opens a new avenue for the study of these important animal pathogens and likely the entire class Mollicutes.

Transcriptomic Responses of *Mycoplasma bovis* Upon Treatments of trans-Cinnamaldehyde, Carvacrol, and Eugenol.[41]

Plant-derived antimicrobials (PDAs) such as food-grade *trans*-cinnamaldehyde (TC), eugenol (EU), and carvacrol (CAR) are inexpensive and generally regarded as safe for humans and animals yet possess strong anti-bacterial properties. In preliminary studies, the authors found that all three PDAs inhibited the growth of *M. bovis* in vitro. Through RNA sequencing, they reported that CAR affected the expression of 153 genes which included the downregulation of energy generation-related proteins, pentose phosphate pathway, and upregulation of ribosomes and translation-related proteins. Few differentially expressed genes were found when *M. bovis* was treated with TC, EU, or when the three PDAs were double or triple combined. These results suggest that, as opposed to the effect of CAR, the growth-inhibitory effects of TC and EU at levels tested may be exerted through mechanisms other than gene expression regulations.

39 Ko, C. C., Merodio, M. M., Spronk, E., Lehman, J. R., Shen, H., Li, G., Derscheid, R. J., & Piñeyro, P. E. (2023). Diagnostic investigation of *Mycoplasma hyorhinis* as a potential pathogen associated with neurological clinical signs and central nervous system lesions in pigs. Microbial pathogenesis, 180, 106172. **https://doi.org/10.1016/j.micpath.2023.106172**

40 Ipoutcha, T., Rideau, F., Gourgues, G., Arfi, Y., Lartigue, C., Blanchard, A., & Sirand-Pugnet, P. (2022). Genome Editing of Veterinary Relevant Mycoplasmas Using a CRISPR-Cas Base Editor System. Applied and environmental microbiology, 88(17), e0099622. **https://doi.org/10.1128/aem.00996-22**

41 Ranjitkar, S., Duan, J. E., Srirattana, K., Alqahtani, F., Tulman, E. R., Mandoiu, I., Venkitanarayanan, K., & Tian, X. (2022). Transcriptomic Responses of *Mycoplasma bovis* Upon Treatments of trans-Cinnamaldehyde, Carvacrol, and Eugenol. Frontiers in microbiology, 13, 888433. **https://doi.org/10.3389/fmicb.2022.888433**
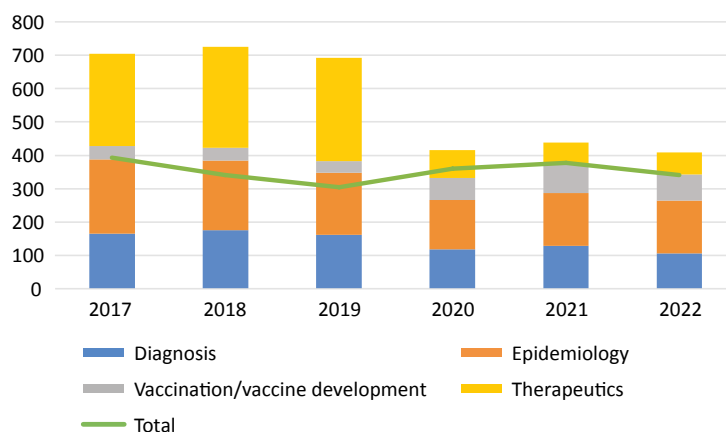
Trends in published research

Total records &
Main topics

Country/ Region of first
Author (2017/2022)
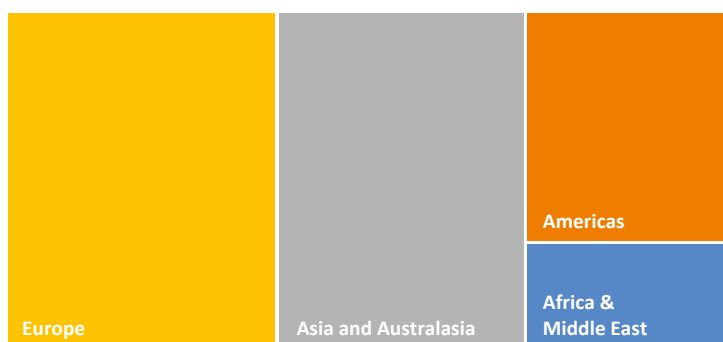
Ongoing research

Non-exhaustive list of ongoing projects on mycoplasmas funded by STAR-IDAZ IRC and STAR-IDAZ Network Members:

Country/Funder	Main Research Institution	Research project	Start Year	End Year
France/ANR	INRAE	RAMbo-V - Approche rationnelle d'un vaccin *Mycoplasma bovis*	2022	2025
Italy/Italian Ministry of Health	IZS VE	Porcine mycoplasmosis: longitudinal study for the in vivo detection of *Mycoplasma hyopneumoniae* and *Mycoplasma hyorhinis* through a non-invasive sampling system (Easy Collection Sampling)	2021	2023
USA/USDA NIFA	MONTANA STATE UNIVERSITY	Mycoplasma - Biofilm Formation by *Mycoplasma ovipneumoniae* as a Mechanism for Immune Evasion and Antibiotic Resistance	2023	2026
USA/USDA NIFA	MONTANA STATE UNIVERSITY	Mycoplasma - Persistence mechanisms of *Mycoplasma ovipneumoniae* in the ovine respiratory tract	2022	2025
USA/USDA NIFA	UNIVERSITY OF CONNECTICUT	Mycoplasma - Rationally Designed *Mycoplasma gallisepticum* Subunit Vaccine	2022	2025
UK/Defra	APHA	Ongoing programme of mycoplasma research		

8. Diagnostic: detection and diagnostic technology development

STAR-IDAZ IRC developed a series of disease specific research roadmaps for diagnostic test development available on the STAR-IDAZ website. More recently, a survey was circulated to collect information on research priorities for detection and diagnostic technology development from animal health diagnostic stakeholders, focusing on the needs of those who will be using the new technologies. This survey signals the start of a series of activities to identify research needs to advance detection and diagnostic in the animal health sector.

Global network:

No global animal health network on research for detection and diagnostic technology development has been identified so far, however some initiatives have been recognised in different settings (see below).

Additional networks

FIND

https://www.finddx.org/

FIND is the global alliance for diagnostics and aims to ensure equitable access to reliable diagnosis around the world, focusing mainly on human health matters. As WHO Collaborating Centre for Laboratory Strengthening and Diagnostic Technology Evaluation, FIND connects countries and communities, funders, decision makers, healthcare providers and developers to promote diagnostic innovation and make testing an integral part of the system. They released a **new strategy in 2021** outlining their vision.

VetLAB

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

The VETLAB network is a global network of national veterinary laboratories coordinated by the Animal Production and Health Section (APH) of IAEA and FAO. The network currently includes 80 national laboratories located in 46 countries in Africa and 19 countries in Asia. It assists IAEA Member States to improve national laboratory capacities to early detect transboundary animal and zoonotic diseases threatening livestock and public health by nuclear-derived technologies, active also on research.

WOAH Reference and Collaborating Centres Network

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

WOAH has a global network of 266 Reference laboratories and 68 Collaborating Centres for the purposes of providing scientific expertise and support to the WOAH and its Members, and for promoting international collaboration on animal health and welfare. WOAH Reference Laboratories and Collaborating Centres are encouraged to continuously working together to strengthen multilateral cooperation, and as per **ToR** propose or develop methods and procedures that facilitate harmonisation of international standards and guidelines applicable to the designated specialty; and carry out and/or coordinate scientific and technical studies in collaboration with other centres, laboratories or organisations.

STAR-IDAZ WG progress

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

DISCONTOOLS research needs

Diagnostic research needs for each of the included diseases can be retrieved via the **database search**. An overarching analysis was recently published by Charlier et al., 2022 **(Lancet Planetary Health 6, e812-e824)**.

Recent developments

Evaluation of acoustic pulse technology as a non-antibiotic therapy for bovine intramammary infections: Assessing bacterial cure vs. recovery from inflammation.[42]

This study, conducted by Blum et al. explores the use of acoustic pulse technology (APT) as a non-antibiotic therapy for bovine intramammary infections, specifically mastitis in dairy cows. APT involves transmitting mechanical energy through soundwaves into the udder. This stimulation triggers anti-inflammatory and angiogenic responses, promoting udder recovery and potentially increasing resistance to bacterial infections. The study involved 129 dairy cows in Israel with mastitis. The cows were categorised into three groups based on their mastitis condition: those with no bacterial findings, those with clinical signs of mastitis or high somatic cell counts (SCC), and those with chronic mastitis. All groups received APT treatment, consisting of 400 pulses on the infected udder quarter, delivered over 3 days. The following results were noted for each group. Group 2 (clinical or high SCC mastitis): The cure and recovery rates were 67.1% and 64.6%, respectively. These rates were similar for both Gram-negative and Gram-positive infections, indicating APT's effectiveness. Group 1 (no bacterial findings): similar recovery rates were observed, suggesting APT could benefit cows even when no bacteria are found. Group 3 (chronic mastitis): cure and recovery rates were significantly lower at 22.2% and 27.8%, respectively. The study's findings suggest that APT treatment could lead to significant cost savings for dairy farmers, potentially up to $15,106/year for a 100-cow herd, due to the lower need for antibiotic treatment. Authors conclude that APT shows promise as a sustainable and economically beneficial alternative to antibiotic therapy for mastitis in dairy cows.

A Machine Learning Approach Reveals a Microbiota Signature for Infection with *Mycobacterium avium subsp. paratuberculosis* in Cattle.[43]

Lee et al. developed a new diagnostic tool for *Mycobacterium avium subsp. paratuberculosis* (MAP) infection in cattle by focusing on the gut microbiota changes associated with MAP-positive ruminants. The researchers used 16S rRNA-based gut microbial community analysis to examine changes in the gut microbiota following MAP infection. They observed a decrease in microbial diversity and the emergence of specific microbial taxa associated with MAP infection. To identify discriminatory microbial taxa for

---

42 Blum, S. E., Krifuks, O., Weisblith, L., Fleker, M., Lavon, Y., Zuckerman, A., Hefer, Y., Goldhor, O., Gilad, D., Schcolnic, T., & Leitner, G. (2023). Evaluation of acoustic pulse technology as a non-antibiotic therapy for bovine intramammary infections: Assessing bacterial cure vs. recovery from inflammation. Frontiers in veterinary science, 10, 1079269. **https://doi.org/10.3389/fvets.2023.1079269**

43 Lee, S. M., Park, H. T., Park, S., Lee, J. H., Kim, D., Yoo, H. S., & Kim, D. (2023). A Machine Learning Approach Reveals a Microbiota Signature for Infection with Mycobacterium avium subsp. paratuberculosis in Cattle. Microbiology spectrum, 11(1), e0313422. **https://doi.org/10.1128/spectrum.03134-22**

MAP infection, the researchers employed machine learning-based feature selection and predictive model construction using taxon abundance data or their transformed derivatives. Key taxa, including *Clostridioides* (formerly Clostridium) *difficile*, were selected. Different machine learning models, such as support vector machine, linear support vector classification, k-nearest neighbor, and random forest, were used to build predictive models with 10-fold cross-validation. The receiver operating characteristic-area under the curve (ROC-AUC) analysis showed that these models had high accuracy, with some achieving up to approximately 96% accuracy.

A useful tool for the safe diagnosis and control of the two main pandemics of the XXI century: COVID-19 and African Swine Fever disease.[44]

In this study by Barroso-Arévalo et al. (2023), the focus is on addressing the COVID-19 pandemic and African Swine Fever disease. The researchers evaluated a new surfactant liquid's ability to inactivate and preserve SARS-CoV-2 and African swine fever virus in non-invasive and environmental samples. Their findings indicate that this surfactant liquid can rapidly inactivate both viruses in just 5 minutes and preserve genetic material for extended periods, even at high temperatures like 37°C. This methodology proves to be a safe and practical tool for recovering RNA/DNA of these viruses from various surfaces and skins, offering valuable applications in disease surveillance for both COVID-19 and African swine fever.

Development and Validation of a New DIVA Real-Time PCR Allowing to Differentiate Wild-Type Lumpy Skin Disease Virus Strains, Including the Asian Recombinant Strains, from Neethling-Based Vaccine Strains.[45]

In response to the LSDV (lumpy skin disease virus) epidemic in Asia, Haegeman et al. developed and validated a new duplex real-time PCR test to distinguish between vaccine strains and recombinant wild-type LSDV strains. The objective was to create a differentiation of infected from vaccinated animals (DIVA) test capable of distinguishing these strains, vital for disease control. The new test's DIVA potential was confirmed in silico and in practical tests on infected, vaccinated animals, LSDV recombinants, vaccine strains, and classic wild-type strains. It displayed high specificity by not cross-reacting with other capripox viruses under field conditions. Moreover, it exhibited high analytical sensitivity, accurately detecting over 70 samples, comparable to a widely used pan capripox real-time PCR. The test also proved robust with low variability in different runs, making it suitable for laboratory use.

Automated monitoring and detection of disease using a generic facial feature scoring system - A case study on FMD infected cows.[46]

Hofstra et al. explore the use of digital images and image processing to monitor and detect diseases in animals. They introduced a generic facial feature scoring system based on seven facial features and applied it to Holstein Friesian heifers during foot and mouth disease (FMD) vaccine trials. The study compared manual and automatic disease scores generated by their system, finding that both show a temporal pattern of increased disease scores 3 days post-infection, followed by recovery, consistent with observations by animal caretakers. The automatic system can differentiate between animals protected by the vaccine and those not protected. It demonstrates high accuracy in detecting healthy and sick animals, with a sensitivity and specificity of 0.94 during the early days of infection in experimental settings.

44 Barroso-Arévalo, S., Díaz-Frutos, M., Kosowska, A., Pérez-Sancho, M., Domínguez, L., & Sánchez-Vizcaíno, J. M. (2023). A useful tool for the safe diagnosis and control of the two main pandemics of the XXI century: COVID-19 and African Swine Fever disease. PloS one, 18(3), e0282632. **https://doi.org/10.1371/journal.pone.0282632**

45 Haegeman, A., De Leeuw, I., Philips, W., & De Regge, N. (2023). Development and Validation of a New DIVA Real-Time PCR Allowing to Differentiate Wild-Type Lumpy Skin Disease Virus Strains, Including the Asian Recombinant Strains, from Neethling-Based Vaccine Strains. Viruses, 15(4), 870. **https://doi.org/10.3390/v15040870**

46 Hofstra, G., van Abeelen, H., Duindam, M., Houben, B., Kuijpers, J., Arendsen, T., van der Kolk, M., Rapp, F., van Spaendonk, J., Gonzales, J. L., & Petie, R. (2023). Automated monitoring and detection of disease using a generic facial feature scoring system - A case study on FMD infected cows. Preventive veterinary medicine, 213, 105880. **https://doi.org/10.1016/j.prevetmed.2023.105880**

Ongoing research

Non-exhaustive list of ongoing projects on diagnostics funded by STAR-IDAZ IRC and STAR-IDAZ Network Members:

Country/Funder	Main research Institution	Research project	Start Year	End Year
Argentina/INTA	INTA	2023-PD-L06-I114 - Development and application of diagnostic methodologies an epidemiological tool for sustainable livestock production with a focus on One Health	2023	2027
Argentina/INTA	INTA	2019-RIST-E5-I111-001 - Veterinary Diagnostic Laboratories National Network	2019	2027
Belgium/FPS Health, Food chain safety and Environment	KU Leuven UGent University of Liège Sciensano	SalmiPIG Salmonella biofilm formation in chronic carrier pigs: impact on gut colonization, genetic markers for functional diagnostics and potential as target for non-antibiotic therapy	2021	2025
Belgium/FPS Health, Food chain safety and Environment	Sciensano in a transnational consortium coordinated by ANSES	FMDV_PersIstOmics - From proteogenomic host response signatures of persistent foot and mouth disease virus (FMDV) infection to diagnostic markers and therapeutic control	2021	2024
Belgium/FPS Health, Food chain safety and Environment	Sciensano ARSIA CER Groupe UCLouvain University of Liège DGZ Vlaanderen	DIBOTUB Research and validation of new diagnostic methods for bovine tuberculosis	2019	2022
Belgium/FPS Health, Food chain safety and Environment	Sciensano University of Liège	BRU-PIG - Brucellin skin test in pigs as a confirmatory test in case of positive serology against *Brucella suis*	2023	2024
CGIAR Initiatives/ SAPLING CGIAR Initiative	ILRI	African swine fever rapid Lateral Flow Assay (LFA) evaluation for implementation in the field in Uganda and Vietnam	2022	2023
China/Ministry of Science and Technology	China VetTRug Control Institute	Development of Diagnostic tools for the diseases of grazing animals	2022	2025
EU/Global Stars Eureka	UGent	Impochlam - Innovative point-of-care tests to diagnose *Chlamydiales* in a One Health setting	2019	2024
EU/ICRAD Joint Cofund call	University Rovira I Virgilii (Spain)	**Biosens4PrecisionMastitis**: Biosensing Bovine Mastitis	2021	2024
EU/ICRAD Joint Cofund call	UGent	**TechPEPCon**- Use of frontline technologies to screen pathogens, environment and pigs for a better disease control in swine herds	2021	2024
EU/ICRAD Joint Cofund call	Warsaw University of Life Science	**CAE-RAPID-** Development of a rapid screening test for on-site serological diagnostics of caprine arthritis-encephalitis using individual milk samples	NA	NA
France/ANR	INRAE	REVE@FARM - REtroViral Emergence @Farm	2022	2026
France/World Bank	Cirad	WOAH Twinning on RVF-Mali- WOHA Twinning (ring trial, accreditation process through the improvement of quality management system), vaccination studies)	2019	2023

Country/Funder	Main research Institution	Research project	Start Year	End Year
Italy/Italian Ministry of Health	IZS AM	MALDI-TOF and Artificial Intelligence for bacterial typing, direct diagnostics and rapid identification of antibiotic resistance (MALD-IA)	2022	2024
Italy/Italian Ministry of Health	IZS LT	Non-human primates: development of protocols for the diagnosis and monitoring of the main communicable diseases including those with zoonotic potential, from a One Health perspective	2021	2023
Italy/Italian Ministry of Health	IZS VE	Diagnostica 2.0 - IT tools to support diagnosis in animal health. Validation of the Dia-Pacemaker system for the diagnosis of porcine respiratory disease complex (PRDC)	2022	2024
Netherland/ Ministry LNV	WBVR	WOT-01-003-085 en KB-37-003-013 - Bio-informatica and deep sequencing applications	2019	2024
Norway/Fram Centre	Norwegian Institute of Bioeconomy Research (NIBIO; coordinator), NVI (partner)	RemoTnitor - New methods for integrated non-invasive genetic monitoring of northern semi-domesticated reindeer and wildlife based on high-throughput sequencing approaches	2023	2025
Norway/Fram Centre	NVI	ePod - ePod Slugs and snails and brainworm tales - an Arctic gastropod mystery	2023	2023
Norway/ Research Council of Norway	Inland Norway University of Applied Sciences (INN; coordinator), NVI	Welfed - Animal welfare, behaviour, health and sustainability – the effects of feeding on reindeer and reindeer herding	2021	2025
Norway/ Research Council of Norway	NVI	Arctic Lice - Impact of fur lice on *Arctic foxes*	2023	2023
Norway/ Svalbard Environmental Protection Fund	NVI	MapEM - Monitoring abundance, prevalence and distribution of *Echinococcus multilocularis* in arctic foxes	2023	2024
UK/Defra	APHA	Developing capability for detection of Monkeypox exposure in animals	2022	2023
UK/Defra	The Pirbright Institute	Development of diagnostic tools for Seneca Valley virus	2022	2022
UK/Defra	The Pirbright Institute	FMD diagnostic development	2020	2023
USA/USAID-FtF	ILRI	Developing a pen-side diagnostic test for East Coast fever using the CRISPR-Cas technology	2020	2025
USA/USDA NIFA	Arizona State University	Diagnostics - Nanotechnology for Agricultural and Food Systems PARTNERSHIP: Portable And Multiplexed Detection Of African Swine Fever With Metal Nanoparticles	2022	2026
USA/USDA NIFA	Biostone Animal Health llc	Diagnostics - Developing A Commercial Multi-Antigen Confirmatory ELISA To Detect Antibodies To African Swine Fever Virus Under Biosafety Level 2 Conditions	2023	2024
USA/USDA NIFA	Biostone Animal Health llc	Diagnostics - PARTNERSHIP: Developing Enzyme Linked Immuno-Sorbent Assay (ELISA) Diagnostics to detect African Swine Fever Antibodies and to Differentiate Infected from Vaccinated Animals (DIVA)	2023	2026

Country/Funder	Main research Institution	Research project	Start Year	End Year
USA/USDA NIFA	Colorado State University	Diagnostics - Multi-species modeling of animal movements and transboundary animal disease outbreaks in the U.S.	2022	2024
USA/USDA NIFA	Cornell University	Diagnostics - Epidemiology, transmission, and pathogenicity of Equine hepacivirus	2022	2024
USA/USDA NIFA	Cornell University	Diagnostics - Novel diagnostic approaches to comprehensively define Salmonella Dublin transmission dynamics and improve disease control in dairy cattle	2022	2025
USA/USDA NIFA	Emergingdx inc	Diagnostics - Low-cost Diagnostic Platform for Aquaculture	2023	2024
USA/USDA NIFA	Michigan State University	Diagnostics - Advancing Gut Health In Dairy Cattle: Immunophenotyping and Inflammation Of The Rumen	2023	2025
USA/USDA NIFA	Mississippi State University	Diagnostics - Developing a diagnostic tool for rapid screening of livestock at risk of developing bovine respiratory disease	2022	2026
USA/USDA NIFA	Sherlock biosciences, inc.	Diagnostics - Field-deployable CRISPR-based diagnostics for improved biosecurity in aquaculture	2023	2024
USA/USDA NIFA	University of Georgia Research Foundation, inc.	Diagnostics - A Molecular Serology Approach For Surveillance Of Avian Pathogenic *E. Coli* In Georgia	2022	2024
USA/USDA NIFA	University of Georgia Research Foundation, inc.	Diagnostics - Development of an Innovative Point-of-Care Platform to Diagnose Viral Infections in Cattle	2023	2026
USA/USDA NIFA	University of Illinois	Diagnostics - Molecular Mechanisms of PRRSV Persistence: Identification and Targeting Viral-Host Signatures for Disease Surveillance and Prevention	2023	2026
USA/USDA NIFA	University of Vermont & State Agricultural College	Diagnostics - Advancing knowledge of non-aureus Staphylococci epidemiology, the leading cause of dairy cattle mastitis: species and strain typing matters	2022	2023

9. One Health

Website:https://www.star-idaz.net/ https://www.glopid-r.org/

Members ca. 25

Budget

Start date: 2023

Overview

The One Health Working Group for STAR-IDAZ and GLOPID-R is a coordinated global alliance to develop and strengthen a collaborative, multisectoral and transdisciplinary One Health approach to infectious diseases research and innovation. STAR-IDAZ IRC secretariat (SIRCAH) and GloPID-R secretariat will act as the Secretariat to the Working Group, providing organisational and communication support, including organising meetings of the Working Group with the Working Group co-chairs.

Aim and priorities

Aims and Priorities: to strengthen the global One Health approach for research and innovation by encouraging collaboration, communication, and coordination across the sectors responsible for addressing infectious diseases and other health concerns at the human-animal-environment interface to address infectious disease outbreaks.

Objectives

- Develop a global One Health research framework, with realistic scope, actions and goals to address infectious disease outbreaks and pandemic preparedness and response
- Raise the profile of the need for One Health Research and fostering collaborative funding schemes
- Identify global and regional successes, challenges and gaps facing implementing a One Health approach
- Collaborate closely with existing One Health networks and communities, including the One Health Commission and One Health High Level Expert Panel
- Bring together diverse communities of research organisations and funders to facilitate collaboration and improve communication within the One Health community, with a stronger focus on low- and middle-income countries (LMICs) and capacity strengthening.

News

A list of experts from different networks/ initiatives were invited to join the WG, including leaders of the quadripartite **One health joint plan of action (2022-2026)**. The inaugural meeting for the WG took place virtually in March 2023, where the group refined the Terms of Reference for the aims, vision and goals of the WG over the coming years.

The WG has started mapping additional initiatives present in the field to better refine the WG scope to increase collaboration with existing One Health communities and develop a strategy that adds value for the field of One Health research. The WG plan to meet again towards the end of 2023 (date yet to be determined), where they will carry out gap analyses activities and work on the strategic collaborative framework.

Additional networks

One Health High-Level Expert Panel (OHHLEP)

https://who.int/groups/one-health-high-level-expert-panel

The One Health advisory group for Quadripartite organisations: the Food and Agriculture Organization of the United Nations (FAO), United Nations Environment Programme (UNEP), World Health Organization (WHO) and World Organisation for Animal Health (WOAH).

PREZODE (Preventing Zoonotic Disease Emergence)

https://prezode.org/

PREZODE is an international initiative with the ambition to understand the risks of emergence of zoonotic infectious diseases, to develop and implement innovative methods to improve prevention, early detection, and resilience in order to ensure rapid response to the risks of emerging infectious diseases of animal origin.

One health Regional Network (HORN)

http://onehealthhorn.net/

HORN, funded by UK Research and Innovation (UKRI) and the Global Challenges Research Fund, is a multidisciplinary, international partnership of the following organisations: the University of Liverpool, and Liverpool School of Tropical Medicine, United Kingdom; University of Nairobi, and International Livestock Research Institute, Kenya; University of Addis Ababa, and the International Livestock Research Institute, Ethiopia; iGAD Sheikh Technical Veterinary School, Somaliland; Hamelmalo Agricultural College, Eritrea; and other national and international organisations and NGOs.

Global Challenges Research Fund One Health Poultry Hub

https://www.onehealthpoultry.org/

Funded by the Global Challenges Research Fund1 (GCRF) of UK Research and Innovation (UKRI), this interdisciplinary Hub will address the need to meet rising demand for poultry meat and eggs in developing countries, while minimising risk to international public health.

Connecting Organisations for Regional Disease Surveillance (CORDS)

https://www.cordsnetwork.org/

This is a One Health initiative that is built up of 28 countries in Africa, Asia, the Middle East and Europe. Their vision is to have a world that are united against infectious disease. Currently they are aiming to help build additional networks in disease hotspots e.g. West Africa and the Indian sub-continent.

STAR-IDAZ WG progress

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

DISCONTOOLS research needs

One Health research needs for specific diseases can be retrieved via the **database search**. It is possible to select and compare research needs among zoonotic diseases. An overarching analysis was recently published by Charlier et al., 2022 **(Lancet Planetary Health 6, e812-e824)**.

Recent developments

A global analysis of One Health Networks and the proliferation of One Health collaborations.[47]

This study examines the operationalisation of the One Health approach through One Health networks (OHNs) at global, regional, and national levels. While the concept gained momentum in the early 2000s, its initial focus was limited to managing zoonotic diseases and high-impact threats, overlooking broader environmental and social issues. The COVID-19 pandemic highlighted the interconnectedness of human, animal, and environmental health and the need for practical implementation. OHNs mainly concentrated on emerging infections and neglected other crucial health security issues. To improve equity and inclusivity, OHNs should adopt more balanced governance structures, involve local communities, and rely less on external funding. Emphasising country leadership and community engagement can enhance the effectiveness of One Health initiatives in addressing global health security threats comprehensively.

One Health challenges for pig reproduction.[48]

This study focuses on the concept of One Health, which emphasises multidisciplinary collaboration to address health hazards facing people, animals, and the global environment from an ecosystem health perspective. The researchers propose that some of these health hazards can be considered as One Health challenges for pig reproduction. The challenges relevant to pig reproduction are linked to food security and availability issues, with the current global population growth and predictions of increased meat production by 2050. Climate change is identified as a pressing One Health challenge that affects pig reproduction, particularly due to rising temperatures impacting the cyclic control centre of the brain and decreasing reproductive performance. The study also highlights the role of environmental toxins, such as endocrine-disrupting chemicals (EDCs) and heavy metals, in affecting both human and animal reproduction. The importance of breeding for resilience in pigs to cope with changing environmental conditions is emphasised, along with the need for collaboration among scientists from different disciplines to develop sustainable solutions for human, animal, and environmental health.

One Health surveillance-A cross-sectoral detection, characterization, and notification of foodborne pathogens[.49]

This study focused on the assessment of cross-sectoral capabilities of laboratories in the European public health, animal health, and food safety sectors to detect, characterise, and report findings of the food-borne pathogens *Campylobacter spp., Salmonella spp.,* and *Yersinia enterocolitica.* Current proficiency tests (PT) or external quality assessment (EQA) schemes mostly target specific sectors like public health, food safety, or animal health. However, the study aimed to evaluate the potential for joint detection and

47 Mwatondo A, Rahman-Shepherd A, Hollmann L, Chiossi S, Maina J, Kurup KK, Hassan OA, Coates B, Khan M, Spencer J, Mutono N, Thumbi SM, Muturi M, Mutunga M, Arruda LB, Akhbari M, Ettehad D, Ntoumi F, Scott TP, Nel LH, Ellis-Iversen J, Sönksen UW, Onyango D, Ismail Z, Simachew K, Wolking D, Kazwala R, Sijali Z, Bett B, Heymann D, Kock R, Zumla A, Dar O. A global analysis of One Health Networks and the proliferation of One Health collaborations. Lancet. 2023 Feb 18;401(10376):605-616. doi: 10.1016/ S0140-673 6(22)01596-3

48 Peltoniemi, O., Tanskanen, T., & Kareskoski, M. (2023). One Health challenges for pig reproduction. Molecular reproduction and development, 10.1002/mrd.23666. Advance online publication. **https://doi.org/10.1002/mrd.23666**

49 Tast Lahti, E., Karamehmedovic, N., Riedel, H., Blom, L., Boel, J., Delibato, E., Denis, M., van Essen-Zandbergen, A., Garcia-Fernandez, A., Hendriksen, R., Heydecke, A., van Hoek, A. H. A. M., Huby, T., Kwit, R., Lucarelli, C., Lundin, K., Michelacci, V., Owczarek, S., Ring, I., Sejer Kjeldgaard, J., … Jernberg, C. (2023). One Health surveillance-A cross-sectoral detection, characterization, and notification of foodborne pathogens. Frontiers in public health, 11, 1129083. https://doi.org/10.3389/fpubh.2023.1129083

characterisation of these pathogens in a One Health perspective, enhancing food safety and cross-sectoral surveillance. The study designed a test panel simulating an outbreak scenario, and 15 laboratories from eight countries participated, analysing samples using their routine methods. Results revealed challenges, including false negatives, with differing detection sensitivities influenced by enrichment methods, sample sizes, and concentrations of target organisms. The study highlighted the potential for cross-sectoral collaboration, discussed the differences in methods and notification practices across sectors, and emphasized the value of considering genomic approaches and improved methodologies for tackling foodborne zoonosis outbreaks.

Dairy production sustainability through a one-health lens.[50]

This paper examines dairy production sustainability in the context of global population growth and concerns about animal welfare, the environment, and community well-being. It highlights improvements in animal health, welfare, and sustainability, as well as the role of microbes in milk production. The article discusses advances in animal welfare, reduced emissions in dairy production, and the industry's economic and nutritional significance. It emphasises the importance of a holistic perspective on dairy agriculture's sustainable future. The authors conclude by advocating for a comprehensive understanding of dairy's multifaceted contributions to society and the environment, underscoring the need for a holistic perspective on the sustainable future of dairy agriculture.

Research and Innovation Opportunities to Improve Epidemiological Knowledge and Control of Environmentally Driven Zoonoses.[51]

This article discusses environmentally driven zoonoses (EDZs) resulting from complex interactions between humans and animals in various environments, including farming, animal markets, environmental management systems, and community leisure spaces. Their reservoirs are in the natural environment, making them difficult to monitor through traditional surveillance methods. Factors like climate change, human population density, and intensified agriculture have been linked to increased transmission of EDZs. The review highlights challenges in the epidemiology, diagnosis, and control of EDZs, using examples like avian influenza and antimicrobial-resistant pathogens. It explores the risk factors involved in these infections, their impact on human, animal, and environmental health, and the difficulties in monitoring them in the environment. The article emphasises the importance of an integrated One Health approach that considers human, animal, and environmental health, to mitigate the impacts of EDZs.

Ongoing research

Non-exhaustive list of ongoing projects on One Health funded by STAR-IDAZ IRC and STAR-IDAZ Network Members:

Country/Funder	Main research Institution	Research project	Start Year	End Year
Argentina/INTA	INTA	Implementation of technologies and new preventive and therapeutic strategies for the sustainable and efficient development of animal production within the framework of One Health	2023	2027
Belgium/FPS Health, Food chain safety and Environment	Sciensano Ghent University University of Liège	PET-AMR 'One Health' implications of the use of antibacterial agents in pet animals	2021	2024

50 Nguyen, B. T., Briggs, K. R., & Nydam, D. V. (2022). Dairy production sustainability through a one-health lens. Journal of the American Veterinary Medical Association, 261(1), 12–16. https://doi.org/10.2460/javma.22.09.0429

51 Proboste, T., James, A., Charette-Castonguay, A., Chakma, S., Cortes-Ramirez, J., Donner, E., Sly, P., & Magalhães, R. J. S. (2022). Research and Innovation Opportunities to Improve Epidemiological Knowledge and Control of Environmentally Driven Zoonoses. Annals of global health, 88(1), 93. https://doi.org/10.5334/aogh.3770

Country/Funder	Main research Institution	Research project	Start Year	End Year
Belgium/FPS Health, Food chain safety and Environment	University of Liège ILVO UGent UC Louvain	GENOPREDICT - Genome based prediction of biological features of uncharacterised viral species in a One Health approach	2022	2025
France/AMI CLIMAE, INRA, INRAE	INRAE	Futuratick, Climatick - Characterization and adaptation to future risk in the context of climate change and its mitigation	2023	2025
France/ANR	ANSES - EnvA	Labex IBEID_Coinfection - New insights regarding tick co-infections	2021	2024
France/ANR	CIRAD	ArchR - Genetic architecture of insecticide resistance: from genomic data to vector capacity	2021	2024
France/ANR	CNRS	Heniphase - Phase separations and transitions by Henipavirus V and W proteins: molecular mechanisms and implications for their functions and pathogenesis	2021	2024
France/ANR	CNRS	SERIOUS - Social and Environmental RIsk factors in the emergence of mOsquito-borne diseases in Urban areaS-SERIOUS	2022	2026
France/ANR	INRAE	AxoTick - Cholinergic receptors-mediated activities of peptidergic neurons innervating salivary glands of the tick *Ixodes ricinus*	2021	2025
France/ANR	INRAE	hIPsTER - Integrative Pathobiology of Tick-borne Flaviviruses	2020	2023
France/INRAE	VetAgroSup - INRAE	RESEDAPP - Entomological Surveillance Network and Early Detection of Arboviruses in support of Public Policies.	2022	2025
France/INRAE MP DIGIT-BIO	INRAE	MIDIIVEC - Modeling the transmission dynamics of arboviruses by their vector and predicting the risk of arboviral emergence and spread	2022	2024
France/INRAE-SA	INRAE	NanoMos - Utilisation of biodegradable polylactic acid nanoparticles in mosquitoes to combat arboviruses	2023	2024
France/RIVOC region occitanie	INRAE	HolisTique	2022	2025
French/INRAE	INRAE	MosquiCells - Establishment of novel mosquito cell lines for deciphering host-pathogen interactions during arbovirus infection	2022	2023
Italy/Italian Ministry of Health	IZS AM	Machine Learning approaches in the identification of risk factors for certain infectious diseases in animal healthcare	2022	2024
Italy/Italian Ministry of Health	IZS AM	VESETIS - Hepatitis E Virus: Epidemiological Surveillance and Development of WGS Diagnostic Techniques for the Improvement of Viral Characterization, Phylogeny, Clustering and Source Identification Activities	2021	2023
Italy/Italian Ministry of Health	IZS LER	One health experimental monitoring techniques on TBE and other tick-borne diseases	2021	2023
Italy/Italian Ministry of Health	IZS LT	Genomics of the zoonotic Campylobacter population in Italy in One Health, with particular regard to antibiotic-resistant campylobacteriosis, and development of a surveillance network prototype at the local level (Lazio Region)	2021	2023

Country/Funder	Main research Institution	Research project	Start Year	End Year
Italy/Italian Ministry of Health	IZS LT	Non-human primates: development of protocols for the diagnosis and monitoring of the main communicable diseases including those with zoonotic potential, from a One Health perspective	2022	2024
Italy/Italian Ministry of Health	IZS PLV	Hepatotropic Virus Hunting: Virological Investigation in Wildlife in an Integrated One Health Context	2022	2024
Italy/Italian Ministry of Health	IZS PLV	Public health issues associated to wildlife in North Italy: One Health approach	2023	2026
Italy/Italian Ministry of Health	IZS SA	Implementation of a surveillance system of antimicrobial resistance (AMR) in bacteria of veterinary origin with particular attention to zoonotic ones	2021	2023
Italy/Italian Ministry of Health	IZS SI	Innovative methods for the assessment of endemic, emerging (AMR) and chemical infectious risks in rural areas with a livestock vocation: human-zootechnical-wildlife interaction	2021	2023
Italy/Italian Ministry of Health	IZS VE	Mammalian Orthoreovirus (MRV): in-deep study of a One Health strategy to counter the emerging risk of animal-human spillover and transmission	2023	2026
Netherland/ Ministry LNV	WBVR	Projectcode: - Participation in several EU projects, such as FARMED: Fast Antimicrobial Resistance and Mobile-Element Detection using metagenomics for animal and human on-site tests	2020	2022
Netherland/ Ministry VWS & LNV	WBVR	ERRAZE - Early Recognition and Rapid Action in Zoonotic Emergencies	2020	2026
Norway/Agenda Vestlandet	NORCE Norwegian Research Centre AS (coordinator), NVI	Effects of microplastics in animals and humans (Pillar 4) - North Atlantic Microplastic Centre	2021	2023
Norway/ Norwegian Agency for Development Cooperation (NORAD)	The Arctic University of Norway	OneHealthAfrica - The Urban-suburban nexus toward One Health approach	2021	2026
Norway/ Research Council of Norway	NVI	ImplementOneHealth - Improving implementation and operation of a One Health platform to combat rabies in Malawi	2021	2025
UK/Defra and BBSRC	APHA led consortium	GAP-DC - Genomics for animal and plant disease (GAP-DC)	2023	2027
UK/Defra and BBSRC	Multiple	VBD One Health research programme (7 projects)	2023	2026
USA/Defence Threat Reduction Agency (DTRA)	Tanzania Veterinary Laboratory Agency	One-Health Approaches to Trans-boundary Disease Surveillance and Molecular Epidemiologic Analysis of Brucellosis in Tanzania and Rwanda	2021	2025

10. Vaccinology

An insightful review focusing on the application of platform technologies in veterinary vaccinology was featured in the May 2022 issue of the *Vaccine* journal (**https://doi.org/10.1016/j.vaccine.2022.03.059**). This comprehensive article delves into the impact of technological advancements on vaccine design, introduces the concept of vaccine platform technologies, and underscores their profound relevance for global veterinary vaccinology and the One Health initiative. The review was co-authored by Gary Entrican, a member of the STAR-IDAZ IRC Scientific Committee, and Michael James Francis.

Building on this work, an upcoming workshop titled 'Platform Technologies for Veterinary Vaccines Against Bacterial Diseases', is scheduled for 17 November, 2023. This workshop will run in conjunction with the 13th **International Veterinary Immunology Symposium**, set to take place in South Africa from 17 to 21 November 2023, in collaboration with UKRI-BBSRC. The primary objective of this workshop is to facilitate in-depth discussions, explore innovative vaccine technologies targeting bacterial pathogens, foster collaborative efforts, and develop a publication intended for widespread dissemination.

During the workshop, leading experts, including the co-author Gary Entrican, will collectively identify gaps in veterinary vaccinology related to bacterial diseases. These discussions will also focus on identifying opportunities to address these gaps within the framework of the One Health approach. Moreover, participants will engage in conversations regarding target product profiles and Technology Readiness Levels for Animal Health (TRLAH) across various stages of research. The culmination of these efforts will be the creation of a positional report containing valuable research recommendations. This report will play a pivotal role in advancing veterinary vaccinology for bacterial diseases on a global scale.

Global networks: International Veterinary Vaccinology Network (IVVN)

Website: http://intvetvaccnet.co.uk/

Members ca.
1900

Budget
£2.8 Million/
4 years

Start date:
2017
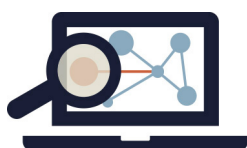
Overview

The International Veterinary Vaccinology Network (IVVN) is a multidisciplinary and inter-connected vaccinology research and development community. Built on the basis of the UK Veterinary Vaccinology Network, the IVVN has to date more than 1900 members.

The IVVN facilitates collaborations between scientists, industrial partners and others from the UK and low-and-middle income countries (LMICs) across the broad range of disciplines that can contribute to vaccine development, by funding scientific meetings, workshops, laboratory exchanges and supporting 'pump-priming' projects. Awards of up to £100,000 were available to support pump-priming projects from collaborative teams of IVVN members, which address a key bottleneck preventing the development of a vaccine for livestock and zoonotic diseases of importance in LMICs. Laboratory exchange funding Awards of up to £10,000 are available to support transfer of expertise between laboratories within the Network, or to fund a proof-of-concept piece of work.

Aim and priorities

Aim: to address the challenges impeding vaccine discovery, as well as evaluation and delivery of vaccines that will have impact on the control of priority livestock and zoonotic diseases in LMICs.

Priorities: vaccinology in the field of Animal health.

Objectives

- Establish an interactive and multi-disciplinary Network to facilitate dissemination of knowledge and exchange of 'state-of-the-art' technology between members of the veterinary (and human) vaccinology communities
- Identify and fund collaborative teams with complementary expertise that through application of novel approaches can effectively address critical 'bottle-necks' in vaccine development for LMICs-relevant pathogens
- Advance the development of veterinary vaccines for LMIC-relevant diseases
- Provide the scientific and logistical support for members to secure substantive funding to expand on the preliminary data generated by pump-priming funding
- Engage with a variety of industry partners, in both developed and LMICs, to ensure the sustainable delivery of effective vaccines.

News

The IVVN continue to run a series of monthly webinar on topic of relevance for vaccinology delivered by experts in their field for more information and additional online event visit the page **https://www.intvetvaccnet. co.uk/events/ivvn-webinars**.

The IVVN have awarded funding to 13 projects over four rounds of funding, the last of which was announced in April 2020. The list of current funded pump-priming grant can be found here: **https://www.intvetvaccnet.co.uk/ catalyst-funding/pump-priming-grants/funded-pump-priming-grants**.

The laboratory exchanges with £10,000 funding available each, resulted in 11 exchanges being funded and more projects are due to be awarded soon.

STAR-IDAZ WG progress

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

DISCONTOOLS research needs

Vaccine research needs for specific diseases can be retrieved via the **database search**. An overarching analysis was recently published by Charlier et al., 2022 **(Lancet Planetary Health 6, e812-e824)**.

Recent developments

Recent advances in antigen targeting to antigen-presenting cells in veterinary medicine.[52]

Advances in antigen targeting within veterinary medicine offer a promising alternative to traditional vaccines for challenging diseases. Success hinges on receptor choice, influencing the immune response post-antigen uptake. Various methods, including antibodies, ligands, fused proteins, and DNA vaccines, have been explored across species such as pigs, cattle, sheep, and poultry. Receptors range from broadly expressed ones to specific cell populations like dendritic cells or macrophages, each yielding different results. DC peptides show high specificity to dendritic cells, enhancing activation and immune responses. MHC-II targeting consistently boosts immune responses, exemplified by a successful vaccine against bovine viral diarrhoea virus. These developments signal significant progress in antigen-targeting vaccines, benefitting animal health. This review focuses on recent antigen targeting advances in veterinary medicine, with a focus on pigs, sheep, cattle, poultry, and dogs.

Recombinant pseudorabies virus usage in vaccine development against Swine Infectious Disease.[53]

This review highlights pseudorabies virus (PRV) as a promising vaccine vector for swine infectious diseases. The article discusses PRV's capacity for genetic modification and its application in constructing multivalent live virus-vectored vaccines. PRV, belonging to the alpha herpesvirus subfamily, has a double-stranded DNA genome with around 70 proteins and has regions that are non-essential for replication, making it suitable for genetic modification. It can serve as an ideal vaccine vector, allowing for the creation of multivalent live virus-vectored vaccines through gene deletion. Gene-deleted PRVs can stimulate the immune system, providing immunity lasting over 4 months. The article provides an overview of PRV biology, the methodology for constructing recombinant PRV, the technology platform for efficient construction, and various applications of recombinant PRV in vaccine development.

A comprehensive review on bacterial vaccines combating antimicrobial resistance in poultry.[54]

Focusing on bacterial vaccines in poultry, this comprehensive review addresses the urgent need to combat antimicrobial resistance. Various bacterial vaccine forms, advantages, and limitations are discussed. The article emphasises the positive impact of bacterial vaccines in reducing antibiotic use, enhancing animal welfare, and promoting sustainable practices.

Advances in babesia vaccine development: an overview.[55]

This overview focuses on advancing vaccine development against babesiosis, a tick-borne zoonotic disease. The review surveys different strategies and molecular candidates for creating effective vaccines. The review covers progress in creating antibabesiosis vaccines against several *Babesia* species, including *B. microti, B. bovis, B. bigemina, B. orientalis,* and *B. divergens*. Various strategies for vaccine development and evaluation are explored, aiming to reduce symptoms in animals and prevent disease spread. The article also discusses molecular candidates for vaccine production against different *Babesia* species and outlines the potential for successful *Babesia* parasite elimination through vaccine evolution. It emphasises ongoing efforts to develop vaccines that prevent disease spread and outlines the potential for controlling *Babesia* parasites.

---

52 Melgoza-González, E. A., Bustamante-Córdova, L., & Hernández, J. (2023). Recent advances in antigen targeting to antigen-presenting cells in veterinary medicine. Frontiers in immunology, 14, 1080238. https://doi.org/10.3389/fimmu.2023.1080238

53 Zhou, M., Abid, M., Cao, S., & Zhu, S. (2023). Recombinant Pseudorabies Virus Usage in Vaccine Development against Swine Infectious Disease. Viruses, 15(2), 370. https://doi.org/10.3390/v15020370

54 Islam, M. S., & Rahman, M. T. (2023). A Comprehensive Review on Bacterial Vaccines Combating Antimicrobial Resistance in Poultry. Vaccines, 11(3), 616. https://doi.org/10.3390/vaccines11030616

55 Jerzak, M., Gandurski, A., Tokaj, M., Stachera, W., Szuba, M., & Dybicz, M. (2023). Advances in Babesia Vaccine Development: An Overview. Pathogens, 12(2), 300. **https://doi.org/10.3390/pathogens12020300**

A novel viral vaccine platform based on engineered transfer RNA.[56]

The article discusses a novel viral vaccine platform based on engineered transfer RNA (ACE-tRNAs). This technology offers a new strategy for rapidly attenuating virus infections and inducing strong immune responses, making it a potential platform for future viral vaccine development. The study focuses on controlling the replication of premature termination codon (PTC)-containing viruses to create live but replication-defective viruses for potent vaccines. ACE-tRNAs are introduced as precision switches to manage PTC-containing virus replication. Authors report superior efficacy in reading through PTCs compared to genetic code expansion (GCE) technology, with a site preference influencing their effectiveness. ACE-tRNAs are used as a viral vaccine platform, tested on human immunodeficiency virus type 1 (HIV-1), pseudotyped virus and pseudorabies virus (PRV). ACE-tRNAs effectively control PTC-containing virus production. PTC-engineered PRV is rendered non-virulent in mice in vivo, and vaccination with PRV containing a PTC generated a robust immune response and full protection against wild-type PRV.

Ongoing research

Non-exhaustive list of ongoing projects on vaccinology funded by STAR-IDAZ IRC and STAR-IDAZ Network Members:

Country/ Funder	Main Research Institution	Research project	Start Year	End Year
Argentina/INTA	INTA	Implementation of technologies and new preventive and therapeutic strategies for the sustainable and efficient development of animal production within the framework of One Health	2023	2027
Argentina/ MINCYT	INTA	Mechanisms of protection induced by R-VAC IMMUNER IBD, the first recombinant vaccine developed in Argentina against Gumboro disease	2020	2024
Argentina/ MINCYT	INTECH-IPADS CONICET-INTA BALCARCE-FCA UNMdP-FCE UNLP	Translational research platform for the development of veterinary vaccines using plants as biofactories: production of *Toxoplasma gondii* antigens as proof of concept	2022	2024
Belgium/FPS Health, Food chain safety and Environment	Sciensano DGZ Vlaanderen ARSIA CER Groupe	NCDVAC - Evaluation of new vaccines and development of appropriate vaccination schedules for Newcastle disease	2020	2023
Belgium/FPS Health, Food chain safety and Environment	Sciensano UGent	PigRResponSe - Unravelling the role of non-responding piglets and sows to vaccination against PRRSV (porcine reproductive and respiratory syndrome virus)	2020	2023
Belgium/FPS Health, Food chain safety and Environment	UGent	CampyBroilerBreed - Immunisation of broiler breeders to protect broilers against *Campylobacter* infection	2020	2023
Belgium/FPS Health, Food chain safety and Environment	UGent	CHLAPEControl - Design of smart ovotransferrins and a mRNA combination vaccine for controlling avian pathogenic *Escherichia coli* (APEC) and *Chlamydia psittaci* in chicken broilers	2022	2025
Belgium/FWO	UGent	mRNA vaccine development against zoonotic *Chlamydia psittaci* infections in pet birds	2020	2024

56 Wang, T. Y., Meng, F. D., Sang, G. J., Zhang, H. L., Tian, Z. J., Zheng, H., Cai, X. H., & Tang, Y. D. (2023). A novel viral vaccine platform based on engineered transfer RNA. Emerging microbes & infections, 12(1), 2157339. **https://doi.org/10.1080/2222175 1.2022.2157339**

Country/Funder	Main Research Institution	Research project	Start Year	End Year
Belgium/ Industrial Company	UGent	R&D contract - mRNA vaccine development for *Chlamydia trachomatis*	2020	2024
Belgium/UGent BOF	UGent	Vaccine development against *Chlamydia trachomatis* in a pig model	2020	2024
Belgium/UGent IOF	UGent	MucoVac-Ad - Adjuvanting aminopeptidase N-targeted oral vaccines to protect against gut pathogens	2023	2025
Belgium/VLAIO	UGent	mRNA vaccines for Chlamydia - mRNA vaccine development for *Chlamydia trachomatis*	2020	2023
CGIAR Initiatives/ SAPLING CGIAR Initiative	ILRI	SNAP- a novel subunit vaccine platform technology to accelerate vaccine development for East Coast fever.	2022	2022
China/Ministry of Science and Technology	Shanghai Veterinary Research Institute, CAAS	Development of vaccine against swine viral diseases	2022	2025
EU/Danemark/ France/TRANS-VAC 2 Europe _ Infrastructure	Proxibioteck	CDIFFVAC-2 - Evaluation of safety, dose-finding and stability of CDIFFVAC, a superior toxoid based vaccine against *Clostridioides difficile* infection	2023	2023
EU/EC	FLI	**SPIDVAC** - Improved control of priority animal diseases: Novel vaccines and companion diagnostic tests for African horse sickness, PPR and FMD	2022	2026
EU/EC	Proxibioteck	CMS-TOXOID-02 - Evaluation of safety, dose-finding and stability of CDIFFVAC, a superior toxoid based vaccine against *Clostridioides difficile* infection	2020	2021
EU/ERC	Fondazione Toscana Life Sciences	**vAMRes** - Vaccines as a remedy for antimicrobial resistant bacterial infections	2018	2023
EU/EC	ENEA, IT	**REPRODIVAC** - Next-generation vaccines and diagnostics to prevent livestock reproductive diseases of worldwide impact	2022	2027
EU/ICRAD Cofound call	UGent Wageningen University LUMC	**Plants4Nemavax**- Plant-based production of glyco-engineered nematode vaccines	2021	2024
EU/ICRAD Cofound call	University of Lyon	**NucNanoFish** - Nucleic NanoVaccines for Fish	2021	2023
EU/ICRAD Cofound call	Wageningen University (NL)	**NanoZoo**- Protein nanoparticle vaccine platform for rapid response against zoonotic viruses in poultry and swine		
EU/ICRAD Joint Cofound call	The Pirbright Institute	**NEOVACC** - Novel strategies to enhance vaccine immunity in neonatal livestock	2021	2024
France/ANR	CNRS	MucRNAVax - Design and evaluation of a LipoParticulate mRNA vaccine carrier, mucus penetrating, able to induce mucosal immune responses against respiratory infectious diseases	2022	2027

Country/ Funder	Main Research Institution	Research project	Start Year	End Year
France/ANR COVID	Université de Tours /INRAE	Nanovaccin 1 - Validation in a K18-hACE2 mouse model of a mucosal vaccine candidate anti-SARS-Cov2 in terms of responses immune and protective	2021	2022
France/Région	Université de Tours /INRAE	Mucovid - Validation in a golden hamster reference model of a new anti-SARS-CoV-2 mucosal vaccine candidate	2021	2022
Italy/Italian Ministry of Health	IZS AM	Bu&Bra - Efficacy study of the *Brucella abortus* vaccine strain RB51 in pregnant buffaloes (*Bubalus bubalis*) subjected to challenge	2022	2024
Italy/Italian Ministry of Health	IZS AM	ORBIVAX - Development and evaluation of the efficacy of inactivated vaccines against two emerging orbiviruses in the Mediterranean basin	2022	2024
Italy/Italian Ministry of Health	IZS LT	Production and efficacy control of an inactivated stabulogenic vaccine for contagious Ecthyma	2021	2023
Italy/Italian Ministry of Health	IZS PLV	Multidisciplinary approach for the development of 'tailor made' vaccination protocols for the prevention of *Streptococcus suis* infections in pig farms in Piemonte region (Italy)	2022	2024
Italy/Italian Ministry of Health	IZS UM	Reduction and control of antimicrobial resistance (AMR) through the development, fine-tuning and validation of new bacterial, viral, protozoal and fungal veterinary vaccines (BVPF); mono and multi-valent formulated with innovative adjuvants	2021	2023
Italy/Italian Ministry of Health	IZS UM	Study, development and validation of new veterinary vaccines developed with innovative immunomodulatory molecules of natural and synthetic origin in order to reduce the use of antibiotics and effectively combat the phenomenon of antimicrobial resistance (AMR)	2022	2024
Italy/Italian Ministry of Health	IZS VE	COMVENIENCE - Development of an OMV (outer membrane vesicles) vaccine for the prevention of rabbit pasteurellosis	2021	2023
Kenya /TAHSSL	ILRI	Evaluate suitability of one nanoparticle platform for veterinary vaccines, BRSV as a model	2019	2021
Kenya /TAHSSL	ILRI	Evaluate suitability of one nanoparticle platform for veterinary vaccines, BRSV as a model	2019	2021
Spain/ National Research Agency	Agencia Estatal Consejo Superior De Investigaciones Científicas (CSIC) - INIA	Design of a multivalent vaccine platform based on the 40fp8 variant of the rift valley fever virus	2022	2025
Spain/ National Research Agency	Agencia Estatal Consejo Superior De Investigaciones Científicas (CSIC) - INIA	Generation of universal DIVA vaccines against bluetongue virus based on bicistronic modified vaccinia Ankara viral vectors and cell-based assays for the rapid detection of neutralizing antibodies	2021	2024

Country/ Funder	Main Research Institution	Research project	Start Year	End Year
Spain/ National Research Agency	Agencia Estatal Consejo Superior De Investigaciones Científicas (CSIC) - INIA	New strategies for optimized recombinant bluetongue vaccines	2022	2025
Spain/ National Research Agency	Agencia Estatal Consejo Superior De Investigaciones Científicas (CSIC) Centro De Biologia Molecular Severo Ochoa (CBM)	Peptide vaccines, antiviral strategies and viral immune evasion mechanisms. biotherapeutic applications	2021	2024
Spain/ National Research Agency	IRTA	Virus and host factors as targets for the design of a new diva strategy against classical swine fever (DIVAFORCSF)	2022	2025
Spain/ National Research Agency	NEIKER-Instituto Vasco De Investigacion Y Desarrollo Agrario Sa	Unveiling early immune responses and trained immunity associated to paratuberculosis vaccination and infection in cattle	2022	2025
Spain/ National Research Agency	Universidad Complutense de Madrid. Centro de Vigilancia Sanitaria Veterinaria (VISAVET)	Trained addressed immunity vaccines using *Streptococcus suis* as experimental model	2021	2024
Spain/ National Research Agency	Universidad de Leon- Facultad Veterinaria	Unveiling early immune responses and trained immunity associated to paratuberculosis vaccination and infection in sheep	2022	2025
Spain/ National Research Agency	Universidad de Zaragoza.- Facultad de Veterinaria	Assesment of vaccine potential of abc receptors for the development of novel vaccines against *Streptococcus suis* (abc-vacciness)	2021	2023
Tanzania/ Tanzania Commission For Science And Technology (COSTECH)	Tanzania Veterinary Laboratory Agency	Development of vaccine against contagious caprine pleuropneumonia for productivity of goats in Tanzania, at Tanzania Vaccine Institute, Kibaha	2021	2024
UK/BBSRC	UGent	Chlamydia abortus vaccine - Biological and pathological characterisation of novel plasmid-carrying avian *Chlamydia abortus* strain 84/2334 for *Chlamydia abortus* vaccine development in sheep	2023	2026
US/USDA	INTA	Detection of FMDV epitopes responsible for mediating crossprotection in susceptible animal species	2023	2025
US/USDA	INTA	Analysis of FMDV avidity of antibodies elicited by O1 Mosaic FMDV vaccine	2023	2024

Country/ Funder	Main Research Institution	Research project	Start Year	End Year
USA/USDA NIFA	USDA ARS	Generation of A Newcastle Disease Vaccine That Protects Against Infectious Laryngotracheitis and Marek`s Disease Which Can Be Delivered in ovo	2023	2026
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	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	Biological mimetics inc	An Improved PCV-2 Vaccine	2023	2024
USA/USDA NIFA	Biostone animal health llc	Partnership: Developing Enzyme Linked Immuno-Sorbent Assay (ELISA) Diagnostics to detect African Swine Fever Antibodies and to Differentiate Infected from Vaccinated Animals (DIVA)	2023	2026
USA/USDA NIFA	Board of Regents of the University of Nebraska	Partnership: Systemic screening of ASFV Proteome for identification of Immunogenic Antigens	2022	2025
USA/USDA NIFA	Conference of Research Workers in Animal Diseases	Conference of Research Workers in Animal Diseases: A Revitalized Interdisciplinary Conference on Animal Diseases and One Health	2022	2022
USA/USDA NIFA	Cornell University	Epidemiology, transmission, and pathogenicity of Equine hepacivirus	2022	2024
USA/USDA NIFA	Cornell University	Novel Broadly Protective Swine Influenza Vaccine Platforms	2022	2024
USA/USDA NIFA	Evergreen aquatics	Developing Tools and Protocols to Establish Freshwater Cod (Burbot; Lota lota) as a New Commercial Aquaculture Species in the US.	2023	2024
USA/USDA NIFA	Genvax Technologies inc	Surveillance and prediction of Swine Influenza A Virus hemagglutinin gene sequences for the rapid development of saRNA-nanoparticle vaccines	2023	2024
USA/USDA NIFA	Ginkgo bioworks, inc.	Extensive SARS-CoV-2 Genomic Survey Supporting Farmed White Tailed Deer Health	2023	2026
USA/USDA NIFA	Iowa State University of Science and technology	Partnership: Basic and applied approach toward eliminating bovine trichomonosis	2022	2025
USA/USDA NIFA	Kansas State University	Broadly Protective Bovine Parainfluenza Virus-3 and Bovine Viral Diarrhoea Virus Vaccine	2023	2026
USA/USDA NIFA	Kansas State University	Development of Vectored Subunit Vaccine Candidates for ASFV	2023	2026
USA/USDA NIFA	Larad inc.	Differentiating between Marek's Disease Virus infected and Herpesvirus of Turkeys vectored vaccinated poultry	2022	2023
USA/USDA NIFA	Long Island University	An 'intelligently-designed' vaccine to prevent bovine respiratory and other diseases due to *Histophilus somni*	2023	2026

Country/ Funder	Main Research Institution	Research project	Start Year	End Year
USA/USDA NIFA	Louisiana State University	Partnership: Novel Pseudorabies Virus (PRV) Vectored Subunit Vaccine Against African Swine Fever	2023	2026
USA/USDA NIFA	Michigan State University	Reducing the spread of *Salmonella* Dublin in dairy farms through evidence-based vaccination protocols	2022	2025
USA/USDA NIFA	Mississippi State University	Development of a dual live attenuated vaccine to prevent motile Aeromonas septicemia and enteric septicemia of catfish	2022	2024
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	Ohio State University, the	Drinking water deliverable chitosan based *Salmonella* and *Campylobacter* subunit vaccine for broilers	2022	2025
USA/USDA NIFA	Oklahoma State University	Defining Antagonism Hierarchy of Porcine Epidemic Diarrhea Virus for Live Vaccines Design	2023	2027
USA/USDA NIFA	Pathovacs incorporated	Broadly Protective Porcine *Streptococcus suis* Vaccines	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	2023
USA/USDA NIFA	Texas A&M Agrilife Research	Development of Extracellular Vesicles as Vaccine Candidates against Ticks	2022	2024
USA/USDA NIFA	Texas A&M Agrilife Research	Impact of timing of vaccination on reproductive success in beef cattle.	2022	2025
USA/USDA NIFA	Texas A&M Agrilife Research	Molecular Epidemiological Assessment of Beef Cattle Management Systems: How Markets and Vaccines Influence Health and Disease	2023	2025
USA/USDA NIFA	Texas A&M Agrilife Research	Passive Immunization Against Rhodococcal Foal Pneumonia Using Nebulised mRNA	2022	2026
USA/USDA NIFA	Thyreos, inc	The first non-neuroinvasive live-attenuated bovine herpesvirus type 1 vaccine	2022	2024
USA/USDA NIFA	Tuskegee University	Adding Value to Weaned Beef Calves Belonging to Small and Limited Resource Producers in the Black Belt of Alabama	2023	2026
USA/USDA NIFA	University of Arkansas system	Controlling Salmonella through enhanced understanding of horizontal transmission and a novel and scalable vaccination strategy in broilers	2022	2026
USA/USDA NIFA	University of Connecticut	Rationally Designed *Mycoplasma gallisepticum* Subunit Vaccine	2022	2025
USA/USDA NIFA	University of Delaware	The Role of Exosomes in Marek`s Disease Virus Pathogenesis and Immunity	2023	2028
USA/USDA NIFA	University of Florida	Development of a mucosally administered multivalent vaccine to prevent infection of poultry by multiple *Eimeria* species	2023	2026
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 Georgia Research Foundation, inc.	A Molecular Serology Approach For Surveillance Of Avian Pathogenic *E. Coli* In Georgia	2022	2024

Country/Funder	Main Research Institution	Research project	Start Year	End Year
USA/USDA NIFA	University of Georgia Research Foundation, inc.	Safe And Broadly Cross-Protective Live Attenuated Influenza Virus Vaccines For Use In Swine	2022	2025
USA/USDA NIFA	University of Illinois	Recombination-negative, immune-enhanced, and clinically-attenuated PRRSV as a vaccine platform	2023	2027
USA/USDA NIFA	University of Maryland, College Park	Evaluating the causes and consequences of infectious bursal disease virus (IBDV) antigenic drift and reassortment in the USA	2023	2027
USA/USDA NIFA	University of Wisconsin System	Partnership: Nanoparticle Vaccines Against Emerging Poultry Infections	2023	2026
USA/USDA NIFA	Virginia Polytechnic Institute and State University	Nanoparticle-based swine vaccine	2022	2025
USA/USDA NIFA	Vst llc	A protein subunit vaccine for control of Asian long-horned ticks in cattle	2023	2024
USA/USDA NIFA	Western University of Health Sciences	Characterising the spatial expression of the clustered homolog of immunoglobulin-like receptors (CHIR) in the chicken intestine after coccidiosis vaccine challenge	2023	2025

www.star-idaz.net

 https://www.linkedin.com/company/star-idaz-irc/

 https://twitter.com/StarIdaz

 Are you a animal health research funder/programme owner wishing to join the STAR-IDAZ International Research Consortium?

Please contact **v.mariano@woah.org** for more information