

# Infectious diseases and how nuclear science can help

By Nicole Jawerth

**I**nfectious diseases are health conditions caused by pathogens — bacteria, viruses, or other microorganisms, such as parasites or fungi. After invading the body, pathogens multiply and disrupt how the body works.

The types and severity of disease symptoms depend on the pathogens and host, namely a person or animal. In the case of COVID-19, for example, some people show no signs or symptoms or only have mild ones, such as fatigue and body aches, but others have severe and debilitating symptoms that, in some cases, can lead to death.

Infectious diseases are caused by pathogens that can spread from person to person, animal to animal or from an animal to a person. Such diseases can also be spread by vectors — living organisms, such as insects, that carry and spread pathogens.

More than 60% of the infectious diseases now affecting humans originated in animals. Scientists have found that over 75% of new animal diseases are zoonotic — diseases and infections that go from animals to people. Every year around 2.6 billion people suffer from zoonotic illnesses, and almost 3 million die from these diseases. Some of the most widely known zoonotic illnesses are Ebola, severe acute respiratory syndrome (SARS) and COVID-19.

## Emerging, re-emerging, spreading

Moving without regard for borders in both people and animals, infectious diseases

pose a persistent threat. New diseases or pathogen strains can emerge, and old ones can disappear only to re-emerge later. Some diseases and pathogens have several strains, or variations. As diseases are constantly evolving, science and medicine have to keep evolving too.

When a disease strikes, it impacts human and/or animal health, and can damage livelihoods and hurt economies. The effects are often disproportionately felt by vulnerable groups, such as children, the poor, the elderly and/or people with compromised immune systems. An overwhelming majority of victims of infectious diseases are in developing countries, particularly in impoverished communities.

The likelihood of infectious diseases emerging, re-emerging and spreading among humans is now greater than ever before. Globalization, population growth and urbanization mean that people are moving around more and living closer together, while deforestation, climate change, migration and the livestock industry are shrinking the barriers between people and animals, which is increasing the risk of zoonotic disease outbreaks.

Managing infectious diseases has also become more challenging owing to some pathogens' increased resistance to antibiotics, the re-emergence of vaccine-preventable diseases and new pathogens that have no available vaccines or treatments. Many countries are not readily equipped to

## Glossary

**Endemic:** regularly found in a certain area or among a particular community.

**Infectious disease:** an illness caused by pathogens, such as bacteria, viruses, parasites or fungi, that can spread from one person to another or from an animal to a person.

**Pathogen:** a bacterium, virus, or other microorganism, such as a parasite or fungus, that can cause disease.

**Vector:** a living organism, such as an insect, that carries and spreads pathogens.

**Vector-borne:** carried and transmitted by vectors.

**Zoonotic:** diseases and infections that are transmitted from animals to humans.

accurately diagnose these infections early, increasing the risk of their spread.

### Prevent, detect, pre-empt

Early detection is key to mitigating the spread of infections and pre-empting the outbreak of epidemics. Nuclear and nuclear-derived techniques are reliable tools that can help investigate, prevent, detect and contain outbreaks of animal and zoonotic diseases.

One of the most widely used and accurate laboratory diagnostic tests is **real time reverse transcription–polymerase chain reaction (real time RT–PCR)**. This nuclear-derived method is used for detecting the presence of specific genetic material of a pathogen, including a virus. A diagnosis can be made by verifying that the pathogen’s genetic material is found in a sample from a patient or an animal. Read a step-by-step explanation of how this method works and how it’s used for detecting COVID-19 on page 8.

Some diseases show few or no symptoms in their earlier stages and may even be mistaken for other health conditions.

**Medical imaging**, such as radiology and nuclear medicine, can be used to quickly and accurately diagnose a disease, as well as to continue monitoring it, increasing the chances of controlling its spread. Learn more

about diagnostic imaging and how it is used for COVID-19 on page 12.

A nuclear-based insect birth control method called the **sterile insect technique (SIT)** can help prevent, control and potentially even stop the spread of certain vector-borne diseases. Research and development are now ongoing on how to use SIT for controlling disease-carrying mosquitoes. Find out more about this on page 22.

Some vaccines contain inactivated versions of a pathogen that, once inside the body, activates the immune system to help prepare it to fight off an infection. **Irradiated vaccines** are now being explored as an option for disease control. Radiation can inactivate a pathogen without affecting its structure. Learn more about irradiated vaccines for fighting animal diseases on page 30.

The IAEA has decades of experience in supporting countries with building their capacity to detect and characterize pathogens early and to rapidly and accurately diagnose, manage and prevent diseases. Often working with partners, such as the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO) and the World Organisation for Animal Health (OIE), this assistance has made an important contribution to helping to control outbreaks of infectious diseases in both animals and people.

## ZODIAC

### The path beyond the COVID-19 pandemic

The ZODIAC, or **Z**Oonotic **D**isease **I**ntegrated **A**ction, initiative was launched by the IAEA in June 2020 to strengthen countries’ capabilities for early detection, diagnosis, prevention and control of zoonotic disease outbreaks. The initiative is designed as a systematic and holistic approach across sectors and disciplines, and integrates emergency assistance measures, including a response team, for addressing new and existing zoonotic pathogens. ZODIAC aims to help countries prepare for, pre-empt and prevent zoonotic disease outbreaks, as well as protect the wellbeing, livelihood and socio-economic status of billions of people worldwide.

Nuclear and nuclear-derived techniques are proven and reliable tools that play a critical role in investigating, detecting, preventing and containing zoonotic disease outbreaks. As a science-driven organization, the IAEA, in collaboration with its partners, is uniquely placed to undertake, coordinate and efficiently implement ZODIAC and to support countries in strengthening their resilience to zoonotic diseases. It has extensive experience in assisting with tackling animal and zoonotic diseases and has a dedicated laboratory as well as a vast network of veterinary laboratory partners around the world.

ZODIAC will build on the IAEA’s cooperation with partners such as the Food and Agriculture Organization of the United Nations, the World Health Organization and the World Organisation for Animal Health.

