BERNHARD NOCHT INSTITUTE FOR TROPICAL MEDICINE

BNITM
Bernhard Nocht Institute for Tropical Medicine

SCIENTIFIC REPORT 2023-2024

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INTRODUCTION

Prof. Jürgen May

Dear readers, dear partners and friends
of the BNITM,

By the time you're holding this annual report in your hands, Hamburg has celebrated 125 years of tropical medicine in the heart of the city: the occasion was marked with a Senate reception and an exhibition at City Hall, a concert in the Recital Hall of the Elbphilharmonie, public information events, and the *European Congress on Tropical Medicine and International Health* (ECTMIH). You can look forward to reading about it in our next annual report.

The two previous years also saw one highlight after another: the special programme *"Computational Science for Pathogen Research and One Health"* gave the institute a further boost in growth. The World Health Organization (WHO) designated the Health Communication Research Group as a *WHO Collaborating Centre for Behavioural Research in*

Global Health (BRIGHT). Together with partners, we founded the *German-Costa Rican Centre for Climate Adaptation and Infectious Diseases* (GC-ADAPT). The Science Authority, Sprinkenhof GmbH, and the Finance Authority signed a Letter of Intent in the historic lecture hall, pledging to renovate the historic institute building and construct a new one. This biennial report provides an account of many other highlights, particularly scientific ones.

At the beginning of December 2023, we were required to undergo the regular evaluation by the Leibniz Association. Reviewers visited the institute, listened to presentations, studied posters, held numerous discussions, both individually and in groups, and asked many critical questions. They were already deeply impressed by the institute's outstanding development and the extent to which the staff identify with BNITM and are committed to its interests.

The outstanding evaluation was both a motivating recognition of our work and an incentive. It strengthens our course of combining internationally visible research with social engagement. While our historical roots may lie in the colonial era, more than a century later, we understand tropical medicine as a discipline of global responsibility.

To mark this anniversary, we are therefore also reflecting on our namesake, Bernhard Nocht, and the obligation that arises from our colonial heritage. Tropical medicine today means working for justice and health worldwide. We feel a strong connection to this goal: with scientific curiosity, ethical standards, and the firm will to face challenges together.

I thank everyone who has accompanied us on this journey. I also thank all colleagues who are committed to the institute in this spirit. The BNITM is very fortunate to have highly qualified employees in all areas who bring the necessary blend of idealism and realism to move things in the right direction.

Jürgen May, July 2025

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RESEARCH SECTIONS

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PATHOGEN

Virology *** S. Günther

Lassa Pathophysiology * T. Omansen

Lassa Immunology * L. Oestereich

Structural Virology ** M. Rosenthal

Cellular Parasitology T. Gilberger

Molecular Parasitology ** J. Matz

Malaria Cell Biology T. Spielmann

How does the infected human body react?

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Protozoa Immunology T. Jacobs

Helminth Immunology M. Breloer

Virus Immunology *** C. Muñoz-Fontela

Mosquito-Virus Interactions *** E. Schnettler

Host-Parasite Interaction I. Bruchhaus

Clinical Immunology of Infectious Diseases M. Addo, *associated UKE Department*

Is an intervention safe and efficient?

PATIENT

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Lassa Pathophysiology* T. Omansen

Zoonoses D. Tappe

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Infectious Disease Epidemiology *** J. May

Arbovirus and Entomology J. Schmidt-Chanasit

Arbovirus Ecology ** R. Lühken

How does it work in practice?

IMPLEMENTATION

Implementation Research N.N.

Health Communication C. Betsch

Health Economics J. Priebe

Zoonoses Control E. Fichet-Calvet

Vector Control R. Lühken

Medical Anthropology S. Park

Global One Health J. Amuasi

One Health Bacteriology D. Dekker

Neglected Diseases and Envenoming B. Kreuels

Drug Implementation G. Mombo-Ngoma

Ethnopharmacology and Zoopharmacognosy F. Schultz

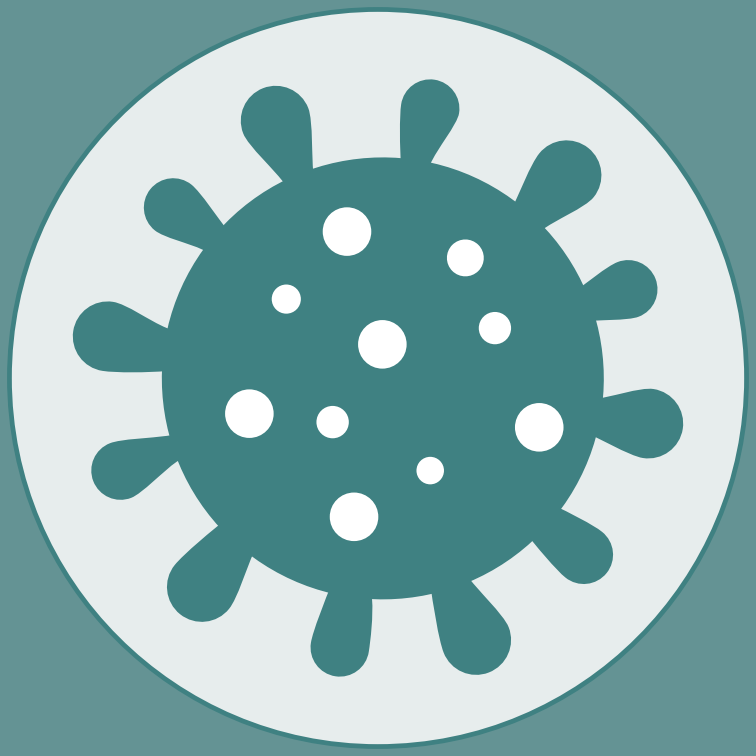
Research Section
Department
Working Goup
Junior Group

* Leibniz Junior Research Group
** BMBF Junior Research Group
*** incl. DZIF financed infrastructures

Date November 2024

T R A N S L A T I O N

WEBSITES OF ALL THE RESEARCH GROUPS

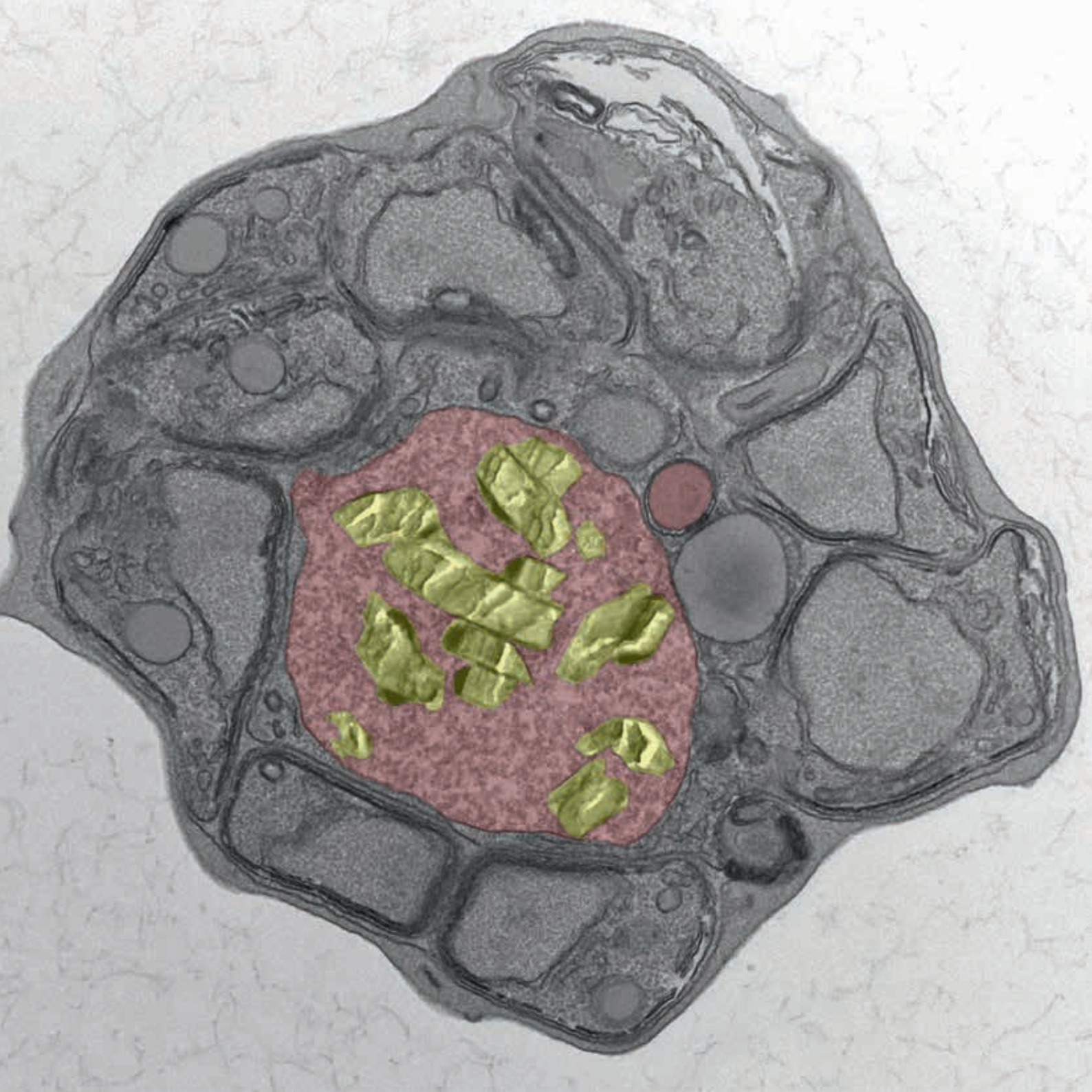


PATHOGEN

What are the starting points for interventions?

Research groups within the PATHOGEN section investigate tropical, emerging, and rare pathogens such as malaria parasites or haemorrhagic fever viruses like the Lassa and Ebola virus. The central question is: How do these pathogens function, and where can they be effectively targeted? Among other aspects, the researchers examine the pathogens' cell organelles and study how their replication machinery works.

A key area of focus is structural analysis conducted at the Centre for Structural Systems Biology (CSSB). At this facility, BNITM research groups use unique methods to resolve the protein components of pathogens down to the molecular and atomic level. This high-resolution analysis of the pathogen structure is essential for identifying potential targets for therapeutic interventions. According to the World Health Organization (WHO), many of these pathogens are classified as global threats, with no vaccines or reliable therapies to date.



THE ACIDIC STOMACH OF THE MALARIA PARASITE

Malaria kills more than 600,000 people worldwide each year. It is caused by a single-celled parasite that multiplies in our red blood cells. The parasite digests the host cell's red blood pigment in a highly specialised "cellular stomach" referred to as the food vacuole. As in humans, this process requires acid to be pumped into the stomach which promotes digestion. It was long believed that this acidification is also essential for certain malaria drugs to reach the food vacuole and take effect.

An enzymatic complex, known as the proton pump V-ATPase, acidifies the parasite's food vacuole. We specifically inactivated components of this complex to disrupt the acidification process. This had fatal consequences for the parasite's digestion. Surprisingly, despite the lack of acidification, the parasite continued to absorb malaria drugs, which remained lethal.

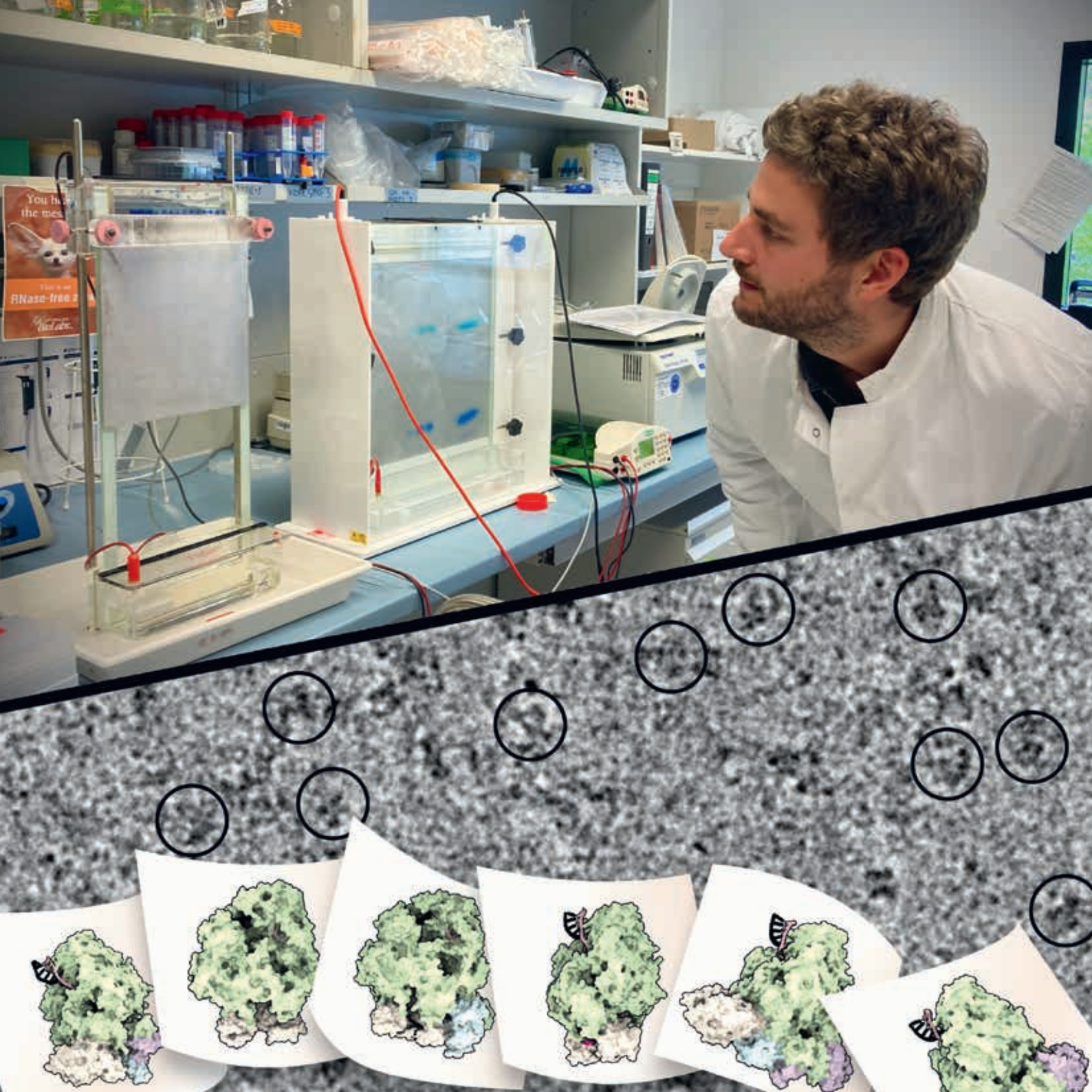
Another interesting finding is that certain components of the proton pump appear to stabilise the food vacuole. Without these parts, not only does the proton pump disintegrate into its individual components, but so does the entire food vacuole. A number of newly developed drugs appear to inhibit the proton pump, making it crucial to understand how this complex system functions. Given the malaria parasite's growing resistance to conventional drugs, developing such innovative therapies is more important than ever.

Alder A et al., Proc Natl Acad Sci U S A. 2023 Jul 25; 120 (30):e2306420120

Arne Alder, Tim-Wolf Gilberger and Joachim M. Matz, as well as external cooperation partners (see publication)

Figure: Malaria parasite under the electron microscope with a food vacuole (red) and digestion end products (yellow)

TO THE RESEARCH GROUP PAGE



SUPERMACHINES OF THE BUNYAVIRUSES

Bunyavirus polymerase proteins, also called L proteins, are true supermachines. They produce various products based on viral genetic information: (1) Viral mRNA for the production of viral proteins. (2) Exact copies of the viral genome to replicate its genetic information, which requires (3) a "negative" copy, the antigenome. How does this supermachine manage to synthesize such diverse products? It is clear that various areas and functions of the L protein have to work together in a coordinated manner. But how exactly?

We wanted to better understand the processes at the molecular level and visualise them step by step, like a flip book. To do this, we used specifically designed reaction components and cryo-electron microscopy – a method to visualise the 3D structure of smallest molecules. We paused the L protein at various steps during its activity and took high-resolution snapshots. This allowed us to uncover essential movements and interactions within the L protein and with the viral genetic information. Our findings are helping us develop targeted antiviral strategies against bunyaviruses.

Williams HM et al., Nucleic Acids Res. 2024 Jun 10;52(10):6049-6065
Williams HM, Thorkelsson SR et al., Nucleic Acids Res. 2023 Feb 22;51(3):1424-1442

Harry M. Williams, Dominik Vogel, Carola Busch, Morlin Milewski and Maria Rosenthal, as well as external cooperation partners (see publications)

Figure: A scientist optimises reaction components to specifically pause the L protein at different RNA production steps. The molecules are then visualised using cryo-electron microscopy (section below); this allows the creation of 3D models of different RNA production steps (individual images of the flipbook).

TO THE RESEARCH GROUP PAGE

Highly infected but not sick

THE LASSA VIRUS IN ITS NATURAL HOST

The Lassa virus is a highly pathogenic microorganism that causes Lassa fever, a haemorrhagic fever, in humans. It is responsible for up to 18,000 deaths annually in West Africa and, according to the WHO, has high epidemic potential. There are currently no approved drugs or vaccines against this pathogen.

Rodents, especially the multimammate mouse *Mastomys natalensis*, transmit the Lassa virus to humans. Although the Lassa virus was discovered more than 50 years ago, the interaction between virus and rodents has been largely unstudied. "What actually happens in an infected host animal?" is one of the unanswered questions we addressed with a series of infection experiments.

One of our most important findings was that the course of Lassa virus infection in *Mastomys* is age-dependent. If rodents first come into contact with Lassa virus as adults, they are infected for only a short time. If young animals become infected with Lassa virus, they retain the virus in their bodies for life. Animals infected with Lassa transmit the virus to their contacts. Infected females in particular show a very high transmission rate to their offspring. The second important finding was that unlike in humans, animals infected with Lassa do not become ill, even though the virus is found in sometimes high quantities almost everywhere in the body.

These findings may be used in the future to develop new measures to reduce the risk of infections in humans.

Hoffmann C et al., Nat Commun 2024 Oct 29;15(1):9319

Chris Hoffmann, Stephanie Wurr, Elisa Adam, Sabrina Bockholt, Jonas Müller, Stephan Günther and Lisa Oestereich, as well as external cooperation partners (see publication)

Figure: The multimammate mouse *Mastomys natalensis* is the natural host of the Lassa virus.

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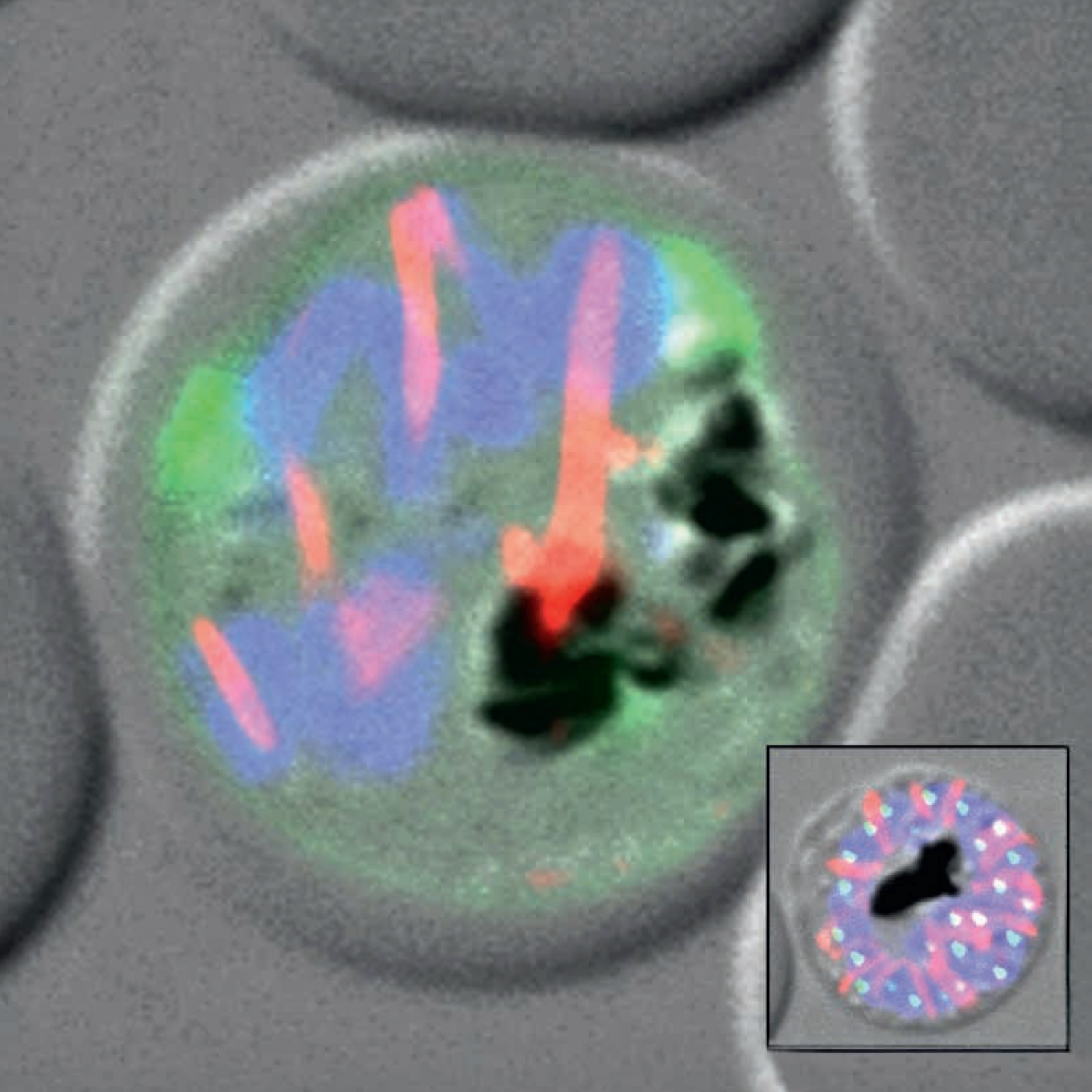


TREASURY OF THE NEW BIOLOGY OF THE MALARIA PARASITE

The function of more than a third of all proteins in the malaria parasite remain unknown. They don't resemble proteins from other organisms. This unknown part of the parasite's biology is important for understanding the pathogen. Its uniqueness could also provide targets for drugs that don't harm the human host.

We searched for such proteins and found many in the nucleus of the parasite. This could be related to the parasites' unique process of nuclear division. To elucidate the function of the unknown proteins, we looked at their structure. Using newly emerged methods to predict 3D structures of these proteins, we were able to compare them with proteins from other organisms, such as humans. Unexpectedly, there were many similarities. This was not apparent from the protein sequence without its structure. We suspect that the pathogen did not reinvent these proteins; rather, the protein sequence changed beyond recognition over the course of evolution.

This means that structural comparisons will be able to predict the function of many unknown proteins in the future. However, the unexpected functional similarities also mean that such proteins may not be good targets for drug development because in their 3D structure they are too similar to human proteins.

Kimmel J, Schmitt M et al., Cell Syst. 2023 14(1):9-23.e7

Jessica Kimmel, Marius Schmitt, Alexej Sinner, Sheila Mainye, Gala Ramón-Zamorano, Jan S. Wichers-Misterek, Jakob Cronshagen, Ricarda Sabitzki, Paolo Mesén-Ramírez, Hannah M. Behrens and Tobias Spielmann, as well as external cooperation partners (see publication)

Figure: Malaria parasite in a red blood cell: The loss of one of the studied "unknown" proteins disrupts the malaria parasite's nuclear division, resulting in its death. The inset shows correct nuclear division, which leads to the formation of new offspring of the malaria parasite.

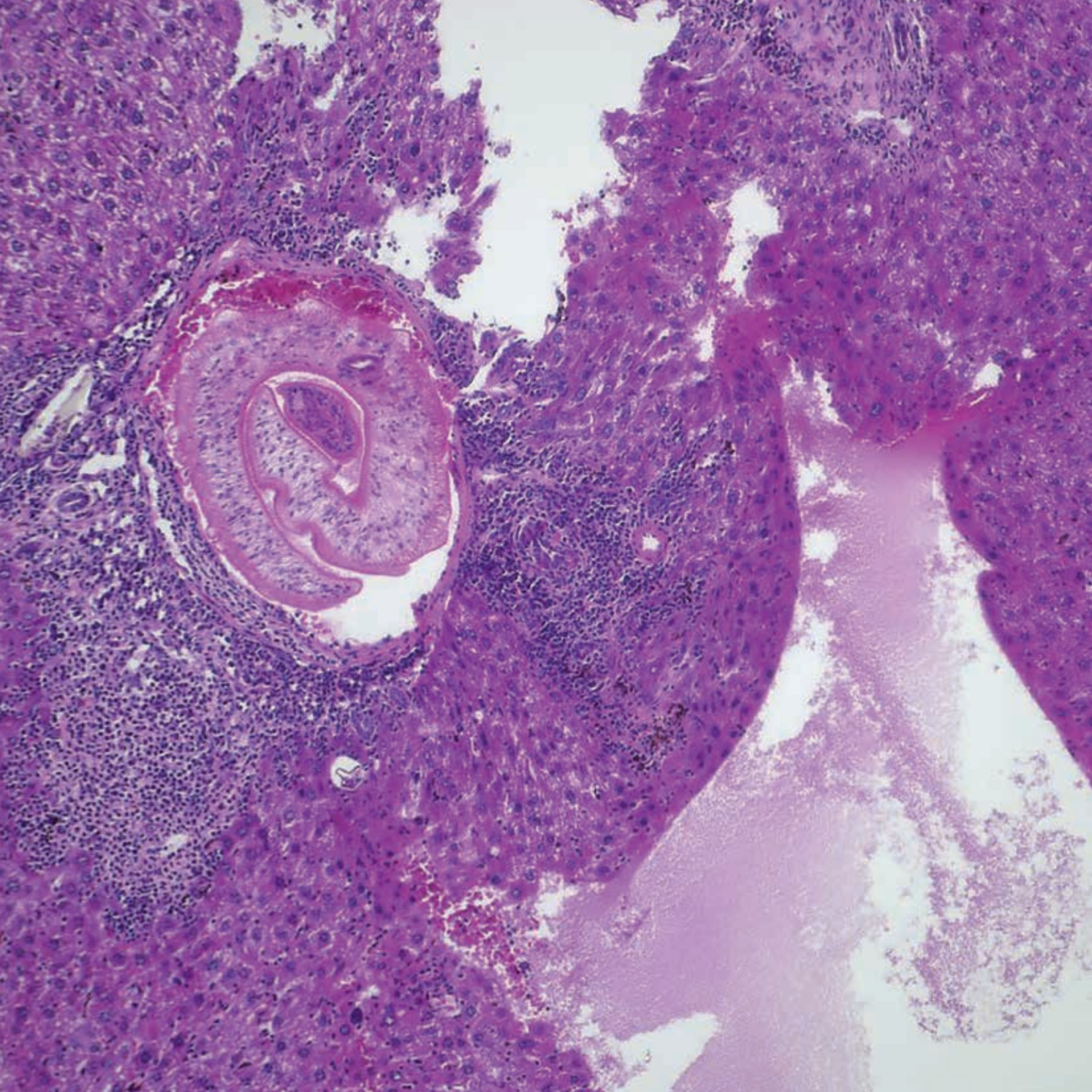
TO THE RESEARCH GROUP PAGE

INTERFACE

How do pathogens, hosts and vectors interact?

In the INTERFACE section, scientists explore the complex interactions between infectious agents, their host organisms, and vectors – organisms that transmit pathogens. The research focuses on how microorganisms trigger immune responses, evade immune defences, and interact with host cells.

The research groups investigate these processes using modern molecular biology methods: they analyse the strategies pathogens use to invade cells and survive within them. They also examine the mechanisms by which pathogens evade or manipulate the immune system. The aim is to gain a deeper understanding of the molecular basis of pathogen-host interactions and to use this knowledge to develop new approaches for the prevention and treatment of infectious diseases.



Tell me what you eat and I'll tell you who you are.

MACROPHAGES: THE QUICK-CHANGE ARTISTS OF THE IMMUNE SYSTEM

Macrophages are phagocytes of the innate immune system. They recognise dead cells, ingest them, and eliminate them. They are remarkably capable of adapting to their environment – a mechanism that is particularly important during infection with the parasitic worm *Schistosoma mansoni*.

Schistosoma mansoni causes the disease schistosomiasis, which causes tissue damage in the liver. Various cell types die in the process. To effectively eliminate the parasite, the immune system must respond flexibly. In our study, we took a closer look at macrophages and investigated how they respond to the uptake of various dying cells.

When macrophages engulfed dying neutrophils, a type of white blood cell, they adopted a tissue-remodelling profile. Upon transferring these macrophages into the bloodstream of mice infected with *Schistosoma mansoni*, they supported liver tissue remodelling in the mice, thus promoting the defence against the parasite. In contrast, macrophages that had consumed dying liver cells showed no effect on parasite defence in the *Schistosoma mansoni* infected mice.

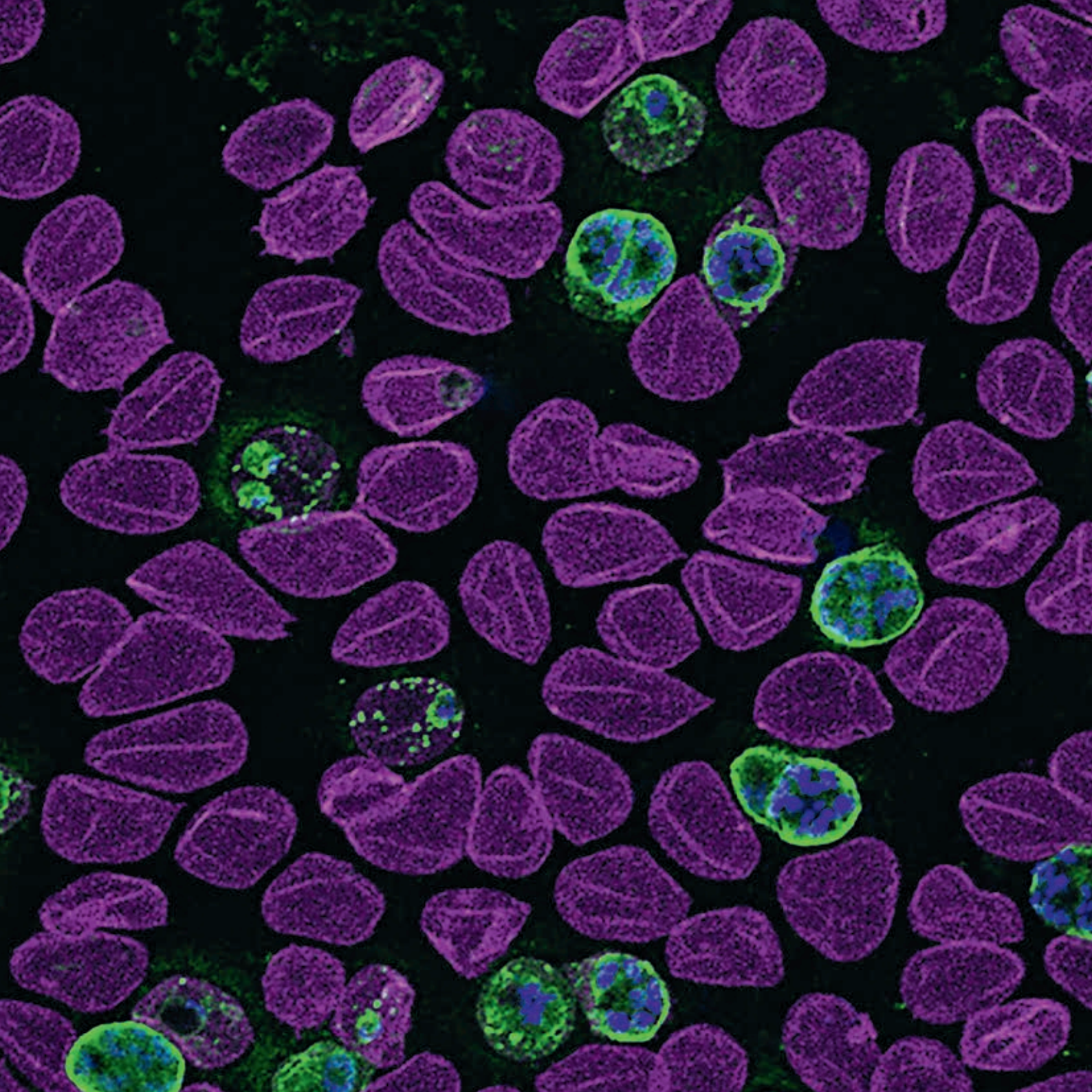
These results provide valuable insights into the role of macrophages in schistosomiasis and pave the way for new therapeutic approaches to treat parasitic infections.

Liebold I et al., Science 2024 Apr 5;384(6691):eab07027

Imke Liebold, Amirah Al Jawazneh, Clarissa Lanzloth, Stephanie Leyk, Madeleine Hamley, Alexandros Hadjilaou, Ulricke Richardt, Petra Eggert, Dennis Tappe, Thomas Jacobs and Lidia Bosurgi, as well as external cooperation partners (see publication)

Figure: The parasitic worm *Schistosoma mansoni* in the liver of a mouse

FURTHER INFORMATION



AUTOIMMUNITY PROTECTS CHILDREN FROM MALARIA

Autoantibodies bind to the body's own cells and tissues, and their presence is often linked to autoimmune diseases. Over the past 50 years, studies have shown a connection between autoimmunity and malaria: autoantibodies are found in the blood serum of patients with acute and chronic malaria, and antibodies in patients with autoimmune diseases can bind to structures of the malaria parasite.

We conducted studies in Mali, where malaria is endemic – meaning it occurs regularly and frequently. Our current research there has shown that children with high levels of autoantibodies have a 41 per cent lower risk of developing febrile malaria. A closer look revealed that these autoantibodies inhibit the growth of the parasite and bind to its proteins that the parasite uses to invade red blood cells.

Malaria has been one of the most powerful selective forces in human evolution. Nevertheless, we still have a poor understanding of its profound impact on our immune system. It has been previously suggested that a genetic predisposition to autoimmunity arose because it conferred a survival advantage against malaria. Our data support this idea and suggest that the ability to produce autoantibodies played a central role in this evolutionary adaptation.

Hagadorn KA et al., Immunity 2024 Aug 13;57(8):1769-1779.e4

Christine S. Hopp and external cooperation partners (see publication)

Figure: Autoantibodies (green) recognise the malaria parasite (cell nuclei in blue) in red blood cells (pink).

TO THE RESEARCH GROUP PAGE

HOW DANGEROUS IS THE BOMBALI VIRUS?

The Bombali virus is a newly discovered species of ebolaviruses. It was first identified in 2018, when it was found in bats in Sierra Leone, and later also in Kenya and Guinea. To date, there have been no known cases of human infection. Nevertheless, what risk does the Bombali virus pose to us?

Until now it has not been possible to isolate the virus from nature. Using published virus sequences, the group of Dr. Thomas Hoenen at the Friedrich-Loeffler-Institut generated the Bombali virus to study its pathogenicity in cell cultures and animal models. They employed reverse genetics methods to synthetically produce a complete viral genome sequence and to produce a living virus, which was then shipped to the BNITM.

This allowed us to study how quickly the Bombali virus replicates, how infectious it is, and how severe the illness it causes might be. In cell culture, the virus grew more slowly than the Zaire ebolavirus, which is highly pathogenic for humans. Compared to the Zaire ebolavirus, the Bombali virus caused less tissue damage in genetically modified mice and the survival rate of these animals was higher. We estimate that the risk of human disease from Bombali virus is low. Further research is needed to understand why the Bombali virus differs from other ebolaviruses.

Bodmer BS et al., Emerg Microbes Infect 2023 Dec;12(1):2164216

Michelle Heung, Jesús E. Brunetti, Christoph Henkel, Jürgen Müller-Guhl, Estefania Rodríguez, César Muñoz-Fontela and Beatriz Escudero-Pérez, as well as external cooperation partners (see publication)

Figure: A scientist in a protective suit works under a sterile bench.

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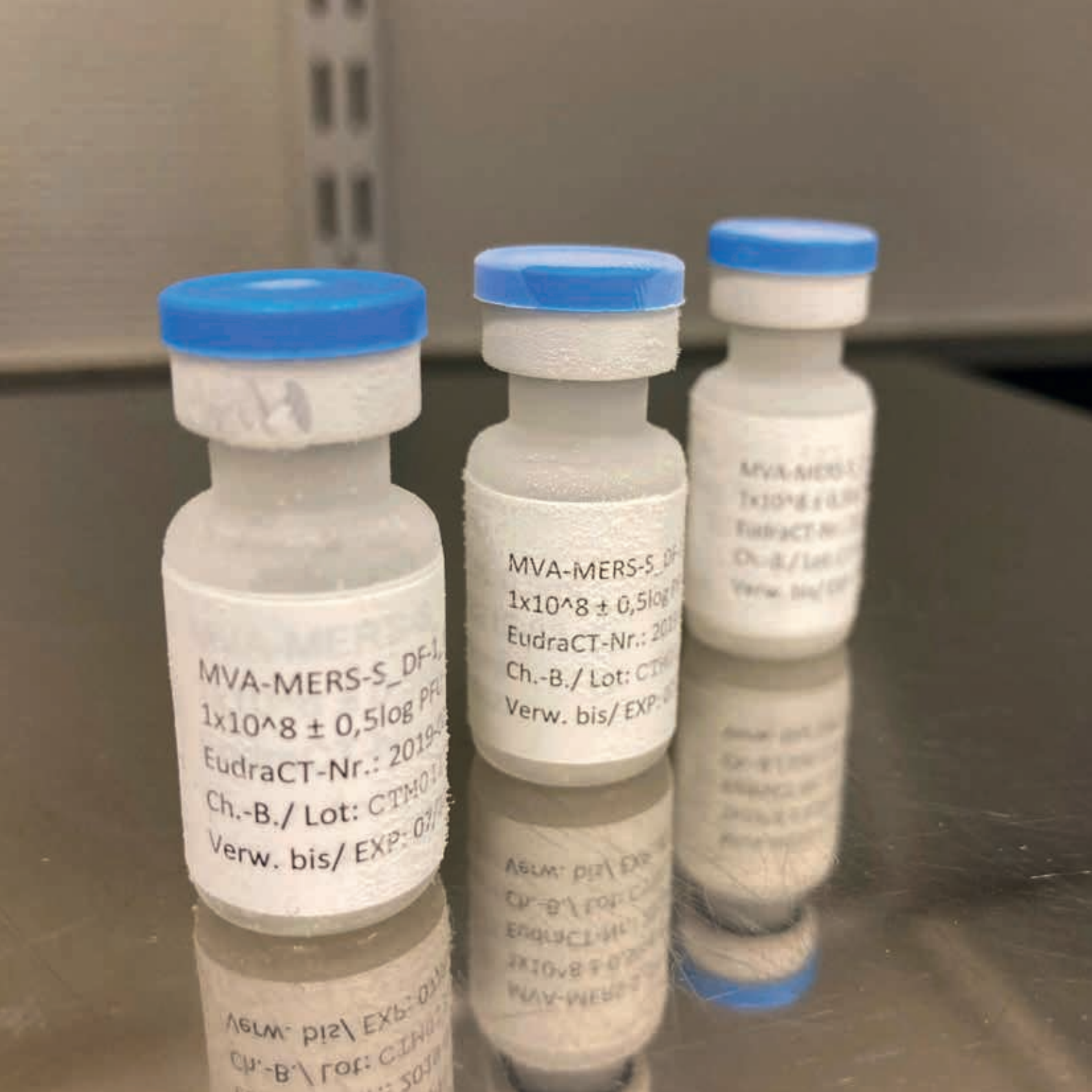
MVA-MERS-S_DF-1,
1x10^8 ± 0,5log PFU
EudraCT-Nr.: 2019-
Ch.-B./ Lot: CTM01
Verw. bis/ EXP: 07/
MVA-MERS-S_DF-
1x10^8 ± 0,5log P
EudraCT-Nr.: 201
Ch.-B./ Lot: CTM
Verw. bis/ EXP: 0

PROGRESS IN VACCINE DEVELOPMENT

Infection with the Middle East Respiratory Syndrome coronavirus (MERS-CoV) can cause severe respiratory disease. It is fatal in up to 36 per cent of infected individuals. There are currently no approved vaccines or specific therapies.

MVA-MERS-S is a vaccine candidate against MERS-CoV. It is based on a weakened poxvirus expressing the spike protein of the MERS-CoV viral envelope. In a clinical trial, we investigated the vaccine's tolerability and whether the immune system's B cells produce antibodies against MERS-CoV. Our results show that different dosages are safe and well-tolerated in humans and elicit an immune response against MERS-CoV. We observed particularly high antibody levels in study participants who received a higher dose of the vaccine and with an extended time interval between the first two vaccinations. A third vaccination also significantly enhanced the immune response.

We also analysed the activation of T cells. Since T cells do not recognise the entire spike protein, but only specific sections (known as epitopes), we specifically searched for these recognition sites. We identified an epitope in one study participant and demonstrated that the immune system's T cells also respond to the vaccination. This plays an important part in the development of protective immunity against MERS-CoV.

Raadsen MP, Dahlke C, Fathi A et al., Lancet Infect Dis 2025 Feb;25(2):231-242. Epub 2024 Oct 7
Harrer CE, Mayer L et al., J Infect Dis 2024 Aug 16;230(2):e327-e332

Christine Dahlke, Anahita Fathi, Caroline E. Harrer, Leonie Mayer, Svenja Hardtke, Leonie M. Weskamm, Tamara Zoran, Susan Lassen, My Linh Ly, Madeleine E. Zinser and Marylyn M. Addo, as well as external cooperation partners (see publications)

Figure: Each vaccine vial contains one dose of the MVA-MERS-S vaccine.

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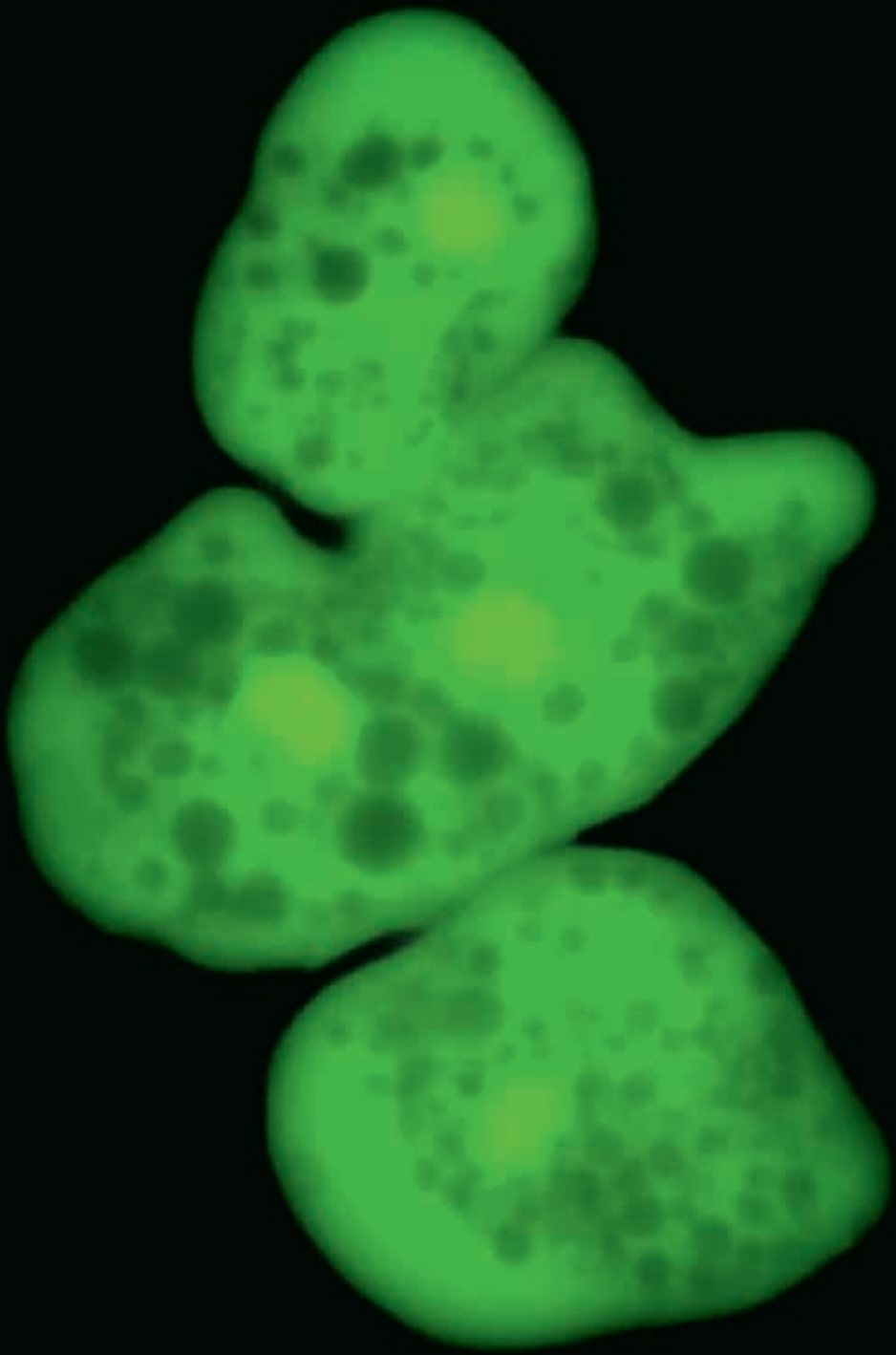

Harmless vs. dangerous

THE PUZZLE OF THE AMOEBA *ENTAMOEBA HISTOLYTICA*

The amoeba *Entamoeba histolytica* can cause either harmless infections or serious diseases such as amoebic colitis and liver abscesses in humans. Why does the infection progress dramatically in some individuals while remaining barely noticeable in others?

It was known that the protein EhHP127 and the protein-cleaving enzymes EhMP8-1 and EhMP8-2 are associated with the pathogenic effects of the amoebae. However, the exact functions of these molecules remained largely unknown.

Until recently, little was known about EhHP127, as there is no comparable molecule in the entire animal kingdom. Our studies have now shown that EhHP127 influences amoebic motility. Higher levels of EhHP127 protein in the amoebae resulted in the parasite spreading more widely and causing more extensive damage to liver cells. Thus, motility emerges as a key factor in severity of infection.

The enzymes EhMP8-1 and EhMP8-2 also play a central role. They control fundamental processes such as amoeba growth and contribute to the destruction of liver and red blood cells. These mechanisms enhance the aggressiveness of the infection. Our findings provide new insights into the molecular basis underlying the different clinical outcomes of *Entamoeba histolytica* infections.

Anders J, König C, Lender C et al., PLoS Pathog. 2023 Dec 22;19(12):e1011745

Juliett Anders, Constantin König, Corinna Lender, Arne Hellhund, Sarah Nehls, Ibrahim Shalabi, Barbara Honecker, Stephan Lorenzen, Martin Meyer, Jenny Matthiesen, Dániel Cadar, Nahla G. Metwally, Hanna Lotter and Iris Bruchhaus, as well as external cooperation partners (see publication)

Figure: Green fluorescent *Entamoeba histolytica*

TO THE RESEARCH GROUP PAGE

PATIENT

Which interventions are safe and effective?

The PATIENT section focuses on people suffering from poverty-related tropical diseases and emerging infectious diseases, such as malaria, infections caused by the African eyeworm *Loa loa*, Lassa fever, or encephalitis caused by bornaviruses. For many of these diseases, effective medications, vaccines, or reliable diagnostic procedures are still lacking. There are many reasons for this: research in these areas is often economically unattractive, scientifically complex, and hampered by a lack of infrastructure for clinical trials.

Scientists at the BNITM investigate which therapies are safe and effective – using new agents or already approved drugs. In clinical trials, they test promising approaches and develop methods to detect infections more quickly and reliably. The goal is to improve medical care for patients worldwide.

African eyeworm remains persistent

WHY *LOA LOA* IS STILL DIFFICULT TO FIGHT

Loa loa is a worm transmitted by horseflies of the genus *Chrysops* and causes the tropical disease loiasis. The infection is prevalent in West and Central Africa. The worm repeatedly migrates visibly through the conjunctiva of the human eye. Loiasis was once considered harmless. However, loiasis can cause severe symptoms and increase mortality, especially in people with high numbers of worm larvae in their blood.

Traditionally used medications for loiasis are diethylcarbamazine and ivermectin. However, these can cause severe side effects in hosts with high worm burdens and are therefore not used in highly endemic areas. Albendazole slowly reduces worm burdens and is used in endemic areas.

We systematically investigated the effectiveness, safety, and tolerability of various treatment regimens with albendazole and ivermectin. We conducted the study jointly with the Centre de Recherches Médicales de Lambaréné (CERMEL) in Gabon. Our results: five weeks of albendazole or three weeks of albendazole plus a single dose of ivermectin reduced the number of worm larvae the most (up to 90 per cent).

However, treatment regimens lasting several weeks are difficult to implement in practice. To combat loiasis effectively and comprehensively, new, simpler forms of therapy are needed; we are therefore evaluating new drugs and drug combinations for the treatment and control of loiasis.

Zoleko-Manego R et al., PLoS Negl Trop Dis 2023 Aug 28;17(8):e0011584

Rella Zoleko-Manego, Luzia Veletzky, Dorothea Ekoka Mbassi, Johannes Mischlinger, Ghyslain Mombo-Nboma and Michael Ramharter, as well as external cooperation partners (see publication)

Figure: Loa loa migrates beneath the conjunctiva of an eye.

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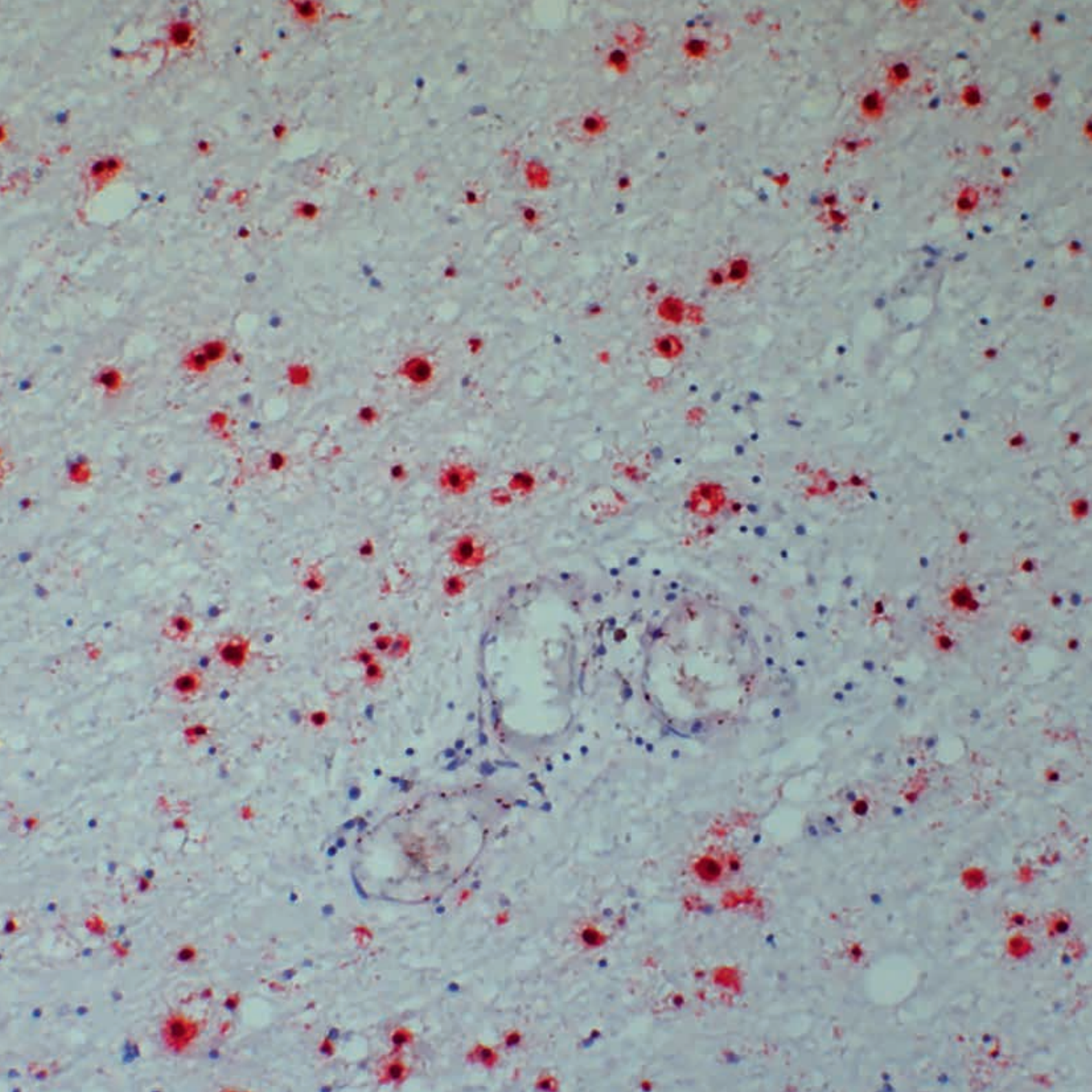


LOCATION MATTERS

The Borna Disease Virus 1 (BoDV-1) causes a rare but almost always fatal encephalitis in humans. The virus's natural host is the bicolored European shrew, and its distribution in Germany extends from Bavaria to the north, close to Hamburg. How the virus spreads and how humans become infected remains a mystery. The incubation period, the time between infection and the onset of symptoms, is presumably very long. This makes it difficult to detect a specific transmission event.

We conducted an epidemiological study with researchers from the Robert Koch Institute (RKI) and the Bavarian State Office for Health and Food Safety (LGL): in a large case series, we interviewed family members in which a person had died from BoDV-1. We collected information on medical history, living environment, occupation, animal contact, outdoor activities, travel and diet. None of the interviews clarified how the infection with the virus had occurred. However, the interviewees often confirmed the presence of shrews, which suggests environmental transmission. The only commonality among all cases was residence in rural endemic regions.

We compared the results with interviews from a control group. So far, we have only identified one risk factor for human bornavirus infection: a household location close to nature, isolated in a crop field or on the edge of a settlement. Targeted prevention of infections, timely diagnosis and early treatment attempts therefore remain a challenge.

Pörtner K et al., Emerg Microbes Infect. 2023 Dec;12(1):e2174778

Dennis Tappe and external cooperation partners (see publication)

Figure: Light microscopy image of a brain section with bornavirus RNA (red)

TO THE RESEARCH GROUP PAGE

Protection for two lives

NEW MALARIA PREVENTION FOR HIV-POSITIVE PREGNANT WOMEN

Malaria prevention during pregnancy protects not only the expectant mother but also the unborn child: malaria can lead to severe anaemia, miscarriages, premature births, and low birth weight. HIV-positive women are particularly at risk because they are not allowed to take the standard malaria prevention drug sulfadoxine-pyrimethamine due to dangerous interactions with the related drug co-trimoxazole. Women take co-trimoxazole in addition to antiretroviral therapy for HIV to prevent infections due to their HIV-weakened immune systems.

In Gabon and Mozambique, in collaboration with cooperation partners we therefore tested the drug dihydroartemisinin-piperaquine for the prevention of malaria during pregnancy. Because of its long-lasting effect, it also provides preventive protection against new infections. The clinical study showed that administering this drug significantly reduces the risk of malaria during pregnancy, without serious side effects. This new prevention concept is well tolerated, offers effective protection and could help better protect mothers and children from malaria in the future. Based on the results of this study, the WHO is considering changes to recommendations for the prevention of malaria during pregnancy in this most vulnerable patient group.

González R, Nhampossa T, Mombo-Ngoma G et al., Lancet Infect Dis 2024 May;24(5):476-487

Ghyslain Mombo-Ngoma, Johannes Mischlinger, Rella Zoleko-Manego and Michael Ramharter, as well as external cooperation partners (see publication)

Figure: Testing a pregnant woman for malaria using a blood smear

TO THE RESEARCH GROUP PAGE

NEED FOR DEVELOPMENT OF LASSA FEVER THERAPEUTICS

The Lassa virus is native to West Africa and causes Lassa fever in humans. Isolated cases of the disease have been reported worldwide. Its potential to cause epidemics makes it particularly dangerous. Lassa fever outbreaks occur regularly in West Africa, with mortality rates of around 20 per cent. Diagnosed patients are admitted to an isolation ward for highly contagious infectious diseases and receive treatment. However, treatment options are limited. High-dose ribavirin therapy is recommended. At the same time, there are doubts about the drug's antiviral effects and whether all patients benefit equally from such therapy.

The Irrua Specialist Teaching Hospital (ISTH) in Nigeria is a long-standing collaborator of the BNITM and currently the largest Lassa fever treatment centre in the world. Together with the University of Hamburg, we conducted the first pharmacokinetic study to date at the ISTH to better understand the mechanism of action and the role of ribavirin in Lassa fever treatment. The results challenge current treatment recommendations: ribavirin appears to have no relevant antiviral effect, although it can influence the course of the disease. The BNITM is now involved in further studies for the clinical development of new treatment options.

Groger M, Akhideno P, Kleist CJ, Babatunde FO et al., Clin Infect Dis 2023 Feb 8;76(3):e841-e848

Mirjam Groger, Julia Hinzmann, Jonas Müller, Mette Hinrichs, Meike Pahlmann, Francisca N. Sarpong, Christine Wagner, Anke Thielebein, Till Koch, Stephan Günther, Michael Ramharter, Lisa Oestereich and Sophie Duraffour, as well as external cooperation partners (see publication)

Figure: Corridor of the Lassa fever isolation ward at the ISTH

TO THE RESEARCH GROUP PAGE

POPULATION

Which infections are relevant and where do they occur?

Infectious diseases pose a major challenge worldwide, but especially in low-resource countries. Yet we still know very little about many pathogens: Where exactly do they occur? Which animals or insects transmit them? What factors influence transmission? And who is most at risk of developing disease?

In the POPULATION section, researchers explore these questions. The goal is to better understand drivers of infection using mathematical models, clinical investigations, and epidemiological studies. This knowledge helps develop measures to reduce the disease burden, and prevent or mitigate disease outbreaks.

USING MOBILE LABORATORIES TO FIGHT THE MPOX VIRUS IN EAST AFRICA

In the summer of 2024, the Mpox virus spread rapidly in several East African countries. The Democratic Republic of Congo was particularly affected, with over 22,000 cases. Infection with Mpox causes flu-like symptoms in humans and a rash with pustules; the infection can be fatal in some cases.

To contain the spread of the Mpox virus, the East African Community (EAC) reacted quickly: it deployed mobile laboratories, truly high-tech labs packed in boxes, in seven East African countries. The mobile laboratories can be set up quickly and deployed anywhere, even in remote areas. The BNITM has been supporting the EAC in this work for years. Together with the mobile laboratory network, we were deployed during the 2024 Mpox outbreak in Burundi, the Democratic Republic of Congo, Kenya, Rwanda, Uganda, South Sudan and Tanzania.

Diagnostics with mobile on-site laboratories delivers results in as little as three hours. Previously, this often took over 24 hours or even several days. In addition to rapid testing, we and our specialist staff have begun examining the viral genetic information of Mpox. This will allow us to track how the virus spreads and mutates in the future; we can also determine whether new variants are emerging, against which vaccines are less effective. The strategy also involves providing on-site training for specialist staff.

The aim of all these measures is to strengthen the region, prevent the international spread of Mpox and respond early to new outbreaks.

Gehre F, Nzeyimana E et al., Euro Surveill 2024 Aug;29(35):2400541

Florian Gehre, Julian A. Nguinkal, Neema Omari, Grace Ochido, Duncan Aluda, Aryse Martins Melo, Jürgen May and Muna Affara, as well as external cooperation partners (see publication)

Figure: EAC laboratory expert during a training session in Arusha, Tanzania

TO THE RESEARCH GROUP PAGE

ANTIBIOTIC RESISTANCE ON THE RISE

Antimicrobial resistance (AMR) is one of the greatest global health threats. When bacteria become resistant to antibiotics, infections can no longer be effectively treated. This results in severe disease progression, higher mortality rates and rising healthcare costs.

A study by an international research network, including the BNITM, shows that without countermeasures, annual AMR-related deaths could almost double by 2050. The analysis was based on over 520 million data sets from 204 countries. The researchers estimate that between 4 and 7.1 million deaths worldwide in 2021 were associated with bacterial AMR; 1.14 million of these were directly attributable to it. While deaths among young children declined, they rose sharply among older people.

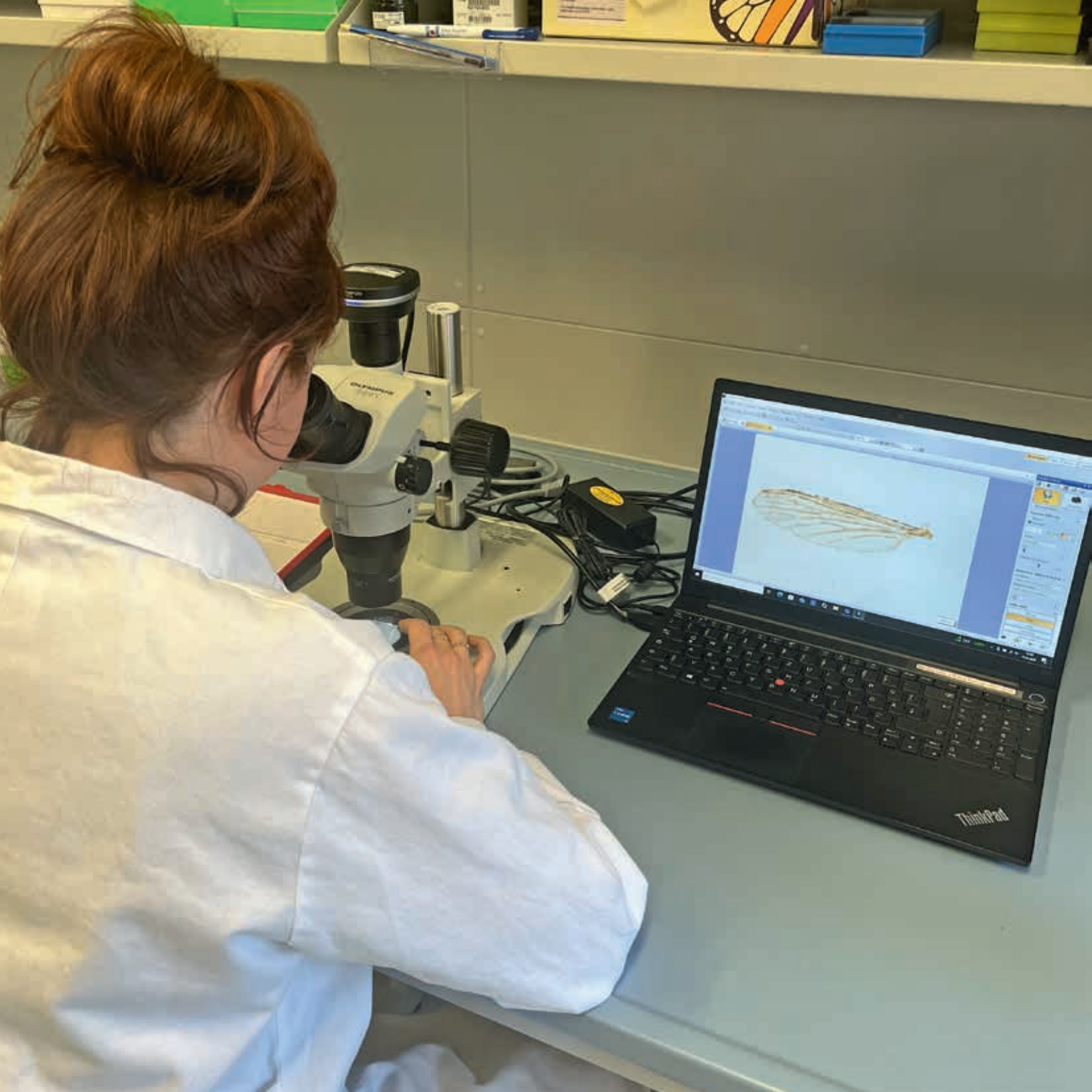
Projections for 2050 indicate that by then, nearly 2 million annual deaths worldwide could be directly attributable to AMR, and up to 8.22 million indirectly. Southeast Asia and Latin America could be particularly affected. Improved healthcare, targeted use of antibiotics, and new active substances offer hope: up to 92 million deaths could be avoided by 2050.

Antimicrobial Resistance Collaborators, Lancet 2024 Sep 28;404(10459):1199-1226

John H. Amuasi, Denise Dekker, Ralf Krumkamp and Jürgen May, as well as external cooperation partners (see publication)

Figure: Testing the antibiotic resistance of a highly resistant bacterium

TO THE RESEARCH GROUP PAGE


ThinkPad

AI IN THE FIGHT AGAINST MOSQUITOES

Mosquitoes are more than just nuisances: they are among the deadliest creatures on earth. They transmit pathogens such as malaria parasites and the dengue virus, causing millions of illnesses and deaths worldwide.

Not all mosquitoes transmit the same pathogens; for example, some species of *Anopheles* mosquito transmit malaria parasites and the tiger mosquito transmits several viruses. For a targeted vector control, they must be precisely identified. Until now, however, identifying mosquitoes and monitoring them on a large scale has been complicated and expensive, requiring experienced entomologists or complex laboratory tests. This represents a challenge, especially in resource-poor areas.

Artificial intelligence (AI) can help identify mosquito species. We have trained an AI to recognise mosquito wings and classify them with high accuracy. The wings are suitable because they are two-dimensional. This AI-supported approach makes it easier to identify species without expert knowledge. It thus contributes to combating the spread of mosquito-borne pathogens. AI facilitates large-scale mosquito monitoring, thus improving early warning and mosquito control measures worldwide.

Sauer FG, Werny M et al., Sci Rep 2024 Feb 7;14(1):3094
Nolte K et al., Parasit Vectors 2024 Sep 2;17(1):372

Felix G. Sauer, Kristopher Nolte and Renke Lühken, as well as external cooperation partners (see publications)

Figure: Microscopy of a mosquito wing

TO THE PAGES OF THE RESEARCH GROUPS

THE NEGLECTED AMONG THE NEGLECTED

Women living in poverty, remote communities and conflict zones often have limited access to healthcare facilities. We want to improve women's health and trigger policy changes. To do so, we need to understand the frequencies of conditions affecting women's health.

Schistosomiasis is a neglected tropical disease affecting over 220 million people worldwide. In women, persistent infection with the *Schistosoma* parasite can lead to female genital schistosomiasis (FGS), causing infertility. FGS affects over 56 million women worldwide. Symptoms of FGS are similar to those of sexually transmitted diseases, which leads to discrimination and social exclusion of people affected by FGS. In Madagascar, where schistosomiasis is common, little is known about FGS.

We examined 500 women in rural Madagascar where we found alarming rates of infections: 62.6 per cent had FGS. 42.7 per cent were infected with human papillomavirus (HPV), which can cause cervical cancer. 26.5 per cent had both FGS and HPV.

This study shows the urgent need to address women's health in Madagascar. We propose that prevention and treatment programmes for schistosomiasis be set up in primary healthcare centres. Vaccination campaigns against HPV and better diagnosis of FGS are also needed to reduce long-term health consequences such as infertility and cervical cancer.

Kutz et al., Infect Dis Poverty 2023 Sep 25;12(1):89

Jean-Marc Kutz, Pia Rausche, Philipp Klein, Anna Jäger, Jürgen May, Dewi Ismajani Puradiredja, Eva Lorenz and Daniela Fusco, as well as external cooperation partners (see publication)

Figures: Midwife during a colposcopy at a primary health care centre in Madagascar

TO THE RESEARCH GROUP PAGE

THE OROPOUCHE VIRUS IS ON THE RISE

Small biting insects (biting midges) transmit the Oropouche virus to animals and humans. Symptoms in humans include fever, headache, muscle aches, nausea and diarrhoea. Since the 1970s, the virus has repeatedly caused major epidemics in South America, particularly in the Amazon region. However, since 2022, the virus has continued to spread, not only in Brazil, but also in Cuba and Colombia. Returning travellers have already brought the Oropouche virus to Italy, Spain and Germany.

We wanted to better understand the virus and isolated it from blood samples from patients in the state of Pernambuco, Brazil. Genetic analyses showed that mutations may have made the virus more aggressive. Genetic changes could also favour adaptation to new hosts and vectors.

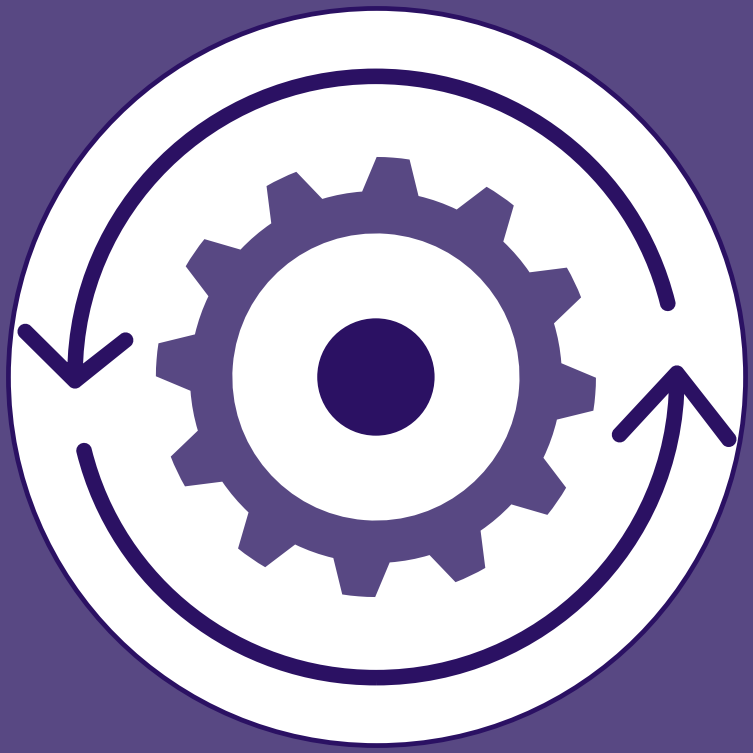
Using phylogenetic analyses, we were able to investigate the relationships between different Oropouche virus strains. The current virus variants likely originate from the state of Amazonas, where the outbreak began in 2022. These findings will help trace the evolution of the virus and better predict future outbreaks. Further research is urgently needed to understand the exact transmission routes and to develop effective measures to combat the virus.

De A. N. Azevedo E, Da Silva AF, Da Silva VG et al., J Med Virol 2024 Oct;96(10):e70012

Gabriel L. Wallau and external cooperation partners (see publication)

Figure: Biting midge

TO THE RESEARCH GROUP PAGE



IMPLEMENTATION

How do interventions work under real-world conditions?

In the IMPLEMENTATION section, researchers investigate how infectious disease control measures work in practice, particularly in low- and middle-income countries. The focus is on identifying which local factors influence the success of such measures.

The research groups take an interdisciplinary approach and adopt a broad perspective: in addition to health communication and drug development, they also consider economic and social aspects. The goal is to analyse and specifically improve the practical applicability, impact, acceptance, and efficiency of interventions. After all, interventions can only be effective when people accept and trust them. Incorporating real-life circumstances helps to tailor interventions more effectively and thereby improve the long-term health of local populations.

IMPORTANT ROLE OF TRADITIONAL HEALERS

Victims of snakebites often seek treatment from traditional healers. This is due to cultural influences and socioeconomic factors, but also to deficiencies in many health facilities. The role of healers in the treatment of snakebites has received little scientific attention to date.

We conducted a survey with traditional healers in Malawi to learn more about their experiences and methods. They provide snakebite victims primarily with herbal remedies. Their treatment ranges from diagnosis to aftercare, and they offer "vaccinations" against snakebites. Healers are convinced that their methods work; however, treatment successes are not scientifically proven, and some methods could also be dangerous.

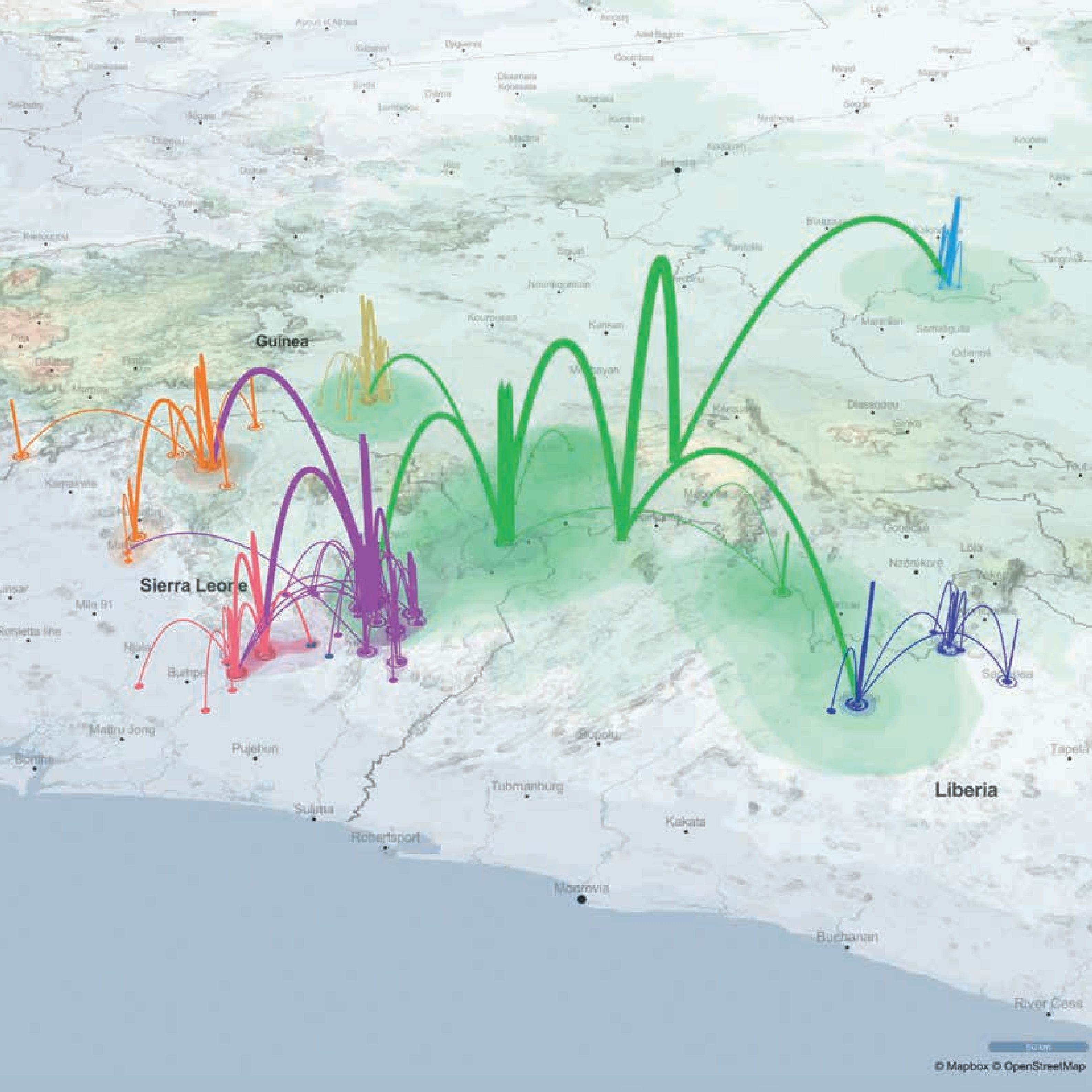
Health facility staff and healers do not currently work together to treat snakebites. However, some healers are open to such cooperation. In many cases of snakebite, adequate wound care may be sufficient. However, if patients also require an antivenom, they must quickly seek medical attention at a conventional medical facility. We recommend that traditional healers be trained in adequate wound care and involved in the initial assessment of patients; this could reduce the number of victims and deaths from snakebites.

Aron MB et al., PLoS Negl Trop Dis 2023 Oct 4;17(10):e0011653

Moses B. Aron, Benno Kreuels and Jörg Blessmann, as well as external cooperation partners (see publication)

Figure: A well-camouflaged puff adder *(Bitis arietans)*

TO THE RESEARCH GROUP PAGE



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Kouroussa
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Tubmanburg
Bopolu
Kakata
Monrovia
Buchanan
River Cess
Tapeta
Lola
Nzérékoré
Guéckédou
Dissodou
Odienné
Samatiguila
Kamakwie
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IN THE FOOTSTEPS OF AFRICAN MICE

For more than 50 years, the Natal multimammate mouse *Mastomys natalensis* has been known to be the main reservoir of Lassa virus in several West African countries. The rodents themselves do not become ill (see p. 21), but they transmit the virus to humans. Lassa virus causes Lassa fever, which affects about 900,000 people in West Africa and claims around 18,000 lives annually.

Where did the virus originally come from? We investigated this by analysing viral rodent-derived sequences. The results allowed us to trace how the virus spread geographically and over time. These phylogeographic data suggest that Lassa virus originated in southern Guinea around 350 years ago. It then spread towards Mali, Liberia, and Sierra Leone at an estimated speed of 1.1 to 1.6 kilometres per year.

However, not only *Mastomys natalensis* transmits the Lassa virus. Frequent spillovers to the related rodent species Guinean multimammate mouse *Mastomys erythroleucus* have recently been observed. This indicates an ongoing host-switching process. This shift appears to be well established: spillovers have been occurring in Ebudin, Nigeria, for about 20 years and in Madina Oula, Guinea, for 40 years. The presence of multiple host species increases the risk of zoonotic transmission of the virus from animals to humans.

Bangura U et al., Emerg Microbes Infect. 2024 Dec;13(1):2290834
Adesina AS et al., Emerg Microbes Infect. 2023 Dec;12(1):2219350

Umaru Bangura, Dániel Cadar, Toni Rieger, Meike Pahlmann, Stephan Günther and Elisabeth Fichet-Calvet, as well as external cooperation partners (see publications)

Figure: Map showing the spread of Lassa virus in Guinea, Sierra Leone, Liberia and Mali over the past 350 years

TO THE RESEARCH GROUP PAGE

VACCINATIONS AND TRUST IN AFRICA

Vaccine hesitancy toward routine vaccinations such as measles and polio is growing worldwide. Often, this is attributed to a lack of trust in social, economic, and governmental institutions. However, research on this topic has so far been limited to wealthier, Western countries or to COVID-19 vaccination campaigns during the pandemic.

We conducted online surveys in six African countries: Ghana, Kenya, Nigeria, South Africa, Tanzania, and Uganda, focussing on three new vaccines against polio, human papillomavirus (HPV), and COVID-19. All 5,203 study participants were recruited through Facebook ads. We collected demographic data such as age and gender and measured how trust in society, the media, government, pharmaceutical companies, and science influenced vaccination willingness.

The results of our study show that two factors in particular predict vaccine hesitancy: a lack of trust in one's own government and state institutions, and a lack of trust in one's own society. This was true in all six countries for all three vaccines. Our conclusion: it is worthwhile to focus on trust dimensions to increase acceptance of routine vaccinations. It is necessary to promote trust in governments and pharmaceutical companies and to emphasize the social benefits of vaccinations.

Unfried K et al., Sci Rep 2024 May 13;14(1):10860

Kerstin Perlik (née Unfried) and Jan Priebe

Figure: Vaccination is a matter of trust.

TO THE RESEARCH GROUP PAGE

DISTORTED MEMORIES OF THE PANDEMIC

How do we remember the coronavirus pandemic? What does the memory of the pandemic have to do with the polarisation in society? To answer this question, we surveyed over 10,000 people from eleven countries.

We were able to show that memories of that time are systematically distorted today. Differences can be seen between people who have been vaccinated against COVID-19 and those who have not. Both groups exhibit memory distortions, albeit in opposite directions: vaccinated people overestimated their perceived risk of infection and their trust in science at the time, while unvaccinated people tended to underestimate both in retrospect. Put simply: from today's perspective, unvaccinated people downplay the pandemic in retrospect, while vaccinated people tend to exaggerate it somewhat. In the past, vaccinated and unvaccinated people were much closer in their perceptions than they remember today. In particular, those who strongly identified with being (un)vaccinated deviate particularly strongly from their assessments at the time.

Distorted memories of the pandemic complicate preparation for future crises and societal dialogue. In another project, we are now investigating how perceptions of measures influence polarisation in other crises, such as the climate crisis.

Sprengholz P, Luca Henkel et al., Nature 2023 Nov;623(7987):588-593

Philipp Sprengholz and Cornelia Betsch, as well as external cooperation partners (see publication)

Figure: Artistic representation of the corona vaccination

TO THE RESEARCH GROUP PAGE

THE DANGERS OF ANTIBIOTIC-RESISTANT PATHOGENS

Increasing antibiotic resistance threatens global health. Of particular concern is the continued spread of extended-spectrum beta-lactamase (ESBL)-producing bacteria. Many common antibiotics are no longer effective against them. This problem severely affects the global South. Antibiotic use there is often uncontrolled, both in human medicine and in animal husbandry.

We examined stool samples from children in rural areas of Ghana. Of 435 children, 41 per cent carried ESBL-producing *Klebsiella pneumoniae* and *Escherichia coli*, both Gram-negative rod-shaped bacteria. This was independent of whether the children had diarrhoea or not. Therefore, children can be carriers of these bacteria. These pathogens can cause life-threatening infections that are difficult to treat. Our detection of multiple drug resistance was also worrying, further severely limiting treatment options.

Our findings underscore the need to improve hygiene measures, use antibiotics more rationally, and monitor them with targeted programs. This would help contain the further spread of resistant pathogens in Ghana and comparable regions.

Akenten CW et al., Antimicrob Resist & Infect Control 2023 Jul 3;12(1):60

Neyaz A. Khan, Ralf Krumkamp, Oumou Maiga-Ascofare, Jürgen May and Denise Dekker, as well as external cooperation partners (see publication)

Figure: Culture of *Escherichia coli*

TO THE RESEARCH GROUP PAGE

SPOTLIGHT

Health in the Context of Climate Change

Metagenomics

Search for New Cures

Artificial Intelligence in Infectious Disease Research

Environmental changes have a direct impact on pathogens, their vectors (e.g., mosquitoes), and humans. Rising temperatures, changing precipitation, and extreme weather conditions create new habitats for vectors such as mosquitoes and alter the spread of transmitted viruses and parasites – with consequences for human health. Floods and droughts influence how pathogens spread in water or soil. Several research groups at the BNITM are dedicated to this increasingly important topic.

Mosquitoes in Germany in transition

How do rising temperatures affect the spread of mosquitoes and the transmission of viruses in Germany? For example, Dr. Anna Heitmann and her team are using laboratory experiments to test whether native mosquitoes, such as the widespread *Culex pipiens*, can transmit viruses such as the West Nile virus or the chikungunya virus. They are investigating how temperature changes affect virus replication in mosquitoes. Dr. Renke Lühken and his team are observing mosquito populations in the field and in experiments. They are recording when and where certain species occur and how their distribution is changing due to climate change. They are using these data to develop models that predict where there will be an increased risk of diseases caused by mosquito-borne pathogens in the future. Researchers in the Department of Arbovirology and Entomology are also investigating invasive mosquito species such as the Asian tiger mosquito *(Aedes albopictus)* and their potential to transmit viruses in Germany.

Research for better climate protection

The PACE *(Planetary Health Action Survey)* project of the Working Group Health Communication at the BNITM, together with numerous scientific partners, is investigating how people in Germany perceive climate change and which factors influence their readiness for climate action. In regular online surveys, the researchers assess public knowledge, risk perceptions, trust, numerous other factors, and behaviour. The goal is to examine the connection between climate change and health and to understand when political measures are accepted and how communication strategies can be designed to better explain climate protection measures. PACE is funded by the Klaus Tschira Foundation until at least 2028.

The World Health Organization (WHO) designated the working group as the *Collaborating Centre for Behavioural Research in Global*

Left: Mosquitoes of the genus Culex during a blood meal

Health (BRIGHT) in 2023. BRIGHT supports the WHO in integrating findings from behavioural research into global health care. The goal is to better understand population behaviour in order to design health measures more effectively.

Spread of infections and resistances

At the *German-Costa Rican Centre for Climate Adaptation and Infectious Diseases* (GC-ADAPT), the BNITM is collaborating with the Costa Rican health institute INCIENSA and the Costa Rican National Meteorological Institute (IMN). Led by Dr. Andrea Molina Alvarado (BNITM), they are investigating how environmental changes such as rising temperatures, changes in precipitation, and extreme weather events influence the spread of infectious diseases and antibiotic resistances. Costa Rica is particularly well-suited as a research location because of the country's diverse climate zones within a small area and its highly advanced disease surveillance system.

In keeping with the One Health approach, the current research phase focuses on the transmission dynamics of bacterial infections through animals, food, and water. The goal is to identify risks early and develop strategies to minimise the health impacts of climate change. GC-ADAPT is funded by the German Federal Ministry of Research, Technology and Space (BMFTR) and is the first institution of its kind in Latin America.

© INCIENSA | Alonso Cedeño

Visit of BNITM employees in Costa Rica at INCIENSA

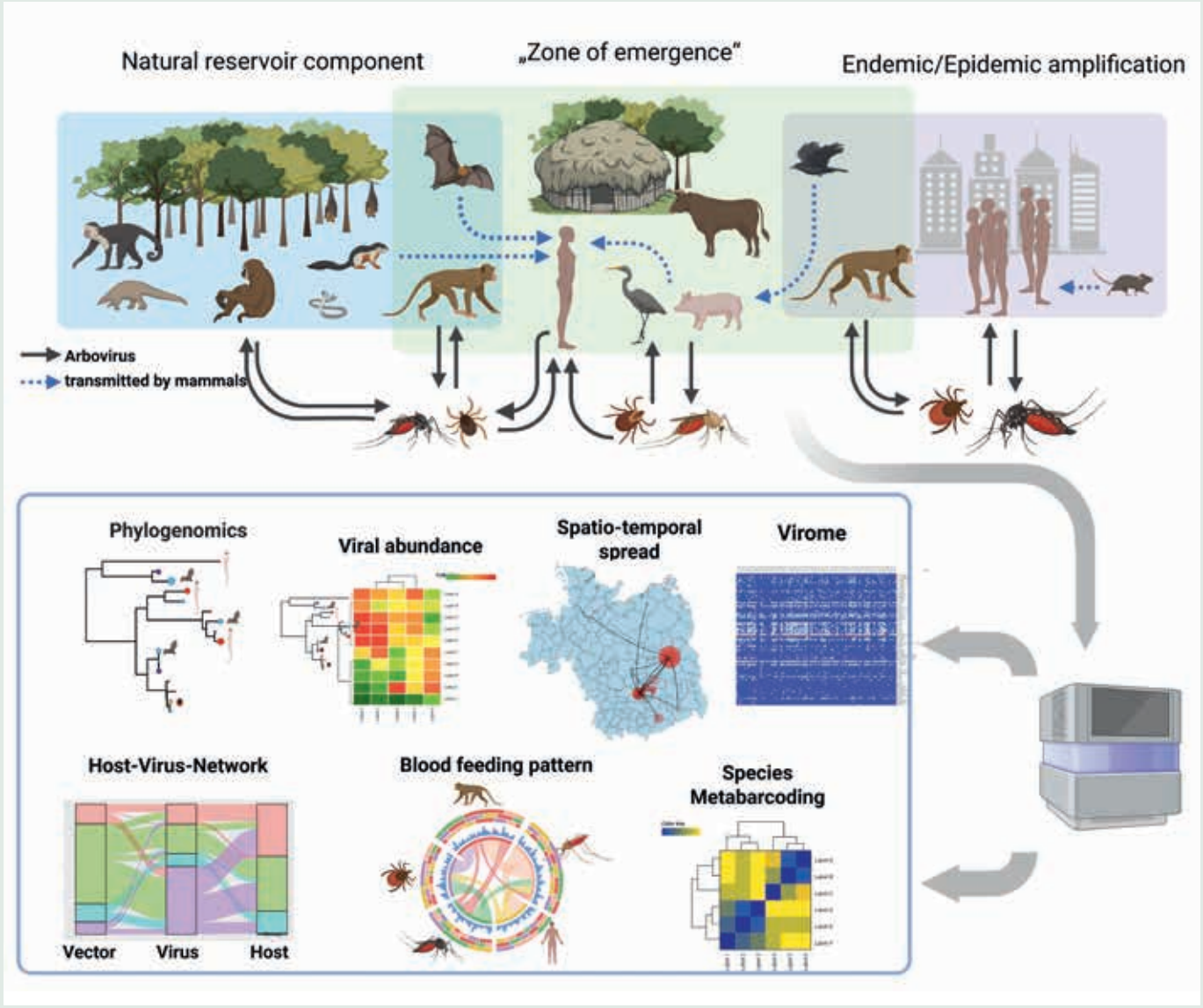
METAGENOMICS – SUPER SCANNER FOR MICROBES

Using metagenomics, researchers at the BNITM detect pathogens directly from samples taken from patients, from vectors such as mosquitoes, and from the environment. They extract the genetic material of all microbes from the sample and analyse it using modern sequencing equipment. This allows them to identify known viruses, discover new pathogens and track how outbreaks develop. The method helps to detect epidemics at an early stage and combat them in a targeted approach.

Recognising virus outbreaks quickly and taking targeted measures with nanopore sequencing

Dr. Sophie Duraffour's team strengthens viral genomic surveillance access in West Africa and where needed through the GHPP-CELESTA project. In close collaboration with partner institutions in Guinea and Nigeria, and across Europe, her team equips local facilities with nanopore next generation sequencing and trains local staff in advanced metagenomic techniques. The BNITM mentors partner laboratories both technically and scientifically by developing workflows, designing user-friendly computational pipelines (*Virus Metagenomics Outbreak Pipeline* (ViMOP)) and assisting in the analysis of genetic data. This support enabled the partners in Guinea in 2024 to detect and characterise two cases of Mpox in the country for the first time. In Nigeria, metagenomic data offered valuable insights into transmission routes during a Lassa fever outbreak, contributing to the containment of the epidemic. CELESTA strengthens regional diagnostic and genomic surveillance capabilities and ensures that emerging viruses can be identified and combated more rapidly; this is an important step toward safe global healthcare.

Loading samples on a nanopore-based sequencing device



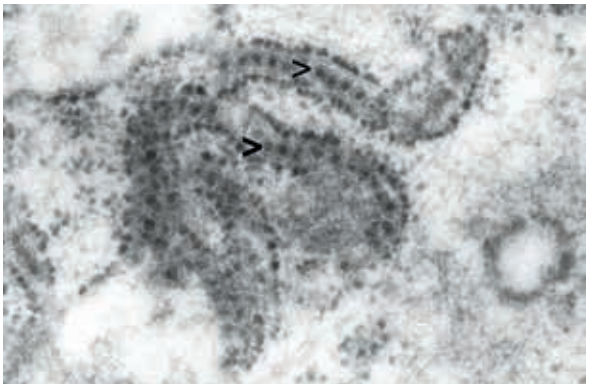
The graphic shows the complex transmission pathways of viruses at the interface between wild animals, vectors and humans in different ecosystems.

Using metagenomic and metatranscriptomic analyses, the "Virus Metagenomics and Evolution" research group investigates viral pathogens in the context of ecological, animal, and human health. Using metagenomics and metatranscriptomics, researchers determine which viruses are present in the samples. The goal is to identify previously undiscovered viruses, understand their evolutionary development, and realistically assess the risks of spillover events – the transfer of pathogens from animals to humans. Environmental changes such as urbanisation or land-use change promote the spread of zoonotic viruses. Dr. Dániel Cadar's team visualises these connections using phylogeographic (to determine the relationship between different virus species and how they spread spatially) and bioinformatics methods. The data obtained contribute to the development of early warning systems and global health prevention.

METAGENOMICS – SUPER SCANNER FOR MICROBES

Mosquito – Virus – Host:
Metagenomics as an early warning system
Researchers in the Arbovirology and Entomology Department are monitoring viruses in mosquitoes: they analyse the entire genetic material from mosquito samples without specifically looking for a specific pathogen. This allows them to identify which viruses are circulating in a region and from which hosts the mosquitoes have fed. In addition to known viruses, they can also detect new or previously undiscovered viruses. Understanding transmission routes and the early detection of infection risks helps with risk assessment for humans and the development of targeted control strategies.

Metagenomics in diagnostics
As part of a study on West Nile virus in blood donors, researchers from the Arbovirology and Entomology Department used metagenomics to verify ambiguous test results. They were able to conclusively detect the virus in 26 cases. In other samples, they found viruses related to West Nile virus, such as Usutu virus or remnants of a vaccine virus, instead of West Nile virus. This demonstrated that metagenomics not only specifically detects known pathogens but also identifies other viruses that are easily confused with conventional tests. The method thus helped avoid false positives and better assess the safety of blood donations.



Electron microscopic image of West Nile virus

Monitoring of viruses in wastewater
In São Tomé and Príncipe, researchers from the Department of Infectious Disease Epidemiology and their partners used metagenomics to detect viruses such as hepatitis A, poliovirus, and SARS-CoV-2 in wastewater. This approach enabled them to identify pathogens without testing individuals. This allows for early detection of which viruses are circulating in a population: it represents a cost-effective approach for health surveillance in resource-limited countries.

SEARCH FOR NEW CURES

There is an urgent need to discover novel active substances against pathogens that occur in tropical regions. Many pathogens still lack effective drug treatments. Moreover, resistances are increasingly leading to the loss of effectiveness of common medications. Researchers at the BNITM are involved in the development and testing of medications. They are pursuing two approaches: the search for active substances derived from natural materials and the discovery of compounds that bind precisely to pathogen structures.

New active ingredients from natural remedies

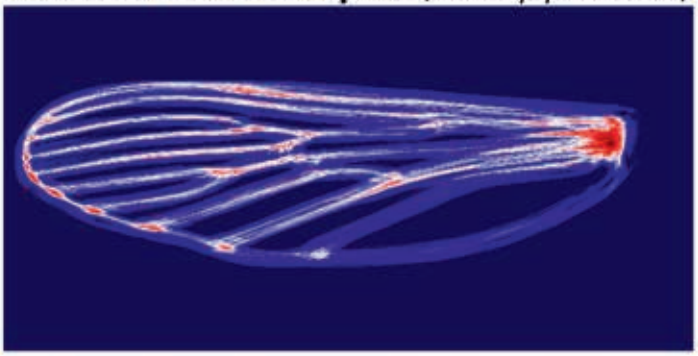
The Ethnopharmacology and Zoopharmacognosy Junior Research Group, led by Dr. Fabien Schultz, is investigating how humans and animals use natural materials, for example, plants, fungi, and insects, to treat diseases. With a strong focus on interdisciplinary collaboration, the research group's activities cover a broad scientific spectrum, ranging from ethnobotanical field research and anthropological studies to pharmacological investigations in the laboratory and AI-assisted early-stage drug discovery. The group is searching for novel bioactive substances for future therapeutics. Thus, the researchers are systematically documenting traditional medicinal knowledge of local communities and evaluating natural products chemically and pharmacologically. Notably, the findings benefit the communities: through ethical-participatory approaches, two-way exchange, feedback workshops and local health and conservation initiatives.

From structure to active ingredient

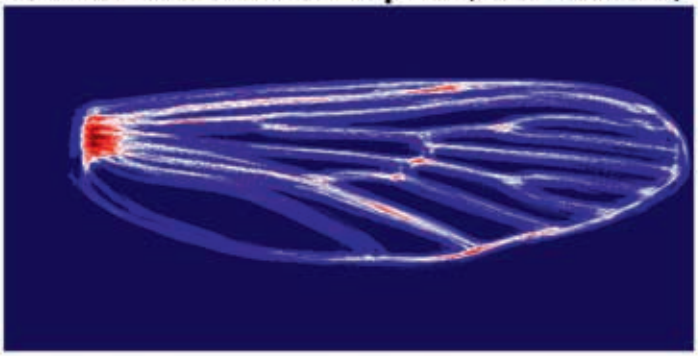
The scientists in the Structural Virology Research Group, led by Dr. Maria Rosenthal, are determining 3D structures of pathogen components. This is important in order to learn how the individual components work and how to specifically disrupt their functions by inhibitors. Structural research also helps answer the question "How exactly does an inhibitor work?"; this aspect is extremely important for drug development. Detailed knowledge of the interaction between an inhibitor and the pathogen component allows to specifically optimise this interaction making future drugs more effective as well as more specific and thereby reducing the likelihood of serious side effects.

Right: Ethnobotanical field research among Batwa communities in remote regions of the Bwindi Rainforest in Uganda

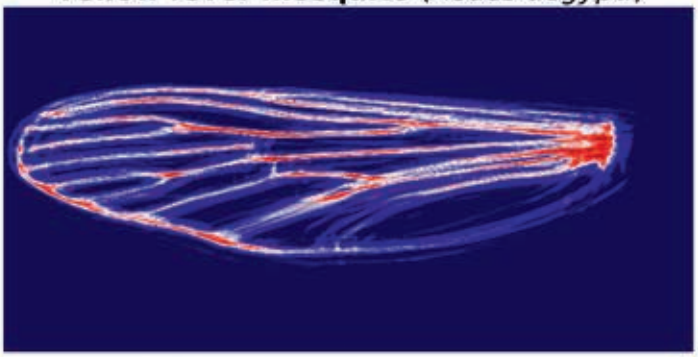
Common house mosquito (*Culex pipiens* s.s.)



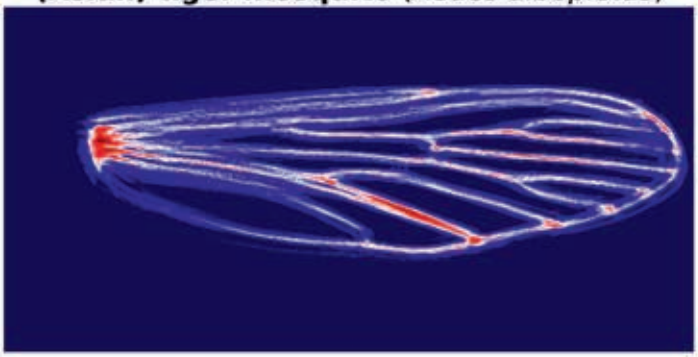
Inland floodwater mosquito (*Aedes vexans*)



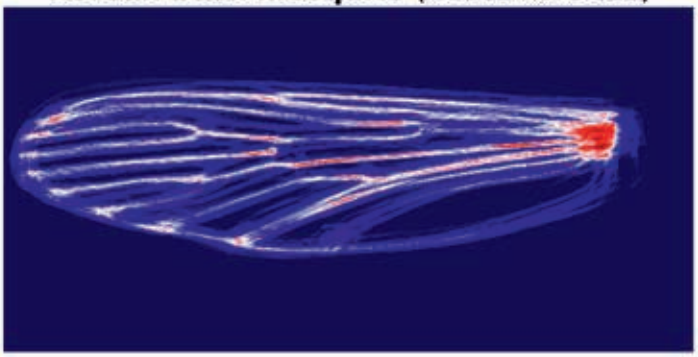
Yellow fever mosquito (*Aedes aegypti*)



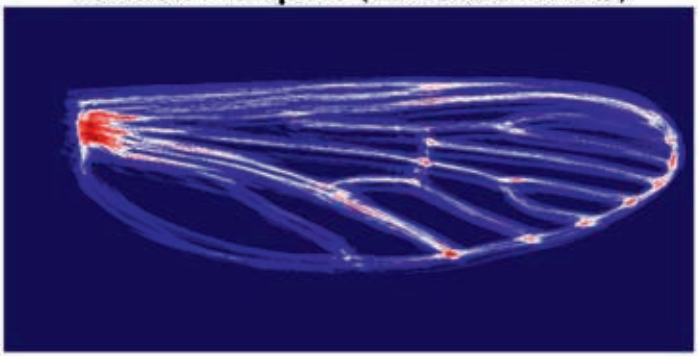
(Asian) tiger mosquito (*Aedes albopictus*)



Korean bush mosquito (*Aedes koreicus*)



Banded mosquito (*Culiseta annulata*)



ARTIFICIAL INTELLIGENCE IN INFECTION RESEARCH

Artificial intelligence (AI) is opening up new perspectives in infection research. Researchers at the BNITM are using AI-supported techniques to analyse large volumes of genomic and image data and develop new diagnostic methods. These approaches are intended to help us better understand disease progression and develop new strategies to combat pathogens.

Spread of mosquitoes and pathogens
Researchers from the Junior Research Group Arbovirus Ecology and the Vector Control Working Group are using AI to predict the temporal and spatial distribution of mosquitoes and the pathogens they transmit. Their machine learning algorithms process large amounts of data, such as climate and land use. Combined with mosquito and pathogen distribution data, they identify underlying patterns and allow predictions.

The researchers are also using AI to reliably and automatically identify mosquito species based on their wings, thus enabling targeted, rapid, and effective monitoring (see p. 53).

Diagnosis of diseases of the cervix
The infectious disease Female Genital Schistosomiasis (FGS) and Cervical Cancer (CC) are highly endemic in sub-Saharan African countries. Their diagnosis by colposcopy relies on visual inspection by experienced personnel, which is difficult to ensure across the population in low-resource settings. Thanks to a cohort in Madagascar (see p. 55), Daniela Fusco's team is collecting and cataloguing colposcopy images to train artificial intelligence. The goal: improved (differential) diagnosis of FGS and CC – even without laboratories or specialists.

Monitoring antibiotic resistances
Researchers in the Global One Health, Infectious Disease Epidemiology, and One Health Bacteriology groups use AI to analyse a wide range of data, including climate, geospatial, and bacterial genotypes, to identify patterns and risk factors for antibiotic resistance at an early stage; this forms basis for predictions, early warning systems, targeted prevention, and action.

Left: AI-generated average wing shapes of various native and invasive mosquito species

NATIONAL COOPERATIONS

CSSB
Centre for Structural
Systems Biology

THE BNITM AT CSSB

Analysing pathogens together using state-of-the-art technology

Since 2018, BNITM groups have been conducting research into the molecular basis of infectious diseases at the Centre for Structural Systems Biology (CSSB) in Science City, Hamburg Bahrenfeld. The goal is to develop new approaches for treatment and prevention.

The CSSB is unique in Germany and brings together experts from nine institutions (three university institutions* and six non-university institutions**). Close cooperation with DESY and access to cutting-edge technologies make the centre, with its nearly 210 researchers from 40 countries, a prime location for interdisciplinary infectious diseases research.

The focus is on understanding the structure, dynamics, and function of pathogens and their interactions with their hosts. To achieve these high-impact insights, researchers have access to specialised platforms such as advanced light and fluorescence microscopy, cryo-electron microscopy, protein production, and protein crystallisation facilities. Together, they allow the visualisation of molecular processes that pathogens need to cause disease. This understanding is crucial for developing new therapeutics.

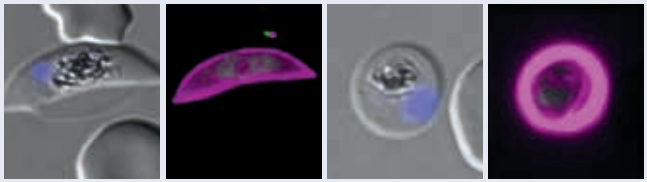
Cellular Parasitology Department at CSSB

"No bananas for a blood breakfast"
The single-celled parasite *Plasmodium falciparum* causes the most severe form of malaria, malaria tropica. The parasite name is inspired from its banana-shaped (falciform) gametocytes, which are the sexually differentiated malaria cells. The malaria parasite undergoes various stages in the liver and red blood cells in humans. The gametocytes, which hide from the human immune system in the bone marrow, are essential for its retransmission to the mosquito. It is believed that the special architecture of these banana-shaped gametocytes is useful for this survival strategy.

* *University of Hamburg (UHH), University Medical Center Hamburg-Eppendorf (UKE), Hannover Medical School (MHH)*
** *Bernhard Nocht Institute for Tropical Medicine (BNITM), German Electron Synchrotron (DESY), Leibniz Institute for Virology (LIV), Research Center Borstel (FZB), Helmholtz Centre for Infection Research (HZI), and European Molecular Biology Laboratory (EMBL)*

Researchers from the Department of Cellular Parasitology, in collaboration with an international research team, discovered and characterised the role of a parasite protein called PfSPM3. They showed that the loss of PfSPM3 leads to a defective cytoskeleton resulting in parasites that are unable to form banana-shaped gametocytes such that they are unlikely to be transmittable.

Wichers-Misterek JS, Binder AM, Mesén-Ramírez P et al., mBio 2023 Feb28; 14(1):e0331822

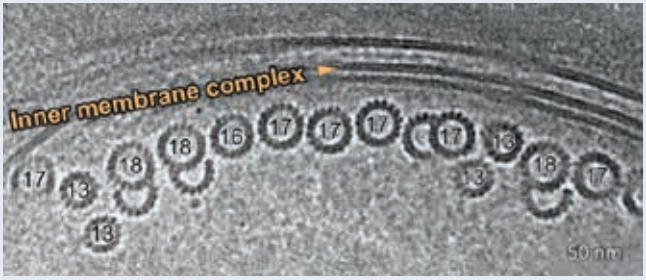


Alteration of cell architecture due to the loss of the SPM3 protein. Left: banana-shaped gametocytes (blue: nucleus, magenta: cytoskeletal microtubules). Right: After the removal of SPM3 using gene-editing, SPM3 deficient parasites can form only round gametocytes.

"Flexible biology down to the smallest cell structures"

Malaria parasites have many faces: over the course of their life cycle, they develop several different cell forms. However, the exact nature of this metamorphosis and how changes in the cytoskeleton are regulated remain largely unknown. Molecular biologists led by CSSB researchers have used high-resolution imaging techniques to visualise the cytoskeleton of various parasite forms. They examined the microtubules, elongated structural elements that underly the cytoskeleton and that are made up of a bundle of typically 13 protofilaments. One of the many surprising results: gametocyte microtubules can be made of anywhere between 13 to 18 protofilaments.

Ferreira JL, Pražák V et al., Nat Commun. 2023 Mar 3;14(1):1216



Cryotomographic evidence of P. falciparum microtubule variation. Hidden beneath the three outer membranes of gametocytes is a unique diversity of microtubules, including giant microtubules with up to 18 tubulin strands.

Structural Virology Junior Research Group at BNTIM

Researchers in the Structural Virology group and their collaborators use methods of structural analysis to examine the protein components of viruses at the molecular level. For example, they used cryo-electron microscopy to gain insight into the molecular mechanisms of the L protein of a bunyavirus. The L protein plays a key role in viral replication; a precise understanding of how the L protein works is essential for developing targeted antiviral strategies. The researchers have come a great deal closer to this goal (see p. 19).

German Center for Infection Research

The German Center for Infection Research (DZIF) combines 35 university and non-university institutions at seven locations in Germany with the overarching goal of effectively translating findings from basic research in infectious diseases into new approaches for diagnosis, prevention and therapy.

The BNITM is a founding member and active partner at the Hamburg-Lübeck-Borstel-Riems site and coordinates the facility together with the University Medical Center Hamburg-Eppendorf (UKE). Within the DZIF, the BNITM's research focuses on numerous projects in the areas of "Emerging Infectious Diseases" and "Malaria and Neglected Tropical Diseases". The BNITM also coordinates the collaboration of the "African Partner Institutions", a unique collaborative DZIF structure.

Prof. Michael Ramharter, coordinator of the DZIF division "Malaria and Neglected Tropical Diseases", is investigating new therapeutic approaches in close collaboration with African partner institutions; one example involves combination therapies for uncomplicated malaria or new drugs against loiasis, a neglected worm disease in Central and West Africa.

The researchers Dr. Lisa Oestereich, Prof. Stephan Günther and Prof. César Muñoz-Fontela of the working group "Clinical Management, Epidemiology, and Immunology of Emerging Infectious Diseases" are developing, inter alia, innovative preclinical models to explore the pathogenesis of viral haemorrhagic fevers. Dr. Ralf Krumkamp, heading the "Mathematical Models and Biostatistics" research group, supports scientists in malaria research with bioinformatics methods.

Deputy site spokesperson Prof. Esther Schnettler has held a DZIF W2 professorship for Medical Entomology since 2016. Within the research area "Emerging Infectious Diseases", she heads the BSL-3 insectary, which, among other things, facilitates experiments to determine the risk of outbreaks caused by insect-borne viruses.

LEIBNIZ
CENTER INFECTION

The Leibniz Center Infection (LCI) is a strategic research alliance between the BNITM, the Leibniz Institute of Virology (LIV), and the Research Center Borstel, Leibniz Lung Center (FZB). Founded in 2005, the three institutes pool their complementary expertise in order to jointly research on infectious diseases of global importance such as HIV/AIDS, tuberculosis, and malaria. The goal is to strengthen the Hamburg Metropolitan Region as an internationally visible centre of excellence for global and emerging infections, in close collaboration with the University Medical Center Hamburg-Eppendorf (UKE) and the University of Hamburg.

The LCI hosts an annual international symposium on current topics in infection research. The research network operates an interdisciplinary doctoral program with the Leibniz Graduate School "Infections" with approximately 100 doctoral students, including LCI fellows. These students are supervised by two research groups from the three LCI institutes, which strengens the scientific collaboration between BNITM, LIV, and FZB. An annual LCI Summer School lasting several days is held for doctoral students to promote exchange and networking among the doctoral students. That is where they present their research projects to each other and benefit from specialist lectures covering a variety of different topics.

Projects at BNITM with LCI scholarships 2023/2024:

"New alternative methods to animal experiments to identify common innate immune pathways involved in viral and parasitic infections"
Principal Investigator (PI): Prof. Hanna Lotter and Prof. Iris Bruchhaus (BNITM) / Prof. Gülşah Gabriel (LIV)

"Chronic infection: impact on the B cell compartment of the bone marrow in malaria and TB"
PI: Dr. Christine Hopp (BNITM) / Dr. Bianca Schneider (FZB)

"Cell type-specific effects of interleukin-27 on the outcome of bacterial and parasitic infection"
PI: Dr. Kristina Ritter (FZB) / Dr. Thomas Jacobs (BNITM)

"Analyzing the structural conservation of LASV proteins to identify novel antiviral targets"
PI: Prof. Maya Topf (LIV) / Dr. Maria Rosenthal (BNITM)

LIV Leibniz Institute of Virology

Research Center Borstel
Leibniz Lung Center

University Medical Center Hamburg-Eppendorf

The close collaboration between the BNITM and the University Medical Center Hamburg-Eppendorf (UKE) is based on a cooperation agreement that has been in place since 1998. This partnership has continuously developed over the years and now includes joint research projects, professorships, and teaching commitments.

A core element of the collaboration includes clinical patient care, travel counselling, and clinical research. Prof. Michael Ramharter, jointly appointed by the BNITM and the UKE to the professorship of "Clinical Tropical Medicine", heads the **UKE Outpatient Clinic for Tropical and Travel Medicine** at the BNITM and the inpatient care of tropical medicine patients at the **Bernhard Nocht Clinic at the UKE**. The widely recognised Centre for Tropical and Travel Medicine offers differentiated diagnostics and treatment for returning travellers with tropical diseases, as well as travel prophylaxis. Treatment is provided by physicians who are both clinically active at the UKE and involved in research and teaching at the BNITM.

The **Collaborative Research Centre (CRC) "Emerging Viruses: Pathogenesis, Structure, Immunity"** was set up in 2024 under the direction of Prof. Marylyn Addo (UKE, associated with the BNITM). It investigates RNA viruses with epidemic potential, including Ebola, Lassa, and MERS viruses. The CRC is funded by the German Research Foundation (DFG) with approximately eleven million euros until at least 2028. More than a third of the leading researchers in this project also work at the BNITM. The work of **Prof. Addo's associated UKE department "Clinical Immunology of Infectious Diseases" at the BNITM** focuses on the preclinical and clinical development of innovative vaccines against emerging or re-emerging viral pathogens (see p. 33).

In 2024, the DFG extended funding for the **research unit "Sex Differences in Immunity"** for four years providing five million euros. The focus is on gender-specific mechanisms of the immune response in autoimmune and infectious diseases, vaccines, asthma, prenatal immune imprinting, and immuno-oncological therapeutic concepts. Participating institutions include the BNITM, the UKE, the Mannheim University Hospital, and the Borstel Research Center. The goal is to gain a deeper understanding of gender-specific immune responses, which in the long run will enable the development of precise and personalised therapies.

Bundeswehrkrankenhaus HAMBURG

Tropical Medicine in the German Armed Forces

The BNITM has been cooperating with the Department of Tropical Medicine at the Bundeswehr Hospital Hamburg for almost 20 years. Our joint work in 2023/2024 included

… in the field of clinical tropical medicine:

- Participation in consulting for returning travellers and travel medicine
- Tropical dermatology consulting
- Speaker activities in the diploma course in tropical medicine and the basic seminar in travel medicine
- The Bundeswehr's own courses "Tropical and Travel Medicine" and "Infectious Diseases in Operations" as well as the "4th Symposium on Tropical Medicine and Infectious Diseases in the International Military Context 2024" at the BNITM

…in the field of tropical medical microbiology:

- Analyses of the incidence and distribution of gastrointestinal and systemic infections in sub-Saharan Africa, taking into account antibiotic resistance
- Investigations into how microbial pathogens in the gut interact with each other in gastrointestinal infections and how concurrent acquired immunodeficiency influences these interactions

…in tropical medical entomology:

- Diagnostic validation to detect the malaria parasite in vectors such as the *Anopheles* mosquito
- Monitoring of horse flies (vectors of the worm parasite *Loa loa*) in Gabon to record the dynamics of transmission of the pathogen from horse flies to humans
- A repellent study in Gabon to evaluate the effectiveness of deterrents against horse flies
- Zoological identification to determine which pathogen patients are infected with

Entomological souvenirs from returning travellers
(Image 1: Tumbu fly maggot Cordylobia anthropophaga, Image 2: Pubic louse Phtirus pubis, Image 3: Adult female of the meadow tick Dermacentor reticulatus, all images: Dr. Albert Eisenbarth, biologist, entomologist, Bundeswehr Hospital Hamburg, Dept. XXI, BNITM branch)

INTERNATIONAL COOPERATIONS

Kumasi Centre for Collaborative Research in Tropical Medicine

Drone view of the KCCR

For 28 years, the Kumasi Centre for Collaborative Research in Tropical Medicine (KCCR) – a joint venture between the Kwame Nkrumah University of Science and Technology (KNUST), the Ghanaian Ministry of Health and the Free and Hanseatic City of Hamburg – has served as a premier platform for cutting-edge research, capacity building, and multidisciplinary collaboration in tropical medicine. The KCCR's ten research groups drive innovation in neglected tropical diseases (schistosomiasis, onchocerciasis, Buruli ulcer, lymphatic filariasis), malaria and other vector-borne diseases. They also conduct research into

BSL-3 laboratory

antimicrobial resistance, One Health, tuberculosis immunology and vaccine development and they focus on global health equity and responses to disease outbreaks as well.

The KCCR operates mid- to large-scale research laboratories in the cities of Kumasi, Agogo, Assin Foso and Agroyesum. In addition to specialised laboratories for PCR, bacteriology, immunology and parasitology, there are two biosafety level 3 (BSL-3) laboratories. One of these has been in operation since March 2023 for research into high-risk pathogens (e.g. drug-susceptible tuberculosis and COVID-19); it was financed by the *Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.*

In the reporting period, the KCCR supervised twelve active clinical trials under the supervision of the Ghanaian Food and Drugs Authority (FDA) and published a total of 230 peer-reviewed publications – 120 in 2023 and 110 in 2024. In the promotion of young researchers, to date the centre has supervised 80 doctoral students (41 graduated, 39 ongoing) and supported 124 Master's students (114 graduated, 10 in training). In addition to formal training programmes, the KCCR runs practical workshops

on topics such as SARS-CoV-2 sequencing, bioinformatics, epidemiological data analysis, research ethics and scientific writing. Biweekly seminars and journal clubs also strengthen scientific exchange. As a reference laboratory accredited by the WHO as part of the external quality assessment (WHO-EQA), the KCCR supports Ghana's Health System in the diagnosis of COVID-19, influenza and neglected skin diseases. In collaboration with the National Malaria Control Programme, it also provides further training for healthcare workers.

Delegation visit on 4 October 2024

Hamburg-Ghana Cooperation

On 4 October 2024, the Second Mayor of the Free and Hanseatic City of Hamburg, Katharina Fegebank, visited the KCCR and KNUST with a 14-member scientific delegation, including Prof. Jürgen May from the BNITM. The aim of the visit was to strengthen collaboration between KNUST, KCCR and research institutions in Hamburg.

Katharina Fegebank and Prof. Richard Phillips

Awards

As part of the *Ghana National Honours and Awards 2023*, the KCCR was honoured by the President of the Republic of Ghana for its outstanding achievements. The centre received a plaque of honour and an official certificate in recognition of its contribution to medical research and public health. In addition, on 2 June 2023, the KCCR was named Best Research Centre of the Year at the inaugural *KNUST Excellence Awards*, organised by the KNUST Scholarship and Research Office, further demonstrating the scientific excellence and national appreciation of its work.

Ghana National Honours and Awards Ceremony

KNUST Best Research Award Ceremony

TO THE KCCR WEBSITE

Centre de Recherches Médicales de Lambaréné, Gabun

The BNITM has been collaborating closely with the Centre de Recherches Médicales de Lambaréné (CERMEL) in Gabon since 2018. CERMEL is an independent research institution focusing on malaria and filarial worm infections, among other research areas. It has modern facilities for clinical trials, basic research, and entomology, is experienced in conducting intervention and vaccination studies, and provides programmes for continuing education in the region.

In 2023 and 2024, CERMEL and the Clinical Research Department of the BNITM published studies on malaria prevention in HIV-infected pregnant women (see p. 43) and on the simultaneous prevention of schistosomiasis and malaria. Research on attitudes toward the tropical worm disease loiasis showed that the affected population is well aware of the disease, but at the same time revealed significant gaps in knowledge regarding disease transmission. The world's first study on the financial impact of loiasis, conducted with the Health Economics Research Group of the BNITM, also demonstrated that the disease represents a considerable economic burden. A study on snakebites in collaboration with Dr. Benno Kreuels (Neglected Diseases and Envenoming Research Group) revealed that the prevalence of snakebites in Gabon is higher than expected and that improved medical care is urgently needed.

An important part of the cooperation between CERMEL and BNITM is the training of medical personnel and the development of new medical and scientific infrastructure in Gabon. Important milestones have been achieved in this area, such as the expansion of the medical station in Sindara (see photo). Sindara will serve both as a primary healthcare provider for the population in a remote rainforest area and as a study centre for loiasis research.

TO THE CERMEL WEBSITE

Irrua Specialist Teaching Hospital, Edo State, Nigeria

Employees from various departments at BNITM work closely with their colleagues at the Irrua Specialist Teaching Hospital (ISTH) in Nigeria. Founded in 1993, the ISTH is the central hospital for 19 local administrative areas, home to several million people. It is now the world's largest Lassa treatment centre and is located in a region where the Lassa virus, which causes Lassa fever, is endemic.

In 2007, the ISTH established the "Institute of Lassa Fever Research and Control" in collaboration with the BNITM. A laboratory for molecular diagnostics was established in 2008 based on a cooperation agreement. This laboratory now examines over 3,000 samples per year, approximately 10 per cent of which are positive for the Lassa virus. An isolation ward has been in place since 2010, and has now been replaced by a newly constructed building to further improve patient care. Staff from the BNITM Virology Department regularly visit to introduce new methods, implement research projects, and train local professionals.

Clinical studies involving the Departments Virology and Clinical Research as well as the Implementation Section demonstrate the benefits of electroencephalography (EEG) and ultrasound in detecting severe forms of Lassa fever. Another study highlights the limitations of ribavirin in treating Lassa fever (see p. 45). As part of a consortium of 15 international partners (INTEGRATE), the BNITM is working to establish a study platform in West Africa to develop new treatment options.

TO THE ISTH WEBSITE

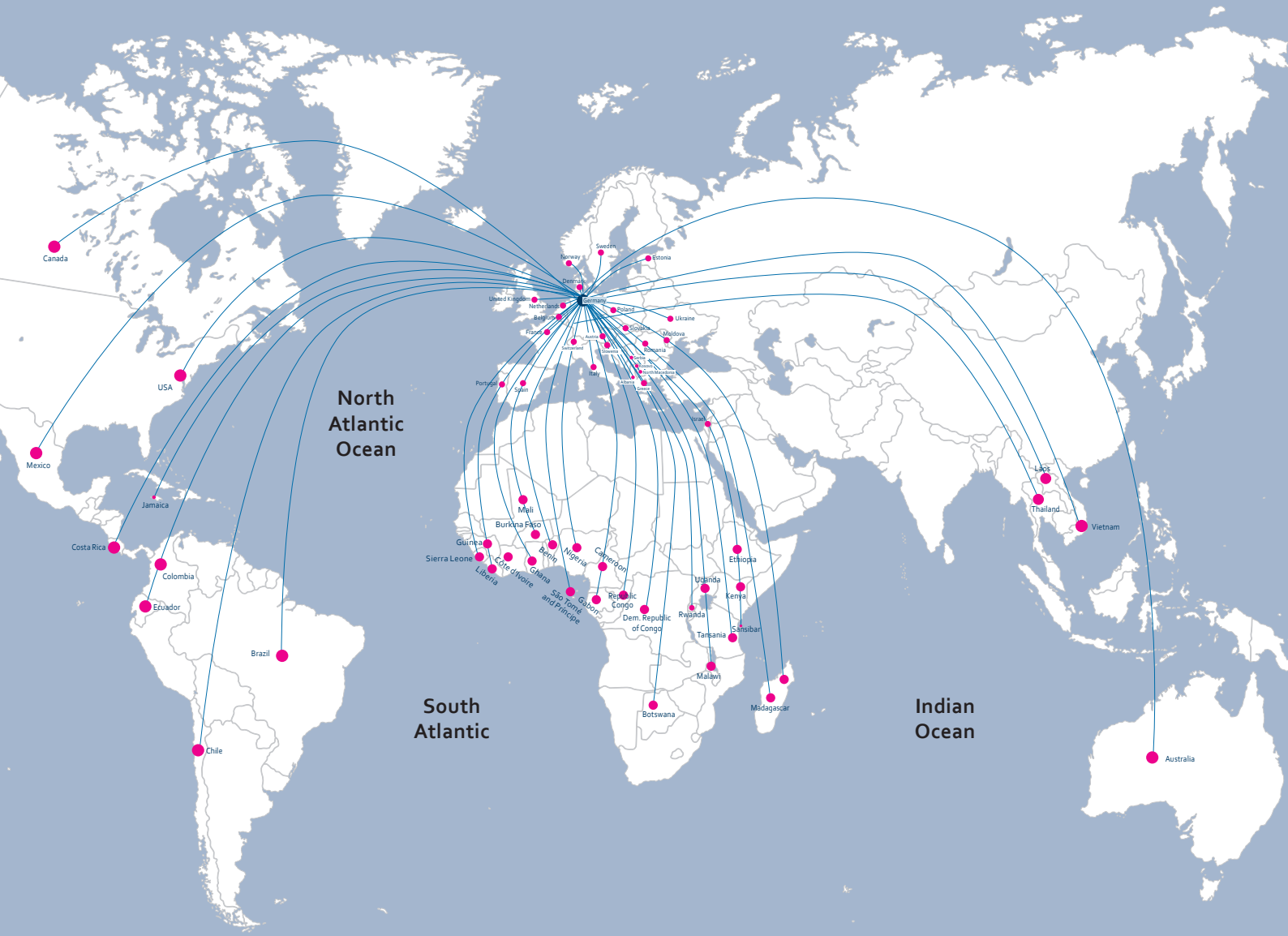
The resumption of hostilities in Eastern Congo in 2022 led to a mass displacement. Approximately 1.2 million refugees lived in Goma. The city, with a population of one million, was under a gruelling state of siege which escalated with the occupation of the city by M23 rebels in 2025.

Cooperation in the Democratic Republic of Congo

Dr. Sung Joon Park of the BNITM and Prof. Dr. Nene Morisho of the Pole Institute in Goma, Democratic Republic of Congo (DRC), are closely collaborating scientifically. Over the past years, they have been conducting medical anthropological projects on various topics including mobility and trust in Ebola epidemics and the COVID-19 pandemic in Eastern DRC. In particular, they are conducting a transdisciplinary analysis of human and virus mobility to investigate factors that contribute to the resurgence of Ebola outbreaks. They are also researching fear, mistrust, and uncertainty in epidemics and pandemics with the aim of developing new forms of communication in crises. These projects are funded by the German Research Foundation (DFG), the Volkswagen Foundation, and Elhra (UK).

The recent cycle of violent conflict (since 2022), which continues a thirty-year history of violent conflict and displacement in Eastern Congo, is complicating their research. The military occupation of Goma by the M23 rebels represents a significant constraint. As in other war zones, fear of repression and an uncertain political future complicate independent research. Still, both partners have been able to continue research albeit on a smaller and modified scale, paying special attention to security measures.

GLOBAL COLLABORATIONS



TO THE WEBSITE
OF THE COLLABORATIONS

EDUCATION AND TRAINING

MEDICAL TRAINING AND FURTHER EDUCATION

A fundamental element of our ongoing medical education and training programme is constituted by our diploma course in tropical medicine. The event has been conducted on an annual basis since 1905, with only five cancellations attributable to war or pandemic circumstances. In the past 16 years, approximately 700 individuals have been awarded a diploma in tropical medicine. The teaching mission constitutes a pivotal endeavour for the institute, and the spectrum of courses has undergone consistent expansion.

Course room of the institute today

DIPLOMA COURSE IN TROPICAL MEDICINE

The aim of the diploma course is to prepare physicians for practice in the tropics and subtropics in accordance with the continuing education regulations of the German Medical Associations. Participants acquire the necessary knowledge and skills to identify and treat diseases imported from these regions in travellers and migrants, as well as to provide preventive medical advice.

The primary focus of the course is to present human diseases that are typical of the tropics. Teaching focuses on the pathogenesis, diagnosis, clinical presentation, treatment, epidemiology, and prevention of parasitic, bacterial, viral, and non-communicable tropical and travel-related diseases. Concurrently, the biology, epidemiology and control of pathogens, in addition to vector animals and animal reservoirs, are also addressed. Further content encompasses the special features of the individual clinical specialties in the tropics, healthcare problems in countries of the Global South, and procedures for medical development, cooperation and disaster relief. The curriculum also encompasses subjects related to the medical care of migrants and refugees, in addition to the fundamentals of occupational medicine in tropical regions.

The curriculum is structured into twelve thematic sections. The taxonomy of the pathogens is supplemented by insights into the fields of travel medicine, migrant and occupational medicine, as well as topics from the public health sector. The curriculum is comprised of approximately 360 hours of lectures plus 60 hours of case discussions, workshops, small group classes and practical exercises that are primarily microscopic based. During the course, participants have access to the German Reference Library for Tropical Medicine Literature at BNITM for self-study. The Diploma Course on Tropical Medicine is recognised by the German Medical Association as part of the further training for the additional qualification "Tropical Medicine" and by the American Society of Tropical Medicine and Hygiene (ASTMH). The Hamburg Medical Association accredits the course on an annual basis, awarding approximately 450 credits for continuing education.

From 2025, the Tropical Medicine Diploma Course will be delivered **entirely in English** and opened to an international cohort of participants.

Course Director:
Dr. Benno Kreuels

TO THE TROPICAL MEDICINE COURSE

FURTHER MEDICAL COURSES

Travel Medicine Basic Seminar
In collaboration with the University Medical Center Hamburg-Eppendorf (UKE), the BNITM offers a 32-hour seminar on travel medicine. This seminar provides basic knowledge of travel risks, preventive measures, and diseases in returning travellers. Upon request, the German Society for Tropical Medicine, Travel Medicine and Global Health (DTG) issues the DTG Travel Medicine Certificate upon successful completion.

Tropical Medicine Refresher Course
The BNITM hosts two annual weekend events for physicians interested in tropical medicine – especially for those who have previously completed the Diploma Course in Tropical Medicine. These compact refresher courses convey current developments in tropical and travel medicine, insights into new research projects, and scientific findings from the BNITM. They are certified as continuing education or refresher courses by the Hamburg Medical Association and the DTG.

Travel Health Day
The annual one-day event provides a forum for physicians to receive updated information on current vaccination recommendations, malaria prophylaxis, the global epidemic situation, and topics that are currently the focus of travel medicine practice. It is recognised by the Hamburg Medical Association and the and the DTG as a continuing education or refresher course.

Online supplementary module: "Working in Tropical Settings"
New in 2024: Graduates of the Travel Medicine Basic Seminar can obtain the DTG certificate "Working Stay in the Tropics" with the online module. This certificate entitles them to be included in a list of physicians with the DTG certificate "Working Stay in the Tropics and Subtropics."

Historical photo: Course room of the institute ca. 1930
On 1 October 1900, the Institute for Tropical Medicine was founded under the direction of Bernhard Nocht. The Institute's task was to treat tropical medicine patients, research the diseases involved and provide further education and training for medical professionals.

iACE

Interdisciplinary Academy

of Competence & Education for Global Health

INTERDISCIPLINARY EDUCATION & TRAINING FOR GLOBAL HEALTH

Over the past years, the International Teaching & Capacity Unit (iTCB), based in the Department of Infectious Disease Epidemiology at the BNITM, has coordinated the institute's international education and training and initiatives. With a focus on public health, epidemiology, One Health, and laboratory capacity exchange, iTCB reached over 1,500 participants from more than 70 countries, primarily in cooperation with partners in the Global South.

Building on this foundation, iTCB has evolved into the Interdisciplinary Academy of Competence & Education for Global Health (iACE Global Health), which was launched in 2024. iACE Global Health expands the scope and impact of BNITM's educational work by integrating interdisciplinary expertise, innovative digital and blended learning formats, and strategic partnerships to deliver scalable, evidence-based learning experiences. This evolution reflects BNITM's commitment to advancing global health through sustainable capacity exchange and inclusive education and training.

GLOBAL HEALTH HIGHER EDUCATION AT BNITM

Since 2019, the BNITM has been a member of tropEd, an international higher education network in the field of global health, which offers a collaborative master's programme. TropEd has established standardised course accreditation and quality assurance procedures. The BNITM annually offers two tropEd-accredited intensive courses: one in infectious disease epidemiology (EPICID), and one on laboratory systems (Lab-SPHERE). Since 2023, iACE Global Health has also coordinated the annual tropEd Global Health Summer School, which draws an audience of more than 300 participants worldwide. After having been tropEd president (2022-24), Dr. Dewi Ismajani Puradiredja has recently been re-elected into the tropEd Executive Committee as *Ex Officio*.

DIGITAL LEARNING INNOVATIONS

Digital innovations are reshaping how competencies in global health are built and shared. Initiatives such as GO4BSB *(German Online Platform for Biosecurity & Biosafety*), EVEER *(Educational Virtual Environment for Epidemic Response)*, and EDDi *(Epidemic Disease Detective)* explore this potential through transnational e-learning platforms, gamified simulations and immersive environments. Developed together with international partners at the intersection of epidemiology, biosecurity, and public health, they combine digital technologies with practical expertise to foster collaboration, responsible practice, and scientific dialogue across the life sciences.

TO THE EPICID COURSE

TO THE LAB-SPHERE COURSE

CONTEXT-SPECIFIC TRAINING OFFERS ON SITE IN PARTNER COUNTRIES

For more than a decade what is now iACE Global Health has delivered context-specific professional training sessions on site, tailored to the needs of health professionals in partner countries. Since 2014, through cross-regional programmes such as GIBACHT *(Global Partnership Initated Biosecurity Academia for Controlling Health Threats)*, over 100 fellows from 25+ countries have been trained in biosecurity and infectious disease control. Other more recent examples include hospital-based training in antimicrobial stewardship, infection prevention and control, and AMR monitoring; these offers combine practical instruction, mentoring, and remote support to ensure sustainable outcomes locally.

STRENGTHENING LABORATORY AND DIAGNOSTIC CAPACITIES

iACE Global Health also supports laboratory and diagnostic capacity strengthening initiatives in collaboration with other groups across the Institute. One particular highlight in March 2024 was a joint interdisciplinary training session by the BNITM Lab Group Infectious Disease Surveillance and Control together with the Friedrich-Loeffler-Institut. This session focused on the molecular identification of pathogens causing tuberculosis in animals and humans. Delivered at the Laboratório Nacional de Referência da Tuberculose (LNR-TB) in São Tomé and Príncipe, the session provided veterinarians and laboratory experts with hands-on training in PCR techniques for detecting *Mycobacterium tuberculosis* complex, and enhancing local capacities within a One Health framework.

DIAGNOSTICS AND OUTBREAK CONTROL

DIAGNOSTICS

BNITM laboratories for special pathogens

The BNITM offers a broad spectrum of highly specialised diagnostics for tropical and emerging pathogens. Through its diverse laboratories and units, the institute contributes to the rapid detection of infections, investigation of outbreaks, and targeted treatment of patients, both in Germany and internationally.

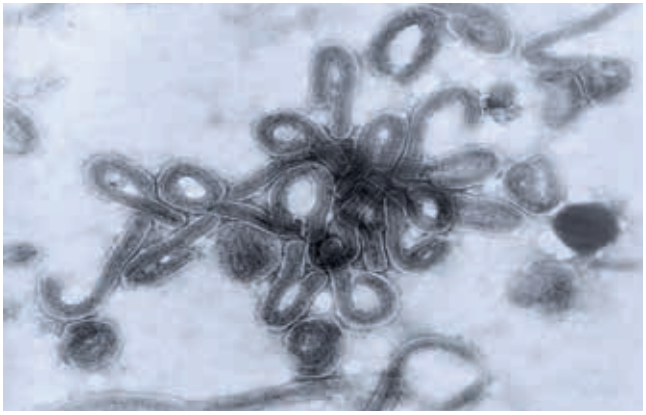
The BNITM's mobile laboratories are deployed in response to outbreaks abroad. These laboratories can be mobilised at short notice upon request from international partners such as the WHO or the EU. The goal is to strengthen the laboratory capacities of the requesting countries and provide on-site support in the diagnosis of pathogens up to biosafety level 4.

Medical Care Centre (Medizinisches Versorgungszentrum, MVZ)
The MVZ, a subsidiary of the BNITM, has been providing outpatient diagnostics for pathogens that do not require high-security laboratories since 2012. In 2024, the MVZ received over 30,000 samples and performed over 90,000 diagnostic tests.

Scientific Director:
Prof. Dr. Stephan Günther

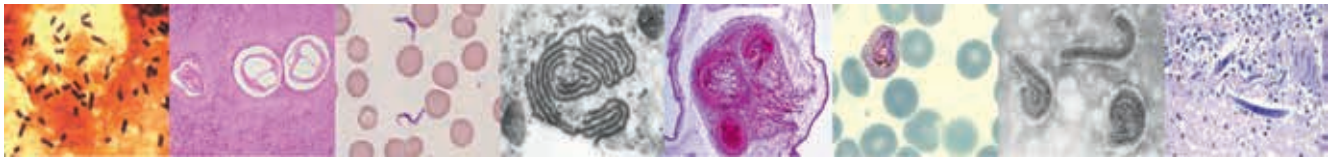
Central laboratory diagnostics
In the BNITM's central laboratory diagnostics, employees detect viruses, bacteria, and parasites using various methods such as antibody diagnostics (serology), microscopy, special culture techniques, and PCR. A variety of self-developed and validated tests are used, because many testing methods are not available on the market. For particularly dangerous pathogens, the BNITM uses its own high-security laboratories (biosafety level 3 and 4 laboratories). An emergency diagnostic service is available for suspected infections with haemorrhagic fever viruses; results are available within six hours. Among other occasions, this emergency service was used in October 2024: a medical student returned to Hamburg from Rwanda with symptoms after contact with a Marburg virus patient. Diagnostics at the BNITM gave the all-clear; the suspicion of infection with the tropical pathogen was not confirmed.

Scientific Directors:
Prof. Dr. Stephan Günther, Prof. Dr. Dennis Tappe



Electron microscopic image of the Marburg virus

National Reference Centre for Tropical Infectious Agents (NRC)
The NRC uses special techniques to analyse rare and exotic bacterial, viral, and parasitic pathogens from body fluids and tissues and performs subtyping. Conventional laboratories are often unable to



detect these pathogens. The NRC supports the Robert Koch Institute (RKI) with technical expertise in investigating outbreaks and specific imported infections, provides reference material for other laboratories, and advises medical professionals. It also supports European partners: for example, the NRC assisted in the diagnosis of alveolar echinococcosis (a worm disease caused by the fox tapeworm) in northern Italy, a new area of distribution.

Scientific Director:
Prof. Dr. Dennis Tappe

Consultant Laboratory for Bornaviruses
Since 2023, staff at the Consultant Laboratory have been investigating cases of unclear encephalitis caused by bornaviruses. They diagnose cases, conduct investigations into the pathogenesis of the disease, advise medical professionals, and work closely with the Robert Koch Institute (RKI), particularly with regard to risk factors and possible transmission routes (see p. 41).

Scientific Director:
Prof. Dr. Dennis Tappe

WHO Collaborating Centre for Arboviruses and Haemorrhagic Fever Viruses
As a WHO Collaborating Centre (WHO CC), the BNITM supports diagnostics and consultations for imported cases of tropical viral diseases throughout Europe. Another focus is cooperation with countries in Africa, Asia, and South America; for example, support is offered in setting up diagnostic laboratories for arboviruses and haemorrhagic fever viruses, conducting clinical research projects, and providing training locally and in Hamburg.

In collaboration with the Paul Ehrlich Institute and the University of Hamburg, the WHO CC conducted the largest European study on the safety of blood donations with regard to West Nile virus (WNV). Over a period of four years, the scientists analysed more than 26 million blood donations from all 16 German states. They were able to demonstrate that the testing methods used (see p. 77 "Metagenomics in diagnostics") reliably detect WNV-infected donations, thus minimizing the risk of transmission through blood products.

Scientific Directors:
Prof. Dr. Stephan Günther, Prof. Dr. Jonas Schmidt-Chanasit

THE EUROPEAN MOBILE LABORATORY

The European Mobile Laboratory (EMLab) responds to outbreaks of high-risk pathogens and provides surge capacity diagnostics, particularly in remote or resource-limited settings, deploying box-based rapid response mobile labs. Utilising state-of-the-art field labs to detect pathogens up to risk group 4, like Ebola virus, EMLab delivers rapid, high-quality results directly in the field, offering molecular diagnostics, serology, microscopy, clinical care support, and genomic sequencing.

EMLab is managed at BNITM, coordinated by the Department of Virology and the institute's *Mobile Laboratory Service Unit*. Since 2014, it has responded to numerous outbreaks, including Ebola virus disease, yellow fever, Marburg virus disease, Lassa fever, and COVID-19, in countries including Guinea, Liberia, Sierra Leone, Nigeria, Uganda, the Democratic Republic of Congo, Germany, and Greece. The EMLab network consists of many partner institutions and experts from all over the world. EMLab is a partner of the WHO *Global Outbreak Alert and Response Network* (GOARN) and its strategic group for *Diagnostic Surge Capacity* (GOARN-DiSC), and is a certified German asset in the European Civil Protection Pool.

Scientific Lead:
Dr. Sophie Duraffour and Dr. Emily Nelson

©EMLab

EMLab training: learning how to set up and operate a mobile laboratory

©www.eu-modex.eu

Simulated medical emergency exercise (EU MODEX) in Çanakkale, Turkey – the final step towards certification of the EMLab in the EU Civil Protection Pool (ECPP)

MOBILISE

The BNITM, together with eight European partners, has developed the mobile high-security laboratory MOBILISE. The EU is funding the project until October 2025. MOBILISE is a special truck that can travel to areas where dangerous infectious diseases occur. Once on site, the truck can be folded out on both sides to form a high-security laboratory. The laboratory meets the highest biosafety standards and uses solar and wind energy to operate autonomously. It enables the diagnosis of highly dangerous risk group 4 pathogens in humans, animals, and the environment. To achieve this, MOBILISE uses molecular diagnostics, serology, microbiology, and genome sequencing. By detecting pathogens at an early stage directly on site, chains of infection can be broken early. The team also collects important data on zoonoses – infectious diseases transmitted between animals and humans. A digital system supports coordination in an emergency. Starting in May 2025, the truck will be deployed in Germany, Austria, Greece, and Tanzania to be tested in various scenarios. The project is working closely with local authorities to establish long-term monitoring structures. With MOBILISE, the BNITM and its partners are strengthening global healthcare.

Scientific Lead:
Dr. Muna Affara and Dr. Florian Gehre

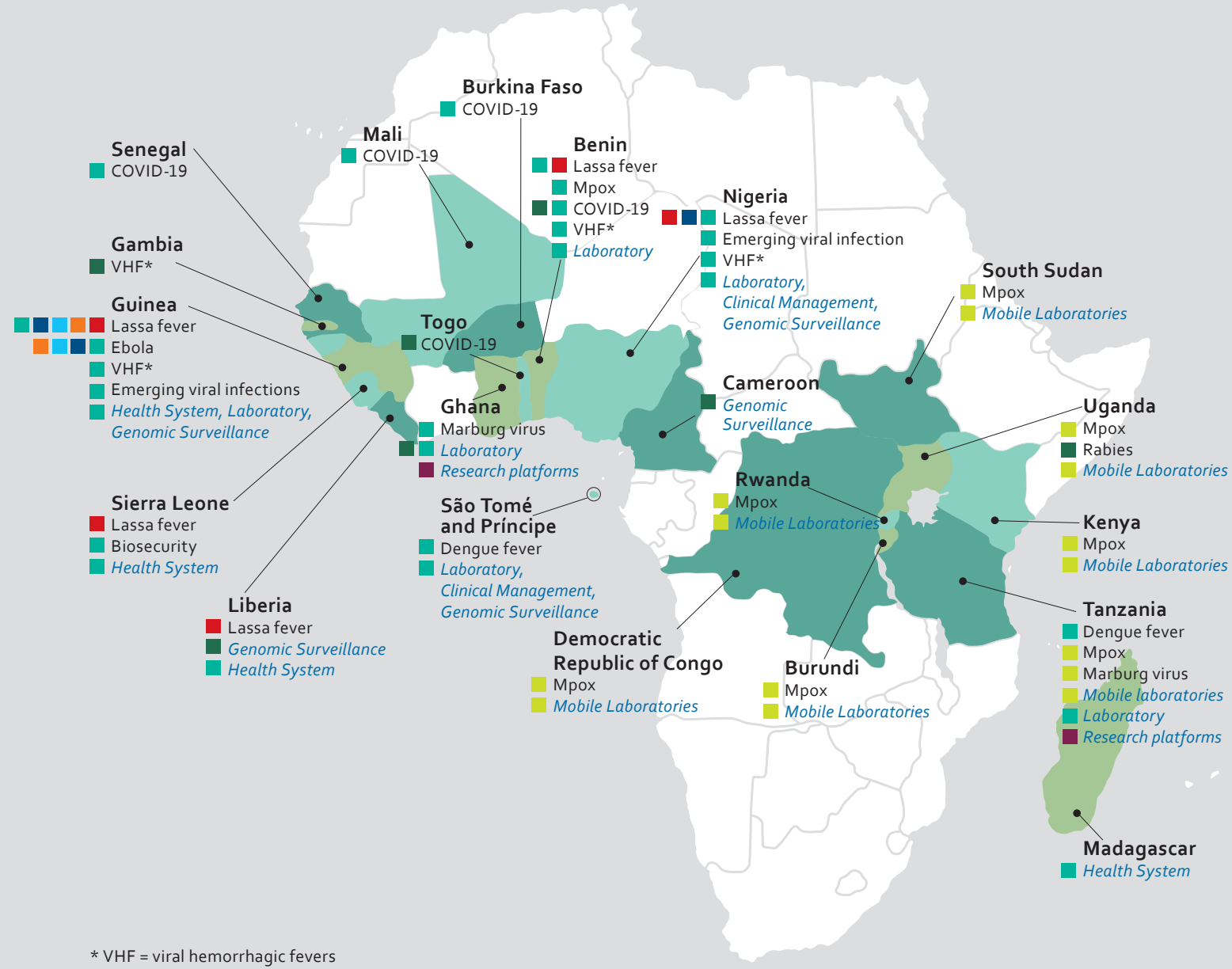
MOBILISE truck in the BNITM parking lot

Working on sterile workbenches in the MOBILISE truck

OUTBREAK PREPAREDNESS AND RESPONSE

BNITM employees actively participate in outbreak investigations, thus strengthening initiatives to contain infectious disease outbreaks globally: they support on-site research and laboratory diagnostics, and they help to monitor and control pathogens with epidemic or pandemic potential, such as SARS-CoV-2 or Mpox. The BNITM initiatives include projects of the *Global Health Protection Programme* (GHPP): ABCdM, AfroLabNet 2.0, CELESTA, Expand-AMR, MEVIN, SMART, and SURVIN-STP, as well as collaborations with the *Coalition for Epidemic Preparedness Innovations* (CEPI) and the *African coalition for epidemic research, response, and training* (ALERRT). Partner countries are also supported through participation in the Global Outbreak Alert and Response Network (WHO GOARN) or the German Epidemic Preparedness Team (SEEG).

Figure right: Missions in Africa 2023-24

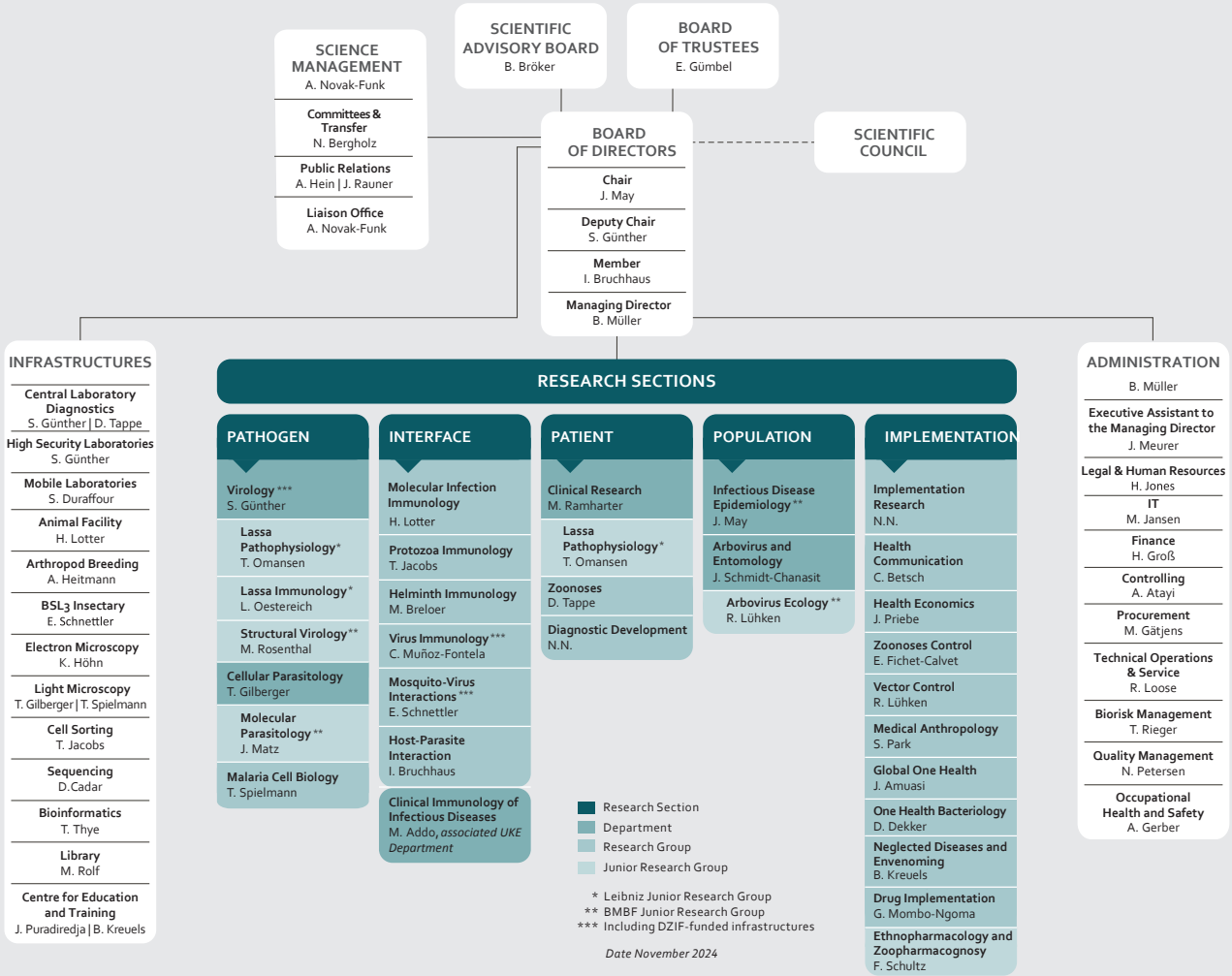


* VHF = viral hemorrhagic fevers

WHO | EMLab | GOARN | EAC | SEEG | GHPP | ALERRT | CEPI

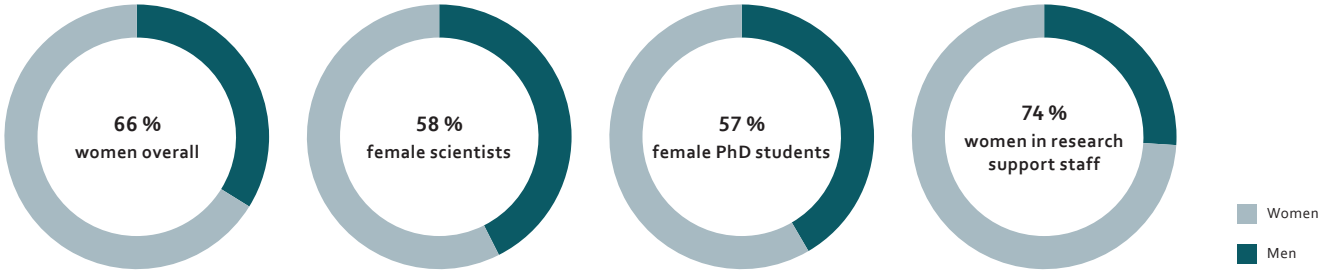
DATA AND HIGHLIGHTS

ORGANISATIONAL CHART



EMPLOYEES

402 employees, including 202 researchers, including doctoral students (as of 31 December 2024)



BUDGETARY RESOURCES

	2023 Mio. EUR	2024 Mio. EUR
Institutional Funding	23,3	23,1
Third-party funding	18,7	17,3
Amount passed through to collaborating partners	3,4	1,7
Amount retained at BNITM	15,3	15,5
Additional in-house resources	4,1	3,4
Total funding	42,7	42,0

The institute received third-party funding from the following organisations:

Alexander von Humboldt Foundation, Federal German Foreign Office, Ministry of Science, Research, Equality and Districts of the Free and Hanseatic City of Hamburg (BWFGB), Blackwell Science Ltd., Federal Office for Agriculture and Food (BLE), Federal Institute for Risk Assessment (BfR), Federal Ministry of Education and Research (BMBF), Federal Ministry of Food and Agriculture (BMEL), Federal Ministry of Health (BMG), Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Centre for Structural Systems Biology (CSSB), Coalition for Epidemic Preparedness Innovations (CEPI), German Research Foundation (DFG), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, German Academic Exchange Service (DAAD), German Red Cross (DRK), German Aerospace Center (DLR), Drugs for Neglected Diseases initiative (DNDi), Else Kröner-Fresenius Foundation, European & Developing Countries Clinical Trials Partnership (EDCTP), European Commission, European Federation of Immunological Societies (EFIS), Free and Hanseatic City of Hamburg, FUJIFILM Toyama Chemical Co., Ltd., GSO – Association for the Promotion of Science and Humanities in Germany, Howard and Gabriele Kroch Foundation, INSTAND e.V. – Society for Promoting Quality Assurance in Medical Laboratories, Institute of Tropical Medicine Antwerp (ITM), Inter-American Development Bank (IDB) – Gender and Diversity Lab (GDLab), International AIDS Vaccine Initiative (IAVI), International Society of Travel Medicine (ISTM), International Vaccine Institute (IVI), ISGlobal – Barcelona Institute for Global Health, Joachim Herz Stiftung, Johanniter International, Jürgen Manchot Foundation, Kirmser Foundation, Klaus Tschira Foundation gGmbH, KfW Development Bank, la Caixa Foundation, Leibniz Association, London School of Hygiene & Tropical Medicine (LSHTM), Ministry of Science, Energy, Climate Protection and Environment of Saxony-Anhalt, National Science and Technology Development Agency – National Center for Genetic Engineering and Biotechnology (BIOTEC), RiGHT Foundation, Robert Koch Institute (RKI), Mercator Foundation, Takeda Pharmaceutical Company Limited, The Coalition for Operational Research on Neglected Tropical Diseases (COR-NTD), Foundation for Innovative New Diagnostics (FIND), German-Israeli Foundation for Scientific Research and Development (GIF), The Hospital for Sick Children (SickKids, Toronto), German Environment Agency (UBA), University Hospital Tübingen (UKT), Association of Friends of the Bernhard Nocht Institute of Tropical Medicine (VdF), Volkswagen Foundation, Werner Otto Foundation, World Health Organization (WHO)

PERFORMANCE INDICATORS

	2023	2024
Publications	**224**	**259**
Peer-reviewed journals	216	247
Average impact factor	10,4	8,3
Median impact factor	4,8	3,8
Other journals	8	12
Scientific qualifications		
Bachelor / Master thesis	30	23
Dissertations	13	21
Teaching, training and further education		
University teaching (teaching hours)	1.311	918
National and international training and continuing education events at BNITM (teaching days)	259	277
Technology transfer (ongoing)		
Patents and licenses	28	26
Invention disclosures	1	0
Laboratory diagnostics (MVZ)[1]		
Number of cases	26.109	30.143
Number of tests	79.551	92.159
International cooperations		
Jointly financed third-party funded projects	101	65
KCCR[2]		
Total projects at KCCR	66	76
Of which external projects	39	56

1 Laboratory diagnostics of the "Medical Care Centre of the Bernhard Nocht Institute for Tropical Medicine GmbH" (MVZ-BNITM GmbH)

2 KCCR
Kumasi Centre for Collaborative Research in Tropical Medicine: Number of projects supervised / number of external projects carried out without BNITM participation

10.01.23
Dr. Scarlett Sett
German Nagoya Protocol HuB, Leibniz Institute-DSMZ, Brunswick, Germany
"Nagoya Protocol – what does it mean in practice?"

17.01.23
Prof. Dr. Federico Gobbi
University of Brescia and IRCCS Ospedale Sacro-Cuore Don Calabria Negrar di Valpolicella, Verona, Italy
"Loa loa and schistosomiasis: when a typical imported cases lead to research projects in LMI"

24.01.23
Dr. Andreas Haas
Institute of Social and Preventive Medicine (ISPM), University of Bern, Bern, Switzerland
"The implementation and effectiveness of HIV and mental health programs: real-world evidence from Southern Africa"

31.01.23
PD Dr. Sabine Specht
Drugs for Neglected Diseases initiative (DNDi)
"Drug development in NTDs, a PDP perspective"

14.02.23
Prof. Dr. Chris Biemann
University of Hamburg, Hamburg, Germany
"Digital Transformation of Research in Hamburg with HOUSE and KIEZ of Computing & Data Science"

28.02.23
Prof. Dr. med. Stefan Uderhardt
University Hospital of Erlangen, Erlangen, Germany
"Using advanced imaging to understand tissue organization and immunology"

25.04.23
Dr. Parichehr Shamsrizi/ Gilda Sahebi
Bernhard Nocht Institute for Tropical Medicine, Hamburg, Germany/Journalist
"The Feminist Revolution in Iran – Impacts on Health Care, Science and Global Aspects"

23.05.23
Dr. Julie Tai-Schmiedel
Springer Nature, Berlin, Germany
"In's and Out's of Research Publishing"

26.05.23
Dr. Justin Boddey & Robyn McConville
The Walter and Eliza Hall Institute of Medical Research (WEHI), Melbourne, Australia
"Plasmepsin IX and X inhibitors arrest liver merosomes and confer sterile immunity to malaria & Investigating protein export in P. falciparum liver stage infection"

30.05.2023
Dr. Corinna Bang
Christian-Albrechts-University Kiel and University Hospital Schleswig-Holstein Campus Kiel, Kiel, Germany
"What is the impact of intestinal protozoan infections on gut microbiome diversity?"

06.06.23
Prof. Dr. Baris Tursun
University of Hamburg, Hamburg, Germany
"Cell Fate Safeguarding in the Context of Reprogramming, Aging, and Infection"

09.06.23
Prof. Dr. Graham Le Gros
Malaghan Institute of Medical Research, Wellington, New Zealand
"Immune profiling, microbiome, metabolomics, and gut physiology of a 1-year controlled human hookworm infection"

21.06.23
Prof. Dr. Thomas D. Otto
University of Glasgow, Glasgow, United Kingdom
"Exploring host-pathogen interaction using Bioinformatics and single cell technologies"

19.09.23
Prof. Dr. Fabian Leendertz
Helmholtz Institute for One Health (HIOH), Greifswald, Germany
"The Helmholtz Institute for One Health and its one health surveillance"

26.09.23
Prof. Dr. Friedemann Weber
Justus-Liebig-Universität Gießen, Gießen, Germany
"Anti-interferon strategies of phleboviruses"

04.10.23
Prof. Dr. Paulo Filemon Paolucci Pimenta
FIOCRUZ - Minas Gerais, Brazil
"Burden of vector-borne diseases in Brazil"

09.01.24
Prof. Dr. Victor Greiff
University of Oslo, Norway
"Systems immunology profiling of adaptive immune receptor repertoires in health and disease"

06.02.24
Prof. Dr. Marina Zimmermann
Institute of Medical Systems Biology, UKE, Hamburg, Germany
"Computational pathology: The gap between research and clinics"

13.02.24
Dr. Lorenz Adlung
Medical Clinic and Polyclinic, University Medical Center Hamburg-Eppendorf (UKE), Hamburg, Germany
"Machine learning of MCMV infection dynamics"

20.02.24
Christopher Gundler
Institute for Applied Medical Informatics, UKE, Hamburg, G ermany
"Technical foundations of Large Language Models, their applications and limitations"

27.02.24
Dr. Olga Zolotareva
Institute for Computational Systems Biology, University of Hamburg, Hamburg, Germany
"Unsupervised patient stratification based on omics data"

12.03.24
Dr. Fatemeh Hadaeghi
Institute of Computational Neuroscience, UKE, Hamburg, Germany
"Predicting clinical response to treatment in inpatients with depression"

23.04.24
Prof. Dr. Angela Relógio
Medical School Hamburg (MSH), Hamburg, Germany
"Systems biology of Cancer"

30.04.24
Dr. Eva Kowalinski
EMBL Grenoble, France
"Winding roads to make an mRNA-insights into RNA processing of trypanosomatids"

28.05.24
Prof. Dr. René Werner
Institute for Applied Medical
Germany
"AI for biomedical imaging: computational superresolution and more"

03.06.24
Dr. Laurent Fraisse
Drugs for Neglected Diseases initiative (DNDi)
"DNDi's Efforts in Addressing health Related Needs in Neglected Populations"

25.06.24
Prof. Dr. Klaus Hurrelmann
Hertie School of Governance, Berlin, Germany
„Wie ticken die Fachkräfte der Zukunft"

02.07.24
Prof. Dr. Sarin Chimnaronk
Mahidol University, Bangkok, Thailand
"Characterization of functional RNA motifs in the dengue virus genome"

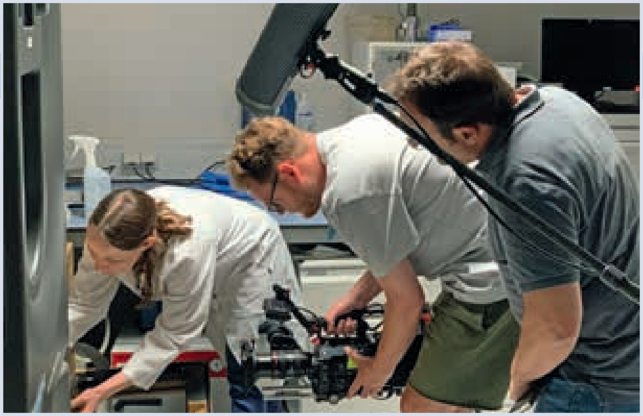
16.07.24
Dr. Fabien Schultz
Hochschule Neubrandenburg, Neubrandenburg, Germany
"Ethnopharmacology & Zoopharmacognosy"

22.10.24
Prof. Dr. Antje Flieger
Robert Koch-Institute, Wernigerode, Germany
"Genetic variants of intestinal pathogens and virulence: emphasis on EHEC and Salmonella"

19.11.24
Prof. Dr. med. Volker Harth, Prof. Dr. med. Markus Oldenburg, Dr. med. Jan Heidrich
Institute for Occupational and Maritime Medicine/University Medical Center Hamburg-Eppendorf (UKE), Hamburg, Germany
"Occupational Health and Infectious Disease Preparedness in the Maritime Environment – Current Research Projects of the Institute for Occupational and Maritime Medicine"

26.11.24
Prof. Dr. Dr. Sören Becker
Saarland University, Homburg, Germany
"Validation and application of new diagnostic tools for bacterial and parasitic infections in Africa"

Prof. Michael Ramharter provides information on travel diseases in *Med-Journal Gesundheitsmagazin* (a special supplement of *Rhein-Main-Presse*), 14 June 2023.



Filming for the *3SAT* science documentary "Elementarteilchen" in June 2023 with Dr. Maria Rosenthal

Q fever outbreak in the municipality of Amt Neuhaus in Lower Saxony: Theresa Haberman explains the symptoms and treatment of the bacterial infectious disease in an interview with *NDR* in March 2023.

Natur und Wissenschaft

Staub als Verstärker

Eine globale Arzneikrise

Besser weiblich?

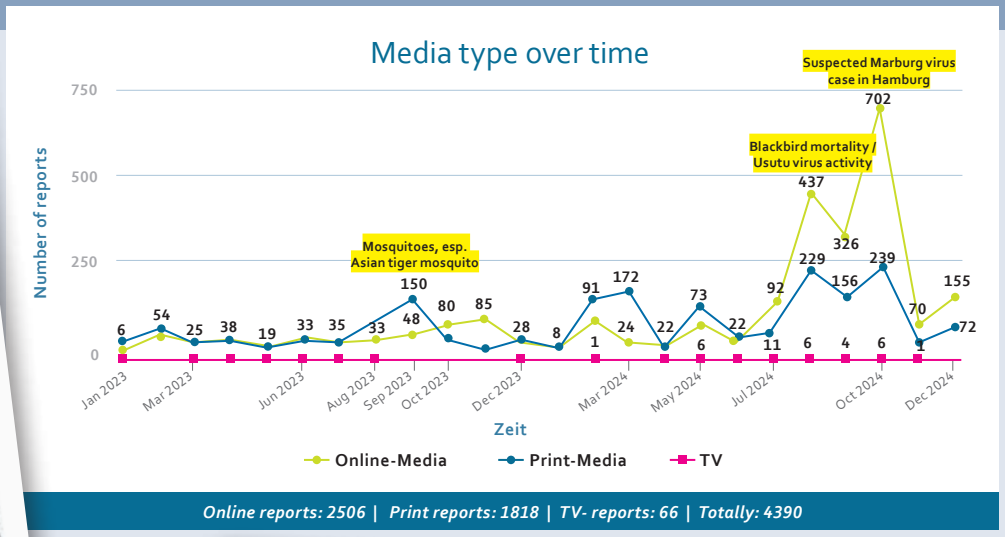
Aufwärts, immer aufwärts

Dr. Jörg Blessmann on snakebite envenoming in the *Frankfurter Allgemeine Zeitung*, 8 March 2023

Marburg-Virus-Sorge hält Hamburg in Atem

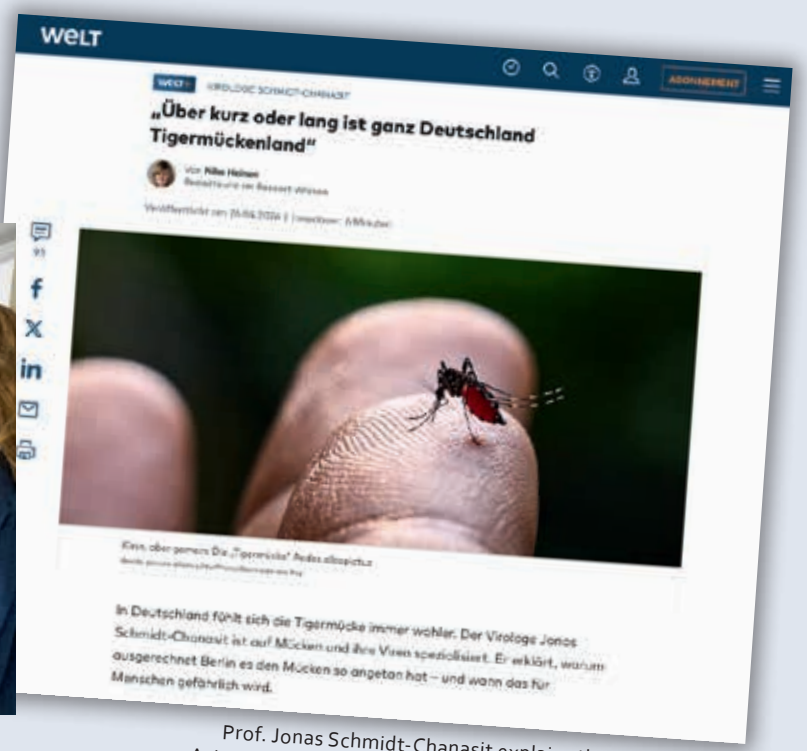
Ruanda-Rückkehrer klagte über Unwohlsein und Fieber / Untersuchung in Klinik bestätigte Verdacht aber nicht

East Frisian newspapers report on a suspected case of Marburg virus infection. Diagnostic testing by the BNITM gave the all-clear, 4 October 2024.



Online reports: 2506 | Print reports: 1818 | TV- reports: 66 | Totally: 4390

In October 2024, *Deutsche Welle* interviews Prof. Stephan Günther about the positive effects of tropical medicine, once shaped by colonialism, which are still evident in global health today.



WELT

„Über kurz oder lang ist ganz Deutschland Tigermückenland"

In Deutschland fühlt sich die Tigermücke immer wohler. Der Virologe Jonas Schmidt-Chanasit ist auf Mücken und ihre Viren spezialisiert. Er erklärt, warum ausgerechnet Berlin es den Mücken so angetan hat – und wann das für Menschen gefährlich wird.

Prof. Jonas Schmidt-Chanasit explains the spread of the Asian tiger mosquito in Germany in *Die Welt*, 26 April 2024.

2023

26 - 27 January 2023
Symposium of the Leibniz Center Infection (LCI) *"Compartments in Infection"*
Around 150 scientists discuss current findings on cellular survival niches of infectious pathogens at the BNITM. The interdisciplinary symposium combines expertise on viral, bacterial, and parasitic pathogens.

30 January 2023
World NTD Day: *"Snack & Talk"* at the Erika House of the University Medical Center Hamburg-Eppendorf (UKE)
Around 70 guests accepted the invitation to the first BNITM talk event on the occasion of World NTD Day (World Neglected Tropical Diseases Day) with a panel discussion, a poster competition, a quiz and film contributions.

Panel discussion on World NTD Day

15 February 2023
Wolfgang Stille Prize for Dr. Mirjam Groger
Recognised for her research on Lassa fever therapy: Dr. Groger shows that the drug Ribavirin does not have a relevant antiviral effect on the Lassa virus (see p. 45).


Dr. Mirjam Groger, Head of the Lab Group Groger

16 February 2023
Continuation of the CuliFo project
The interdisciplinary research project "Culiciden- (from *Culicidae*, Latin for mosquitoes) Forschung" (CuliFo) is launching its third round with a kick-off meeting in the historic lecture hall of the BNITM. CuliFo 3 investigates how different viruses in mosquitoes interact and how this affects their ability to transmit viruses to animals and humans. The German Federal Ministry of Food and Agriculture (BMEL) is funding the project with three million euros until 2026.

22 February 2023
DFG/ANR funding for Ebola research
The research group led by Dr. Sung-Joon Park has received 810,000 euros from the German Research Foundation (DFG) and the Agence Nationale de la Recherche (ANR) for an interdisciplinary project on medical anthropological Ebola research. The team is investigating the resurgence of Ebola in West and East Africa and the role social, cultural, and economic aspects played in the spread of the virus (see p. 98).


Dr. Sung-Joon Park, Head of the Medical Anthropology Research Group

20 March 2023
Rudolphi Medal for Dr. Joachim Matz
The Karl Asmund Rudolphi Medal of the German Society for Parasitology (DGP) goes to the BNITM for the second time in a row: Dr. Joachim Michael Matz is honoured for his "internationally acclaimed and groundbreaking research on experimental genetics of malaria pathogens".


Dr. Joachim Michael Matz, Head of the Junior Research Group Molecular Parasitology

23 - 24 March 2023

15th Malaria Meeting at BNITM

Over 100 international scientists exchange ideas on new approaches in malaria research: on drugs, vaccines, immunology, epidemiology and the vector mosquitoes. The aspect of translation continues to be a feature: the transfer of findings from basic research into application, including the topics of implementation and One Health.

Participants at the Malaria Meeting

28 March 2023

Spin-off of Panadea Diagnostics GmbH

(Former) employees have developed and patented a special technology for antibody detection. They are founding a start-up to market it. The BNITM board and Panadea Diagnostics GmbH have signed a corresponding license and cooperation agreement.

13 April 2023

Letter of intent for renovation and new construction signed

Sprinkenhof GmbH, the Science Authority, the Finance Authority and BNITM agree on a comprehensive modernisation of the institute building as well as a new building.

Press conference with Katharina Fegebank and Dr. Andreas Dressel, among others

17 April 2023

Passing of Prof. Christian G. Meyer

The BNITM mourns the loss of Prof. Christian G. Meyer, long-time scientist, textbook author and dedicated mentor of tropical medicine.

16 June 2023

DTG Prize for Dr. Johannes Mischlinger

For his work in improving the diagnosis and treatment of tropical infections, Dr. Mischlinger receives the award from the German Society for Tropical Medicine, Travel Medicine and Global Health (DTG).

Dr. Johannes Misschlinger, Head of the Lab Group Mischlinger

30 June 2023

Promotional prizes of the VdF

Dr. Wiebke Herr and Dr. Chris Hoffmann have been awarded the doctoral prize of the Association of the Friends of the Tropical Institute Hamburg e. V. (VdF). Dr. Herr investigated the effects of coinfections with malaria and parvovirus B19 on anaemia in children in Ghana and found that simultaneous infection does not lead to more severe disease progression. Dr. Hoffmann researched the viral dynamics of the Lassa virus in multimammate mice and demonstrated that the virus can cause lifelong infections, particularly in newborns. Both these works received 1,000 euros each and make significant contributions to the understanding of tropical infectious diseases.

Award ceremony for Dr. Wiebke Herr and Dr. Chris Hoffmann

01 July 2023

35 certificates in the diploma course in tropical medicine

After thirteen intensive weeks of training, 35 participants receive their diploma in the historic lecture hall of the BNITM.

01 July 2023

Ten years of the German Biosafety Programme

The BNITM, together with partners such as the Robert Koch Institute (RKI) and the *Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH*, looks back on a decade of international cooperation in healthcare.

Training within the framework of GIBACHT in the German Biosafety Programme

20 July 2023

Rainbow flag hoisted

A sign of diversity and acceptance: the Executive Board, Staff Council and Equal Opportunities Team are jointly making a visible statement.

The flags as a sign of support, inclusion and solidarity with LGBTIQ

08 August 2023

Mosquito monitoring started with the Institute for Hygiene and Environment (HU) Hamburg

BNITM and HU are installing mosquito traps at four strategic locations in the Port of Hamburg. Their catches are regularly tested to identify species and potential pathogens. The goal is to detect potential introductions of exotic mosquitoes, such as the Asian tiger mosquito, at an early stage and minimize health risks.

© Institut für Hygiene und Umwelt

Mosquito trap

25 August 2023

Prof. Dr. Marylyn Addo receives the Federal Cross of Merit

The physician and scientist is being honoured for her outstanding medical and scientific achievements in researching infectious diseases such as HIV, Ebola and COVID-19, as well as for her dedicated social commitment during the pandemic.

© BWFG

Prof. Marylyn Addo, on the right: Katharina Fegebank

12 September 2023

Information event *"Accomplices for the Future"* with the Hamburg Adult Education Centre

Close to 60 guests discuss with BNITM experts how climate change promotes the spread of infectious diseases.

Prof. Jonas Schmidt-Chanasit giving a lecture in the BNITM lecture hall

02 - 03 October 2023

BNITM at the Citizens' Festival in Hamburg

On German Unity Day, the BNITM presents itself in the science tent – with a glove box, mosquitoes under the microscope, and microbe plush toys. Even Science Senator Katharina Fegebank puts on three layers of lab gloves and uses a pipette.

Katharina Fegebank at the Glove Box

01 December 2023

WHO appoints another collaborating centre at BNITM

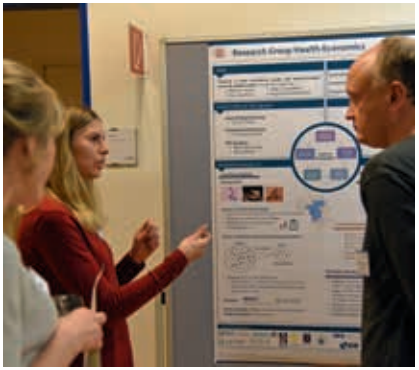
The BNITM Health Communication Working Group becomes the *WHO Collaborating Centre for Behavioural Science for Global Health* (WHO CC BRIGHT).

WHO CC BRIGHT team

04 - 05 December 2023

BNITM evaluation

In December, the BNITM undergoes its regular scientific evaluation by the Leibniz Association. The external reviewers were impressed by the institute, its development, and its research achievements.



Poster presentation at the evaluation

14 December 2023

7.4 million euros for vaccine research against Marburg viruses

The BNITM coordinates the European MARVAX consortium, which aims to develop novel vaccine candidates through to phase I trials. Participating institutions include the Pasteur Institute (France), the Spanish CNB-CSIC, and the company CZ Vaccines. The 7.4 million euros funding comes from the EU research program *Horizon Europe*.

Electron microscopic image of Marburg virus

2024

30 January 2024

World NTD Day

Around 50 guests receive understandable insights into research on the neglected tropical diseases snakebite envenoming, echinococcosis and leprosy in the BNITM lecture hall.

Speakers at the World NTD Day

31 January 2024

EMLab in the EU Civil Protection Pool

The BNITM's mobile laboratories (EMLab) are officially included in the European Union Civil Protection Pool (ECPP), allowing them to be deployed worldwide in the event of health crises.

© European Commission

EMLab visit to the European Commission in Brussels

01 - 02 February 2024

LCI Symposium on Long-Term Consequences of Infections

At the 13th LCI Symposium *"Long-term Consequences of Infections"*, over 120 participants discuss international research on post-COVID and long-term consequences of other infectious diseases.

06 February 2024

BNITM supports Nigeria in combating the current Lassa fever outbreak

A clinical and a laboratory team from the BNITM are deployed to the epicentre of the Lassa fever outbreak in Nigeria's Edo State to support the Irrua Specialist Teaching Hospital (ISTH) in its response. A new research study aims to provide important insights, especially for pregnant women affected by the disease.

Group photo of the international cross-institutional team from BNITM and ISTH

15 February 2024

The BNITM establishes the Centre for Computational Sciences

With a new centre, the BNITM strengthens digital infection research starting in 2025. Funding for the new special area of *"Computational Sciences"* is provided by the Leibniz Association.

Image created with Adobe Firefly

07 March 2024

Virology information event

More than 70 pupils and young students from the young researchers' network JuForum e. V. are learning about mobile laboratories, vaccine development and research on health communication in the lecture hall.

Participants in the information event

20 March 2024

Youth Future Day

Child-friendly insights into tropical medicine: close to 30 young people experience various interactive stations in the laboratory.

21 March 2024

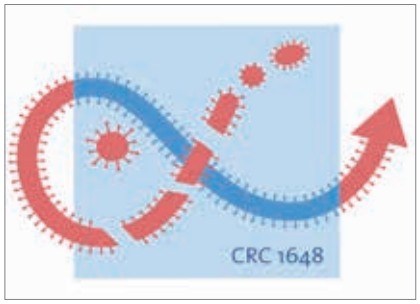
New Leibniz Lab Pandemic Preparedness

The new Leibniz Lab *"Pandemic Preparedness: One Health, One Future"* connects 41 institutes. The BNITM is part of this interdisciplinary alliance for pandemic preparedness.

31 May 2024

The BNITM participates in the start of SFB 1648

The German Research Foundation (DFG) has approved the Collaborative Research Centre *"Emerging Viruses: Pathogenesis, Structure, Immunity"*, with significant participation from the BNITM. Approximately 11 million euros are available until 2028.



01 June 2024

The BNITM at Science City Day

At the first Science City Day on the DESY site in Bahrenfeld, the BNITM shows laboratory-bred, non-viable mosquitoes such as the native *Culex pipiens* and the invasive Asian tiger mosquito under the microscope and provides information on BNITM research.

Visit to the BNITM stand

18 June 2024

DFG funding for AG Bruchhaus

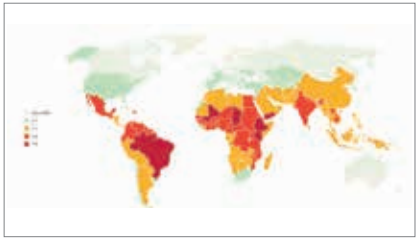
The German Research Foundation (DFG) has granted Prof. Iris Bruchhaus 450,000 euros to research the immune response in infections with *Entamoeba histolytica*.

Prof. Iris Bruchhaus, Head of the Host-Parasite Interaction Research Group

27 June 2024

Second NTD expertise presented

Around 90 guests discuss the new expertise on the German Research Contribution to Neglected Tropical Diseases (NTDs) in the Bundestag restaurant. The BNITM was once again responsible for coordination.



© DNTDs

Distribution of neglected tropical diseases in the world

28 June 2024

VdF doctoral awards

Dr. Kristina Meier and Dr. Michaela Raacke are being honoured by the Association of the Friends of the Tropical Institute Hamburg e. V. (VdF) for their work on virus structure and immune responses. Using cryo-electron microscopy, Meier was the first to elucidate the high-resolution structure of the multifunctional L protein of the Sin Nombre virus, a hantavirus, opening up new approaches for antiviral therapies. Raacke's research showed that the blood plasma of malaria patients increases the production of pro-inflammatory signalling substances in human brain endothelial cells, suggesting a possible mechanism for severe disease progression such as cerebral oedema.

© Kristina Meier © Michaela Raacke

Dr. Kristina Maier and Dr. Michela Raacke

28 June 2024

Diploma course in tropical medicine completed

After three and a half months of intensive training, 28 participants of the diploma course receive their final certificates.

Participants of the diploma course in tropical medicine

09 July 2024

Successful evaluation by the Leibniz Association

Top marks for the BNITM: external reviewers predominantly awarded grades ranging from "excellent" to "very good". According to the evaluation committee, the Institute is extremely successful in research, care, and teaching in the field of infectious and tropical medicine, with a focus on Africa.

01 August 2024

Internal IT department

We welcome our IT staff as a separate department at BNITM. Previously, IT staff worked at the Institute through an external service provider; now, IT is integrated into the BNITM as an independent organisational unit.

20 August 2024

World Mosquito Day and Blackbird Extinction

The BNITM and the German Nature and Biodiversity Conservation Union (NABU) are calling for support for bird monitoring in Germany. The reason for the recent bird deaths appears to be increased Usutu virus activity in Germany.

Submissions of blackbirds from one day to the BNITM

26 August 2024

Mpox deployment in East Africa

The BNITM supports the mobile laboratories of the East African Community (EAC) in combating Mpox in Tanzania (see p. 49).

EAC laboratory experts during a training in Arusha, Tanzania

01 Oktober 2024

Kick-off BNITM anniversary 2025

The jubilee year marking BNITM's 125th anniversary on October 1, 2025 is being launched: information events, a city hall exhibition, a Senate reception, and a concert at the Elbphilharmonie are being prepared for 2025. In addition, the BNITM, the German Society for Tropical Medicine, Travel Medicine and Global Health (DTG), and the Federation of European Societies of Tropical Medicine and International Health (FESTMIH) expect more than 1,000 guests to attend the 14th European Congress on Tropical Medicine and International Health (ECTMIH) from 29 September to 2 October 2025, in Hamburg.

02 - 08 October 2024

Delegation trip to Ghana

Science Senator Katharina Fegebank is traveling to Ghana with a Hamburg delegation, including the BNITM Chair, Prof. Jürgen May. A highlight is a visit to the Kumasi Centre for Collaborative Research in Tropical Medicine (KCCR), which is run in partnership with the BNITM (see p. 92).

© KCCR

Katharina Fegebank visits the KCCR

08 October 2024

Obituary for Prof. Dr. Thomas Löscher

The BNITM mourns the loss of tropical medicine specialist, university lecturer, physician and internationally renowned researcher Prof. Dr. Thomas Löscher.

21 October 2024

Appointment to the Ethics Council

Prof. Cornelia Betsch, head of the Health Communication working group at the BNITM, was appointed to the German Ethics Council.

© Marco Borggreve

Prof. Cornelia Betsch, Head of the Health Communication Research Group

23 October 2024

New junior research group at BNITM

The junior research group Ethnopharmacology and Zoopharmacognosy, led by Dr. Fabien Schultz, is researching new active ingredients from traditional remedies (see p. 78). They are also observing self-medication in animals.

© Fabien Schultz

Dr. Fabien Schultz, Head of the Junior Research Group Ethnopharmacology and Zoopharmacognosy

14 November 2024

Memento Prize for Prof. Dr. Michael Ramharter

The Memento Alliance honours Prof. Michael Ramharter for his commitment to combating the neglected tropical disease loiasis, caused by the African eyeworm *Loa loa*.

© Michael Ramharter

Prof. Michael Ramharter and his team after the award ceremony

03 December 2024

Success in the Leibniz Competition 2025

The Vector Control working group led by Dr. Renke Lühken has received 500,000 euros to research the mating behaviour of mosquitoes under climate change conditions.

Dr. Renke Lühken, Head of the Research Group Vector Control

13 December 2024

Centre for Climate Adaptation and Infectious Diseases

The BNITM is establishing a centre for research into climate-related health risks together with the Costa Rican research institute INCIENSA (see p. 74).

© INCIENSA | Alarso Cedeño

Team meeting at INCIENSA

19 December 2024

Research on gender and immune response

The German Research Foundation (DFG) is providing five million euros in funding for another four years to the research unit 5068 "*Sex Differences in Immunity*" of the BNITM and its partner institutions. The researchers hope to discover why women and men respond differently to infections.

RU 5068

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Global health is a crucial foundation for economic development, social justice, and peace. This understanding drives us forward.

Today, health risks are rising worldwide — due to emerging infectious diseases, climate change, and global mobility. Pathogens know no borders. For 125 years, the Bernhard Nocht Institute for Tropical Medicine (BNITM) has been at the forefront of global health research. As Germany's largest institution dedicated to tropical and emerging infectious diseases, our mission is more urgent than ever.

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To our donation page:

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THANKS!

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Working in the biosafety level 4 laboratory

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