BNITM
Bernhard Nocht Institute for Tropical Medicine

Research for Global Health

2025

Strategy of the Bernhard Nocht Institute for Tropical Medicine

www.bnitm.de

At the Port of Hamburg for over 100 years. – The BNITM is expanding its global health research.

Infections are a major cause of illness and death worldwide.
Particularly in countries of the Global South, they can lead to disability, stigmatisation and poverty. We strive to make a significant contribution to combating and controlling infections through our research. In order to achieve this goal, we hold the people as the focus of our research and regularly adapt our research strategy to new technological developments.

In this we apply a two-pronged approach, utilising the latest innovative technologies to investigate infections and immune responses in humans, while also maintaining a focus on the environmental and social conditions as important factors for global well-being.

TABLE OF CONTENTS

I. THREE STRATEGIC TOPICS

1. CONTROL GLOBAL AND LOCAL EPIDEMICS

Combating highly infectious pathogens in resource-poor regions

- Experimental research on haemorrhagic fever viruses in the high security laboratory
- Development of efficient vaccines against potentially outbreak-causing pathogens
- Development and application of highly specific and sensitive next-generation diagnostics
- Meaningful clinical studies even in outbreak situations
- Epidemiological analysis of infections and modelling of outbreaks
- Establishment of mobile laboratories for the fastest possible response to epidemics
- Development of digital surveillance technologies
- Training of staff to control infectious diseases

2. DECIPHER STRUCTURES AND INTERACTIONS OF PATHOGENS

Integrative techniques for the investigation of pathogens and infections

- Systems biology of pathogens with state-of-the-art technology at the Centre for Structural Systems Biology (CSSB)
- Definition of pathogen structures at highest resolution
- Modeling of molecular structures in living pathogens
- Functional investigations of pathogens using modern molecular genetics methods
- Systematic analysis of the interaction of pathogens and host cells
- Experimental investigation of mosquitoes and other carriers of disease (vectors)
- System genetics of pathogen, host and vector

3. COMBAT POVERTY-RELATED AND NEGLECTED DISEASES

Innovative disease control with interdisciplinary approaches

- **Scientific investigation and optimisation of disease control programmes**
- **Development of robust diagnostics for use under resource-poor conditions**
- **Infection epidemiology in neglected and remote regions**
- **Integrative epidemiology including all influencing factors (One Health)**
- **Testing of new drugs directed against tropical diseases in controlled clinical trials**
- **Development of innovative tools to combat diseases**
- **Mapping and investigation of disease vectors in endemic countries**
- **Analysis of the international spread of drug resistance**
- **Innovative training in tropical medicine**

II. EIGHT GOALS FOR TROPICAL MEDICINE RESEARCH OF THE FUTURE

Working in a high-security laboratory – Research with highly pathogenic pathogens enables better outbreak control.

How do pathogens work?

1. Explore pathogens

Systems, cell and structural biology with state-of-the-art technology

In **basic research** on tropical pathogens, the BNITM pursues a **holistic research approach.** The focus is on both the pathogens themselves and their interactions with the host organism at the atomic, molecular, cellular and systemic level. The rapidly developing biochemical and bioinformatic methods open up new and promising avenues. Simultaneous investigations of a multitude of individual elements are now possible (genome, transcriptome, proteome, metabolome analyses), including their computational merging and modulation **(systems biology)**, as well as experimental testing (e.g. by altering the pathogen genome). The infection process can be elucidated in its entirety, thus covering the entire spectrum from the investigation of minute molecular structures to innovative clinical research.

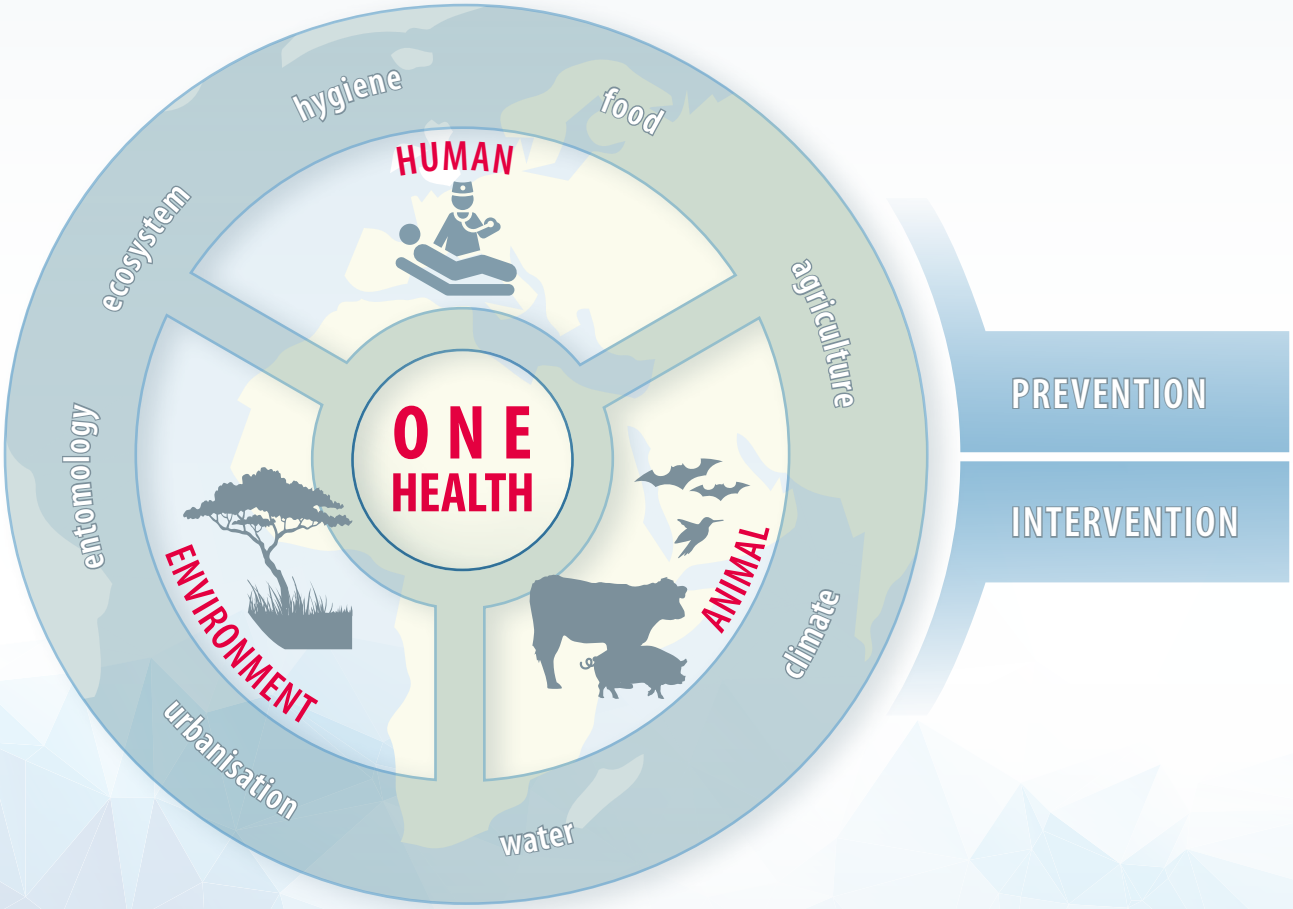
The BNITM will continue to strengthen the research capacity of its internationally recognized research groups, which necessarily focus on special topics, and set up additional systems-oriented teams. These research efforts target the use of innovative approaches to combat tropical diseases. Unique infrastructures allow experimentation with pathogens of the highest safety level, to establish suitable animal models for highly dangerous diseases, to breed carrier mosquitoes and to conduct infection experiments. On this basis, the BNITM can carry out innovative basic research at the highest level.

The BNITM's expansion into the Centre for Structural Systems Biology (CSSB) on the DESY campus provides access to the world's best imaging techniques. They enable previously unimaginable research projects to be carried out to elucidate details from the individual molecular structures of the pathogens, up to the complex molecular interactions between host and pathogen.

Close cooperation with partner institutions in endemic areas allows the investigation of well characterized clinical samples. This creates the prerequisites not only for conducting studies in the laboratory and in animal experiments, but also for testing their relevance under clinical conditions. The close interaction between the research units in the institute will contribute to gaining fundamental insights into the basics of the infection process. This will allow a deeper understanding of diseases in order to open up new ways of disease prevention and control.

Holistic view as a sustainable approach

An advanced 'One Health' approach uses diverse data sources to analyse the conditions of infectious diseases and health in resource-poor regions.



How and why do infections occur?

2. Understand infections

Analyzing and modelling infections with tropical pathogens

Epidemiological and **infection immunological research** at the BNITM is already making a decisive contribution to understanding and combating infectious diseases that occur worldwide. The BNITM develops, maintains and applies special statistical and immunological methods for the analysis of data from resource-poor regions. The long-standing **entomological research** on carrier mosquitoes at the Institute is represented by a dedicated working group with a W2 professorship and a high-security insectarium. Here, researchers work on the mechanisms by which mosquitoes transmit pathogens such as the Dengue or Zika viruses.

The aim is to gain a more detailed understanding of factors influencing tropical infections. In one aspect, this includes the conditions of pathogen transmission, in particular by mosquitoes. However, a second focus is on human risk factors, in particular genetics and epigenetics as well as social determinants including nutrition and behaviour. In addition, the BNITM is investigating the reaction of the immune system to the invading pathogen. The aim of this interdisciplinary approach is to collect and holistically analyse all important environmental data on infection risks in tropical countries under realistic conditions.

In order to meet the current challenges of tropical medicine, the BNITM offers a broad, state-of-the-art spectrum of methods. This includes the latest techniques in immunology (in the host and vector) and vector competence analysis as well as the digitised collection and evaluation of data - from modern modelling techniques to the handling of high-dimensional data (big data) and the analysis of high-resolution satellite data. This enables a precise investigation of infection dynamics, in particular of transmission pathways and the spread of antimicrobial drug resistance (AMR), especially in resource-poor regions.

In the future, the BNITM will further intensify its work efforts for the population groups most severely affected by infectious diseases. For this purpose, detailed risk analyses will be carried out with the help of powerful mobile laboratories in remote and neglected parts of certain countries. The Institute carries out these studies in close, trustful partnership with institutions in the respective regions.

Examination of a study patient in Gabon – Modern techniques in clinical studies bring new knowledge about tropical diseases.

How do infected people get sick?

3. Explain diseases

Investigate processes in the body with modern techniques

For many infections with tropical pathogens it is not known why they often progress without symptoms and only in certain cases lead to illness - sometimes with severe consequences. So far, the underlying **mechanisms of pathophysiology** are poorly understood. It is therefore especially important for the BNITM to better understand the **development of diseases** after the pathogens have penetrated the body. To this end, the BNITM examines the i**nteraction of pathogens and infected people,** through methods of clinical infectiology, immunology and cellular and molecular biology.

In the future, the processes in the infected body will be analysed at different levels under conditions that are as realistic as possible. Immune reactions will be investigated using the latest techniques in humans or, if necessary, in experimental models. Infection-induced disturbances of the processes in a cell, a cell group or an organ are recorded using current methods of molecular and cell biology as well as clinical examination procedures.

The goal is to understand excessive and abnormal immune reactions and severe disturbances of cell physiology that ultimately lead to organ failure and death. This knowledge will enable the development of strategies to interrupt pathophysiological cascades with blockades and thus prevent death.

The disease mechanisms of tropical infections should be better understood at all levels - cell, tissue, organ, organism - in order to derive and test possible therapeutic interventions. In the long term, interventions that turn out to be effective in models will also be tested on humans.

High-performance diagnostics in a miniature format – Field-compatible tests open up new possibilities for on-site pathogen research.

Who is infected with which pathogen?

4. Detect diseases

Highly-specific and sensitive next-generation diagnostics

Reliable diagnosis of infections is a prerequisite for high-quality clinical and epidemiological studies and plays a key role in combating and eliminating poverty-related and neglected diseases. The BNITM offers an extraordinarily broad range of diagnostics for **tropical infections** that is unique in Germany. As the **National Reference Centre** for Tropical Infectious Agents and WHO (World Health Organisation) Collaborating Centre (WHO CC) for Arbovirus and Hemorrhagic Fever Reference and Research, the Institute will continue to focus on the development of improved diagnostics. In addition, the BNITM will continue to provide ISO-accredited, high-quality tests for direct and indirect pathogen detection.

Our goal is to further expand the importance of the BNITM as an internationally sought-after reference centre for the diagnosis of pathogens relevant to tropical medicine and also those that are newly emerging. To this end, additional reference activities will be established at the BNITM, such as a WHO Collaborating Centre for Malaria Reference and Research. In addition, the Institute plans to develop field-ready rapid tests for tropical diseases in order to improve diagnostics and research in the affected countries. New diagnostics for infectious diseases, in particular point-of-care tests for resource-poor regions, are to be evaluated in clinical studies.

At the same time, the BNITM will establish new round robin tests, some of which will be digital, in order to further improve the internal and external quality control of diagnostic laboratories for tropical pathogens.

Especially in the recent past, epidemics have shown that diagnostic tests for new pathogens must be available in the shortest possible time. The BNITM therefore plans to create a modular system that will enable the development of new diagnostics for several pathogens at the same time in the future. In addition, in close cooperation between clinical research, epidemiology and diagnostics, a comprehensive biobank with very well-characterised reference samples will be created.

International workshop at the BNITM – Interdisciplinary collaborations are the basis for future implementation research.

How can control measures be applied most effectively?

5. Improve control

Innovative measures and implementation research with interdisciplinary approaches

For many tropical infectious diseases there are already **vaccines, medicines or other ways of combating** them. Nevertheless, these measures often do not reach the affected people and the number of infections is not reduced as much as expected. Why such measures often fail under real conditions is due to complex causes, some of which are not understood and the underlying factors of which are often unclear. This question is addressed by a relatively new discipline, **implementation research,** which is seen by the World Health Organization (WHO) as the key to the development and implementation of effective control strategies.

At the BNITM, implementation research will therefore be developed as a forward-looking, new branch of research. Scientific methods will be used to investigate how infectious diseases in resource-poor areas can be effectively combated with established or newly developed interventions. In this way, the BNITM aims to make a relevant contribution to eliminating poverty-related diseases.

In implementation research, studies will be carried out to optimise infection control at the level of exposed or diseased people, but also of host animal reservoirs and vectors (e.g. mosquitoes). Taking into account the traditions and cultures of the respective region, the measures are to be integrated as far as possible into existing health systems in order to achieve greater acceptance.

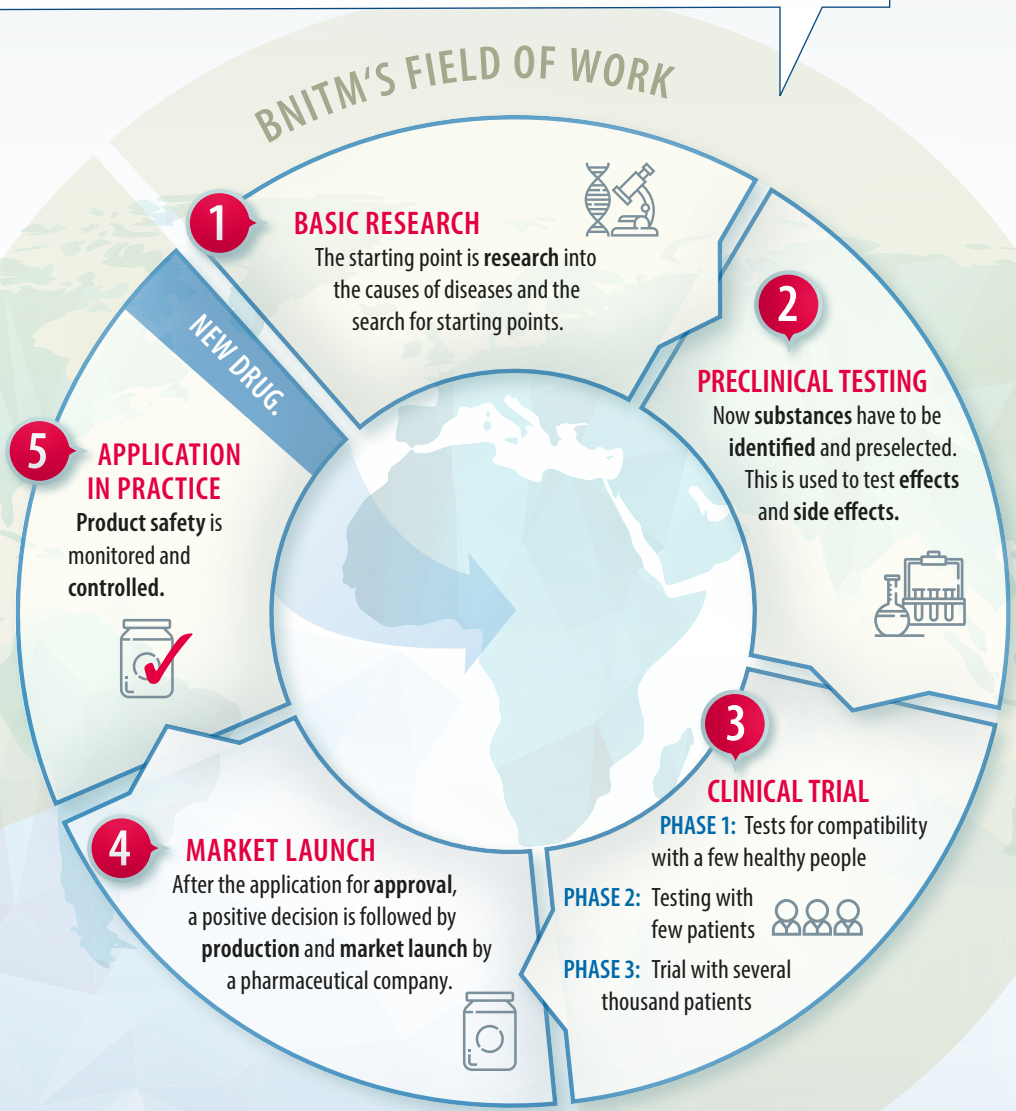
The aim is to develop innovative infection surveillance methods that work even in resource-poor areas and form the basis for effective control programmes. Mobile laboratories and local infrastructures are to be set up which, even in the case of epidemics, enable diagnostics and research in remote regions.

For implementation research, long-term partnerships with institutions in key regions, as well as networks for joint research and the transfer of technology and knowledge are essential. Equally crucial is the deepening of existing cooperation with WHO and other international organisations and institutes that play a role in global outbreak control.

The goal of the BNITM is, together with partners in Germany, to establish an internationally visible research location for implementation research, from which pioneering initiatives for the control and elimination of tropical diseases can emanate.

The development of drugs and vaccines

The BNITM is intensively involved in various phases of drug development - from basic research to investigating how drugs are optimally used.



Which medicines and vaccines work best?

6. Develop medically active substances

Controlled testing of new drugs and vaccines for tropical diseases

Novel interventions and medically active agents are urgently needed to combat and control epidemics and neglected diseases. The aim is therefore to expand **clinical research** and the necessary infrastructure at the BNITM and African partner institutions. To this end, a corresponding **study centre** will be established as a **platform.** Here, clinical research and studies with national and international partners will be carried out according to the highest quality standards. In this context, the BNITM plans to prioritise the expansion of **research activities in the tropics.** The scientific focus in this area will be on drug development and research on prevention of malaria and neglected tropical diseases. In addition, there will be a clinical research focus on tropical viral diseases. International research collaborations in the field of tropical and travel medicine will be intensified.

Travel medicine is becoming increasingly important against a background of increasing international travel, especially to tropical countries. Our goal is to establish the BNITM as a leading centre for the clinical development of evidence-based travel medicine interventions (vaccines, drugs, preventive measures). A professorship for travel medicine will therefore be established to further develop the profile.

Simulation of scenarios with 3D technology – Innovative training is a key for future research collaboration.

How can the conditions for research in the tropics be established?

7. Create capacities

Modern training with innovative techniques

The BNITM regards **interdisciplinary education,** the development of junior staff and further training of students, scientists, doctors and other **medical specialists** in the field of clinical tropical medicine as a central concern. The BNITM's long-standing strengths include the close interconnectedness between science, teaching and health care in the institute, the experience gained in capacity-building programmes in the countries of the global South and an established partner network in these countries. Sound **training of local staff** in research and health care in low-income countries is a prerequisite for successful and sustainable improvement of health care and research structures.

In this context, the BNITM has set itself the goal of expanding its leading position in the field of capacity building in clinical tropical medicine and infection research. To this end, existing international training programmes on biosafety, infection diagnostics and epidemiology will be expanded, including the tried and tested BNITM computer learning platform. All teaching content and lecture recordings will be made available online on the BNITM computer learning platform and thus form an element of the online teaching materials. In addition, the BNITM is establishing new PhD and fellowship programmes to facilitate access to tropical medicine education and training for students and scientists from partner countries and to improve their academic prospects. Existing courses in medical training will be adapted to modern requirements and oriented even more internationally.

Medical advice at the BNITM – Tropical diseases are treated on the basis of the latest research results.

How can patients be treated optimally?

8. Improve patient care

Best possible medical care in tropical and travel medicine

With increasing global mobility and internationalization, the demand for **health care** in tropical and travel medicine will continue to rise. The BNITM therefore intends to further expand its recognized **clinical expertise** in these areas. This will be achieved, in part, through close cooperation with the Tropical Medicine Section of the University Hospital Hamburg-Eppendorf (UKE) in the fields of **patient management** and **management of highly infectious diseases.** The BNITM is also planning to expand its consultancy service, which provides advice to physicians in the field of clinical tropical medicine, nationwide. In addition, relevant special outpatient clinics are to be set up within the field.

The further development of travel and migration medicine is a major focus of the BNITMs clinical orientation. In order to keep the care of patients in tropical and travel medicine excellent and up to date, close cooperation between the clinic and clinical research at the BNITM will remain a central focus. A Clinical Reference Centre for diagnostics, therapy and management of imported diseases will be founded. The already close cooperation with the UKE will be further strengthened in order to develop Hamburg into a focal point for the comprehensive clinical care of patients with tropical diseases.

III. OUR GUIDELINES

1. Researching excellently

One of the main tasks of the BNITM is to conduct qualified research in the field of tropical medicine. This is to be supported by scientific events, teaching, training and further education as well as advice and care in the fields of infectious and tropical medicine.

To this end, we pursue an integrative approach and see cooperation as a central building block for our research success. In addition, we rely on continuous internal and external quality control and regularly adapt our research focuses and methods.

Ongoing optimisation of our infrastructure, systems, processes and quality is of course important to us. To this end, we make bureaucratic processes as lean and flexible as possible.

2. Sharing and applying knowledge

Our scientific data and results are public, transparent and accessible free of charge. From our point of view, this offers an opportunity to make the most of their potential. In addition, we are in contact with industry in order to make the best possible use of the knowledge we generate and to transfer it into useful applications.

We also report on our research in a generally understandable manner, participate in public discussions and open our house to all sections of the population with various events. We regard our long history and high profile as both an opportunity and an obligation.

3. Support employees and students

In order to achieve our ambitious goals, we need outstanding and motivated employees. For this reason, we give every employee the opportunity to fully exploit their own potential through specific further training and individualised support services, and by ensuring relevant framework conditions. We prepare our students and young scientists in the best possible way for their future careers. To this end, we reflect on and optimise our understanding of leadership.

Especially employees with families often face special challenges in science in order to balance career and family. This makes it all the more important for us at BNITM to provide the best possible individual solutions. We are convinced that science and society benefit from diversity and are committed to the goals of equality, diversity and internationalisation.

4. Setting ethical standards

Our research shall exclusively serve humane and peaceful purposes. We therefore protect ourselves against the misuse of our research. We also fully respect the rights of countries and patients to their biological resources. We avoid or minimise any negative effects of our research on people, society and the environment. With our work we are committed to the UN Sustainable Development Goals.

5. Achieving goals together

Our goal is clear: We want to conduct relevant and excellent research. To achieve this, we rely on a trustworthy and reliable partnership with national and international research institutions and organisations. We focus our cooperation on sustainable success for the benefit of all parties involved.

We are committed to a strong regional research environment and recruit excellent scientists through competitive processes. In addition, we create additional infrastructures and sharpen the profiles of Hamburg as a location for science.

We rely on a global alumni network consisting of former BNITM employees and participants of BNITM training events. In this way, we facilitate cooperation and increase the visibility of the BNITM.

Collegial cooperation at the BNITM contributes significantly to our success. We promote this by valuing in-house collaborations, creating opportunities for regular scientific exchange and developing goals together with our employees. We advocate a sustainable organisational structure solution that will ensure that the BNITM will continue to be maintained as a unit at one location.

Strategy in flux

We conduct research in a rapidly changing world. Population development, climate change and technological progress have a significant and lasting impact on our work. Regular adjustments to our research strategy are therefore essential if we are to continue to pursue our goals successfully.

Global health is a crucial basis for economic development, social justice and peace. This knowledge spurs us on.

BNITM
Bernhard Nocht Institute for Tropical Medicine

Bernhard Nocht Institute for Tropical Medicine

Bernhard-Nocht-Straße 74
20359 Hamburg
Germany

Tel.: +49 (0) 40/42818-0
Fax: +49 (0) 40/42818-265

E-Mail: bni@bnitm.de
URL: www.bnitm.de

Twitter: @bnitm_de

EDITOR
Bernhard Nocht Institute for Tropical Medicine
Bernhard-Nocht-Straße 74
20359 Hamburg
Germany

RESPONSIBLE AUTHORS
Egbert Tannich, Jürgen May, Stephan Günther, Birgit Müller

IMAGE PROCESSING AND LAYOUT
gemeinsam werben, Hamburg

IMAGE CREDITS
The photographs and graphics were provided by employees of the BNITM and the agency „gemeinsam werben, Hamburg".

Leibniz Gemeinschaft
Bundesministerium für Gesundheit
Hamburg | Behörde für Wissenschaft, Forschung und Gleichstellung