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The Norwegian Zoonoses Report 2022

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Content

Summary

The occurrence of most zoonotic pathogens in animals was stable in 2022 compared to previous years, although Mycobacterium bovis was detected for the first time since 1986 in one bovine dairy herd late 2022. In humans the incidence of several zoonotic infectious diseases increased after the decline seen during the COVID-19 pandemic. As in previous years, campylobacteriosis has the highest number of reported cases followed by salmonellosis

Introduction

The Zoonosis Report is published annually in Norway in accordance with the requirements of the EU Council Directive 2003/99/EC. In addition, data on specified zoonoses in feed, animals and food are reported to the European Food Safety Authority (EFSA). Corresponding data from humans are reported to the European Center for Disease Control (ECDC). These two European institutions compile an annual European zoonosis report based on the received data:
https://www.efsa.europa.eu/en/publications?sub_subject=61616

The Norwegian Veterinary Institute (NVI) is responsible for reporting of Norwegian data to EFSA, while the Norwegian Institute of Public Health (NIPH) reports Norwegian data to ECDC. The Zoonosis Report is written by the NVI in collaboration with the Norwegian Food Safety Authority (NFSA) and NIPH.

Origin of data

Humans

"The Norwegian Surveillance System for Communicable Diseases" (MSIS) was implemented nationally in Norway in 1975, and the NIPH is responsible for managing the system. The main purpose of MSIS is surveillance to describe trends and detect outbreaks of communicable diseases.

According to the Infectious Disease Control Act, all clinicians and laboratories that analyse samples from humans must report all cases of specified communicable diseases (at present 73 different diseases). All zoonoses described in this report, with the exception of toxoplasmosis, are notifiable.

Patients who have not travelled abroad during the incubation period for the diagnosed infection are classified as "infected in Norway". Patients who develop the diagnosed infection abroad or shortly after returning home to Norway are classified as travel associated and "infected abroad". Patients for whom information regarding travel is not available are classified as «unknown origin» with respect to where the infection was contracted.

The District Medical Officer must notify the NFSA in cases where humans are believed to be infected from animals or food.

Feed, animals and food
The data presented in this report are obtained through national surveillance programmes, projects, diagnostic investigations and various inspections performed by public authorities and private companies. Two types of data are reported:

- Data on detected notifiable diseases and data from public surveillance. The NFSA decides which infectious agents are notifiable and which surveillance programmes should be carried out. The NVI assists with planning and laboratory analyses, data processing and reporting. Testing of animals and food for various zoonotic agents is also in association with import and export. In addition, surveillance in association with commercial slaughter through pre-and post-mortem inspections are carried out by the NFSA.
- Data from diagnostic investigations and data from internal control systems of food-, and feed-producing companies are also included in the Zoonosis Report. All laboratories are obliged to report any detection of notifiable diseases in animals to the NFSA. A large proportion of the laboratory diagnostics (including pathology) performed on animals in Norway is performed by the NVI. In cases where laboratories abroad are used, the responsible veterinarian is obliged to report any detection of notifiable disease in animals. Data from internal control of companies are not always available. One exception is Salmonella-control in feed producing companies, where data from most of the performed internal control is made available and is presented in this report.

Notifiable diseases/agents in animal and humans are presented in Table 1.

Preventive and protective measures

Norway has strict regulations to prevent introduction and spread of certain infections in animals and humans.

Humans
When clusters of notifiable zoonoses are detected in humans, investigations are performed to trace the source of infection and measures to prevent new cases are implemented. In cases where food or animals are suspected to be the source, NFSA is notified and an outbreak investigation team consisting of NFSA, NVI, relevant municipal doctors and NIPH is established.

People employed in the food industry or health personnel working with patients should not work while symptomatic with infections that may be transmitted through food. Before returning to work they should have two negative faecal samples after clinical improvement. For Enterohaemorrhagic Escherichia coli (EHEC/VTEC), Salmonella Typhi, S. Paratyphi and Shigella dysenteriae 1 the number of negative faecal samples should be three.

Feed, animals and food
According to the Food Act, https://lovdata.no/dokument/NL/lov/2003-12-19-124 Food Business Operators are responsible for implementing appropriate measures to prevent the occurrence or spread of contagious disease in animals, and to notify the NFSA about any suspicion of contagious disease in animals that has potential to cause significant negative consequences for society.

The Regulation on Notification of Diseases in Animals https://lovdata.no/dokument/SF/forskrift/2022-04-06-631#KAPITTEL_5 states that veterinarians and laboratories must notify the NFSA about specified animal diseases categorized as 1-, 2-, and 3-diseases. This list includes, but is not limited to, the notifiable diseases in EU EUR-Lex, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02016R0429-20191214. In addition, there is a general duty to notify diseases in animals that:

- could cause death or serious disease in humans.

- could result in high numbers of animals becoming diseased or exposed to infection.
- could result in substantial economic losses for society.
- could cause other substantial consequences for society.
- are presumed not to exist in Norway or have an unexpected distribution.
- compromise animal health in an unexpected manner or in an unexpected fashion.

Suspicion or diagnosis of Group 1 and 2 diseases in animals must be notified immediately to the NFSA. Diagnosis of group 3 disease in animals shall be reported to the NFSA as soon as possible.

If a group 1- or 2-disease is detected in animals in Norway, restrictions will be imposed on the infected animal or animal holding, and efforts will be made to eradicate the infective agent. The measures depend on EU's categorisation of the disease animal species, management system, and the infective agent. When a zoonosis is detected or suspected, the NFSA must notify the District Medical Officer if the infection has transmitted, or may transmit, to humans.

Companies that produce or sell food are responsible for ensuring that the products they produce is safe to consume. The NFSA follows up and inspects food industry facilities to ensure that they exercise their responsibility. Food producers must also consider zoonoses in their internal control systems. In addition to the national surveillance programmes and various short-term projects initiated by the head office of the NFSA, regional NFSA offices perform some sampling. However, the data from regional offices are not included in this report.

Feed business operators are obliged to apply an internal control system to secure the hygienic quality of the feed, the absence of Salmonella in particular, to prevent zoonotic infections in animals. In total, 14 border inspection posts and 7 associated control centres in Norway perform control of foods and foodstuffs of animal origin that are imported from non EU and non EEA-countries.

If a zoonotic agent is detected in a food or foodstuff, measures are carried out to prevent spread and to identify the source. The District Medical Officer must be notified, and if there is a risk that animals have been infected or may become infected, the NFSA must perform further investigations.

***Tabell 1**. Disease/agents included in the zoonosis report in 2022 and their status with respect to notifiability and existing surveillance programmes.*

Disease/agent	Notifiability			Feed, animals and food
	Humans	Feed and food	Animals	Surveillance programme
Salmonellosis	Yes	Yes	Yes (2-disease)	Yes
Campylobacteriosis	Yes	No*	No**	Yes
Yersiniosis	Yes	No*	No	No (occasionally)
Listeriosis	Yes	No*	No***	No
Pathogenic *E. coli*	Yes	Yes*	No	No (occasionally)
Tuberculosis	Yes	Yes	Yes (2-disease)	Yes
Brucellosis	Yes	Yes	Yes (1-disease)	Yes
Trichinellosis	Yes	Yes	Yes (2-disease)	Yes
Echinococcosis	Yes	Yes	Yes (2-disease)	Yes
Toxoplasmosis	No	No	No	No
Rabies	Yes	-	Yes (1-disease)	No
Q-fever	Yes	-	Yes (2-disease)	No (occasionally)
BSE og vCJD	Yes	-	Yes (2-disease)	Yes
MRSA	Yes	-	Yes (2-disease)	Yes

* Some conditions are notifiable according to national regulation within specific areas. Otherwise, the food law contains a general obligation to immediately inform the competent authorities if there exists a risk or potential risk (to human, animal and plant health) of significant consequences to the society.
** The exception is broiler chickens slaughtered before 51 days of age between May and October, because these are included in the surveillance programme, and measures are implemented if samples are positive.
*** Listeriosis in animals was notifiable until April 2022.

Acknowledgements

Institute of Marine Research, Geno, Norsvin and the feed industry are acknowledged for providing data for this report.

Salmonellosis

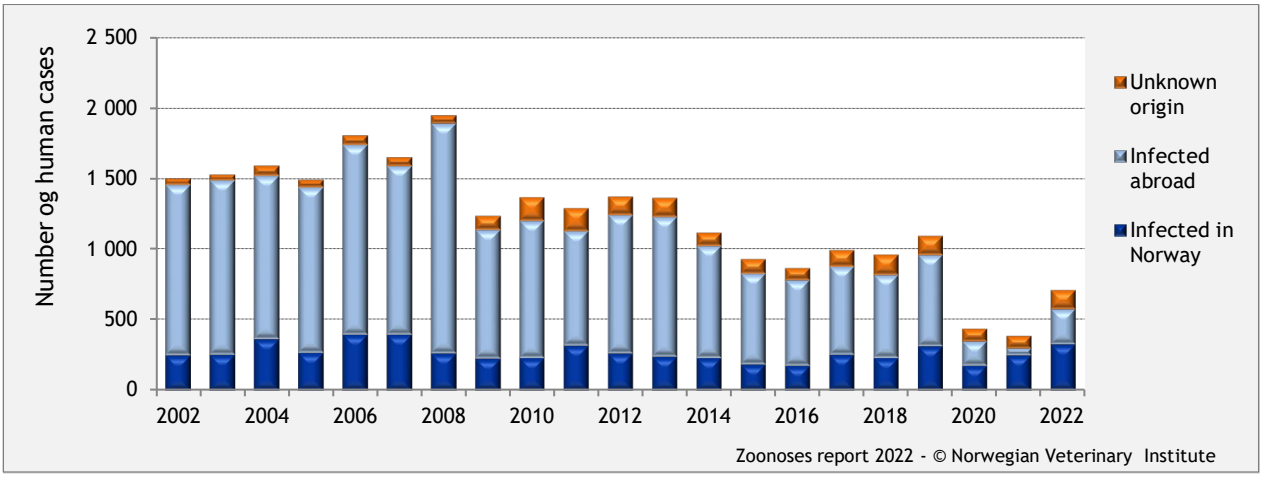
The disease and its transmission routes
There are more than two thousand variants of *Salmonella* bacteria. The most common symptom of infection is diarrhoea, both in humans and in animals, but healthy carriage is not uncommon. *Salmonella* are shed in faeces and the most important sources of infection are contaminated food, feed or water. *Salmonella* can also spread through direct contact with infected individuals.

Surveillance and control
Salmonellosis in humans is notifiable in Norway. From 2017, both *Salmonella* infections verified by PCR and/or by culture are registered in MSIS. *Salmonella*-infection in animals is notifiable (group 2-disease in Norway). Detection of *Salmonella* in feed or food must also be reported to the NFSA.

Surveillance of *Salmonella* in feed, cattle, swine and poultry (live animals and animal products) started in 1995. Testing is performed in cases of disease, live animal import and as part of *Salmonella* control systems in feed production. Vaccination of animals against *Salmonella* is forbidden in Norway.

Results 2022

A total number of 712 cases of salmonellosis in humans was reported in 2022. The number of reported cases of Salmonellosis in humans has increased compared to the pandemic years (2020 and 2021), but the number of cases is still lower than before the pandemic. This is mainly due to a decrease in the number of travel associated cases. In 2022, there were four outbreaks of salmonellosis in the human population. Information on the most frequently detected serotypes is presented in the Appendix.



***Figur 1**. Reported cases of salmonellosis in humans. Data from MSIS*

The surveillance programmes for *Salmonella* covering animals, meat and eggs, include testing of live animals (pigs, poultry and cattle) and fresh meat (pigs and cattle). Altogether 9,065 faecal samples from 1,331 poultry holdings were investigated, and all samples were negative for Salmonella. Salmonella was not detected in 1,310 faecal samples from 67 elite and multiplier breeding swine herds, but three of 3,169 lymph node samples from pigs were positive for Salmonella giving an estimated Salmonella prevalence of 0.09% at the individual carcass level. One out of 3,337 lymph node samples from cattle was positive for *Salmonella* giving an estimated Salmonella prevalence of 0.03% at the

individual carcass level. A total of 6,049 swab samples of cattle and swine carcasses were examined, and one sample from a cattle carcass was positive for Salmonella, giving an estimated Salmonella prevalence of 0.02% at sample level. A total of 3,161 samples of from crushed meat were examined, and Salmonella was not detected.

In the diagnostic services at the NVI, Salmonella was detected in faecal samples from two cattle farms, three swine herds, two dogs, thirty two cats, eight reptiles, and three wild boars.

Cheeses were included in the surveillance program for ready-to-eat foods. No positive samples were found among the 40 analysed samples.

Evaluation of the current situation

The number of salmonellosis cases in humans has decreased over the past 10 years. The incidence of cases infected in Norway has varied between 3.2 to 6.1 in the period 2015-2022, with the lowest incidence during the COVID-19 pandemic probably due to measurements against COVID-19 in Norway and reduced travel. The reduced prevalence of *Salmonella* in European poultry is presumed to contribute to the observed reduction, with less people infected abroad. Data from outbreaks of salmonellosis indicate that a great variety of foods can be implicated. When infection is contracted in Norway, imported foods are more often implicated than foods produced in Norway.
In Norway, food-producing animals are very rarely infected with Salmonella. This is well documented in the surveillance program (Figure 2). *Salmonella diarizonae* is occasionally detected in Norwegian sheep, and was detected in 2 sheep flocks in 2022. This variant is only rarely associated with disease in animals and is not considered a public health threat.

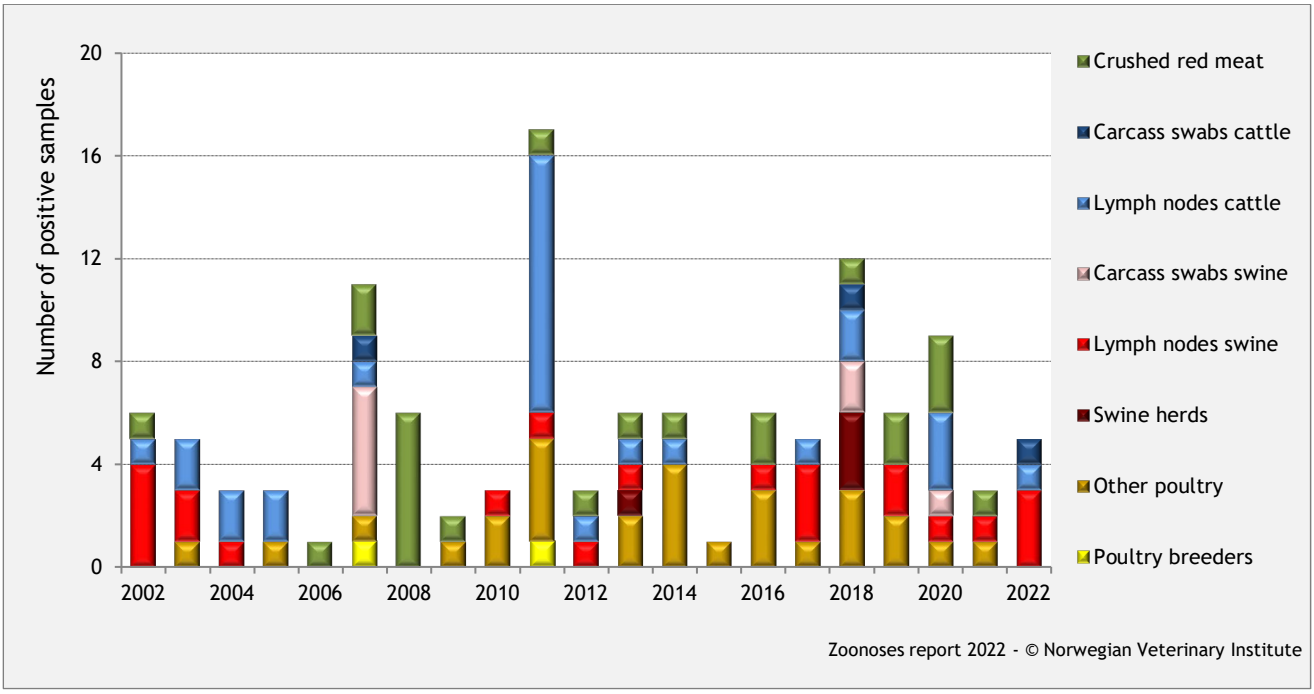


***Figure 2**. The number of positive samples in the Salmonella surveillance programme.*

Salmonella is occasionally detected in dogs and cats and in reptiles in Norway. In 2020, an increase in salmonellosis was evident particularly in cats. This coincided with an outbreak of salmonellosis in wild birds and a winter with less snow than usual, which is likely to have enabled cats to hunt more easily. The same trend was not observed in 2021, and in 2022 the number of detected cases was also quite high (n=32) compared to previous years. However, this may also reflect increase awareness among veterinarians that salmonellosis is a possibility in cats presenting with non-specific symptoms like fever and lethargy early spring, and hence more testing.

Salmonella spp. is also sporadically detected in wild boar in Norway. During 2022, *Salmonella* was detected in samples from 3 of 208 hunted wild boar from which fecal samples were submitted for laboratory analysis. The only serotype detected during 2022 was *S. enterica* subsp. *diarizonae*. In the autumn of 2020, *Salmonella* Choleraesuis was detected in a domestic pig herd in southern Sweden for the first time in more than 40 years, and since then *S.* Choleraesuis has also been detected in Swedish wild boar. S. Choleraesuis has not been detected in samples from wild boars in Norway.

In 2017, an exemption was made for 19 species on the general ban on import and marketing of reptiles in Norway. Reptiles frequently carry Salmonella and may pose a source of infection to humans. *Salmonella* Typhimurium can sometimes be detected from wild birds and hedgehogs in Norway. Contamination of food and water by these animals may lead to infection of humans.

Feed given to domestic animals in Norway is generally free from *Salmonella*, but *Salmonella* is sometimes detected in feed factories, especially those producing fish feed. Continued surveillance of *Salmonella* in animals, feed and food is necessary for early detection, to facilitate control and to sustain the beneficial situation with respect to *Salmonella* in Norway.

Campylobacteriosis

The disease and its transmission routes
There are many *Campylobacter* variants, but *C. jejuni* and *C. coli* are the most important zoonoses. These are commonly found in the guts of healthy birds, and humans may contract the infection through contaminated food or water or by direct contact. Diarrhoea is the most common symptom of campylobacteriosis, but more severe disease may also occur.

Surveillance and control
Campylobacteriosis is notifiable in humans in Norway, but not in animals (except *C. fetus* in cattle). In humans, both campylobacter infections verified by PCR and/or culture are registered in MSIS.

Norway has a surveillance program for *Campylobacter* in broiler chickens. All flocks slaughtered before 51 days of age between the 1st May and 31st October are tested prior to slaughter. Carcasses from positive flocks are heat treated or frozen prior to sale in order to reduce the potential for transmission to humans. Pasteurisation of milk and disinfection of water are other measures that prevent transmission of *Campylobacter* to humans.

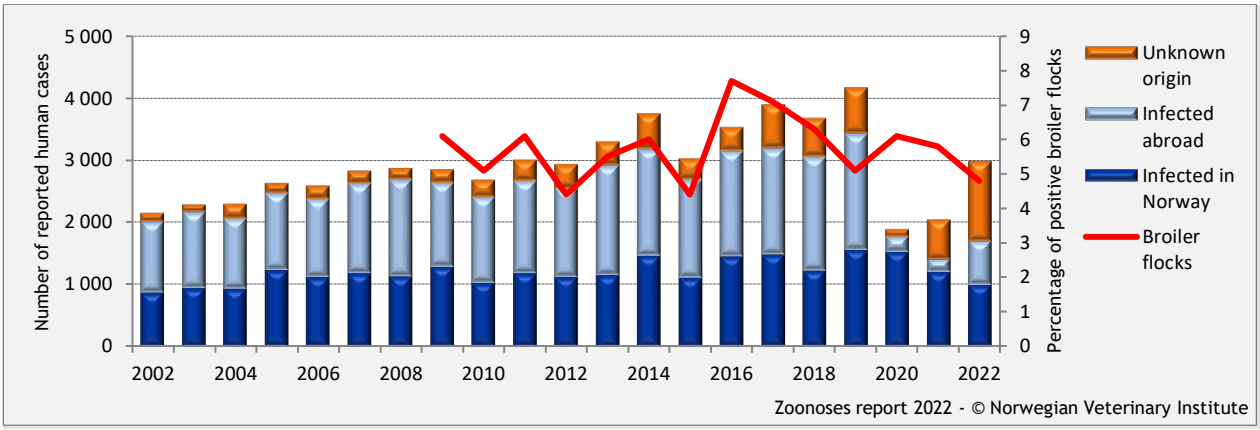
Results 2022

In MSIS, 2,983 human cases of campylobacteriosis were reported in 2022, of which 989 contracted the infection in Norway. For 1,282 of the cases, place of infection was unknown. From 2017, all cases verified by PCR and/or culture are registered in MSIS and reported. However, when the total number of positive cases for 2017, 2018 and 2019 are compared to positive cases verified by both culturing and/or PCR in 2015 and 2016, the numbers for each year are similar, suggesting that there has not been an increase in the occurrence of campylobacteriosis in Norway (Figure 3).

Surveillance in 2022 showed that a total of 106 flocks (4.8%) tested positive for *Campylobacter spp.* when all broiler flocks slaughtered before 51 days of age during the period 24th of May – 31st of October were tested. In total 2,189 flocks from 515 farms were sampled. Of all farms sampled, 72 (14%) had positive flocks, and of these, 22 (4.3% of all farms) had two or more positive flocks. This means that 52.8% of the positive flocks originated from 4.3% of the farms. The carcasses from the positive flocks were either heat treated or frozen for a minimum of three weeks before being marketed. This year's result is somewhat more favourable than the results from 2019, 2020 and 2021 with 5.1%, 6.1% and 5.8% positive flocks, respectively. The prevalence is still very low, compared to most other European countries.

During 2022 caecal samples from 2 189 chicken flocks were examined for *Campylobacter* in the national antimicrobial resistance monitoring programme (NORM-VET). *C. jejuni* was detected in 86 of the samples
(3.9%) and *C. coli* in only one (0.05%).

In the diagnostic services at the NVI, *Campylobacter* was detected in samples from 20 cattle, five sheep, 34 dogs and one cat. For details see the Appendix.



***Figur 2**. The number of reported cases of campylobacteriosis in humans (data from MSIS) and the percentage of positive broiler flocks (sampled between 1st May and 31st October).*

Evaluation of the current situation

Campylobacteriosis is the most commonly reported zoonosis in humans in Norway. The number of reported cases has increased compared to the pandemic years (2020 and 2021), but the number of cases is still lower than before the COVID-19 pandemic. This is mainly due to a decrease in the number of travel associated cases (11% in 2020 and 2021 and 24% I 2022). In the period 2017-2019, the proportion of cases infected abroad accounted for about half of the cases.

The trends for campylobacteriosis might be uncertain because of the changes in diagnostics (from 2017 there has been an increased use of PCR) and also because of infection control measures implemented due to the COVID-19 pandemic.

Case-control studies have shown that the most common source of campylobacteriosis in Norway is drinking untreated water at home, at holiday homes or in nature. Eating or preparing poultry and barbeque meals have also been identified as risk factors for infection. No studies have demonstrated a link between eating beef or lamb and campylobacteriosis. However, one study showed that eating inadequately heat-treated pork was associated with an increased risk of *Campylobacte*r infection. Studies have also shown that direct contact with domestic animals (cattle, sheep, poultry, dogs and cats) is associated with an increased risk of campylobacteriosis in humans.

The prevalence of *Campylobacter* in broilers is low in Norway (3-8% of slaughtered flocks) compared to other countries. A few farms deliver a large proportion of the contaminated flocks. The measures implemented in Norway to reduce *Campylobacter* in chicken meat are considered to have had a positive effect on public health. A few farms seem to deliver a high proportion of the positive flocks.

Yersiniosis

The disease and its transmission routes
Certain serogroups of the bacteria *Yersinia enterocolitica* can cause disease in humans, for which the most common symptom is diarrhoea. Swine are considered to be the main source of these disease-causing variants. The most common sources of human infection are contaminated food and water.

Yersinia pseudotuberculosis, which belongs to the same genus as *Y. enterocolitica*, may also cause disease in humans and animals.

Surveillance and control
Yersiniosis in humans is notifiable, while detection of *Y. enterocolitica* and *Y. pseudotuberculosis* in animals are not. There is no surveillance for this bacterium in animals or food in Norway. Because healthy swine can be carriers, contamination of carcasses may occur at slaughter. Good hygiene at slaughter reduces this risk.

Results 2022

The number of reported human cases of yersiniosis in 2022 (n=117) was higher compared to 2021 (n=85), 2020 (n=83) and 2019 (n=85) (Figure 4). The reported cases in 2022 were caused by *Y. enterocolitica* (n=115) and *Y. pseudotuberculosis* (n=2).

In 2022 *Y. enterocolitica* was detected in one reindeer.

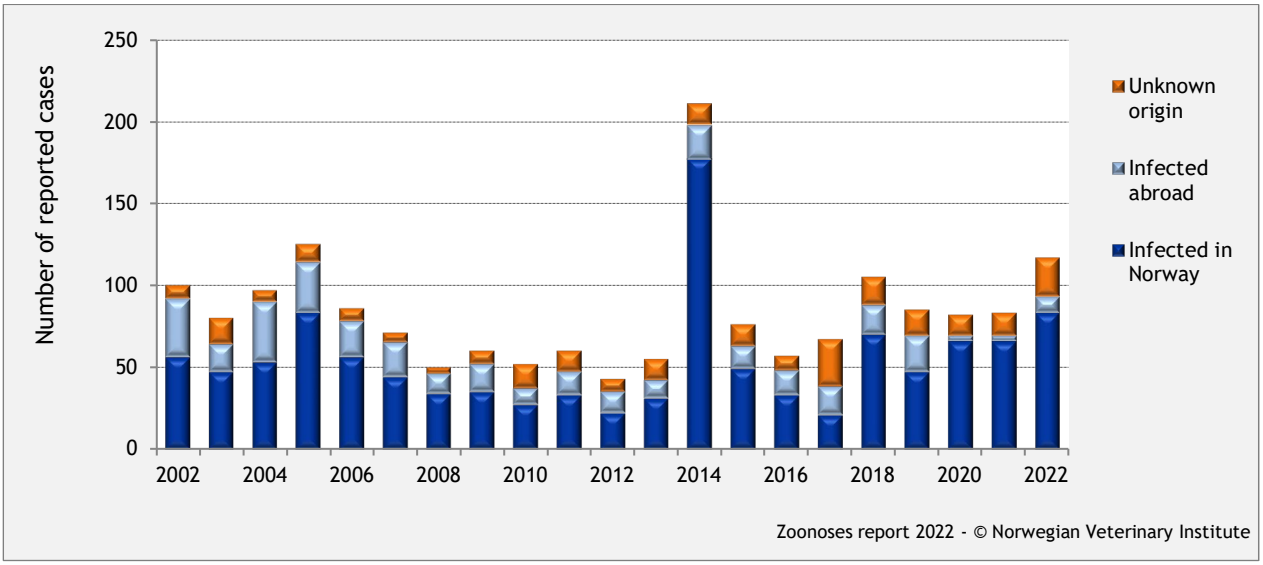


***Figure 4**. The number of reported cases of yersiniosis in humans. Data from MSIS.*

Evaluation of the current situation

Most yersiniosis cases in humans in Norway are sporadic and have been acquired domestically. In 2014, 2018 and 2021, there was an increase in the number of reported cases due to outbreaks. In 2022, two outbreak investigations were conducted due to *Y. enterocolitica* O:3. These outbreaks included 37 and

14 cases, respectively (https://www.fhi.no/publ/2023/utbrudd-av-smittsomme-sykdommer-i-norge-i--2022.-arsrapport.-vesuv/).
Y. enterocolitica is presumed to be prevalent in swine and the bacteria cannot be eliminated from swine herds. During the 1990s routines for improved slaughter hygiene were implemented and this has contributed to reducing the number of human cases of yersiniosis. In a survey of pathogenic *Y. enterocolitica* in minced pork carried out in 2019, pathogenic *Y, enterocolitica* was isolated from 5.9% (9/152) samples. Eight of the isolates belonged to serogroup O:3, while the last one was of unknown serogroup.

Listeriosis

The disease and its transmission routes
Listeria monocytogenes occurs naturally in the environment and is mainly pathogenic for pregnant women, the elderly and people with a compromised immune system. The main route of infection in is contaminated food or water, and listeriosis can cause fever, abortion, meningitis and septicaemia. In animals, listeriosis also causes meningitis and abortion, and feed is the main source of infection.

Surveillance and control
Listeriosis in humans is notifiable. In animals, it is categorised as a group C-disease and detection in animals usually does not result in any measures.

Detection of *L. monocytogenes* is part of the control system in the manufacture of certain food products. The upper limit in ready-to-eat foods is 100 cfu/g during the entire shelf life period, and 0 cfu/ml in products intended for small children or other vulnerable persons. If the upper limit is exceeded, the food must be withdrawn from market and corrective action must be taken to avoid further contamination. Dietary advice is available; www.matportalen.no and www.fhi.no

Results 2022

The number of listeriosis cases in humans in 2022 (n=31) were higher than in 2021 (n=20). The numbers vary somewhat from year to year without a clear trend. Twenty-seven of the cases were infected in Norway and four were infected abroad (Figure 5). Two outbreaks, with a total of 10 cases were reported in 2022. One of the outbreaks, with five cases, was probably linked to smoked salmon.

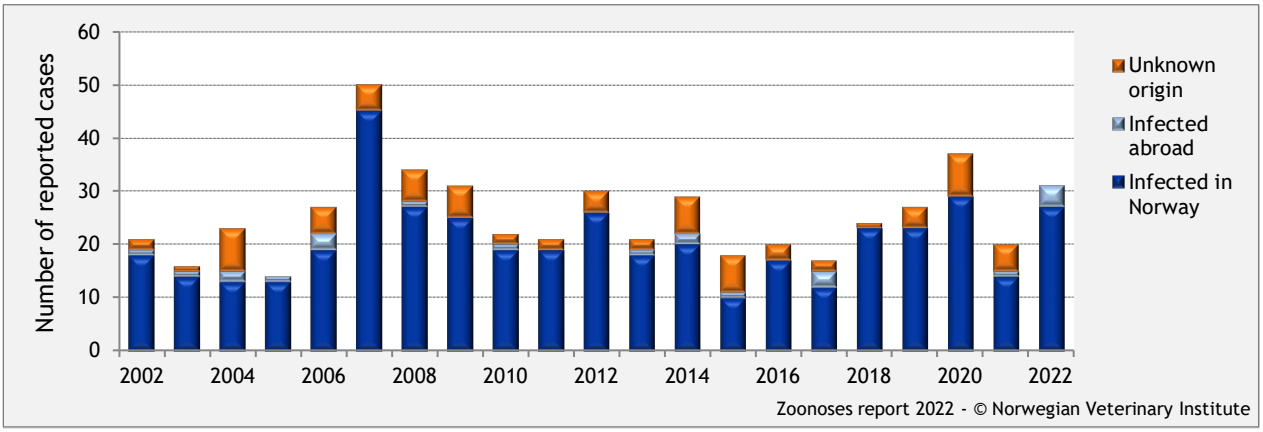


***Figure 5**. The number of cases of listeriosis in humans. Data from MSIS.*

In the diagnostic services at the NVI, *L. monocytogenes* was detected in six sheep, one goat and one hare in 2022. Five out of 373 samples in the surveillance program for ready-to-eat foods in 2021 were positive for *Listeria monocytogenes*. The concentrations were below 100 cfu/g in all cases. It should be noted that the analyses are performed at the end of shelf life of foods stored at 4 °C, while the expected storage temperature at consumer level is higher and more favourable for growth of Listeria. Among the positive samples, 1 was from salad, 2 meat products and 2 from smoked fish.

The Institute of Marine Research (Havforskningsinstituttet) examined 31 samples of imported fish products, and *L. monocytogenes* was not detected in any of them.

In addition to surveillance samples, NVI received samples during the investigation of the outbreak with smoked salmon, as well as verification samples of sporadic human listeriosis cases and suspicions of contaminated food in a hospital kitchen.

Evaluation of the current situation

In Europe an upward trend in the number of listeriosis cases in humans has been observed in the last years. The number of listeriosis cases in both humans and animals in Norway is low, but the infection can have severe consequences. Therefore, it is important that manufacturers of ready-to-eat foods have proper routines in place for preventing *Listeria* in their products, and systems for traceability and withdrawal of products from the market in cases where *L. monocytogenes* are detected. The surveillance program for ready-to-eat foods has had 1-5 positive samples per year, with concentrations in the range <10 cfu/g to more than 10 000 cfu/g. The positive samples have been from vegetables, meat and seafood products. Farmers, especially sheep farmers, must ensure that feed has good quality in order to reduce the risk of listeriosis in animals.

Until a few years ago, it was considered that most illness cases of listeriosis were sporadic. After the implementation of WGS, it has been found that apparently sporadic cases can be linked to each other via the DNA sequence, indicating that the cases are parts of outbreaks that may last for years. Reaserach to generate knowledge about the reservoirs and reasons why some strains cause such long lasting outbreaks while other strains don’t is needed. As important, the bioinformatic methods applied for comparison of DNA sequences from different isolates of *L. monocytogenes* need to be sufficiently sensitive to detect differences between apparently matching strains, in order to avoid misinterpretations.

Verotoxin producing *E. coli* (VTEC)

The disease and its transmission routes
Escherichia coli are normal inhabitants of the intestines of humans and animals. Some *E. coli* can produce verotoxin (also called shigatoxin). These variants are called verotoxin (VTEC) or shigatoxin (STEC) producing *E.coli*, and can cause serious disease and bloody diarrhoea in humans (hence the term EHEC – enterohaemorrhagic *E. coli*). Transmission occur via food, water or by animal contact.

Surveillance and control
EHEC and diarrhoea-associated haemolytic uremic syndrome (HUS) are notifiable in humans. Detection of VTEC in animals is not notifiable but the NFSA should be informed so that measures can be considered. There is no routine surveillance of VTEC in animals or food, but several screening studies have been performed.

VTEC should not be found in ready-to-eat foods and detection of these bacteria in such foods would lead to withdrawal of the product from the market. Good hygiene and proper routines at slaughter reduces the risk of contamination of meat with VTEC.

Results 2022

The number of reported EHEC cases in humans in 2022 was 518. In 2020 and 2021 the number was 331 and 438, respectively (Figure 6). The number of cases developing HUS remains low (2-10 cases/year). Of the cases in 2022, 59% were diagnosed with low-virulent VTEC.

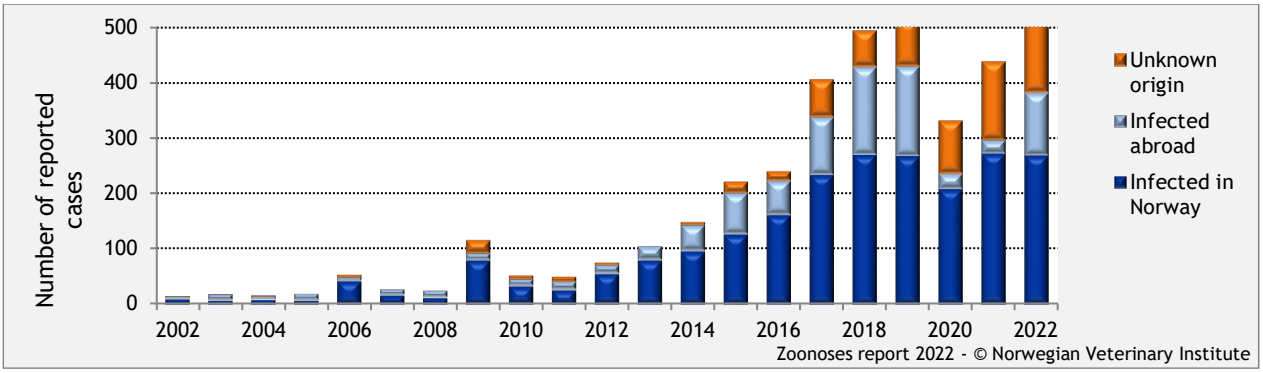


***Figure 6**. The number of reported cases of EHEC (enterohaemorrhagic E. coli) in humans. Data from MSIS.*

In a surveillance programme for wheat flour where the samples were collected in 2021, STEC was isolated from three of 151 samples. The isolates were characterized as STEC O187:H28 (*stx*2g), O155:H21 (*stx*2g) and O154:H31 (*stx*1d) and none of the isolates harboured the *eae* gene.

Evaluation of the current situation

More than half of the cases of EHEC have been infected in Norway. The increase seen from 2012 is most likely associated with the introduction of culture independent diagnostics (PCR) as a routine in primary diagnostics and the fact that more patients than before are investigated for EHEC. Several major medical microbiological laboratories investigate all submitted faecal specimens for several different pathogens, including EHEC. Previously, analysis for EHEC was only performed based on defined clinical or epidemiological indications. The number of reported cases of EHEC has returned to the same level as

in 2019 after a decline during the COVID-19 pandemic. For the number of domestically infected cases, the trend appears to be relatively stable since 2018. However, a large proportion of cases with an unknown place of infection in the past two years makes the trend difficult to interpret. In a survey of zoonotic *E. coli* in Norwegian cattle, conducted in 2014, the Norwegian Veterinary Institute (NVI) found a low occurrence of STEC, with 15.6% % of 179 herds positive for at least one STEC belonging to six serogroups (O26, O91, O103, O121, O145 and O157). In a survey of minced meat performed by the NVI in 2018, STEC were isolated from 2 of 308 samples, these two isolates belonged to serogroups O26 and O91. In 2020, 137 samples of domestically produced fermented sausages were analysed for STEC. STEC O76:H19 (*stx*$_{1c}$ positive) was isolated from one sample.

Tuberculosis

The disease and its transmission routes
Tuberculosis is caused by species in the *Mycobacterium tuberculosis*-complex. As a zoonosis, *Mycobacterium tuberculosis* subsp. *bovis* (*M. bovis*), which causes bovine tuberculosis, is the most important. This bacterium is mostly found in cattle. Humans are usually infected by drinking unpasteurised milk. Tuberculosis in humans is usually caused by *M. tuberculosis subsp. tuberculosis* (*M. tuberculosis*) which is transmitted between humans in microscopic airborne droplets. Humans may also transmit tuberculosis to animals. Tuberculosis can cause an array of symptoms depending on the affected organ system, but symptoms from the respiratory system are most common. Tuberculosis is a chronic infection in both animals and humans.

Surveillance and control
Tuberculosis in humans is notifiable in Norway. Persons in higher-risk groups are offered BCG vaccination. Tuberculosis caused by *M. bovis* and *M. tuberculosis* in animals is categorised as a group 2 disease in Norway and a category B disease in EU, while detection of other non-tuberculous mycobacteria are group C.

Norway is free of bovine tuberculosis, and this is acknowledged in the EEA agreement where Norway is declared as officially free. Vaccination of animals against tuberculosis is forbidden in Norway. All animals, except poultry, are inspected for tuberculosis at commercial slaughter. Any suspicious findings will be examined further. Tuberculin testing is performed on all breeding bulls and breeding boars at semen collection facilities, imported animals, and in cases where tuberculosis is suspected or must be excluded. Animals with a positive tuberculin test will be euthanized and further examined. The NFSA have a surveillance program for *M. tuberculosis* in cattle, camelids and farmed deer.

Results 2022

In total, 174 cases of tuberculosis in humans were reported in 2022. None of these was caused by *M. bovis,* and most of the infections were contracted abroad.

As part of the surveillance program for tuberculosis all cattle, sheep, goats, swine, horses and reindeer commercially slaughtered were examined *post mortem,* and any suspicious lesions are submitted for testing. Defined risk animals (imported animals and fallen stock) are also examined and tested, and so are any suspicious lesions found in fallen or suspected ill and culled animals, or hunted animals.

As part of the surveillance programs, the NFSA submit samples from suspicious lesions for testing. A total of 48 cattle from 47 herds, two camelids and one red deer were examined, and one cattle was positive. One cow showing suspicious lesion on *post mortem* routine meat inspection in November 2022, was later found positive for *M. bovis*.

In addition, 235 breeding boar studs and 491 breeding bulls were tuberculin tested, and all were negative. As part of diagnostic testing, samples from 5 swine were tested for *Mycobacterium* spp, but *Mycobacterium bovis* was not detected in any of the samples.

Evaluation of the current situation

M. bovis infection in humans is rarely reported in Norway. Less than 1% of the reported human tuberculosis cases in the last 10 years were caused by *M. bovis,* and these patients were either infected abroad or many decades ago in Norway. Since the mid-1990s, the number of tuberculosis cases caused

by *M. tuberculosis* has increased in Norway due to immigration, but since 2013 the number has decreased.
Bovine tuberculosis, *M. bovis* infection in cattle, was eradicated in Norway in 1963, but was detected in two areas in the 1980s. Source of *M. bovis* in these cases is unknown, but possibly transmission from an infected human. Tuberculosis in animals caused by M. *tuberculosis* is rare in Norway and was last reported in a dog in 1989.

Import of live animals to Norway, especially camelids like llama and alpaca, is associated with a risk of introducing *M. bovis* to the Norwegian animal population. Therefore, camelids are tested upon import to Norway. Infected humans are considered to represent a potential, but very low risk of introducing *M. bovis* and *M. tuberculosis* to Norwegian animals.

Following the finding of *M. bovis* in one cow with suspicious lesions in November 2022, investigative tests of the originating herd found 36 IFN-γ test positive animals. One receiving contact herd found one IFN-γ test positive animal. Further testing, contact tracing and follow up till be done in 2023.

Brucellosis

The disease and its transmission routes
Brucellosis is caused by *Brucella* bacteria, of which *B. abortus* (cattle), *B. melitensis* (sheep), and *B. suis* (pigs) are the most important zoonotic species. *B. canis,* which causes disease in dogs, is less pathogenic for humans.

Brucellosis may cause sterility and abortion in animals. In humans, fever is the most common symptom. The bacteria are shed in milk, and humans are usually infected through consumption of unpasteurised milk and products made from unpasteurised milk.

Surveillance and control
Brucellosis in humans is notifiable and brucellosis in animals is a notifiable as a list 1-disease.

The surveillance program for *Brucella* includes blood tests from cattle that have aborted and annual blood testing of a sample of the sheep and goat population. In addition, breeding bulls and boars and imported animals are tested. Vaccination of animals against brucellosis is forbidden in Norway. According to the EEA agreement, Norway is officially free of *B. abortus, B. melitensis* and *B. suis* in the bovine animals populations, and of *B. melitensis* in the ovine and caprine animal population.

Results 2022

One cases of brucellosis in humans were reported in 2022, and the person was infected abroad.

As part of the surveillance programmes, 78 cattle from 23 herds, 9,609 sheep from 3136 flocks, and 1,798 goats from 198 herds were tested. Antibodies against *Brucella* spp. were not detected. In addition, 535 breeding cattle and 2250 breeding pigs were tested and were negative for antibodies against *Brucella spp.* No alpacas were tested. Five dogs tested negative for *B. canis* antibodies and/or by culture.

Evaluation of the current situation

In humans, brucellosis is rare with only 2-4 reported cases per year, most of which have been infected abroad. The last case infected in Norway was in 2016.

Bovine brucellosis was eradicated from Norway in 1953 and brucellosis in sheep, goats and pigs has never been detected in Norway. In April 2021, ESA granted Norway status as officially free from *Brucella melitensis* in sheep and goats. *B. canis* has been detected in Sweden, but not in Norway.

Trichinellosis

The disease and its transmission routes
Trichinellosis is caused by small round worms, called *Trichinella*. Animals and humans may be infected through consumption of raw or poorly heat treated meat containing larvae. In the intestines, the larvae grow into adult worms and reproduce. Adult females set free larvae that move away from the intestines to muscle tissue. The most common symptom of trichinellosis is muscle pain, but the disease can also take more serious forms. Raw or poorly heat treated meat is the main source of infection.

Surveillance and control
Trichinellosis in humans is notifiable, and in animals it is a group B-disease. All carcasses of pigs and horses are checked for the presence of *Trichinella* at slaughter. Positive carcasses will be destroyed. Predator animals that are hunted/slaughtered and used for consumption (eg. wild boar or bear) should also be tested for *Trichinella*.

Results 2022

No cases of trichinellosis were reported in humans in 2022.

All commercially slaughtered pigs and horses were tested for *Trichinella*, and none were positive. The NVI also recommend that all hunted wild boar are tested for *Trichinella* before consumption. A health surveillance program for wild boar was started in 2018, and in 2022 samples from 219 wild boar harvested through hunting were tested for *Trichinella*, none were positive. Two hundred arctic foxes and one polar bear from the high Arctic archipelago of Svalbard were also analysed for *Trichinella* in 2022, four of the foxes and the one polar bear were positive, and *Trichinella nativa* identified.

Evaluation of the current situation

Trichinellosis in humans is very rare in Norway. The last case was reported in 1996, and the last case infected in Norway was reported in 1980.

Trichinella in domestic animals in Norway was last reported in two pig herds in 1994, and before that in 1981. *Trichinella* may be found in wild animals, and the parasite may transmit to domestic animals kept outside such as swine and horses. To date only two species of *Trichinella* have been confirmed in animals in Norway: *Trichinella nativa* and *T. britovi*. Since September 2018, hunters have had the opportunity to submit muscle tissue samples from wild boar hunted in Norway for free of charge *Trichinella* analysis when blood, feces and nasal swab samples are also submitted. The number hunted wild boar samples tested for *Trichinella* has increased significantly since 2018, and no samples have been positive. Muscle samples from selected wild predators were collected in 2020-2021 for *Trichinella* analysis and analysed in 2022. *Trichinella* larvae were detected in two of the 62 lynx analysed, in one of 16 wolves and in 6 of 79 wolverine. Species identification of these larvae is ongoing.

Echinococcosis

The disease and its transmission routes
Echinococcus granulosus and *E. multilocularis* are small tapeworms that can cause serious disease in humans. The parasites have their adult stage in the intestines of predators (eg. fox and dog), and parasite eggs are shed in faeces of these hosts (definitive host). Other animals (intermediate host) are infected through ingestion of the eggs. In the intermediate host the eggs hatch to larvae that migrate and encapsulate in cysts in various organs. The intermediate host must be eaten by a definitive host for the parasite to develop further into adult stages. It is the larval cysts in the intermediate host, e.g. in humans, that cause disease. Humans may be infected through eating fruit and berries contaminated with eggs or through direct contact with infective definitive hosts (e.g. dogs).

Surveillance and control
Echinococcosis in humans is notifiable in Norway and in animals it is a group 2 disease. Intermediate hosts for *E. granulosus* (eg. reindeer and cattle), are examined at slaughter. Since 2006, hunted red foxes have also been examined for *E. multilocularis*. This surveillance was intensified in 2011 when the parasite was detected in Sweden.

Results 2022

Nine cases of echinococcosis in humans were reported in 2022, all infected abroad.

In the surveillance program for *E. multilocularis*, 503 foxes and 24 wolves were examined, and *E. multilocularis* was not detected in any of them. All commercially slaughtered cattle, sheep and pigs were examined for *Echinococcus post mortem*, and no cases were identified. For details see the Appendix. In autumn 2022 cystic hydatidosis was identified in the lungs of a hunted moose during meat inspection and *E. canadensis* (G10 genotype) identified.

Monitoring of *E. multilocularis* prevalence was also carried out in the high Arctic archipelago of Svalbard in 2022. A total of 200 arctic foxes were examined and three positive animals found.

Evaluation of the current situation

Echinococcosis has never been a public health problem in Norway. During the years 2013-2022 between 0 and 11 cases have been reported annually of which almost all cases have been infected abroad. For the few remaining cases the place of infection were unknown.

E. granulosus was common in reindeer in northern Norway until the 1950s. Systematic treatment of shepherd dogs and reduced feeding of these dogs with raw meat and offal was effective and the parasite is now very rare in reindeer. It was last detected in 1990 and 2003. In cattle, *E. granulosus* was last reported in 1987. The detection of *E. canadensis* in a moose in the autumn of 2022 was not surprising given a known wolf-wild cervid cycle in neighbouring regions in Sweden and a shared wolf population. Advice has been provided to hunters in Norway to increase awareness of this parasite. This includes ensuring the proper disposal of slaughter waste, preventing hunting dogs from getting access to raw offal and, where this is not possible, giving the dogs appropriate anthelmintic treatment during the period with high infection risk (autumn hunt). The use of anthelmintics requires a prescription and so should be done in dialogue with the hunters' veterinary surgeon.

E. multilocularis has never been detected in mainland Norway. However, it is detected in Sweden, and surveillance of red foxes has been intensified in Norway in order to rapidly detect the parasite should it be introduced to Norway. Since 2002, 6,051 red foxes have been tested, and all were negative.

E. multilocularis is endemic in Svalbard in sibling voles (*Microtus levis*) and the Arctic foxes (*Vulpes lagopus*). Dogs and people in Svalbard are therefore at risk.

Dog owners must ensure that dogs entering Norway from other countries are given antiparasitic treatment according national regulations, https://lovdata.no/dokument/SF/forskrift/2016-05-19-542. *Echinococcus* is endemic in many European countries, including Denmark, Sweden, the Baltics and central Europe. Infection may be introduced to Norwegian via untreated, imported dogs or dogs returning with their owners after holidays abroad.

Toxoplasmosis

The disease and its transmission routes
Toxoplasma gondii is a single celled parasite that has its adult stage in the cat (definitive host). The parasite is shed in faeces and intermediate hosts (e.g. sheep, human, rodents) are infected through contaminated food or water or by direct contact with contagious cats. Humans can also be infected through consumption of inadequately heat treated meat. Healthy adults will usually not become sick from toxoplasmosis. However, if women contract the infection for the first time during pregnancy, it may result in abortion or harm the foetus.

Surveillance and control
Toxoplasmosis is not notifiable in humans or animals in Norway.

The NFSA provides dietary advice to persons in risk groups (http://www.matportalen.no). Every year some animals are tested for *T. gondii* due to disease, abortion or in association with import/export. Testing of cats for *T. gondii* is not considered necessary.

Results 2022

As part of the diagnostic work at the NVI, 11 sheep were tested serologically for *T. gondii and one was positive*.

Evaluation of the current situation

T. gondii is prevalent in Norway, but less prevalent than in southern Europe. It has been estimated that 90% of Norwegian women are susceptible to infection, and that 2 in 1,000 pregnant women contract the infection for the first-time during pregnancy. The parasite is estimated to transmit to the foetus in approximately 50% of these cases.

T. gondii is prevalent in several mammals in Norway, in particularly cats and sheep. In an investigation of lambs in the 1990s, 18% of the tested lambs had antibodies against *Toxoplasma,* and positive animals were found in 44% of the tested flocks. Similarly, in a study performed between 2002 and 2008, 17% of tested goats were antibody-positive, and positive animals were found in 75% of the tested herds. In another study, performed in the 1990s, 2.6% of pigs for slaughter were antibody positive. In a serological survey of Norwegian cats, 41% of 478 cats were seropositive for *Toxoplasma*, and the risk of positivity increased with age (Sævik *et a*l, 2015). Wild deer may be infected with *T. gondii*. In a serological study of 4,300 deer hunted between 1992 and 2000, 34% roe deer, 13% elk, 5% hart deer and 1% reindeer were antibody positive.

Rabies

The disease and its transmission routes
Rabies is caused by a lyssavirus, and the infection manifests itself as a neurological disease. The virus transmits though bites, or from exposure of open wounds to saliva from rabid animals. The incubation period is usually 1-3 months but may be longer. Untreated rabies is fatal. There are currently 17 species of lyssavirus. Bats are the principal reservoir hosts for most lyssaviruses, whereas carnivores, as well as bats, maintain circulation of rabies virus (RABV), and are the main source of infection in humans. In Europe, classic rabies is attributed to RABV, and bat rabies are caused by different virus. European bat lyssavirus 2 is detected in Norway and several neighbouring countries. Bat rabies in Europe has a much lower zoonotic potential than classic rabies.

Surveillance and control
Rabies is notifiable both in humans and in animals (group 1 disease). A vaccine is available for people who are traveling to high risk areas for extended periods. The vaccine is also used in combination with anti-serum to treat people who may have been exposed to rabies.

Animals with rabies will be euthanized, and measures will be implemented to stop further spread. From the 1st January 2012, dogs and cats imported from EU and EEA countries are only required to be vaccinated against rabies. Previously, a blood test to prove sufficient antibody titres was also mandatory. For dogs and cats imported from non EU non EEA countries, both a rabies blood test and proof of antibody titre is required.

Results 2022

Rabies was not detected in Norway in 2022.

One cat was tested for rabies at the NVI. Rabies was not detected.

Evaluation of the current situation

In rare cases, bat rabies may transmit from bats to other warm-blooded animals, including humans. Therefore, care is advised when handling bats, and any bite from a bat should be consulted with a doctor. It is not considered necessary to start vaccinating animals in Norway due to the detection of bat rabies in 2015.
Classic rabies has never been detected in animals in mainland Norway, but it has been detected in Arctic fox, reindeer and a ringed seal in Svalbard. The last detection was in 2011-2012 and before that 1999. Hence, outbreaks of rabies occur sporadically in Svalbard, most probably due to migrating arctic foxes during winter. It is important that persons living in or traveling to Svalbard are aware that rabies may occur among wild animals and take necessary precautions.
Dogs imported to Norway without vaccination may confer a risk of introducing rabies to mainland Norway. In a study performed at the NVI in 2012, serological results indicated that approximately 50% of dogs imported from Eastern Europe were improperly vaccinated or not vaccinated at all. Illegal import of dogs to Norway poses a threat to human and animal health due to the risk of introducing rabies to the country.

Q-fever

The disease and its transmission routes
Q-fever is caused by the bacteria *Coxiella burnetii*, and is mainly associated with ruminants. However, humans and other animals may also become infected and sick. The bacteria are shed in urine, faeces, foetal fluids, placenta and foetal membranes, and can survive for extended periods in the environment. Transmission is airborne via aerosols. In animals, infection results in weak offspring, abortions, infections of the placenta and uterus. In humans *C. burnetii* may cause influenza-like symptoms and rarely more serious disease.

Surveillance and control
Q-fever in humans has been notifiable in Norway since 2012, and is a group 2-disease in animals. Animals with clinical signs of Q-fever must not have contact with animals from other herds/farms and the NFSA may impose restrictions on animal holdings where infection is confirmed or suspected.

From 2012, samples collected in the surveillance programme for *Brucella abortus* in cattle have also been tested serologically for *C. burnetii*. The programme involves passive clinical surveillance, and blood samples from cattle with an abortion in the second half of the pregnancy are analysed.

Results 2022

Four cases of Q-fever in humans were reported in 2022, all were infected abroad.

At the NVI, blood samples from a total of 81 cattle were tested serologically for *C. burnetii* in the surveillance program and 12 cattle were tested before export. In addition, 5 alpacas were tested after import. Antibodies were not detected in any samples. For further information see the Appendix.

Evaluation of the current situation

Q-fever is currently not a problem for human or animal health in Norway. The infection became notifiable in humans in 2012, and for the years 2013-2022, 38 cases have been reported in total. Of these, 33 cases were infected abroad and five cases had an unknown place of infection.
Q-fever has not been detected in Norwegian animals. Screening studies were performed in 2008 (460 bovine dairy herds and 55 bovine meat herds), in 2009 (349 goat herds and 45 bovine herds) and in 2010 (3,289 bovine dairy herds). Testing is regularly performed on imported animals and as part of diagnostic testing of sick animals and from 2012, serological testing for Q-fever has also been included on samples from cattle collected in the surveillance program for Brucella.

BSE and vCJD

The disease and its transmission routes
Bovine spongiform encephalopathy (BSE, mad cow disease) in cattle and Creutzfeldt-Jacob disease (CJD) in humans are transmissible spongiform encephalopathies (TSE). These fatal diseases cause spongy degeneration of the brain and spinal cord. The infective agents are prions, protein structures without DNA. A form of CJD, variant CJD (vCJD) was first described as the cause of death in a person in the UK In 1995. The disease was suspected to be caused by consumption of beef containing the prion associated with classic BSE.

Other TSE-diseases that do not transmit between animals and humans have also been described, such as atypical BSE in cattle, scrapie in sheep, sporadic CJD in humans and chronic wasting disease (CWD) in deer.

Surveillance and control
Surveillance for BSE started in Norway in 1998, and includes testing of imported animals and their offspring, emergency slaughtered cattle, cattle with defined clinical signs at slaughter and a sample of routinely slaughtered cattle. All small ruminants with scrapie are tested to rule out BSE.

At slaughter, specified risk material (SRM) is removed from cattle and small ruminants. It is forbidden to use protein from animal (including fish protein) in feed for ruminants. Norway banned the use of bone meal in ruminant feed in 1990.

Results 2022

No cases of vCJD were reported in humans in 2022.

In total, 6,987 cattle were tested, and all were negative for BSE.

Antimicrobial resistance

Antimicrobial resistant bacteria may be zoonotic and transmit through direct or indirect contact, including through food. One example is methicillin resistant *Staphylococcus aureus* (MRSA), which may transmit between animals and humans.

Surveillance and control
Infection and carriage of some types of antimicrobial resistant bacteria such as MRSA is notifiable in humans (www.fhi.no) and in animals (NFSA) in Norway. In addition, selected microbes from certain infections, and their resistance profiles, are reported annually to the NORM surveillance programme for antimicrobial resistance in human pathogens. Correspondingly, antimicrobial resistance in bacteria from animals, feed and food are reported through the NORM-VET surveillance programme. There is a separate surveillance programme for MRSA in swine, aimed at identifying MRSA positive herds as Norway has chosen a strategy to eradicate MRSA from swine.

The 2022 data confirm that the situation regarding antimicrobial resistance in bacteria from animals and food in Norway is good. The occurrence of multi-drug resistance (MDR), i.e. resistance to three or more antimicrobial classes, and specific emerging resistant bacteria/mechanisms such as resistance to extended-spectrum cephalosporins (ESC), are low. Carbapenem-resistant *Enterobacterales* (CRE) have never been isolated in samples from production animals or food in Norway. This still applies for the 2022 results.

A total of 91 *Campylobacter jejuni* isolates from chicken were susceptibility tested in 2022. Only two isolates of *C. coli* were identified, and these were not further analyzed. A total of 89.0% of the *C. jejuni* isolates were fully susceptible to all antimicrobial agents included in the test panel. MDR was detected in 1.1% of the isolates.

The MRSA surveillance programme in pigs did not detect any pig herds with MRSA in 2022. In total, 591 herds were included in the survey, of which 82 were genetic nucleus or multiplier herds, 11 herds were central units of the sow pool herds, 16 were of the largest farrow to grower or farrow to finish herds, and the remaining 482 were herds with more than 10 sows.

Evaluation of the current situation

Antimicrobial resistance in bacteria has become a serious threat to human and animal health globally. The prevalence of antimicrobial resistant bacteria is still low in both humans and animals in Norway compared to other European countries. However, the situation is threatened by the high use of antimicrobials globally.

MRSA was most likely first introduced to Norwegian swine production through labourers carrying the bacteria, and subsequently spread further through movement of live animals. From swine, MRSA may transmit back to humans through direct or indirect contact. This form of transmission is difficult to control and is a modern biosecurity challenge in Norwegian food production.

Foodborne outbreaks

An outbreak is either defined as more cases than expected of a specific disease within a defined geographical area and time period, or as two or more cases of a disease with a common source of infection. In 2005, the NIPH and the NFSA introduced a web-based system for reporting outbreaks, Vesuv. The system is used by specialist- and municipal health services and the NFSA to notify outbreaks. The following types of outbreaks are notifiable through Vesuv: outbreaks of conditions that are notifiable in MSIS; outbreaks associated with food or water; outbreaks caused by particularly serious infections; very large outbreaks; and outbreaks in healthcare institutions. The four last categories also include outbreaks of conditions that are not notifiable in MSIS.

The purpose of investigating foodborne outbreaks is to stop the outbreak, implement control measures and prevent future outbreaks. The District Medical Officer is responsible for coordinating investigation and response to outbreaks in his/her municipality. Proper outbreak investigation requires cooperation between local and central health authorities, the NFSA and other relevant authorities.

Results 2022

In 2022, the NIPH received 34 notifications through Vesuv of possible or confirmed foodborne outbreaks outside health institutions. In total, 628 persons were reported to have become sick in these outbreaks. The number of affected persons in each of the outbreaks varied between 2 and 100 (median 9). Norovirus caused eight outbreaks, Salmonella five, Cryptosporidium three and Yersinia three. In 11 of the outbreaks, the causative agent was not identified (Figure 7).

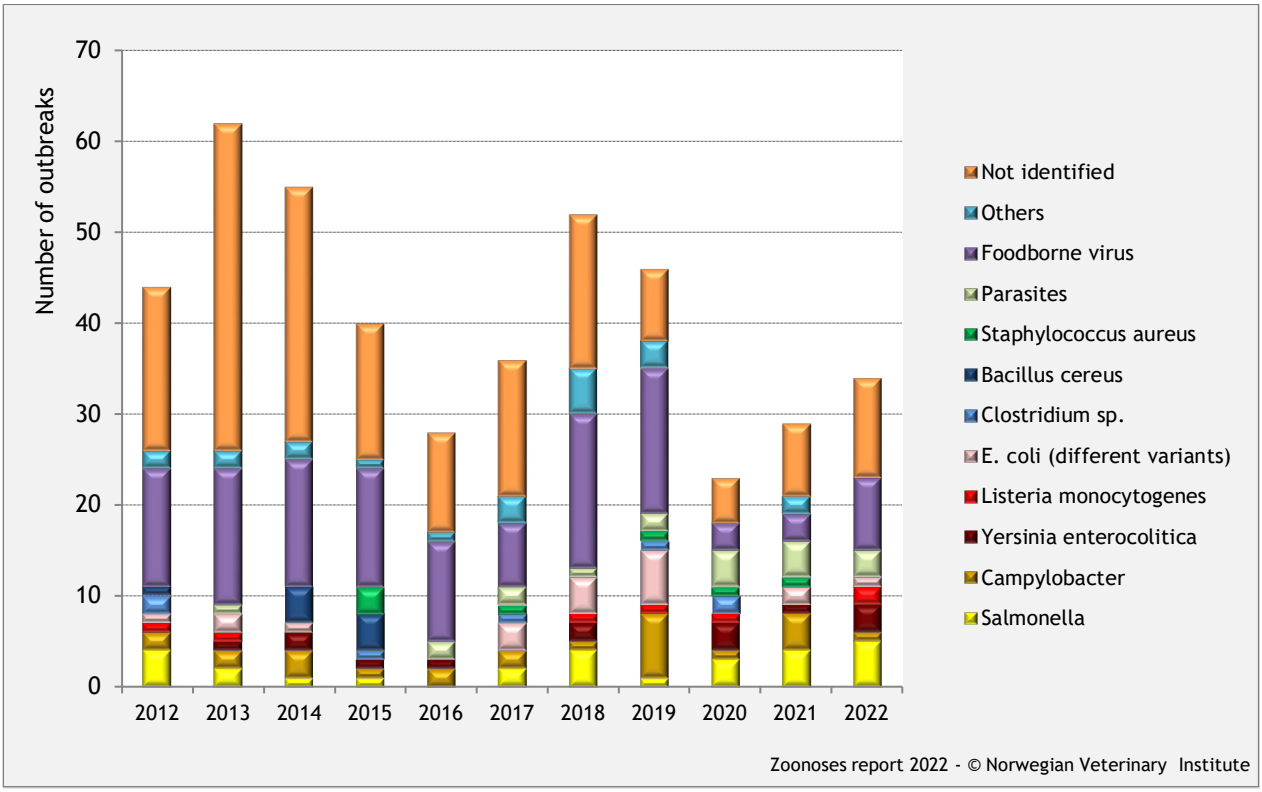


***Figure 7**. The number of reported foodborne outbreaks where an agent was verified or strongly suspected.*

Appendix Tables

Table 1. *Human population of Norway per 1st January 2022 (from statistics Norway).*

Age group	Female	Male	Total
0 - 9	285998	301716	587714
10 - 19	315148	331872	647020
20 - 29	339869	361714	701583
30 - 39	365394	383728	749122
40 - 49	347881	366352	714233
50 - 59	354218	370641	724859
60 - 69	297200	298918	596118
70 - 79	238584	225744	464328
80 - 89	111418	82317	193735
90 -	32228	14330	46558
Total	2687938	2737332	5425270

Table 2. *Animal population of Norway in 2022.*

Animal species - category	Number*		
	Herds /flocks	Animals	Slaughtered animals
Cattle - total	11 700 [a]	897 000 [a]	300 000 [c]
Dairy production	6 700 [a]	210 000 [a]	
Meat production	6 000 [a]	100 000 [a]	
Combined production	1 000 [a]		
Sheep - total			1 100 000 [c]
Sheep >1 year	13 200 [a]	927 000 [a]	
Goats - total	1 400 [a]	75 000 [a]	25 000 [c]
Dairy goats	300 [a]	35 500 [a]	
Swine - total	2 400 [a]	750 000 [a]	1 600 000 [c]
Breeding pigs	900 [a]	41 500 [a]	
Slaughter pigs	800 [a]	425 000 [a]	
Chickens (*Gallus gallus*)			
Grandparent stock – egg producers	2 (3)[b]		
Parent stock – egg producers	8 (25)[b]		
Parent stock – broiler	84 (195)[b]		
Laying hens	575 (887)[b]		
Broilers	588 (4 679[1])[b]		75 000 000 [c]
Turkey, goose and duck			
Parent stock	6 (25)[b]		
Meat production	54 (449[1])[b]		960 000 [c]
Farmed deer	150[a]	6 000[a]	

[a] Figures from the registry of production subsidy per 31.3.2022.
[b] Figures from the surveillance programme for *Salmonella* in 2022
[c] Figures from the Norwegian Agriculture Agency (based on delivery for slaughter)
[1] Slaughter batches

Table 3. *The most common Salmonella serovars found in humans in Norway in 2022.*

Serovar	Place of infection			Total
	Norway	Abroad	Unknown	
S. Enteritidis	44	116	42	202
S. Agona	80	1	3	84
S. Typhimurium monophasic variant	43	12	8	63
S. Typhimurium	28	19	12	59
S. Java	7	3	5	15
S. Newport	7	5	1	13
S. Stanley	7	5	1	13
S. Chester	1	8	3	12
S. Infantis	9	1	1	11
S. Blockley	10	0	0	10
Andre	88	82	60	230
Totalt	**324**	**252**	**136**	**712**

Table 4. *Human cases of campylobacteriosis (infected in Norway) in 2022 distributed by county. From 2017 both cases verified by PCR and/or culturing are notifiable to MSIS and included in the table. PCR positive cases are also included for 2015 and 2016.*

County	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Agder	55	81	41	57	77	44	51	71	60	43
Innlandet	113	121	82	107	152	114	113	137	131	94
Møre og Romsdal	47	73	34	32	71	59	47	62	43	40
Nordland	46	60	47	37	44	58	45	66	47	37
Oslo	103	121	56	54	109	145	126	165	132	103
Rogaland	169	129	116	150	205	130	118	150	105	95
Troms og Finnmark	29	74	55	76	71	56	66	66	50	45
Trøndelag	124	151	120	121	149	118	130	145	96	109
Vestfold og Telemark	76	119	68	62	147	109	239	121	85	69
Vestland	142	182	148	163	216	189	350	234	159	188
Viken	246	260	117	128	271	203	266	298	294	166
Totalt	**1150**	**1371**	**884**	**987**	**1512**	**1225**	**1551**	**1515**	**1202**	**989**

***Table 5**. Foodborne outbreaks 2022.*

Agent	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Salmonella sp.	2	1	1		2	4	1	3	4	5
Campylobacter sp.	2	3	1	2	3	1	7	1	4	1
Yersinia sp.	1	2	1	1	1	2		3	1	3
Listeria monocytogenes	1					1	1	1		2
Escherichia coli (VTEC)	2	1		1	3	4	6	0	2	1
Clostridium sp.			1		1		1	2		
Bacillus cereus		4	4					0	1	
Staphylococcus enterotoxin			3		1		1	1	1	
Parasites	1			2	2	1	2	4		3
Virus	15	14	13	11	7	17	16	3	4	8
Other	2	2	1	1	1	5	3	0		
Unknown	36	28	15	11	15	17	8	5	8	11
Total	**62**	**55**	**40**	**29**	**36**	**52**	**46**	**23**	**25**	**34**

***Table 6**. Salmonella in feed and feedstuff 2022.*

Category	Number tested*	Number positive	Comment
Feedstuff			
Cereal grain	153	0	
Corn	34	0	
Rape	35	0	
Soya	2 196	1	S. enterica subsp. arizonae
Sunflower	7	0	
Legume seeds etc.	10	0	
Tubers, roots etc.	15	0	
Other plant based feedstuffs	415	13	S. Agona (5), S. enterica subsp. enterica (1), S. Havana (2), S. Jodhpor (1), S. Molada (1), S. Rissen (3)
Meat based feedstuff	347	0	
Marine based feedstuff	183	0	
Feed			
Domestic animals (cattle, swine, poultry)	42 (20)	0	
Fish	2 299 (33)	0	
Environmental samples in factories producing feed and feedstuff	14 242	166	35 different serovars

Total numbers are presented, in brackets the number of samples collected by Authorities.

Table 7. *Salmonella in animals 2022.*

Category	Number tested[1]	Number positive[1]	Comment
Chicken – surveillance - breeding flocks	223	0	
Chicken – surveillance – layer flocks	887	0	
Chickens – surveillance – broiler flocks[2]	4 679	0	
Chicken flocks – other samples	3	0	
Turkey, ducks, geese – surveillance - breeding flocks	25	0	
Turkey, ducks, geese – surveillance – meat flocks[2]	449	0	
Turkey, ducks, geese – other samples	0	0	
Cattle – surveillance – animals (lymph nodes)	3 337	1	*S.* Typhimurium
Cattle – diagnostics - herds	37	2	*S.* Typhimurium, *S.* Typhimurium monofasisk (4,[5],12 : i :
Sheep – diagnostics - herds	11	2	*S. diarizonae* 61:k:1,5,7
Goats- diagnostics - herds	1	0	
Swine – surveillance – slaughter pigs – animals (lymph nodes)	1 761	1	*S.* Typhimurium
Swine – surveillance – sows – animals (lymph nodes)	1 408	2	*S.* Typhimurium
Swine – surveillance – breeding herds	67	0	
Swine – diagnostics - herds	30	3	*S.* Typhimurium
Horse – diagnostics – animal	8	0	
Dog - diagnostics	93	2	*S.* Typhimurium. *S.* Oranienburg
Cat - diagnostics	73	32	*S.* Typhimurium
Alpaca – herds - diagnostics	3	0	
Wild boar – surveillance - animals	208	3	*S.* ent. subsp. *diarizonae*
Animals/birds/zoo birds/zoos	24	2	*S.* ent. subsp. *diarizonae*, *S.* ent. subsp. *salamae*
Reptiles	10	8	*S.* ent. subsp. *diarizonae* (4), *S.* Enteritidis, *S.* Jangwani, *S.* Oranienburg, *S.* Vitkin
Various wild animals	10	0	
Wild birds	9	0	

[1] Units for numbers are given in the first column.
[2] Number of slaughter batches

Table 8. *Salmonella in food 2022.*

Category	Number sampled	Number positive	Comment
Cattle – swab of carcass – surveillance	3 081	1	*S.* ent. subsp. *diarizonae* 61:k:1,5,7
Swine - swab of carcass – surveillance	2 968	0	
Meat scrapings (cattle, swine. sheep) - surveillance	3 161	0	
Fish raw – Norwegian – IMR*	0	0	
Fishery products – imported – IMR*	98	0	
Shellfish - Norwegian – IMR*	42	0	

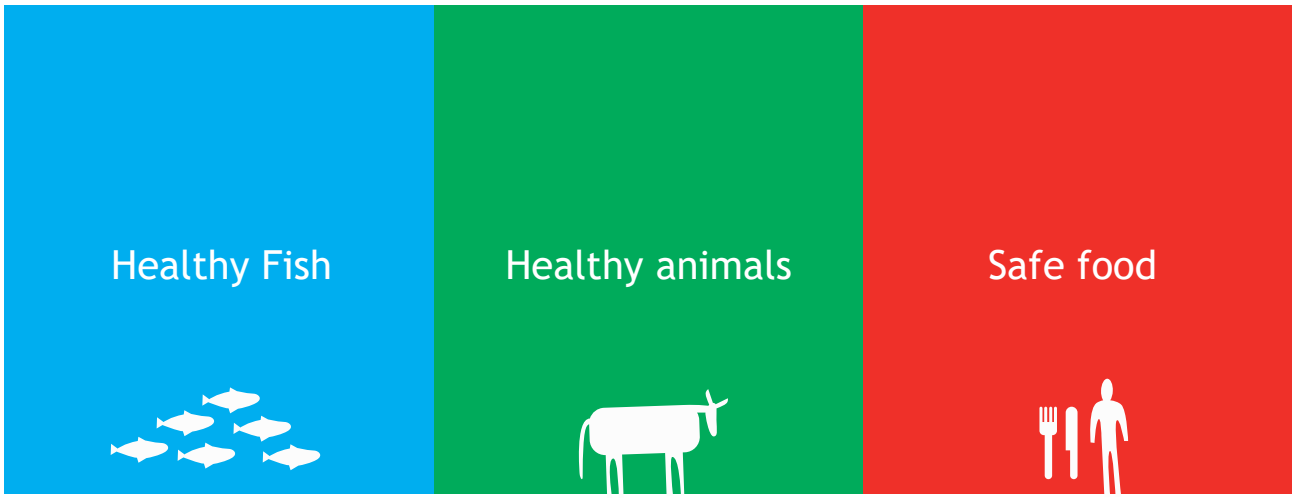
* Data from Institute of Marine Research (Havforskningsinstituttet)

***Table 9**. Selected zoonoses in animals 2022. Salmonella is presented in separate tables.*

Infection/agent	Category	Number tested	Number positive	Comment
Campylobacteriosis	Broiler chicken flocks – surveillance	2 189	106	May - October
	Cattle – diagnostics	48	20	*C. jejuni*
	Dog – diagnostics	75	34	*C. upsaliensis* (26), *C. jejuni* (8)
	Sheep – diagnostic	22	5	*C. jejuni*
	Cat – diagnostics	15	1	*C. upsaliensis*
Tuberculosis	Cattle – surveillance - animals	48	2**	*M. bovis*
	Camelides – surveillance - animals	2	0	
	Red deer – surveillance - animals	1	0	
	Swine – diagnostic – herds	5	5	*M. avium* subsp. *Hominissuis*
	Cattle – tuberculin testing	491	0	
	Swine – tuberculin testing	235	0	
Brucellosis	Cattle – surveillance	78	0	
	Cattle – breeding animals	535	0	
	Sheep – surveillance	9 609	0	
	Goat – surveillance	1 798	0	
	Swine – breeding stock	2 250	0	
	Dog	5	0	
Echinococcosis	Fox – surveillance	503	0	
	Wolf – surveillance	24	0	
	Moose – diagnostics	1	1	*E. canadensis* G10
	Cattle, small ruminants, swine, horse	All slaughtered*	0	
Toxoplasmosis	Sheep – diagnostics	11	1	*T. gondii*
	Cat – diagnostics	1	0	
Trichinellosis	Pig and horse	All slaughtered*	0	
	Wild boar – surveillance	219	0	
	Arctic fox	200	4	*T. nativa*
	Polar bear	1	1	*T. nativa*
Q-fever	Cattle – surveillance	81	0	
	Cattle – export	12	0	
	Alpaca – import	5	0	
BSE	Cattle – surveillance - animal	6 987	0	
MRSA	Swine – surveillance – herds	591	0	

* Commercial slaughtered animals (for animal population see Table 2).

** For more details see chapter on tuberculosis



Scientifically ambitious, forward-looking and collaborative- for one health!

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