



## Averting biological dangers

A man buys castor beans on the internet and manufactures ricin. Then he orders materials for a cluster bomb. When a special commando unit arrests him in Cologne in summer 2018, RKI's task force is already standing by. Wearing protective suits, they comb through the flat with a team of the Federal Criminal Police Office (Bundeskriminalamt), collect samples and take them to Berlin for analysis.

Castor beans

and tularaemia, the smallpox and Ebola viruses, the bacterial poison, botulinum toxin, and also the plant poison, ricin. If a bioterrorist attack is suspected, RKI experts support the security services. The institute is the central office in Germany for the detection, assessment and management of biological threats. The scientists collect information on highly-pathogenic agents and toxins, develop recommendations for protective measures, and provide training for emergency forces. With a whole range of diagnostic methods, they are able to identify pathogens quickly and reliably in an emergency and thus also avoid false alarms.

RKI does not only focus on attacks. After all, all pathogens that can be used for attacks occur in nature and can also cause spontaneous outbreaks. The scientists therefore investigate diseases such as anthrax, botulism or Ebola in order to understand them even better.

Highly-pathogenic viruses such as Ebola are studied in the institute's high-security laboratory, or BSL-4 laboratory, for short. The lab is hermetically sealed off from the rest of the building, and staff working there wear full protective suits with their own air supply, which are decontaminated for several minutes in a special shower after work.



Fotolia, M. Schuppich

*RKI supports health authorities, police and fire brigade in bioterrorist threat situations or disease incidents caused by highly-pathogenic agents.*

"Dirty Dozen" – that is the name of the group of pathogens and toxins that, at least theoretically, could be used in terrorist attacks. Anthrax bacteria are among them, the pathogens of plague



RKI's BSL-4 laboratory

## Identifying health trends and prevention approaches

How much do people weigh in this country? How does the social status influence well-being, what about the mental health of children and adults – in short, how are people in Germany doing? RKI provides answers to these questions: the nationwide health monitoring and the federal health reporting are hallmarks of the institute. RKI epidemiologists conduct their own population-wide studies of children and adults and analyse health trends and risks. With their results, they provide policymakers and other stakeholders with an important basis for decisions, for example on preventive measures or the targeted expansion of medical care.

*RKI is data-driven. With the institute's research data management, health trends can be recorded and evaluated even better.*

People in Germany are getting older and older – as a result, however, chronic illnesses such as cardiovascular diseases, cancer and diabetes mellitus are increasing. For example, almost half a million people develop a malignant tumour every year, and almost seven million adults have diabetes. More than one in seven people over 18 meet the criteria for depression in the course of their lives, and one in six children have mental health issues. In addition, the pandemic has added a new, complex clinical picture in the form of Long COVID. And the health consequences of the climate crisis are only just beginning to become visible.

Researchers at RKI have all this in mind. They calculate the burden of disease in the population, research risk factors such as poverty and identify gaps in knowledge and care – with the aim of improving health for all people and creating conditions for healthy ageing.



Pixabay, Daniel Punks

The publications on health reporting are based on numerous data sources. For example, an RKI Health Panel is currently being created, for which in future around 100,000 people throughout Germany will be regularly surveyed on their state of health and related aspects – such as whether they smoke, practise sports or have recently been at the doctor's office. The results and other key health indicators will then be made available on a digital platform which will be updated regularly.

## The Robert Koch Institute

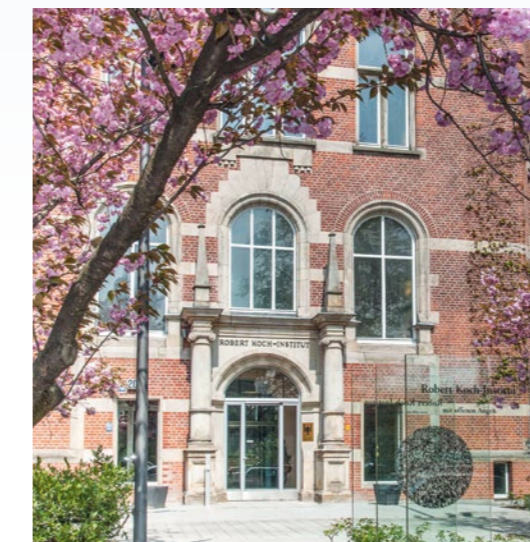
- 1891** The "Royal Prussian Institute for Infectious Diseases" is founded, with Robert Koch as director. He heads the institute until 1904
- 1905** Robert Koch receives the Nobel Prize for Medicine for his discovery of the tuberculosis pathogen in 1882
- 1933** During the Third Reich, the institute is considerably involved in the National Socialist politics of violence
- 1952** RKI becomes part of the new Federal Health Office
- 1982** Following the first AIDS cases in Germany, an AIDS case registry is set up at RKI
- 1994** The Federal Health Office is dissolved. RKI is given a second major topic: non-communicable diseases
- 2001** The new Protection against Infection Act (IfSG) strengthens the tasks of RKI
- 2003** Start of the longitudinal study on child and adolescent health KiGGS
- 2008** The Bundestag resolves to develop the institute into a modern Public Health Institute
- 2014** In West Africa, RKI helps to contain the largest ever Ebola outbreak
- 2015** A new laboratory building with a BSL-4 laboratory is opened at the Seestraße site
- 2019** RKI gets a Centre for International Health Protection
- 2020** RKI provides regular situation reports and recommendations in the context of the COVID-19 pandemic
- 2021** A Centre for Artificial Intelligence in Public Health Research is established at RKI

The Robert Koch Institute (RKI) focuses on the health of the population (public health). The institute is the Federal Government's central institution in the field of biomedicine: its core tasks include detecting, preventing and combating infectious diseases and improving the health situation in Germany. The focus is on research; about half of the approximately 1,500 employees conduct research. The RKI advises the specialist public and policymakers and is an important interface to international actors such as the European Centre for Disease Prevention and Control (ECDC), the World Health Organisation (WHO) and national public health institutes in other countries. It is also very active in the qualification of researchers and has a wide range of training and education opportunities.

[www.rki.de/en](http://www.rki.de/en)

[www.rki.de/socialmedia](#)

Nordufer site, Berlin



Robert Koch Institute 2023

THE INSTITUTE FOR PUBLIC HEALTH

The Robert Koch Institute

ROBERT KOCH-INSTITUT

## Fighting infectious diseases

It started in winter 2019. In Wuhan, China, people fell ill with pneumonia – caused by a new type of coronavirus. Even before SARS-CoV-2 began to spread across the globe, infectious disease epidemiologists and virologists at RKI were keeping an

*The prevention of and protection against diseases is a task for society as a whole – and can only succeed if all work together.*

eye on the situation. Since the beginning of January 2020, they published risk assessments, recommendations on how to deal with those infected and on measures that were able to at least slow down the spread of SARS-CoV-2. They assessed the disease burden and severity, and later the benefits of COVID-19 vaccination, and detected new variants. The RKI data help to map the course of the COVID-19 pandemic in Germany

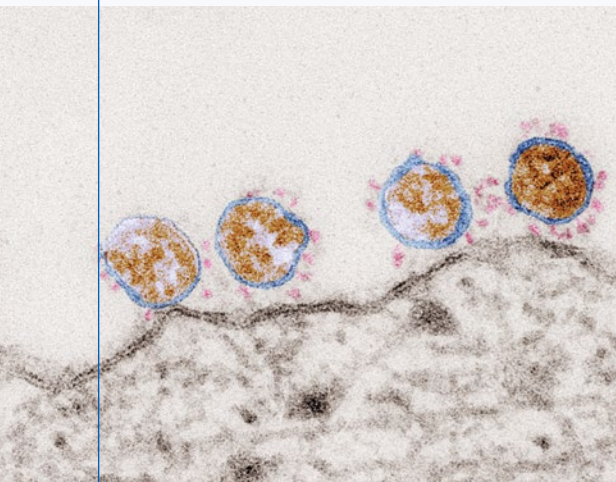


Electron microscopy

and to be able to respond in an adapted manner to the respective situation.

It is not only in times of pandemics that continuous and comprehensive infection monitoring – also known as surveillance – is essential to quickly identify disease outbreaks and trends. Data on notifiable diseases such as influenza, HIV infections, measles, tuberculosis, TBE or HUS (EHEC) from all over Germany are pooled and evaluated at RKI. The institute is home to national reference centres and consultant laboratories which specialise in various pathogens. The scientists investigate how bacteria, viruses, fungi, parasites or prions are transmitted – how they can be diagnosed, characterised and rendered harmless – and, if necessary, support outbreak control on site.

RKI researchers also monitor the development of vaccination rates in Germany. Analyses of the various vaccinations help the Standing Committee on Vaccination (STIKO), an independent expert commission, to adapt its vaccination recommendations.



SARS-CoV-2

## Analysing and networking data

Traffic movements, flows of goods, climate and geo information: In the digital age, masses of data accumulate every day, which, when analysed intelligently, can help to identify health risks even faster and more precisely. Scientists at RKI want to tap into this treasure trove of data – with the support of digital epidemiology. Artificial intelligence, machine learning, Big Data and systems analysis, bioinformatics, computer simulations and modern data visualisation are some of the methods for tomorrow's health protection.

A separate group of complex data emerges from genome analyses: nowadays, modern sequencers decipher the entire genome of a pathogen in no time – often several hundred thousand building blocks of DNA. Using special computer algorithms, bioinformaticians, together with microbiologists, can filter out the crucial information, such as how SARS-CoV-2 is changing, or which strain of bacteria is behind an outbreak and whether it is resistant to antibiotics.

*Artificial intelligence opens up new paths in public health research.*

With these methods and the use of new data sources, even the dynamics of epidemics can be better predicted. Air network data reveal the routes along which infectious diseases like influenza spread across the globe – and at what speed. At the local level, the same is true for commuter



The global flight network

movements on buses and trains. Scientists can also link several data sources, for instance mobility data and information from social networks with pathogen genome data, in order to evaluate trends even better.

At the same time, the institute's own research data management ensures that the diverse research data are well structured and connected so that they can also be used by researchers worldwide in the long term.

## Focus on global health protection

Be it emerging respiratory pathogens like SARS-CoV-2, multi-resistant bacteria or highly-pathogenic viruses like Ebola: it has never been easier for pathogens to spread than in today's mobile, interconnected world. In order to identify and address health hazards in good time, an efficient public health care system is indispensable. The Robert Koch Institute cooperates with partners



WHO Director General Tedros Ghebreyesus at RKI, 2021

around the world to strengthen local systems and thus improve the health of everyone.

*As an international hub of health protection, RKI works closely with WHO, ECDC and public health institutes in other countries.*

RKI staff help contain disease outbreaks – including the worst ever Ebola epidemic in 2014/2015 in West Africa with more than 39,000 people infected, and the 2017 plague outbreak in Madagascar. Especially during the COVID-19 pandemic,

RKI has been a sought-after partner for public health actors worldwide and has supported crisis response in more than 70 countries – sometimes with strategic advice, sometimes with training for health workers, sometimes with the expansion of laboratories. The institute also has an international focus on non-communicable diseases – obesity and cancer pose major challenges to populations



Training in Namibia

worldwide, as do the health consequences of the climate crisis.

In its role as the German point of contact for global health protection, RKI is also an important cooperation partner of the World Health Organization (WHO) and regional institutes, including the European Centre for Disease Prevention and Control (ECDC) and the Africa Centres for Disease Control and Prevention (Africa CDC). Furthermore, RKI is a founding partner of the "WHO Hub for Pandemic and Epidemic Intelligence", which was launched in Berlin in 2021.

## Avoiding hospital-acquired infections and antibiotic resistance

In Germany, an estimated 400,000 to 600,000 patients contract hospital infections every year – mostly wound infections after operations, urinary tract infections or pneumonia. About 10,000 to 20,000 of them die.

Some of these infections could be prevented by consistently adhering to hygiene measures, for



Traces of bacteria on a hand

example by better hand hygiene in all contacts with patients. The RKI-based Commission for Hospital Hygiene and Infection Prevention (KRINKO) draws up recommendations on the basis of studies, which represent the state of medical knowledge. A list of disinfectants and disinfection procedures used for officially prescribed measures is also compiled at the institute.

Some infections can only be treated with difficulty, in some cases not at all: pathogens such as Klebsiellae or certain E. coli bacteria are in-

creasingly unresponsive to common antibiotics. The experts at RKI examine resistant bacteria and collect nationwide data on how their resistance spectrum is changing – and how many antibiotics are used in Germany's hospitals: improper use of the medicinal products promotes the development of resistance.

The ways in which pathogens spread can be traced in their DNA. It has long been known that antibiotic-resistant bacteria are not only passed from person to person, but also between hospitals and nursing homes, for instance. Antibiotic-resistant bacteria, for example Methicillin-resistant Staphylococcus aureus (MRSA), also occur in animals such as pigs and fattening poultry. RKI therefore advocates the One Health approach: human, animal and environmental health are closely connected – the challenge of antibiotic resistance can only be met if all work together.

