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The Norwegian Zoonoses Report

2021



The Norwegian Zoonoses Report 2021

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Summary

The occurrence of most zoonotic pathogens in animals was stable in 2021 compared to previous years. The occurrence in humans decreased in 2020 and 2021 probably due to less traveling and the application of infection control measures in the COVID-19 situation. The decrease was highest for campylobacteriosis, salmonellosis and *E. coli* (EHEC/VTEC) infections, mainly due to less travel associated cases

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

Human

“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 (reported to the NFSA) 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 states that veterinarians and laboratories must notify the NFSA about specified animal diseases categorized as A-, B-, and C-diseases. 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 A and B diseases in animals should be notified immediately to the NFSA. Diagnosis of group C disease in animals should be reported to the NFSA within seven working days.

If a group A- or B-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 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 are 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, 13 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.

Table 1: Disease/agents included in the zoonosis report in 2021 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 (B-disease)	Yes
Campylobacteriosis	Yes	No*	No**	Yes
Yersiniosis	Yes	No*	No	No (occasionally)
Listeriosis	Yes	No*	Yes (C-disease)	No
Pathogenic <i>E. coli</i>	Yes	Yes*	Yes*	No (occasionally)
Tuberculosis	Yes	Yes	Yes (B-disease)	Yes
Brucellosis	Yes	Yes	Yes (A-disease)	Yes
Trichinellosis	Yes	Yes	Yes (B-disease)	Yes
Echinococcosis	Yes	Yes	Yes (B-disease)	Yes
Toxoplasmosis	No	No	Yes (C-disease)	No
Rabies	Yes	-	Yes (A-disease)	No
Q-fever	Yes	-	Yes (C-disease)	No (occasionally)
BSE og vCJD	Yes	-	Yes (B-disease)	Yes
MRSA	Yes	-	YES (B-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.

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 B-disease). 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 2021

A total number for 390 reported cases of salmonellosis in humans was reported in 2021. The number of reported cases decreased in 2020 and 2021 compared to the years before the covid-19 pandemic (Figure 1). Information on the most frequently detected serotypes is presented in the Appendix.

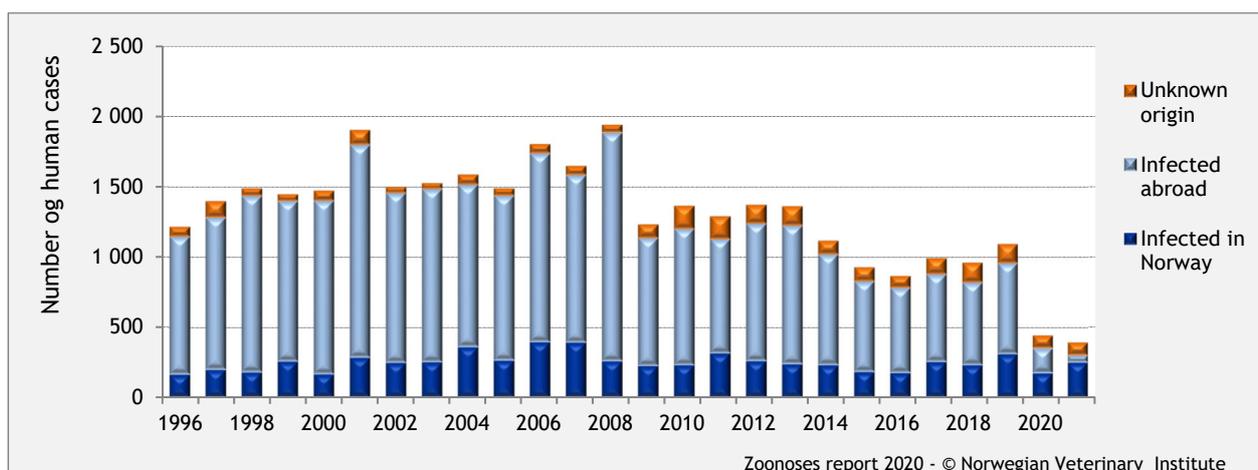


Figure 1: Reported cases of salmonellosis in humans. Data from MSIS

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). From altogether 9,121 faecal samples in 1,334 poultry holdings one layer flock was positive for *Salmonella*, giving an estimated *Salmonella* prevalence of 0.1 % in egg production flocks. *Salmonella* was not detected in 1,355 faecal samples from 72 elite and multiplier breeding swine herds, but one of 3,079 lymph node samples from slaughtered pigs was positive for *Salmonella* giving an estimated *Salmonella* prevalence of 0.03% at the individual carcass level. None out of 3,327 lymph node samples from cattle were positive for *Salmonella*. A total of 6,005 swab samples of cattle and swine carcasses were examined, and one sample from a swine carcass was positive for *Salmonella*, giving an estimated *Salmonella* prevalence of 0.02% at sample level. From a total of 3,145 samples of from crushed meat one sample was positive for *Salmonella*, giving an estimated *Salmonella* prevalence of 0.03% at sample level.

In 2021, as part of the NORM-VET program, detection of *Salmonella spp.* was performed in samples collected with regard to Commission Implementing Decision 2020/1729/EU on a total of 301 caecal samples from cattle less than one year of age and 324 caecal samples from fattening pigs. None were positive for *Salmonella spp.* *Salmonella* was detected in samples from three dogs and five cats, in 15 of 17 samples from reptiles, and in 13 of 287 tested 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 number of cases infected in Norway has remained relatively stable with an incidence of 3.6 to 6.1 for the period 2015-2019, but decreased to 3.2 in 2020 and 4.6 in 2021, probably due to measurements against covid-19 in Norway. 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 (n=1 flocks in 2021). This variant is only rarely associated with disease in animals and is not considered a public health threat.

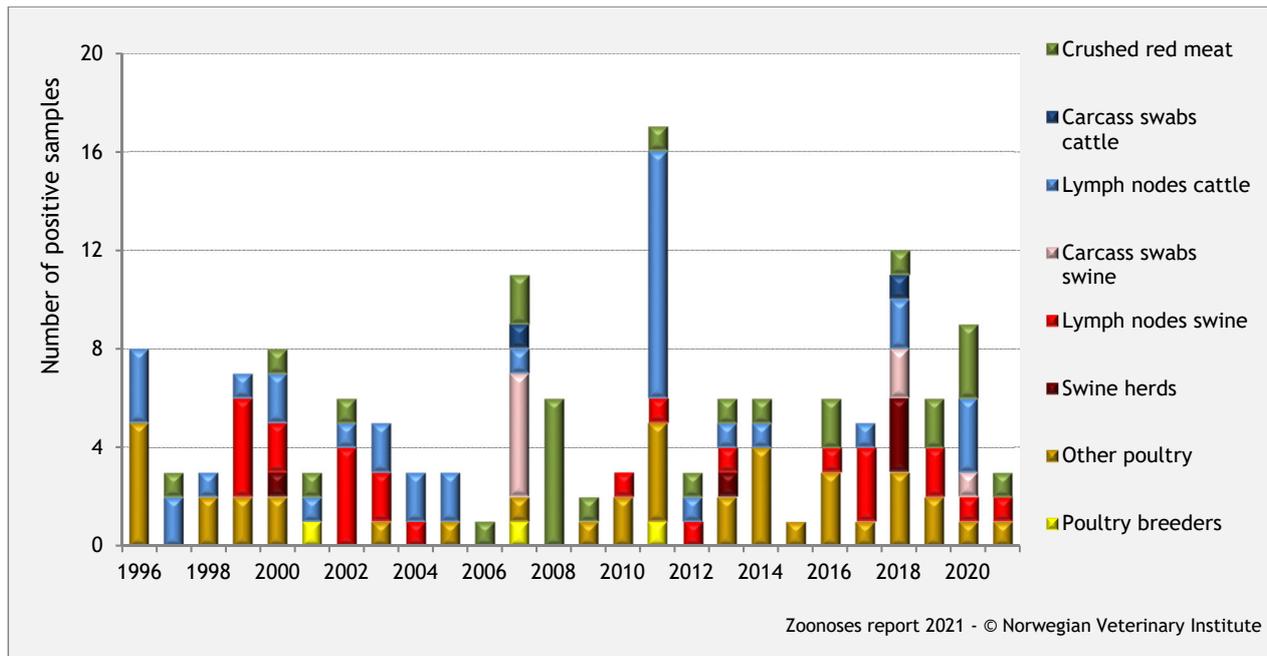


Figure 2: The number of positive samples in the *Salmonella* surveillance programme

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. *Salmonella* spp. is also sporadically detected in wild boar in Norway. During 2021, *Salmonella* was detected in samples from 13 of 287 hunted wild boar from which fecal samples were submitted for laboratory analysis. The predominant serotype during 2021 with seven cases 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 2021

In MSIS, 2,055 human cases of campylobacteriosis were reported in 2021, of which 1,196 contracted the infection in Norway. For 636 of the cases, place of infection was unknown. The decreased number of cases in 2021 compared to the years before the covid-19 pandemic is mainly due to less cases infected abroad. Approximately half the reported cases during 2017-2019 were infected abroad. The number of cases infected in Norway were slightly lower in 2021 (1,196) than in 2020 (1,514).

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 2021 showed that a total of 110 flocks (5.8%) 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 1 891 flocks from 485 farms were sampled. Of all farms sampled, 84 (17.3%) had positive flocks, and of these, 20 (4.1% of all farms) had two or more positive flocks. This means that 41.8% of the positive flocks originated from 4.1% 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 2016 - 2018 and 2020 with 7.7%, 7.1%, 6.3% and 6.1% positive flocks respectively, and a bit higher than the result from 2019 (5.1% positive flocks). The prevalence is still very low, compared to most other European countries.

During 2021 caecal samples from 326 fattening pigs and 307 cattle less than one year were examined for *Campylobacter* in the national antimicrobial resistance monitoring program (NORM-VET). *C. jejuni* was detected in 17 of the samples from pigs (5.2 %) and in 136 of the samples from cattle (44.4 %). Respectively, *C. coli* was detected in 293 of the pig samples (89.9 %) but in none of the cattle faecal samples.

In the diagnostic services at the NVI, *Campylobacter* was detected in samples from 32 cattle, 37 dogs and 1 cat. For details see the Appendix.

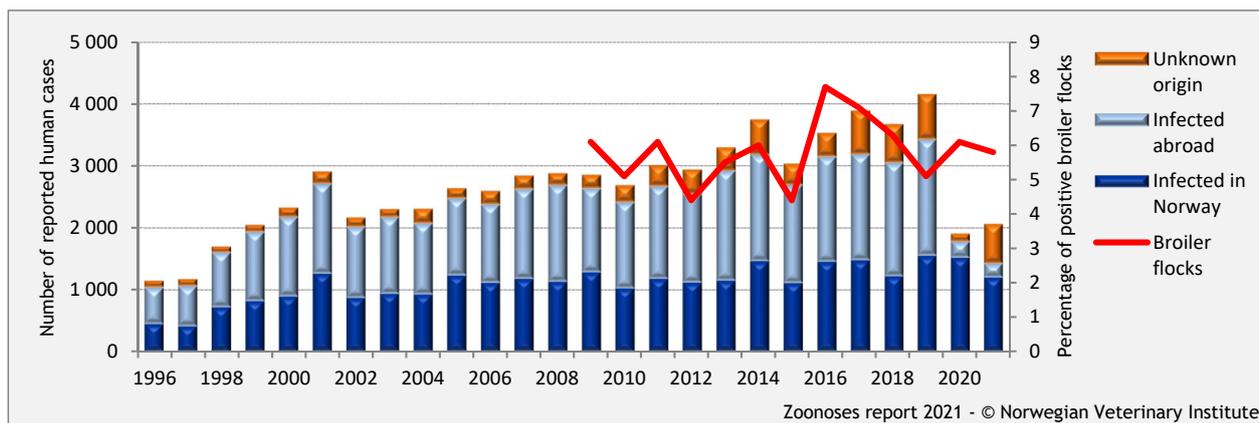


Figure 3: The number of reported cases of campylobacteriosis in humans (data from MSIS) and the percentage of positive broiler flocks (sampled between 1st May and 31st October)

Evaluation of the current situation

Campylobacteriosis is the most commonly reported zoonosis in humans in Norway. Before the covid-19 pandemic more than half the cases were usually reported as travel associated (infected abroad). 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 *Campylobacter* 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

Results

The number of reported human cases of yersiniosis in 2021 (85) was similar compared to 2020 (Figure 4). The reported cases in 2021 were caused by *Y. enterocolitica* (83) and *Y. pseudotuberculosis* (2). *Y. enterocolitica* O9 was detected in one calf and one hare in 2021, while one goat, one deer and one zoo-animal were positive for *Y. pseudotuberculosis* in 2020.

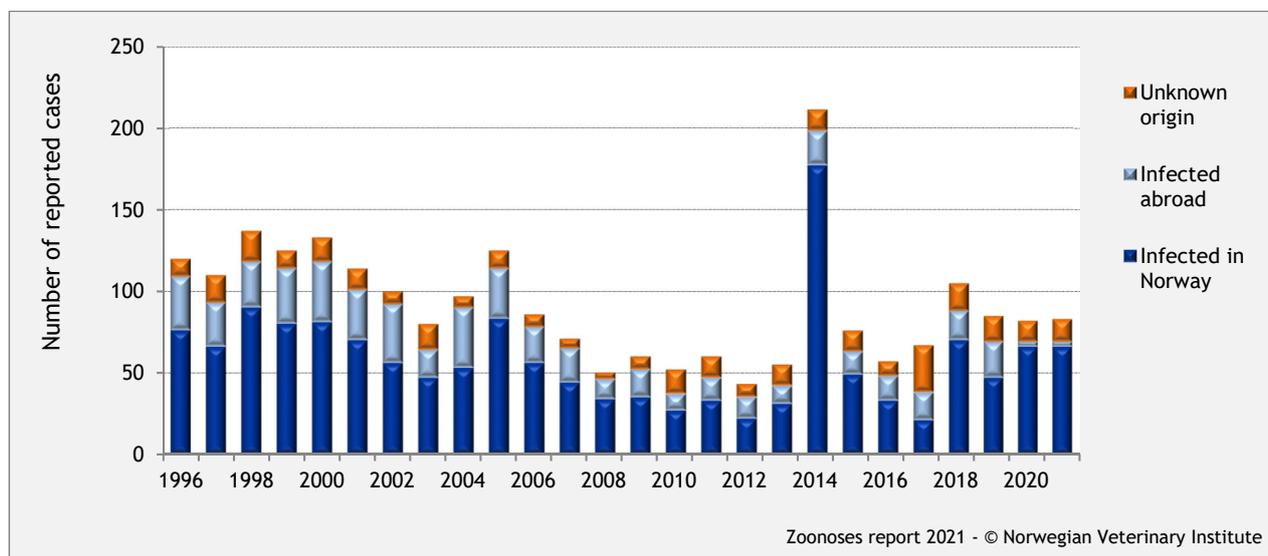


Figure 4: The number of reported cases of yersiniosis in humans. Data from MSIS

Evaluation of the current situation

Most yersiniosis cases in humans in Norway are sporadic and have been acquired domestically. In 2014 and 2018, there was a significant increase in the number of reported cases due to outbreaks. In 2021, one outbreak investigation was conducted due to *Y. enterocolitica* O:3. This outbreak included 17 cases.

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 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 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 2021

The number of listeriosis cases in humans in 2021 (20) is lower than previous years. Fourteen of the cases were infected in Norway (Figure 5). No outbreak was reported in 2021.

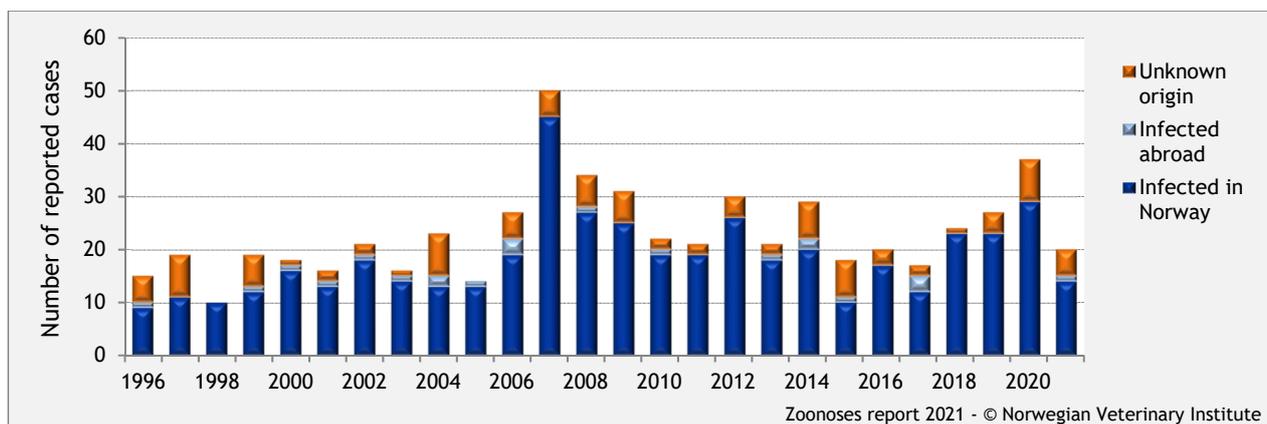


Figure 5: The number of cases of listeriosis in humans. Data from MSIS

In the diagnostic services at the NVI, *L. monocytogenes* was detected in 19 sheep from 12 farms in 2021. One out of 302 samples in the surveillance program for ready-to-eat foods in 2021 was positive for *Listeria monocytogenes*. The sample contained less than 100 cfu/g. The Institute of Marine Research (Havforskningsinstituttet) examined 68 samples of seafood from Norway for *L. monocytogenes*, one of which was positive, but with less than 100 cfu/g. Fifty five samples of imported fish products were also analysed, and *L. monocytogenes*

was not detected in any of them. In addition to surveillance samples, NVI received samples from sporadic human listeriosis cases and verification samples from commercial labs. One of the illness cases were related to high concentrations of *Listeria* in "sylte" (meat jelly).

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. Knowledge about the reservoirs and reasons why some strains cause such long lasting outbreaks while other strains don't is needed.

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 2021

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

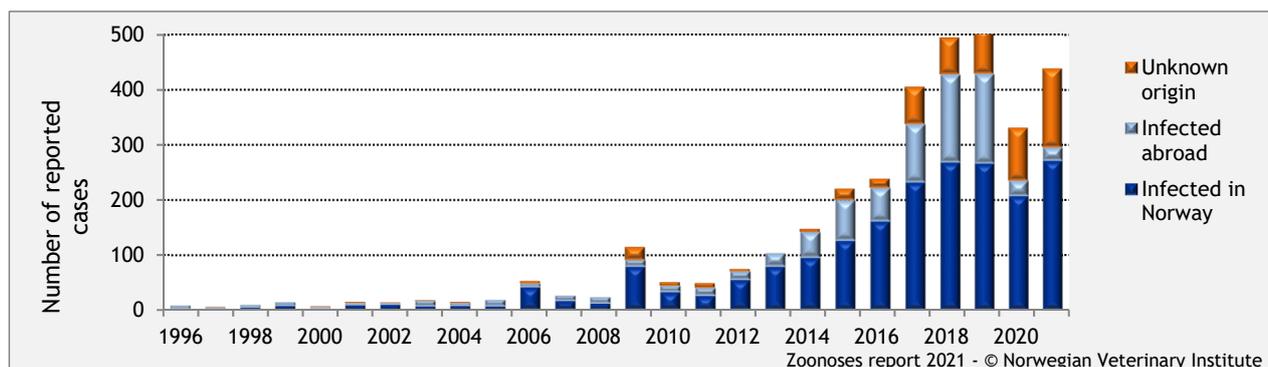


Figure 6: The number of reported cases of EHEC (enterohaemorrhagic *E. coli*) in humans. Data from MSIS

Two samples were received for analyses at the Norwegian Veterinary Institute in relation to investigation of one case of EHEC infection in a human in 2020. EHEC/STEC were not detected in these samples. Cheese samples in the surveillance program for ready-to-eat foods were analysed for VTEC. None of the 40 samples were positive. Samples of wheat flour were collected in 2021 and are in the process of tested for STEC. Results will be presented in the 2022 report.

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 trends for EHEC might be uncertain because of the infection control measures due to the covid-19 pandemic.

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 B disease, 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 2021

In total, 154 cases of tuberculosis in humans were reported in 2021. None of these was caused by *M. bovis*, and most of the infections were contracted abroad.

All cattle, sheep, goats, swine and horses commercially slaughtered were examined *post mortem*. Also, as part of the surveillance programs, the NFSA submit samples from suspicious lesions for testing, and five cattle, two camelids and one red deer were examined, and all were negative. In addition, 207 breeding boar studs and 254 breeding bulls were tuberculin tested, and all were negative. As part of diagnostic testing, samples from 3 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 one area in the 1980s. This was most probably 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. Foreign farm labourers represent a potential, but very low risk of introducing *M. bovis* and *M. tuberculosis* to Norwegian animals.

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 listed as a notifiable group A-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 2021

Three cases of brucellosis in humans were reported in 2021, both of them were infected abroad.

As part of the surveillance programmes, 106 cattle from 34 herds, 9,030 sheep from 3123 flocks, and 1,540 goats from 52 herds were tested. Antibodies against *Brucella* spp. were not detected. In addition, 344 breeding cattle and 2447 breeding pigs were tested and were negative for antibodies against *Brucella* spp. Forty alpaca were tested due to export and were negative. Three 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.

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 2021

No cases of trichinellosis were reported in humans in 2021.

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 2021 samples from 292 wild boar harvested through hunting were tested for *Trichinella*, none were positive.

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. 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.

Echinococcosis

The disease and its transmission routes

Echinococcus granulosus and *E. multilocularis* are small tape worms 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 B 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.

Dogs entering Norway must be treated for *Echinococcus* before arrival. Regular anti-parasitic treatment of dogs is also recommended in areas with reindeer.

Results 2021

Eleven cases of echinococcosis in humans were reported in 2021. Ten cases had contracted the infection abroad, and for one case the place of infection was unknown.

In the surveillance program for *E. multilocularis*, 511 foxes and 19 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.

Evaluation of the current situation

Echinococcosis has never been a public health problem in Norway. During the years 2012-2021 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.

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, 5,548 red foxes have been tested, and all were negative.

E. multilocularis is endemic in Svalbard in sibling vole (*Microtus levis*) and the Arctic fox (*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 to the regulations. Echinococcosis occurs in dogs in southern Europe, and the infection may be introduced to the Norwegian population 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 2021

As part of the diagnostic work at the NVI, 3 sheep were tested serologically for *T. gondii*. None were 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 seroscreening study of Norwegian cats, 41% of 478 cats were seropositive for *Toxoplasma*, and the risk of positivity increased with age (Sævik *et al*, 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 through 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 A 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 2021

Rabies was not detected in Norway in 2021.

One dog, one cat, five bats, and one reindeer from Svalbard were tested for rabies at the NVI. Rabies was not detected in any of these. For further information see the Appendix.

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 C-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 2021

Three cases of Q-fever in humans were reported in 2021. Two had contracted the infection abroad, and for one case the place of infection was unknown.

At the NVI, blood samples from a total of 137 cattle were tested serologically for *C. burnetii* in the surveillance program and 20 cattle were tested before export. In addition 15 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 2013-2021, 33 cases have been reported in total. Of these, 28 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 2021

No cases of vCJD were reported in humans in 2021.

In total, 7,037 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 (MSIS) 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.

In 2021, 290 *Campylobacter coli* and 17 *Campylobacter jejuni* from fattening pigs, and 127 *C. jejuni* from cattle less than one year, was susceptibility tested. Overall, 81.7% of the *C. coli* isolates from fattening pigs were fully susceptible to all antimicrobial agents included in the panel, while the remaining isolates were resistant to quinolones. Among the 17 *C. jejuni* pig isolates, only one isolate was resistant (to quinolones). A total of 86.6% of the *C. jejuni* from cattle were fully susceptible to all antimicrobial agents included in the panel. The remaining isolates were resistant to either quinolones and/or tetracyclines.

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 under threat 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 2021

In 2021, the NIPH received 25 notifications through Vesuv of possible or confirmed foodborne outbreaks outside health institutions. In total, 327 persons were reported to have become sick in these outbreaks. The number of affected persons in each of the outbreaks varied between 3 and 30 (median 13). *Campylobacter* and *Salmonella* caused four outbreaks each. Norovirus caused three outbreaks. In 8 of the outbreaks, the causative agent was not identified (Figure 7).

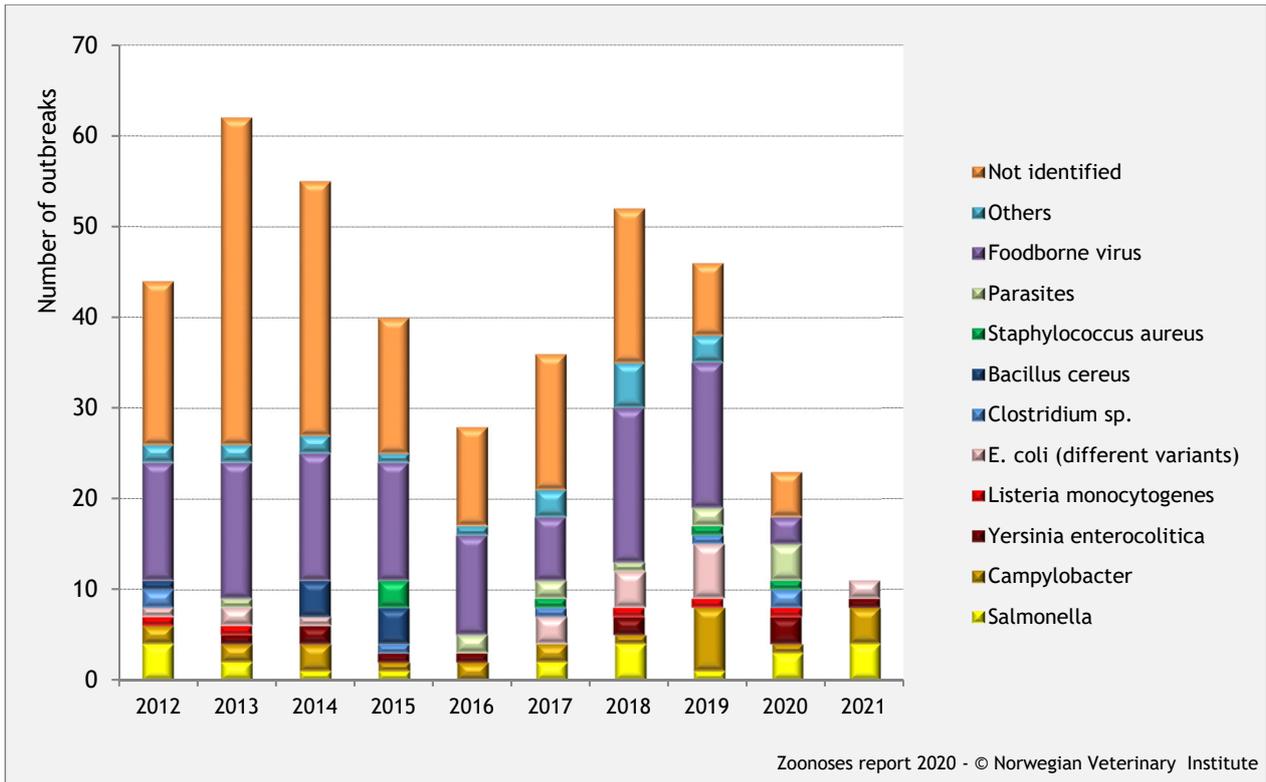


Figure 7: The number of reported foodborne outbreaks where an agent was verified or strongly suspected

Appendix Tables

Table 1. Human population of Norway

Table 2. Animal population of Norway

Table 3. *Salmonella* serovars in humans in Norway

Table 4. Human cases of campylobacteriosis distributed by county

Table 5. Foodborne outbreaks

Table 6. *Salmonella* in feed and feedstuff

Table 7. *Salmonella* in animals

Table 8. *Salmonella* in food

Table 9. Selected zoonoses in animals

Table 1: Human population of Norway per 1st January 2021 (from statistics Norway).

Age group	Female	Male	Total
0 - 9	288 649	304 884	593 533
10 - 19	313 858	330 399	644 257
20 - 29	341 826	363 481	705 307
30 - 39	360 785	378 339	739 124
40 - 49	350 211	369 380	719 591
50 - 59	348 742	365 421	714 163
60 - 69	293 409	295 110	588 519
70 - 79	232 063	218 405	450 468
80 - 89	110 422	79 887	190 309
90 -	32 145	13 953	46 098
Total	2 672 110	2 719 259	5 391 369

Table 2: Animal population of Norway in 2021.

Animal species - category	Herds /flocks	Number*	
		Animals	Slaughtered animals
Cattle - total	13 100 ^a	883 000 ^a	301 000 ^c
Dairy production	7 300 ^a	213 000 ^a	
Meat production	6 400 ^a	104 000 ^a	
Other stock		566 000 ^a	
Sheep - total			1 204 000 ^c
Sheep >1 year	13 800 ^a	944 000 ^a	
Goats - total	1 400 ^a	66 000 ^a	28 600 ^c
Dairy goats	400 ^a	35 900 ^a	
Swine - total	1 900 ^a	749 000 ^a	1 568 000 ^c
Breeding pigs	1 000 ^a	41 600 ^a	
Slaughter pigs	1 700 ^a	425 000 ^a	
Chickens (<i>Gallus gallus</i>)			
Grandparent stock - egg producers	2 (3) ^b		
Parent stock - egg producers	7 (21) ^b		
Parent stock - broiler	87 (206) ^b		
Laying hens	595 (910) ^b		
Broilers	551 (4 674 ¹) ^b		74 290 000 ^c
Turkey, goose and duck			
Parent stock	6 (20) ^b		
Meat production	56 (460 ¹) ^b		1 203 000 ^c
Horse	4 600 ^a	23 500 ^a	46 ^c
Farmed deer	170 ^a	6 600 ^a	

^a Figures from the registry of production subsidy per 31.3.2021.

^b Figures from the surveillance programme for *Salmonella* in 2021

^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 2021.

Serovar	Place of infection			Total
	Norway	Abroad	Unknown	
S. Enteritidis	58	18	16	92
S. Typhimurium	29	5	12	46
S. Newport	18	1	4	23
S. Typhimurium monophasic variant	14	0	9	23
S. Blockley	11	0	2	13
S. Mikawasima	8	1	1	10
S. Montevideo	6	0	2	8
S. Dublin	4	0	3	7
S. Java	7	0	0	7
S. Braenderup	5	0	1	6
S. Saintpaul	5	0	0	5
S. Stanley	3	1	1	5
Others	80	23	42	145
Total	248	49	93	390

Table 4. Human cases of campylobacteriosis (infected in Norway) in 2021 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	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Agder	54	55	81	41	57	77	44	51	71	60
Innlandet	96	113	121	82	107	152	114	113	136	130
Møre og Romsdal	36	47	73	34	32	71	59	47	62	42
Nordland	31	46	60	47	37	44	58	45	66	46
Oslo	136	103	121	56	54	109	145	126	165	131
Rogaland	124	169	129	116	150	205	130	118	150	105
Troms og Finnmark	26	29	74	55	76	71	56	66	66	50
Trøndelag	146	124	151	120	121	149	118	130	145	96
Vestfold og Telemark	90	76	119	68	62	147	109	239	121	84
Vestland	152	142	182	148	163	216	189	350	234	158
Viken	223	246	260	117	128	271	203	266	298	294
Total	1114	1150	1371	884	987	1512	1225	1551	1513	1196

Table 5: Foodborne outbreaks 2021.

Agent	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
<i>Salmonella</i> sp.	4	2	1	1		2	4	1	3	4
<i>Campylobacter</i> sp.	2	2	3	1	2	3	1	7	1	4
<i>Yersinia</i> sp.		1	2	1	1	1	2		3	1
<i>Listeria monocytogenes</i>	1	1					1	1	1	
<i>Escherichia coli</i> (VTEC)	1	2	1		1	3	4	6	0	2
<i>Clostridium</i> sp.	2			1		1		1	2	
<i>Bacillus cereus</i>	1		4	4					0	1
<i>Staphylococcus enterotoxin</i>				3		1		1	1	1
Parasites		1			2	2	1	2	4	
Virus	13	15	14	13	11	7	17	16	3	4
Other	2	2	2	1	1	1	5	3	0	
Unknown	18	36	28	15	11	15	17	8	5	8
Total	44	62	55	40	29	36	52	46	23	25

Table 6: Salmonella in feed and feedstuff 2021.

Category	Number tested*	Number positive	Comment
Feedstuff			
Cereal grain	129	0	
Corn	60	1	S. Tennessee
Rape	69	0	
Soya	2 621	4	S. Molade, S. Schwartzengrund, S. Mbandaka, S. Ouakom
Sunflower	18	0	
Legume seeds etc.	24	0	
Tubers, roots etc.	15	0	
Other plant based feedstuffs	142 (10)	2	S. Senftenberg
Meat based feedstuff	347	6	S. Rissen (2), S. Havana (5)**
Marine based feedstuff	149	0	
Feed			
Domestic animals (cattle, swine, poultry)	194 (52)	0	
Fish	2 167 (102)	0	
Fur animals	25	0	
Environmental samples in factories producing feed and feedstuff	16 137	288	52 different serovars

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

** Both serotypes in one sample

Table 7: Salmonella in animals 2021.

Category	Number tested ¹	Number tested ¹	Comment
Chicken - surveillance - breeding flocks	230	0	
Chicken - surveillance - layer flocks	910	1	<i>S. diarizonae</i> 61:k:1,5,7
Chickens - surveillance - broiler flocks ²	4 674	0	
Chicken flocks - other samples	2	0	
Turkey, ducks, geese - surveillance - breeding flocks	25	0	
Turkey, ducks, geese - surveillance - meat flocks ²	470	0	
Turkey, ducks, geese - other samples	8	0	
Cattle - surveillance - animals	3 327	0	
Cattle - diagnostics - herds	54	0	
Sheep - diagnostics - herds	7	1	<i>S. diarizonae</i> 61:k:1,5,7
Goats- diagnostics - herds	2	0	
Swine - surveillance - slaughter pigs - animals	1 657	1	<i>S. Typhimurium</i>
Swine - surveillance - sows - animals	1 422	0	
Swine - surveillance - breeding herds	72	0	
Swine - diagnostics - herds	9	0	
Horse - diagnostics - animal	64	1	<i>S. Typhimurium</i>
Dog - diagnostics	97	3	<i>S. Typhimurium</i> , <i>S. Enteritidis</i> , <i>S. Derby</i>
Cat - diagnostics	43	5	<i>S. Typhimurium</i>
Alpaca- herds - diagnostics	2	0	
Wild boar - surveillance - animals	287	13	<i>S. Typhimurium</i> (2), <i>S. ent. subsp. diarizonae</i> (7), <i>S. ent. subsp. enterica</i> , <i>S. Newport</i> , <i>S. Hessarek</i> , <i>S. Duesseldorf</i>
Animals/birds/zoo birds/zoos	48	2	<i>S. Typhimurium</i> , <i>S. ent. subsp. diarizonae</i>
Reptiles	17	15	<i>S. ent. subsp. diarizonae</i> (4), <i>S. Kedougou</i> (2), <i>S. Adelaide</i> (2), <i>S. ent. subsp. salamae</i> (2), <i>S. Enteritidis</i> , <i>S. Oranienburg</i> , <i>S. Kisarawe</i> , <i>S. Cotham</i> , <i>S. Taunton</i>
Various wild animals	8	0	
Wild birds	6	0	

¹ Units for numbers are given in the first column.

² Number of slaughter batches

Table 8: Salmonella in food 2021.

Category	Number sampled	Number positive	Comment
Cattle - swab of carcass - surveillance	3 172	0	
Swine - swab of carcass - surveillance	2 833	1	<i>S. ent. subsp. diarizonae</i> 61:k:1,5,7
Meat scrapings (cattle, swine. sheep) - surveillance	3 145	1	<i>S. Typhimurium</i> monophasic (4,[5],12 : i :-)*
Fish raw - Norwegian - IMR**	0	0	
Fishery products - imported - IMR**	84	0	
Shellfish - Norwegian - IMR**	47	0	

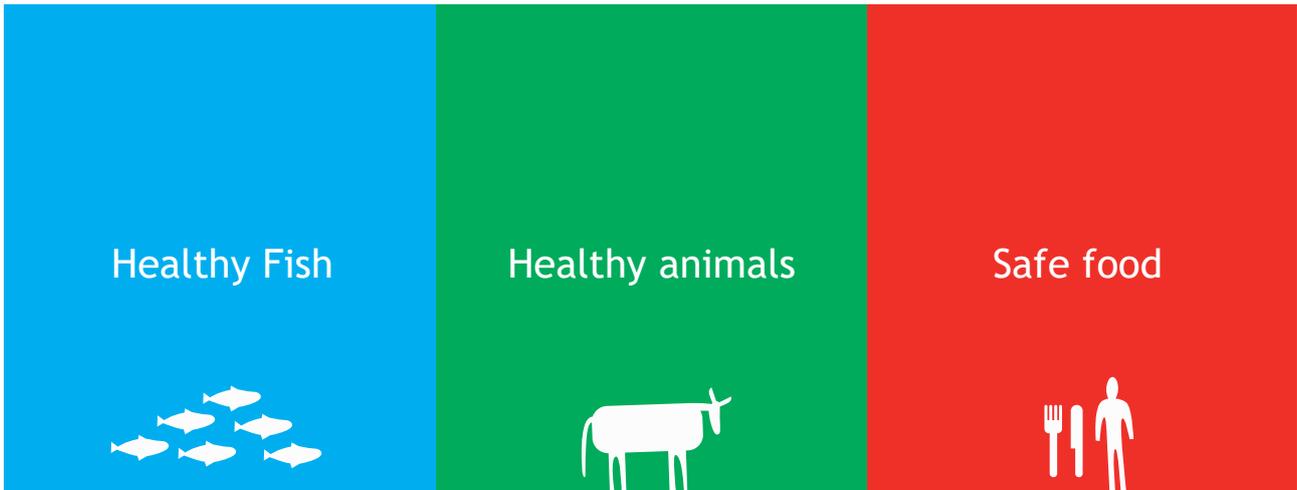
* Isolated from imported swine meat

** Data from Institute of Marine Research (Havforskningsinstituttet)

Table 9: Selected zoonoses in animals 2021. Salmonella is presented in separate tables.

Infection/agent	Category	Number tested	Number positive	Comment
Campylobacteriosis	Broiler chicken flocks - surveillance	1 891	110	May - October
	Cattle - diagnostics	32	20	<i>C. jejuni</i>
	Dog - diagnostics	100	37	<i>C. upsaliensis</i> (34), <i>C. jejuni</i> (3)
	Cat - diagnostics	13	1	<i>C. jejuni</i>
Tuberculosis	Cattle - tuberculin testing	254	0	
	Swine - tuberculin testing	207	0	
	Swine - diagnostics	3	3	<i>M. avium</i> subsp. <i>hominissuis</i>
Brucellosis	Cattle - surveillance	106	0	
	Cattle - breeding animals, export	344	0	
	Sheep - surveillance	9 030	0	
	Goat - surveillance	1 540	0	
	Swine - breeding stock	2 447	0	
	Dog	2	0	
	Alpaca - export	21	0	
Echinococcosis	Fox - surveillance	511	0	
	Wolf - surveillance	19	0	
	Cattle, small ruminants, swine, horse	All slaughtered*	0	
Toxoplasmosis	Sheep - diagnostics	9	0	
Rabies	Reindeer - diagnostics (Svalbard)	1	0	
	Red fox - diagnostics	1	0	
	Dog - diagnostics	1	0	
	Cat - diagnostics	1	0	
	Bat - diagnostics	4	0	
	Trichinellosis	Pig and horse	All slaughtered*	0
Wild boar - surveillance		292	0	
Q-fever	Cattle - surveillance	137	0	
	Cattle - export	20	0	
	Alpaca - import	15	0	
BSE	Cattle	7 037	0	
MRSA	Swine - surveillance	763	0	

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



*Scientifically ambitious, forward-looking
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