

ROBERT KOCH INSTITUT



THE INSTITUTE FOR THE HEALTH OF THE NATION

The Robert Koch Institute

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Fighting infectious diseases

The virus strikes in winter, usually at the very start of the New Year. It surges through Germany, year after year, sweeping along millions of people in its wake: the flu (influenza). In order to recognise

'From viruses in body cells to obesity in the population – RKI investigates disease on all levels.'

Professor Dr Lothar H. Wieler, President of RKI

and contain outbreaks quickly, nationwide surveillance is essential. The influenza experts at the Robert Koch Institute have been monitoring the course of flu epidemics for years: they prepare weekly situation reports for Germany, investigate which flu viruses are in circulation and check the efficacy of the flu vaccine. Their data and that of other selected laboratories around the world help the World Health Organisation (WHO) to put together the best possible flu vaccines for the coming season.



RKI keeps an eye on other infectious diseases as well. The institute hosts National Reference Centres and Consultant Laboratories specialising in various pathogens. Scientists investigate how viruses, bacteria, fungi, prions and parasites are transmitted and how they can be diagnosed and combatted. Data on notifiable diseases like HIV, tuberculosis, tick-borne encephalitis and salmonellosis from the whole of the country are recorded and evaluated at the institute. Bioinformatics and modelling also play a central role in infection research: by analysing data streams, it is possible to predict the dynamics of epidemics and to trace the spread of antibiotic-resistant bacteria.

RKI continually evaluates the efficacy of vaccinations such as those against rotavirus and human papilloma virus (HPV). These studies help the German Standing Committee on Vaccination (STIKO), an independent expert commission, to update its vaccination recommendations on an annual basis. RKI scientists also monitor vaccination coverage in Germany where young people, in particular, are often insufficiently protected against measles, for example, so the disease breaks out time and again – in Berlin in 2014/2015, more than 1,300 people caught measles.



Influenza viruses

Containing outbreaks

Whether we consider the SARS epidemic in Asia in 2003, the EHEC outbreak in northern Germany in 2011, or the flu pandemic (so-called swine flu) of 2009, whenever an infection breaks out anywhere in the world, RKI scientists analyse the real risk to Germany. They advise the federal states on the measures they should take and share information with international partners like the European Centre for Disease Prevention and Control (ECDC) and WHO.

‘International engagement benefits health in Germany, as well.’

Professor Dr Lothar H. Wieler, President of RKI

The measures that can be taken in the case of a flu pandemic, for instance, are contained in the German Influenza Pandemic Preparedness Plan which RKI drew up in collaboration with the national and federal governments. On top of this, there are general infection alarm plans that prescribe fundamental procedure – irrespective of the pathogen. During the Ebola outbreak in West Africa in 2014/2015, RKI collaborated with many experts to draw up a strategy for Ebola virus disease in the event that individual cases should be imported into Germany. Amongst other things, the strategy describes how a patient suspected of having contracted Ebola should be isolated and how doctors can protect themselves against infection. To some extent, Ebola diagnosis has to be conducted in a high-security laboratory; a laboratory of this kind will soon be operating at RKI.



EHEC bacteria

RKI also provides support in cases of local outbreak investigations and helps to identify the source of the infection. During the EHEC outbreak in northern Germany in 2011, which cost 53 lives, the pathogen was discovered in fenugreek shoots. At international level, as well, RKI's expertise is increasingly in demand: during the Ebola epidemic in West Africa, RKI staff helped to contain the disease locally.

Tracking down new pathogens

The animal kingdom is a veritable breeding ground for pathogens. Every year during the last few decades, a new zoonotic pathogen has emerged which, in the opinion of the World Health Organisation, could pose a threat to humans – including novel flu viruses and the MERS coronavirus. Africa's tropical forests are a high-risk area: RKI scientists regularly spend time there searching for previously unknown bacteria and viruses amongst animals.



Examining a bat in Africa

The major Ebola outbreak in West Africa in 2014/2015 was in all probability caused by an infected bat: RKI researchers discovered that a child in Guinea had become infected whilst playing with the creature. More than 11,000 people died of Ebola virus disease in West Africa. The AIDS

pathogen HIV also originated in the animal kingdom: the virus was probably transmitted from apes to humans in the early 20th century. Today, HIV is one of the most frequent causes of death by infection. Since it was discovered in the early 1980s, research on the HI virus has been ongoing at RKI: experts observe, for instance, whether the viruses are becoming resistant to drugs and search for ways of permanently banishing HIV from the body.



Ebola viruses

Prions – wrongly folded proteins that can cause brain diseases – are another focus of RKI scientists' activities. The most famous example is the cattle disease BSE which in humans leads to the fatal variant Creutzfeldt-Jakob disease. Prion-like proteins may also play a role in neurodegenerative diseases such as Alzheimer's and Parkinson's. RKI has therefore developed sterilisation techniques which prevent the transfer of prions by surgical instruments.

'RKI is an international hub of health protection.'

Professor Dr Lothar H. Wieler, President of RKI

Avoiding hospital-acquired infections and antibiotic resistance

Every year in Germany, some 400,000 to 600,000 patients are thought to catch infections whilst in hospital – usually surgical site infections after operations, urinary tract infections and pneumonia. Approximately 10,000 to 15,000 of them die.

More stringent hygienic measures, such as improved hand hygiene in all patient contacts, could avoid some of these infections. The RKI-based Commission for Hospital Hygiene and Infection

by conventional antibiotics. RKI experts study these bacteria and collect nationwide data on where the resistant pathogens occur, how their spectrum of resistance mutates, and how many antibiotics are used in Germany's hospitals: improper use of these drugs promotes the development of resistance.

The ways in which the pathogens spread can be traced in their genome. It has long been known that antibiotic-resistant bacteria are not only passed from person to person but also between hospitals and old people's homes or by travellers. Methicillin-resistant *Staphylococcus aureus* (MRSA) is an example of antibiotic-resistant bacteria that also occur in animals such as pigs and fattening poultry. RKI therefore advocates a one health approach: human, animal and environmental health are closely connected – the problem of antimicrobial resistance can only be solved if everybody works together.



Traces of bacteria on a hand

Prevention (KRINKO) draws up recommendations deriving from studies which present the most up-to-date medical knowledge. The institute also prepares a list of disinfectants and disinfection methods that are used for officially prescribed measures.

Some infections are very difficult to treat: ever more frequently, pathogens like *Klebsiella* or certain *E. coli* bacteria are proving to be unaffected



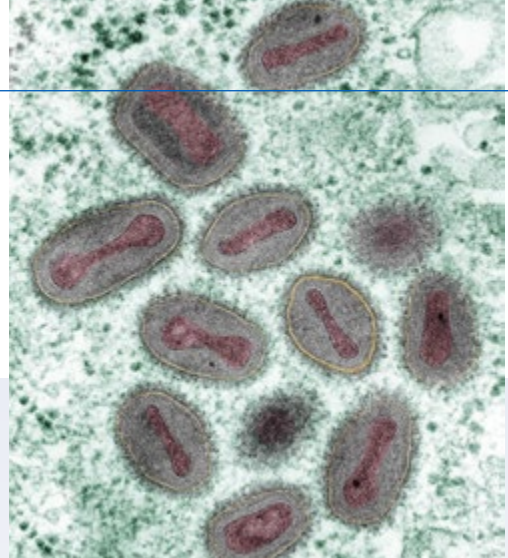
Averting the dangers of bioterror

The term “dirty dozen” refers to a group of pathogens and poisons that, at least in theory, could be used for terrorist attacks. They include anthrax bacteria, the plague and tularaemia, smallpox and Ebola viruses, the bacterial poison, botulinum toxin, and the plant poison, ricin.

‘It is the responsibility of public health protection to be prepared for events involving highly-pathogenic agents.’

PD Dr Lars Schaade, Vice President of RKI

The Centre for Biological Threats and Special Pathogens at RKI is the German centre for the detection, assessment and handling of high-risk situations caused by bioterrorism. Scientists collate information on highly-pathogenic agents and toxins, assess the potential risks and prepare recommendations for protective measures as well as offering courses for doctors and emergency personnel. Employing a whole raft of diag-



Smallpox viruses

nostic methods, RKI experts are able to identify pathogens quickly and reliably – and thus also avoid false alarms.

RKI does not, however, only focus on bioterrorism, because all pathogens that can be used for terrorist attacks occur in nature and can trigger spontaneous outbreaks. Scientists therefore investigate diseases like smallpox, anthrax or botulism in order to understand them better.

In the last few years, there have been a number of outbreaks of cowpox in Germany, for example. Whilst it is much less dangerous than human smallpox, the disease can also become very serious. With their sensitive methods of analysis, virologists at RKI were soon able to throw light on events: the victims had been infected by their fancy rats.



Decontamination during preparedness exercises



Identifying health trends and preventive measures

What do children in this country weigh? How does social status influence well-being? What is the state of adult psychological health – in short, how are people in Germany doing? RKI has the answers: nationwide federal health reporting and health monitoring are signature activities at the institute. RKI epidemiologists study health trends and risks. Their findings help form the basis for decision-making by government and other actors on issues like preventative measures and the targeted development of healthcare.

'We record and evaluate the really important health trends.'

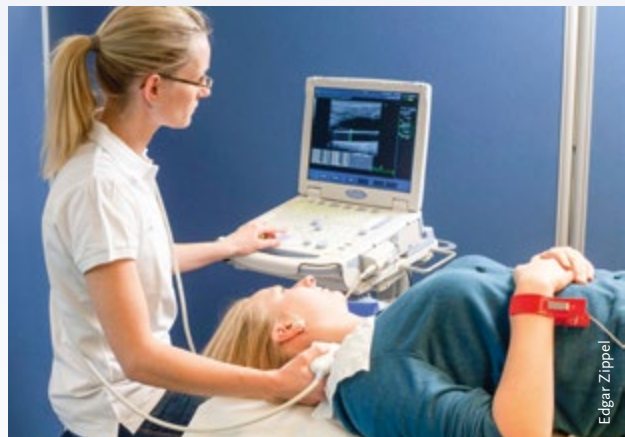
Professor Dr Lothar H. Wieler, President of RKI

Most people in Germany are in good health or very good health and it is pleasing to note that they reach an even greater age. The result of this, however, is that chronic illnesses like cardiovascular diseases, cancer and diabetes mellitus are on the increase. Scientists want to elucidate the risk factors relating to these diseases and thus create the preconditions for healthy ageing.

Currently, almost half a million people per year are diagnosed with a malignant tumour. RKI's Centre for Cancer Registry Data bundles the data from the whole of Germany, puts together an overall picture and identifies developments that urgently need to be investigated. Moreover, at

RKI, National Diabetes Surveillance is being drawn up to map the burden of the disease and the care quality experienced by some six million diabetics in Germany.

The publications of federal health reporting are largely based on the data from RKI's own health monitoring. For the major health surveys KiGGS (German Health Interview and Examination Survey for Children and Adolescents) and DEGS



Examination during RKI health monitoring

(German Health Interview and Examination Survey for Adults), many thousands of participants are surveyed and examined. During the GEDA study (German Health Update), which is conducted at shorter intervals, more than 20,000 adults are surveyed by telephone and online.

The history of the institute at a glance

- 1891** ○ Founding of the “Königlich Preußisches Institut für Infektionskrankheiten” (Royal Prussian Institute for Infectious Diseases) with Robert Koch as director. He heads the institute until 1904
- 1905** ○ Robert Koch receives the Nobel Prize in Medicine for his discovery of the tuberculosis pathogen in 1882
- 1952** ○ The Robert Koch Institute becomes part of the newly-established Federal Health Office



- 1994** ○ After the dissolution of the Federal Health Office, RKI becomes a higher federal authority
- 1998** ○ Following evaluation by the German Council of Science and Humanities, the institute undergoes major reorganisation and sharpens its thematic profile
- 2008** ○ The Bundestag resolves to develop the institute into a modern public health institute (“RKI 2010”)
- 2016** ○ RKI celebrates its 125th birthday

The Robert Koch Institute

The Robert Koch Institute (RKI) monitors public health. It is the Federal Government’s central institution in the field of biomedicine: its core mission includes the detection, prevention and combatting of infectious diseases as well as the improvement of the health situation in Germany. The focus is on research: some 450 of about 1,100 members of staff are scientists. RKI advises the specialist public and government and functions as an important interface in relations with international actors, such as the European Centre for Disease Prevention and Control (ECDC) and the World Health Organisation (WHO). It is also very active in training scientists and has a broadly-based portfolio of educational opportunities.

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