

Solutions to Global One Health Challenges



netherlands
centre for
one health



NCOH Partners

The Netherlands Centre for One Health (NCOH) unites top-leading academic research institutes in the Netherlands in an open innovation network with a focus on One Health: public, veterinary, wildlife, and ecosystem health. It aims for an integrated approach to face the global risk of infectious diseases and to develop durable solutions regarding major societal health challenges. This virtual and science-driven institution focuses on research and the increase of knowledge on antibiotic resistance, emerging infectious diseases, smart farming, and healthy ecosystems. NCOH stimulates collaboration between academic and research institutes, governments, NGOs, public health institutes, and industrial partners. Below are the NCOH Partners:



Associate Partner



One Health

“Epidemics have occurred throughout history. Virtually all the infectious diseases we’ve experienced in the past made the leap from animals to humans at some point, just like our current coronavirus disease 2019 (COVID-19) pandemic. The difference in today’s world is that an epidemic can develop into a pandemic in a matter of weeks, due to global trade and travel and because many people live in large, densely-populated cities.”

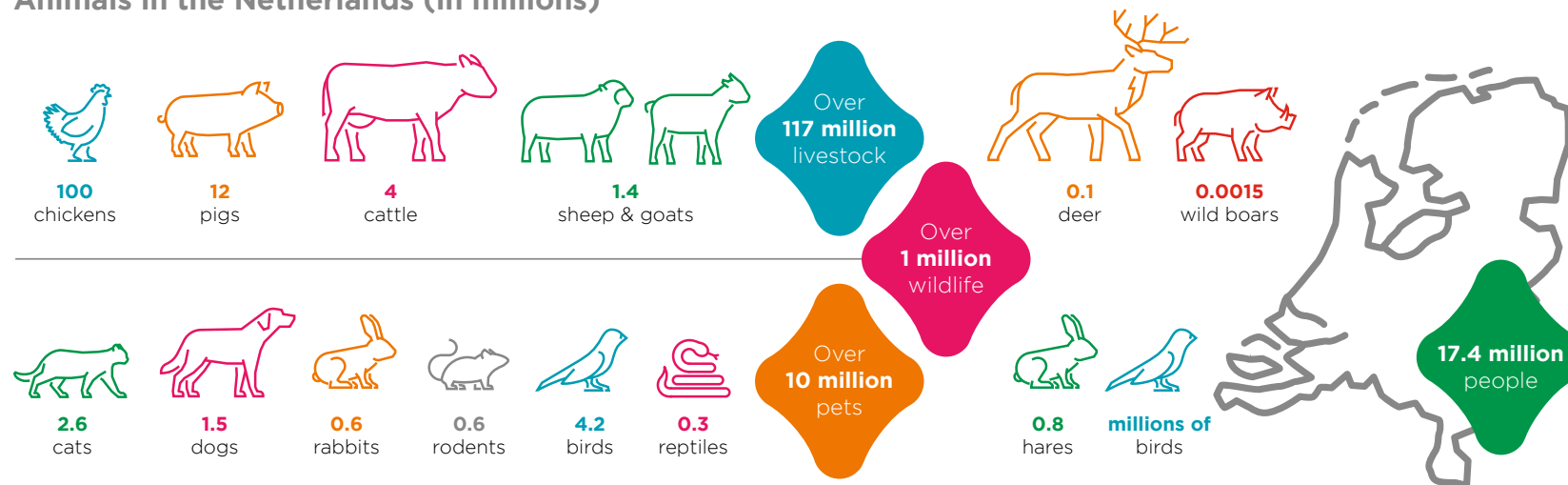
“We live in a world where ecosystems and interaction between humans and animals have become dysfunctional. A world in which a local incident can have global consequences. We saw this in 2007-2008 with the Q fever outbreak, which started in the Netherlands. New risks will continue to emerge and established risks will evolve, catalyzed by changes in our climate, ecosystems and biodiversity.

A changing climate affects us, and our environment, in a variety of ways. Flora and fauna are adjusting, finding new opportunities, and expanding their habitat. Mosquitoes from the Mediterranean are moving north, bringing with them various vector-borne diseases such as dengue and West Nile fever. Ticks hitch rides on migratory birds and are able to survive the mild winters in the Netherlands, bringing with them tick-borne encephalitis.



Dick Heederik
chair NCOH Executive Board

Animals in the Netherlands (in millions)



One Health

Communal thinking needs to move away from the strict compartmentalisation of people, animals, and the environment. An integrated approach to health, One Health, is the only way for humans, animals, and our environment to thrive.

Clinicians, epidemiologists, and modellers collaborate to model if an outbreak is heading towards a peak, is stabilising, or declining. Relying on the expertise of virologists and bacteriologists who tediously study exactly how a particular virus or bacteria is transmitted and how long the incubation period is. Entomologists know all about the life cycle of insects such as mosquitoes and ticks. Ecologists study nature, including fauna, flora and other organisms, with a focus on how these organisms interact with one another and the environment. Yet, further collaboration with other fields is needed for a true One Health approach. For example, during the first wave of COVID-19 behavioural scientists and psychologists were essential in identifying ways to reduce reproduction rate (R).

Controlling outbreaks, we are still too often left playing catch-up. When an infectious disease emerges, or an old one re-emerges, we head to the lab to grow cultures, study its characteristics, and find the right parameters to build models. All this takes (a lot of) time. With cutting-edge technologies we can monitor and detect changes that emerge in the metagenome or virome at an early stage. These technologies put it within our reach to take action and develop a vaccine before a pathogen can cause large-spread havoc. This is still in its infancy, but this approach holds a lot of promise for the future, and it is a key area of focus for NCOH.

The National Institute for Public Health and the Environment (RIVM) coordinates the expertise on infectious diseases and takes charge of outbreak response. The RIVM draws on the expertise of universities, research centers, and medical centers associated with NCOH.

The past decades, we have had most viruses and bacteria under control for a long time. In fact, as early as in 1967, a now infamous quote was made by the United States Surgeon General, Dr. William H. Stewart (1965-1969), "It is time to close the book on infectious diseases, and declare the war against pestilence won." This belief has been disproved many times ever since. Yet, this belief is stubborn and infectious diseases have been somewhat overlooked. The COVID-19 pandemic has made it clear how important the work of NCOH is. NCOH brings the best research together under the One Health umbrella. So far, we have secured funding for over 65 young researchers, which will enable us to develop cross-disciplinary, sustainable solutions for human, animal, and environmental health."

“ *We need to move away from the strict compartmentalisation of people, animals, and the environment. NCOH's integrated One Health approach is the only way for us to tackle or prevent pandemics.* **”**



Dick Heederik
chair NCOH Executive Board

Creating impact

The global population is growing rapidly and is heavily concentrated in major cities. There has also been significant growth in international trade and travel, which means infectious diseases and contaminated products can move around the world at lightning speed. The implications of this are now evident, with COVID-19 posing huge challenges to humanity.

We have already seen cross-border outbreaks of many other diseases, such as bird flu, SARS (severe acute respiratory syndrome), ebola, MERS (Middle East respiratory syndrome-coronavirus), and zika. Those experiences have taught us that infectious disease outbreaks affects almost every aspect of our lives and surroundings.

The spread of infectious diseases is not restricted to any one species. They pose a threat to the health of animals, ecosystems, and humans. Infections can jump from one species to another or from one environment to another. That is why we need an integrated 'One Health' approach, where our perspective includes not just human health but also the health of animals and the environment (soil, water, air, climate). The research we carry out must be based on an integrated and cross-disciplined approach. It is the only way we will be able to find sustainable solutions to infectious diseases.

The focus of NCOH is on (re-)emerging infectious diseases, epidemics, and antimicrobial resistance,

including veterinary and environmental challenges. For example, virologists work with veterinarians on the rapid detection of potential pathogens in wild animals and livestock. Researchers unravel the genetic makeup of viruses to determine the risks and to develop vaccines.

NCOH aims to identify research gaps and to explore them from the One Health perspective. We do this at both the scientific and political level. The objective of NCOH is to find sustainable solutions for global One Health challenges.

NCOH and its researchers accomplish this through:



Creating impact

1. Research

We initiate several new doctoral One Health research projects every year. The projects fit into our NCOH PhD Research Programme and are thematically clustered into Research Topics. Current research topics are:

- Complex systems & Metagenomics
- Disease intervention strategies
- Vector-borne diseases



2. Knowledge exchange

We host a One Health platform to enable discussion and knowledge exchange and to accelerate research. We share expertise with co-workers around the world. We facilitate data exchange between researchers and research groups, and we train future scientists. The Young NCOH network enables PhD students and post-docs to share their knowledge and expertise among early career researchers.



3. Visibility

We share the One Health message nationally and internationally through our website (ncoh.nl), newsletters, social media, and by organising scientific (online) meetings, workshops, and conferences.



Strategic Research Themes

The four NCOH strategic research themes are complementary and interactive. They focus on studying the interactions and connections between human, animal, and environmental health in pursuit of durable solutions to major societal challenges requiring a One Health approach.

1. Tackling Antimicrobial Resistance: NCOH-AMR

NCOH-AMR aims to decrease the morbidity and mortality of antibiotic-resistant bacterial infections in humans through use-inspired, excellent, fundamental, translational, and applied One Health research on antimicrobial resistance.

2. Emerging Infectious Diseases Preparedness: NCOH-EID

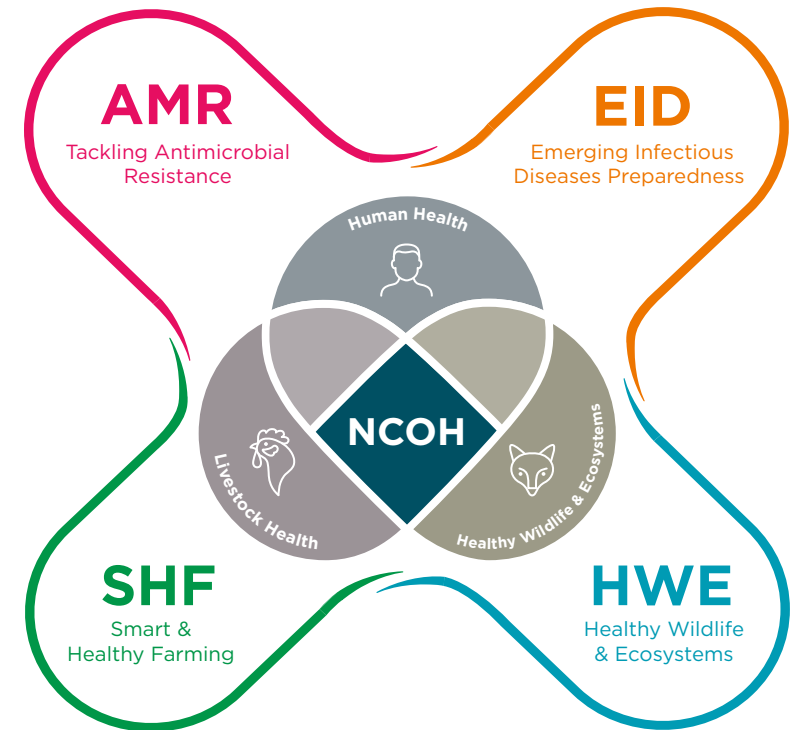
NCOH-EID aims to improve research and veterinary and public health preparedness for (re-) emerging infectious diseases. It will do so by providing fundamental insights into host, microbial, and environmental factors leading to disease. Moreover, to translate this into improved prediction, detection, prevention, and control strategies in a time frame that is compatible with fast-spreading Emerging Infectious Diseases (EID).

3. Smart & Healthy Farming: NCOH-SHF

NCOH-SHF aims to improve animal health and reduce or eliminate human health risks arising from livestock and food production through user-inspired, fundamental, translational, and applied research, contributing to more robust animals, early signaling of health-disease status of the animal (animal signals of disturbance of health) with new biomarkers, and smart and healthy farming practices.

4. Healthy Wildlife & Ecosystems: NCOH-HWE

NCOH-HWE aims to decrease the detrimental effects of wildlife-related disease on human health, livestock production systems, and ecosystems through understanding, anticipation, and (potential) prevention of environmental factors driving spread of wildlife diseases using an integrated, multidisciplinary approach.



PhD Research Programme

A group of related NCOH PhD research projects on a One Health topic are initiated annually, embedded within the **NCOH Strategic Research Agenda**. Many projects involve several NCOH Strategic Research Themes, and collaboration is key to ensure a multidisciplinary and holistic approach. The PhD research projects are thematically clustered into three overarching Research Topics:

Complex systems & Metagenomics

This topic studies the complex interaction between people, animals, and the environment by studying microbiomes and genomes and by looking into the consequences of these interactions for the (re-)emergence of infectious diseases. For example, this can be done by looking at the transmission of microbial strains, pieces of genetic information, or how evolutionary pressures results in the development of antimicrobial resistance. A notable feature of this topic is that it does not just focus on a specific element of the pathogen. It is about analysing the metagenome in order to understand the microbiome as a whole, including the fungi and viruses that exist at the interfaces between humans, animals, and the environment.

Disease intervention strategies

A team of microbiologists, immunologists, chemists, and clinical microbiologists work together to develop a better understanding of the interactions between pathogens and hosts. They aim to develop innovative therapies for (re-)emerging diseases.

Vector-borne diseases

This topic aims to understand how changes in climate, farming practices, water management, and travel may lead to vector-borne disease outbreaks in the Netherlands. With a dense population of humans and livestock, international transport and travel hubs, and a water-dominated landscape, the Netherlands is thought to be particularly vulnerable to vector-borne infectious disease outbreaks.

Investments

NCOH brings together Dutch academic research institutes active in various complementary fields of One Health research with other leading parties. NCOH collaborates with organisations in both the private and public sectors, particularly Dutch universities, university medical centers, the Dutch Research Council (NWO), the Royal Netherlands Academy of Arts and Sciences (KNAW), and the Dutch National Institute for Public Health and the Environment (RIVM). Furthermore, NCOH provides strategic and organisational embedding for the Netherlands Antibiotic Development Platform (NADP), which fosters public-private collaborations in the development of new antibiotics and alternatives.

In the broader European context, NCOH's Partners are also part of the One Health European Joint Programme (EJP) through Wageningen Bioveterinary Research and RIVM. This brings nutritionists, doctors, veterinarians, and environmental scientists together to work on zoonotic diseases and antimicrobial resistance.

Partner Contribution for NCOH PhD research programme

NCOH's Partners signed a Consortium Agreement, jointly committing to €11 million in the first 5 years for novel interdisciplinary PhD projects

Top Sector Life Sciences & Health – NCOH One Health projects

€1.9 million through public-private partnerships

One Health EJP

5 million from European funds

One Health PACT

€10 million through NWO as part of the Dutch Research Agenda (NWA)

Regio Deal Foodvalley

€14.6 million through the provinces of Utrecht and Gelderland, Waterschap Vallei en Veluwe, VNO-NCW Midden, and the agricultural organisation LTO Noord

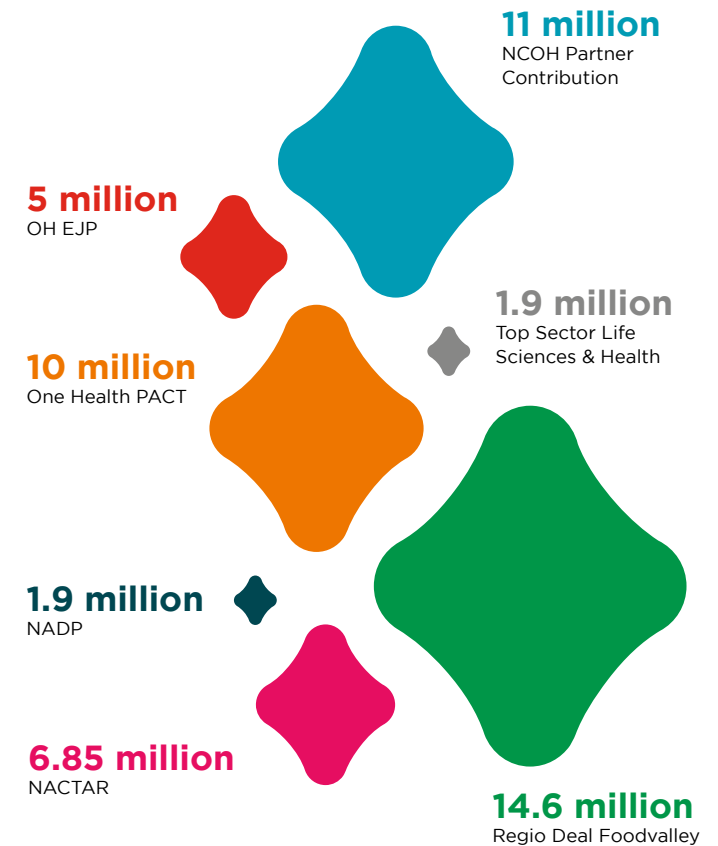
NADP

€1.9 million through the Ministry of Health, Welfare and Sport

NADP-NACTAR programme (Novel Antibacterial Compounds and Therapies Antagonizing Resistance)

€6.85 million from the Ministry of Health, Welfare and Sport, NWO's Applied and Engineering Sciences Domain, and Holland Chemistry

Investments (in €)



Teaching & training

One Health issues cannot be solved by any one discipline on its own. Interdisciplinary collaboration is essential if we are to create new, innovative, and sustainable solutions.

By working at NCOH's various partner organisations, our PhD students build lifelong networks, learn from each other to approach issues from different angles, and jointly work to build a sustainable solution.

Summer schools

NCOH organises summer schools linked to the PhD programme and to the One Health European Joint Programme every summer. Summer schools are an important part of NCOH. These schools help train the next generation of scientists, providing them with skills and expertise that can help them devise solutions to the infectious diseases that threaten the health of people, animals, and the environment around the world. The topics explored include zoonotic diseases, emerging infectious diseases, resilience, and vectorborne diseases.

Young NCOH

Young NCOH is a network that brings together early career researchers (PhD students and post-docs) from all the NCOH partner organisations. The network enables

participants to share knowledge and expertise in One Health. This can foster new insights and research collaborations. They also organise events, company visits, and the annual Young NCOH day.

Conferences

NCOH organizes various events, including an Annual Scientific Meeting, an Annual Science Café, and monthly webinars. During these events NCOH affiliated scientists present the progress of their work, topical news items are discussed, and these events provide excellent networking opportunities for all participants benefitting further One Health collaboration.



Stories

“The recent COVID-19 crisis has shown quite dramatically the vulnerability of our society. Intensive stock breeding and globalisation of transport and tourism have led to increased risks of exchange and distribution of exotic species, germs, and viruses. After previous outbreaks related to ebola, Q-fever, and bird flu virus, the COVID-19 crisis has shown that pandemic explosions are not a rare exception but a real and continuous threat. Scientific research plays an important role into understanding and controlling future pandemics. The aim of NCOH is to obtain new scientific insights, facilitate interdisciplinary research, and connect important research institutes. Since pandemic outbreaks are not just a health issue but also have an effect on our economy and social interactions between people, the impact of NCOH's One Health approach extends far beyond health care.”

Prof. Stan Gielen
President NWO Executive Board



Prof. Nico van Meeteren
Executive Director and
Secretary General, Health-Holland
(Top Sector Life Sciences & Health)



“In light of the present corona crisis one may ask - no, should ask - not only oneself but also everybody around and involved “What if we had invested more, earlier and more robustly in a community, rapidly grown excellent, as the NCOH?” Let's consider to agree: this particular “What if ...?” in this very specific respect is really the last time that we spelled it out. The world owes it, all living creatures owe it, we owe it to ourselves. And what is more: based on its past performance and ambitions, NCOH for sure has the potential to help us eliminate this question.”

“At Deltares, we need to understand and forecast the impacts of our worldwide work on human health. What are the risks and spread of diseases through delta systems and how can human health be improved by interventions in urban, rural, and marine ecosystems? Collaboration with NCOH is a natural and complementary match. Deltares gains access to a group of knowledgeable partners in the health sector, whilst offering our expertise on water and subsurface systems. Together, we support capacity building, innovative applied research, and knowledge sharing to address challenges caused by pressures from increasing population and climate change.”

Eline Boelee, PhD
Water, Environment &
Health at Deltares



Showcases

AMR



**Tackling
Antimicrobial
Resistance**

EID



**Emerging
Infectious Diseases
preparedness**

SHF



**Smart & Healthy
Farming**

HWE



**Healthy Wildlife
& Ecosystems**

How and why resistance emerges

**Bacteria with resistance to antibiotics pose a threat to human health.
If we better understand how resistance emerges, we may be able to prevent it.**

When people are hospitalised, it is standard practice to ask if they have been anywhere near livestock farms. Resistant bacteria in hospitals, such as the notorious methicillin-resistant *Staphylococcus aureus* (MRSA), can be traced back to livestock. But new insights into how resistance emerges indicate that this may not always be the case. Resistance can also be transmitted from person to person. The culprits are enzymes known as extended-spectrum beta-lactamases (ESBLs).

ESBLAT - ESBL-Attribution Analysis

Duration	2013 - 2017
Participants	Wageningen University & Research, Utrecht University, RIVM, UMC Utrecht, Animal Health Service
Funded by	Top Sector 1H4F (One Health for Food)
Further details	www.1health4food.nl

“*ESBL is an enzyme produced by certain bacteria that ensures that those bacteria are able to develop resistance to some antibiotics. About 5% of the Dutch population carries ESBL-producing bacteria in the gut. That percentage is noticeably larger among livestock farmers and abattoir workers. Their ESBLs are comparable to those found in livestock itself, rather than to other people. That's because of the intensive, direct contact between livestock farmers and their animals. Researchers on the ESBLAT study found significant similarities between the ESBLs of healthy carriers and people with an infection caused by the bacteria. But these ESBLs were different to the ESBLs in livestock farmers. That means the transmission of resistant bacteria occurs mostly from one person to another, and that contact with livestock plays less of a role than we had previously thought.*”

Marc Bonten, Scientific Director NCOH-AMR



Fighting bacteria with a natural enemy

When people and animals become infected with resistant bacteria, there is often little that doctors can do. New antibiotics are needed, along with effective alternatives to antibiotics. That is what the Netherlands Antibiotic Development Platform (NADP) is working towards.

Between 1940 and 1962 around 20 new families of antibiotics were discovered, and very few families have been added since then. Bacteria are becoming increasingly resistant to greater numbers of these antibiotics, so our stock of effective treatments is at risk of depletion. Antimicrobial resistance is already resulting into the deaths of thousands of people around the world every year. A worst-case scenario would be an outbreak by a superbug. This term refers to a bacterium that has become resistant to antibiotics commonly used to treat it, such as methicillin-resistant *Staphylococcus aureus* (MRSA) or any multidrug-resistant bacterium.

NADP - Netherlands Antibiotic Development Platform

Duration	2017 - 2022
Participants	NCOH Partners, Centre for Antimicrobial Research (CARES), Center for Sustainable Antimicrobials (CeSAM)
Funded by	Ministry of Health, Welfare and Sport
Further details	www.nadp.nl 🐦 @NADP_AMR

“Universities are focusing on fundamental research in order to discover and characterise new antibiotics and alternative leads. The NADP then facilitates the collaboration between public and private organisations to further enhance the development of new therapies. Its focus is on human and animal health, both in terms of prevention and treatment. One area of research, for example, is looking at the potential application of bacteriophages, which are viruses that attack bacteria and could therefore be used to combat bacterial infections. In theory, bacteriophages are a good alternative for combating resistant bacteria, but at present there's insufficient evidence that this actually works in clinical practice. That's why we need to carry out more research, so we can find out what the added value of bacteriophages would be, and how we can safely use them.”

Marc Bonten, Scientific Director NCOH-AMR

AMR
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Antimicrobial
Resistance

EID
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Farming

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& Ecosystems

Climate change exacerbates virus risk

The Netherlands, with its dense population of humans and livestock, international transport and travel hubs, and water-dominated landscape is particularly vulnerable to infectious disease outbreaks. We aim to understand if and how changes in climate, farming, water management and travel lead to mosquito-borne disease outbreaks, to be better prepared.

Developments in the human, animal or environment domains can trigger processes that disturb the fragile balance in the complex human-animal-environment ecosystem, up to the point where the conditions are created for (new) infectious disease outbreaks, in animals and/or humans. In these situations, the state of the system has reached a pathogen-

specific vulnerability threshold, which we refer to as 'tipping point'. In this project we will consider four change scenarios that could lead to the occurrence of such tipping points and disease emergence: (I) changes in climate, (II) in water management, (III) in farming practices, and (IV) in importation risk.

One Health PACT - Predicting Arboviruses Climate Tipping points

Duration	2020 - 2024
Participants	Erasmus MC, Utrecht University, Wageningen University & Research, Leiden UMC, Radboudumc, NIOO-KNAW, Avans University of Applied Sciences, Leiden University, UMC Utrecht
Participants/ investors	Deltares, RIVM, Royal Netherlands Meteorological Institute (KNMI), Red Cross Blood Bank Curaçao, Sanquin, Technasium Foundation, Netherlands Centre for Monitoring of Vectors
Funded by	Dutch National Research Agenda: Research along Routes by Consortia (NWA-ORC)
Further details	www.onehealthpact.org @OneHealthPact

“ Every environmental intervention can lead to the disruption of a delicate balance. We're currently observing how the habitat of the Hyalomma tick is expanding into northern Europe. Our native tick already causes problems, but this one actively seeks out blood and can carry the Crimean-Congo virus, which causes a haemorrhagic fever and is fatal in 30-50% of cases. Diseases can emerge when a certain tipping point is reached, which is what we saw with the zika outbreak in South America. We need to look at the consequences of our landscape interventions carefully. One of our outputs is the development of a complex calculation model using an 'integrated system approach'. In the future, this will help us understand how best to prevent infections and control outbreaks.”

Marion Koopmans, Scientific Director NCOH-EID



AMR Tackling Antimicrobial Resistance

EID Emerging Infectious Diseases preparedness

SHF Smart & Healthy Farming

HWE Healthy Wildlife & Ecosystems

How Twitter and sewage water reveal emerging viruses

The detection and prediction of human and animal health threats arising from current and predicted global changes can be revolutionised by shifting from a mostly reactive (single) pathogen targeted surveillance into a system that instead focuses on drivers of disease emergence and spread.

Our vision is to establish a Versatile Emerging infectious diseases forecasting, nowcasting, and tracking system that serves as an interactive virtual observatory for the generation and distribution of high quality actionable information for evidence-based early warning, risk assessment and monitoring of Emerging Infectious Diseases (EID) threats by public health actors and researchers in the One-Health domain. We refer to this Versatile EID Observatory as “VEO” or “the VEO system”.

VEO - Versatile Emerging infectious disease Observatory

Duration	2020 - 2025
Participants	Erasmus MC, DTU Denmark, FLI Germany, EMBL Germany, APHA UK, ELTE Hungary, RIVM, IFREMER France, AUTH Greece, Amsterdam UMC, IP France, CSIC Spain, EPFL Switzerland, CBS Heerlen, UEDIN UK, University of Bologna UNIBO Italy, UNIPD Italy, UU Sweden, UH Finland, UCPH Denmark
Funded by	European Union's Horizon 2020 research and innovation programme
Further details	www.veo-europe.eu @EuropeVEO

“The VEO is prioritising 10 diseases that we know have the potential to develop into a pandemic. The Netherlands was relatively late to respond to COVID-19, even though the Programme for Monitoring Emerging Diseases (ProMED), an early warning system for medical professionals, had been fairly quick to flag up the problem. What we're doing with VEO is building an advanced version of ProMED, based on data from Google, Twitter, pharmaceutical purchases, and much more. We will also be monitoring the microbiome of urban residents by analysing sewage water. This will alert us to viral DNA or RNA at a very early stage. Our ambition is to revolutionise the way we flag outbreaks of emerging infectious diseases. If we detect and analyse them earlier, we'll also be able to act at an earlier stage than we can now. And that will put us in a better position to manage the consequences.”

Marion Koopmans, Scientific Director NCOH-EID



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A preference for local protein

We want to start producing protein for animal feed closer to home and improve the recycling of protein from by-products. What implications does this have on the health and emissions of livestock?

Protein for animal feed is currently sourced from afar. A shift must be made towards a circular food system with effective circular animal feed concepts that can be used within the poultry, pig, veal, and goat farming sector. The selected alternative proteins should not be suitable for human consumption. They must not have any negative effects on animal health and welfare or emissions (such as nitrogen, particulate matter). New feed concepts with alternative protein sources and techniques to reduce emissions are investigated under experimental and field conditions with new sensor technology to measure health, welfare, and emissions. The best solutions for alternative proteins and new emission techniques are tested. The health of employees in animal husbandry, local residents, and livestock is a priority.

Regio Deal Foodvalley

Duration	2020 - 2024
Partners	National Government, Foodvalley Region, Province of Gelderland, LTO Noord, Province of Utrecht, Vallei and Veluwe Water Authority, Utrecht University, Wageningen University & Research, Confederation of Netherlands Industry and Employers (VNO-NCW Midden)

Further details www.boeraanhetroer.nl

“ *We can replace these proteins with lupin beans or with insects, and we can use proteins from waste streams to contribute to the circular economy, but we need to safeguard animal health and welfare when new feed concepts are being used. For NCOH, the issue is the impact on animal health, emissions, livestock farmers, and local residents. We'll also be linking AMR and SHF by researching the microbiome of animals fed with circular feed and comparing it to the microbiome of animals given regular feed. We'll be recruiting farmers who are willing to collaborate. We'll also be talking to companies who want to process circular-products into innovative animal feed. We'll be looking at the impact on animal health and welfare. We'll do this by monitoring them 24/7 with smart farming technologies, such as sensors and biomarkers in and around the barn. That data is also useful for the livestock farmers, who can then monitor what exactly is happening on their farm.”*

Annemarie Rebel, Scientific Director NCOH-SHF



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Lung problems in residents nearby goat farmers

Pneumonia is more common in people who live near goat farms. NCOH is researching the possible causes. Sampling is carried out at various locations in the barn, from the goat, and in the surrounding area to study what agents play a role.

On average, 1,650 out of 100,000 people develop pneumonia every year. In 12% of cases, the affected people live within a 2km radius of a goat farm. Previous research has shown that people who have at least 15 livestock farms close to their home experience impaired lung function. One of the causes is ammonia in the air, released from fertiliser. But that does not fully explain the number of cases near goat farms. That is why follow-up research was launched in 2019, aimed at finding out what causes these lung problems. The research studies goat farmers and their staff, goats, and goat farmhouses to investigate pathogens such as bacteria, viruses, and fungi, and other types of antigens and associate this with the likelihood of developing lung problems.

VGO-II Goat farming

Duration	2019 - 2020
Participants	RIVM, Institute for Risk Assessment Sciences (IRAS), Nivel, Wageningen University & Research
Funded by	Ministry of Agriculture, Nature and Food Quality, Ministry of Health, Welfare and Sport and TOP Grant ZonMw
Further details	www.rivm.nl

“ We don't know what caused these lung problems while we also do not know why people living close to livestock farms are less likely to suffer from allergies. As part of this research to find the agents that cause lung problems, we are taking a vast number of samples from the air, manure, goats, people, and barns. We are looking for infectious and non-infectious factors such as endotoxins, and maybe we will find something there that either causes lung problems or perhaps even find agents that are associated with fewer allergies. However, this is not the research question within this present study.”

Annemarie Rebel, Scientific Director NCOH-SHF



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Hare bacteria pose risk to hunters

Hares can transmit a rare disease to humans. A better understanding of tularemia would help doctors diagnose suspected cases and provide suitable treatment.

Until recently, tularemia has not been seen in the Netherlands since the 1950s, and the disease was fading from public awareness. However, there has been a resurgence of tularemia. Infected hares have been found, and eight people (mainly hunters) have contracted the disease. Tularemia is caused by the bacterium *Francisella tularensis*, which is found in a large number of animal species, from insects to mammals. Rabbits, hares, and rodents are particularly susceptible. People can be infected through cuts on the skin or through the bite of insects acting as intermediate hosts. The insect bite becomes infected somewhere between one and ten days later, leading to swollen lymph nodes and fever. When inhaled, the bacteria can lead to pneumonia. Tularemia is not caused by an imported or exotic bacteria: the disease is endemic to the northern hemisphere and is often seen in Scandinavia. The resurgence of the disease in the Netherlands is still a mystery.

“*There are so many other unanswered questions. We identified a small outbreak in hares in Friesland in 2015. No humans were infected at that time. The bacterium was found to be concentrated in water and infecting the hares in that way. But we don't have a sufficient understanding of the life cycle. Wageningen Bioveterinary Research has developed a diagnostic test to be able to confirm the presence of the bacterium, which is now available in Utrecht as well. It's important for doctors to be aware that tularemia has returned to the Netherlands. This will enable them to provide appropriate treatment.*”

Andrea Gröne, Scientific Director NCOH-HWE



Duration	2013 - present
Participants	RIVM, Dutch Wildlife Health Centre (DWHC), WUR - Bioveterinary Research
Funded by	Ministry of Agriculture, Nature and Food Quality and Ministry of Health, Welfare and Sport
Further details	www.dwhc.nl

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Ticks: not just a vector of Lyme disease

There is a serious type of meningitis transmitted by ticks, but it was always assumed that this particular type did not exist in the Netherlands. Recent research in deer has shown that this assumption was incorrect.

Several people are now known to have been infected with tick-borne encephalitis (TBE) within the Netherlands. The disease is caused by a virus transmitted through a tick bite, which is how it moves from animal to animal, and from animals to humans. Two national parks – the Sallandse Heuvelrug and the Utrechtse Heuvelrug – are focal points for the virus, where it has been identified in deer. The numbers are still very low, and in most people the infection passes unnoticed. But if symptoms arise, they can become serious. There is an initial phase lasting 2 to 7 days with fever, fatigue, and headaches, which then clear up. Then there is a second phase, with severe headaches, fever, and meningitis/encephalitis. This form of meningitis/encephalitis is fatal in 1-2% of patients, while others are left with recurring symptoms.

Duration	2016 - present
Participants	RIVM, Dutch Wildlife Health Centre (DWHC)
Funded by	Ministry of Agriculture, Nature and Food Quality and Ministry of Health, Welfare and Sport
Further details	www.dwhc.nl www.rivm.nl

“With the help of hunters, we were able to carry out random sampling of deer blood. That’s how we discovered that TBE does indeed exist in the Netherlands. The virus does not lead to illness in deer, but the animals do produce antibodies against the virus which can then be identified in their blood. Until recently, we assumed that anyone with TBE must have acquired the disease overseas. If that person had not recently been overseas, TBE was ruled out. This disease shows us the importance of collaboration between veterinary and human medicine. It also shows the importance of environmental factors: the location of ticks, the prevention of tick bites, and the prevalence of ticks in a changing climate.”

Andrea Gröne, Scientific Director NCOH-HWE



AMR
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Resistance

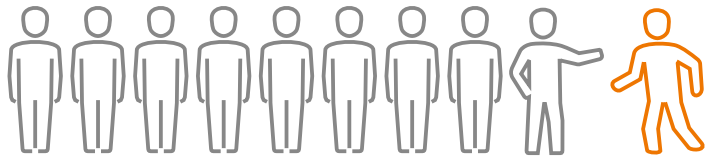
EID
Emerging
Infectious Diseases
preparedness

SHF
Smart & Healthy
Farming

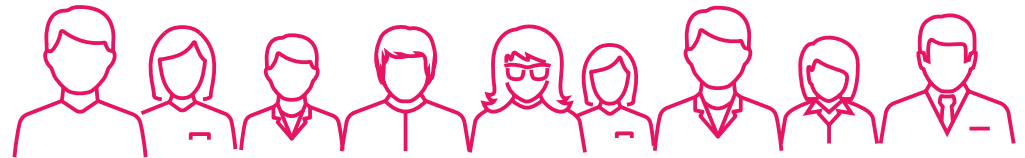
HWE
Healthy Wildlife
& Ecosystems

Facts 2020

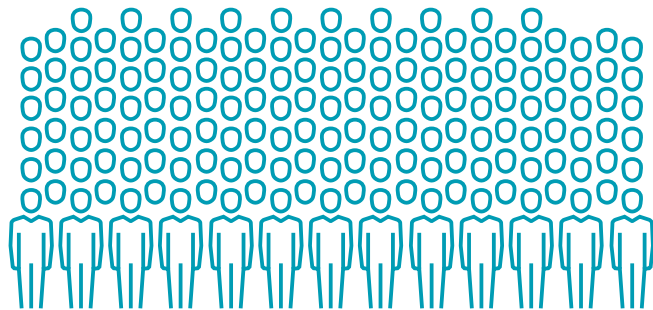
9 Partners + 1 Associate



98 Principal Investigators



> 400 active participants



50 million invested



> 30 collaborative projects



> 65 PhD students



Colophon / contact / collaboration

NCOH aims for an integrated One Health approach to tackle the global risk of infectious diseases.

Top leading academic research institutes with excellent research communities connect to partners from across the world to build regional and global networks.

Interested in joining the Netherlands Centre for One Health? NCOH is a virtual institute, bringing together knowledge in the areas of human, animal, and environmental health.



**netherlands
centre for
one health**

www.ncoh.nl



www.linkedin.com/company/netherlands-centre-for-one-health-ncoh

For general information

Please contact Jovanka Bestebroer from the NCOH Management Office

For media inquiries

Please contact Maarten Hoek from the NCOH Communications Office

If you have a project you would like to discuss

Please contact Vincent Rijsman from the NCOH Partnering Team

For questions regarding Young NCOH

Please contact Romy Zwittink from the Young NCOH Board

