ZOONOSES IN SWEDEN IN 2008

SVA NATIONAL VETERINARY INSTITUTE

Jordbruks verket
Swedish Board of Agriculture

SMITTSKYDDSINSTITUTET
Swedish Institute for Infectious Disease Control

LIVSMEDELS VERKET
NATIONAL FOOD ADMINISTRATION

CONTENTS

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Introduction

Zoonoses are diseases or infections, which can be transmitted between animals and humans. Infections can be clinical, subclinical or mild and animals or humans may asymptomatic carriers of the organism. Over 200 zoonoses have been described and they involve all types of agents: bacteria, parasites, viruses and unconventional agents. This report covers information on fifteen zoonoses and zoonotic agents in feed, food, animals and humans. The information has been collected in co-operation with National Veterinary Institute (SVA), Swedish Board of Agriculture (SJV), National Food Administration (SLV), and Swedish Institute for Infectious Disease Control (SMI), Swedish municipalities and the industry.

1. Bovine tuberculosis

Tuberculosis is a serious disease in humans and animals and is caused by the species of the *Mycobacterium tuberculosis complex*. *M. bovis* causes bovine tuberculosis in several animal species and humans. The reservoir of this bacterium is cattle but other species, such as badgers and farmed deer, can also maintain the infection. Humans acquire the infection usually via unpasteurized milk or via inhalation.

INCUBATION PERIOD

The incubation period varies from weeks to years.

DISEASE

Symptoms of tuberculosis in animals and humans depend on which organ the infection is localized. Usually the lung is affected. Symptoms of tuberculosis in animals and humans are often fever, cough and weight loss.

SURVEILLANCE

Humans

Tuberculosis is a notifiable disease according to the Communicable Disease Act.

Animals

M. bovis in animals is notifiable. All food producing animals are inspected at slaughter for lesions of bovine tuberculosis. *M. bovis* was diagnosed in farmed deer in 1991. These animals had been imported in 1987. A voluntary control program (American spelling is program)was started in farmed deer in 1994 and has been compulsory since 2003. The last case in deer was diagnosed in 1997.

RESULTS IN 2008

Humans

In 2008, there were two reported cases of *M. bovis*. The infections were imported from Iraq and Syria.

Animals

M. bovis was not detected in any of the tested samples.

TRENDS AND EPIDEMIOLOGY

Sweden was declared free from *M. bovis* in 1958. It is officially free from *M. bovis* in bovine herds according to EU legislation. The control program in farmed deer is in its final stage and most probably bovine tuberculosis has been eradicated in the farmed deer population.

2. Brucellosis

Brucellosis is caused by bacteria belonging to the genus of *Brucella*. Most human cases are caused by four species, each having a preferred animal host. *B. melitensis* occurs in goats and sheep, *B. suis* in swine, *B. abortus* in cattle and *B. canis* in dogs. Transmission can occur through contact with infected animals or animal tissue or contaminated animal products such as cheese made of unpasteurized milk.

INCUBATION PERIOD

The incubation period varies from 5 to 60 days but is commonly 1-2 months.

DISEASE

Humans

Brucellosis is a disease with acute or insidious onset and continued or intermittent fever, headache and weakness. The disease may last for months if not treated.

Animals

In animals, brucellosis mainly affects the reproductive system causing abortions and infertility. The organism is shed into milk, urine and placental fluids.

SURVEILLANCE

Humans

Brucellosis has been a notifiable disease since 2004 according to the Communicable Disease Act.

Animals

Brucella is notifiable in animals in Sweden. Serological screening is performed on cattle, swine, sheep and goats. In addition, all clinically suspected cases are analyzed for brucellosis.

RESULTS IN 2008

Humans

In 2008, seven cases were reported. For six of these cases the country of infection was stated and most of the persons acquired their infection in the Middle East.

Animals

In 2008, serum samples from 1000 beef cattle from 774 different herds and bulk tank milk samples from 2022 dairy herds were collected. Of cattle, 15 fetuses were examined, 317 animals were tested at breeding centers, 38 for import or export reasons and 3 herds due to clinical suspicion. One serum sample tested positive for the presence of antibodies but further testing was negative. Thus, the result was considered false positive. Moreover, 32 swine fetuses were cultured for *Brucella*. One dog tested positive for *B. canis*. All other samples tested negative.

TRENDS AND EPIDEMIOLOGY

Human infections are mainly associated with travel to endemic countries. Previously, some cases were reported each year through a voluntary laboratory reporting system, but none of the reported cases has been infected in Sweden during the last years.

The last case of bovine brucellosis in Sweden was reported in 1957. According to EU regulations Sweden has been officially free from bovine brucellosis since 1994 and free from goat and sheep brucellosis since 1995. The risk of getting brucellosis from domestic food-producing animals is negligible. Imported dogs might harbor *B. canis*. Because infected dogs only shed the agent in semen and placental fluids, the risk of getting brucellosis from infected castrated dogs is considered small.

3. Campylobacteriosis

Campylobacter species are the most common causes of human bacterial gastroenteritis in many countries. A seasonal peak in the summer months is observed in most European countries. A number of *Campylobacter* species have been implicated in human illness. Most human infections are caused by *C. jejuni*, followed by *C. coli* and a few by *C. lari* and *C. upsaliensis* or other species. Birds are considered the principal reservoir although *Campylobacter* has been detected in many animal species. The bacteria are excreted in feces. *Campylobacter* are fragile organisms but are able to survive in water for longer periods. The infectious dose is low. Most human infections are sporadic, which makes tracing of sources difficult. Risk factors for infection include ingesting or handling undercooked contaminated meat products (especially poultry), consuming contaminated unpasteurized milk and other dairy products, drinking water from contaminated supplies, foreign travel and contact with pets.

INCUBATION PERIOD

The incubation period of campylobacteriosis is usually between 2 to 5 days.

DISEASE

Humans

Campylobacteriosis is an acute enteric disease that is usually self-limiting, resolving within a week. In some individuals the symptoms may last longer. The symptoms are mild to severe: diarrhea, fever, abdominal pain, nausea and malaise. The infection can be complicated by reactive arthritis and a neurological disorder, Guillain-Barré syndrome.

Animals

Asymptomatic carriage of thermophilic *Campylobacter* is common in several animal species. However, *Campylobacter* may cause gastrointestinal disease in animals, especially in dogs and cats.

SURVEILLANCE

Humans

Infection with *Campylobacter* is notifiable according to the Communicable Disease Act.

Food

Monitoring is based on own control of the companies and sampling by the authorities. Official sampling has been very limited during the year.

Animals

Thermophilic *Campylobacter* are not notifiable in animals. Only *Campylobacter fetus* sp. *venerealis*, which causes bovine genital venerealis is notifiable in cattle in Sweden.

Because broilers are an important source of human campylobacteriosis, a surveillance program for these birds was initiated in Sweden in 1991. The program was operated by the industry (Swedish Poultry Meat Association) and involved sampling of flocks at slaughter. The program was extended in 2001 to be part of poultry health control. During 2001-2005 cloacal swabs and neck skin samples were collected at slaughter. Since 2006, sampling is performed by collecting intact cecum from 10 birds from every slaughter batch at the major slaughterhouses and pooling these samples to one. The program covers 99% of broilers slaughtered in Sweden.

In 2008 a European baseline study on the prevalence of *Campylobacter* spp. in broiler flocks and *Campylobacter* spp. and *Salmonella* spp. in broiler carcasses was performed. A total of 410 slaughter batches were randomly sampled at the same abattoirs as in the *Campylobacter* monitoring program. Cecum of 10 birds and 1 carcass were collected from each sampled slaughter batch.

CONTROL

Campylobacter are sensitive to heat and numbers are reduced by freezing. Strict hygiene in the kitchen

by avoiding cross-contamination between food to be heated and raw vegetables is essential.

Reducing *Campylobacter* prevalence at farm level decreases the risk of human infection. Applying high biosecurity has decreased the number of *Campylobacter* positive slaughter batches in Sweden. Several other control measures to reduce flock prevalence are under investigation such as fly control, bacteriocins to compete *Campylobacter*, bacteriophages and vaccines.

Carcasses are easily contaminated during evisceration at slaughter. *Campylobacter* negative birds can be contaminated at slaughter. This could be prevented by slaughtering flocks tested positive or flocks from operators often delivering positive birds separately from *Campylobacter* free flocks. In addition, freezing *Campylobacter* positive carcasses reduces the risk for consumers.

RESULTS IN 2008

Humans

During 2008, 7692 cases were notified of which 2201 were infected in Sweden (Figure 1). The total number of cases has increased by 7% since 2007. Among the domestically infected most were children between 0-4 years (418 children). As in previous years more than half of all cases were men.

Of the 5220 persons infected abroad, 1260 were reported from Thailand, which reflects the increased travelling from Sweden to Southeast Asia.

Food

Reported samples are too few to be commented upon.

Animals

In 2008, thermophilic *Campylobacter* were detected in 12.3% of the slaughter batches in the national *Campylobacter* program (Figure 2). In the EU baseline study, prevalence of *Campylobacter* was at a similar level in the cecal samples (12.4%) and slightly higher in the carcasses (13.4%). As in previous years, the prevalence of *Campylobacter* in broilers was very low in winter but high in late summer (Figure 3).

The broiler producers can be divided into three groups on the basis of the prevalence of *Campylobacter* positive slaughter batches. Approximately 50% of the Swedish producers seldom or only sporadically deliver *Campylobacter* positive slaughter batches whereas 38% of the producers have seasonal problems with the pathogen. A group of 12-13% producers often deliver *Campylobacter* positive slaughter batches. This group accounts for 40% of the *Campylobacter* load of domestic

Figure 1. Number of notified cases of *Campylobacter* in humans in Sweden in 1990-2008

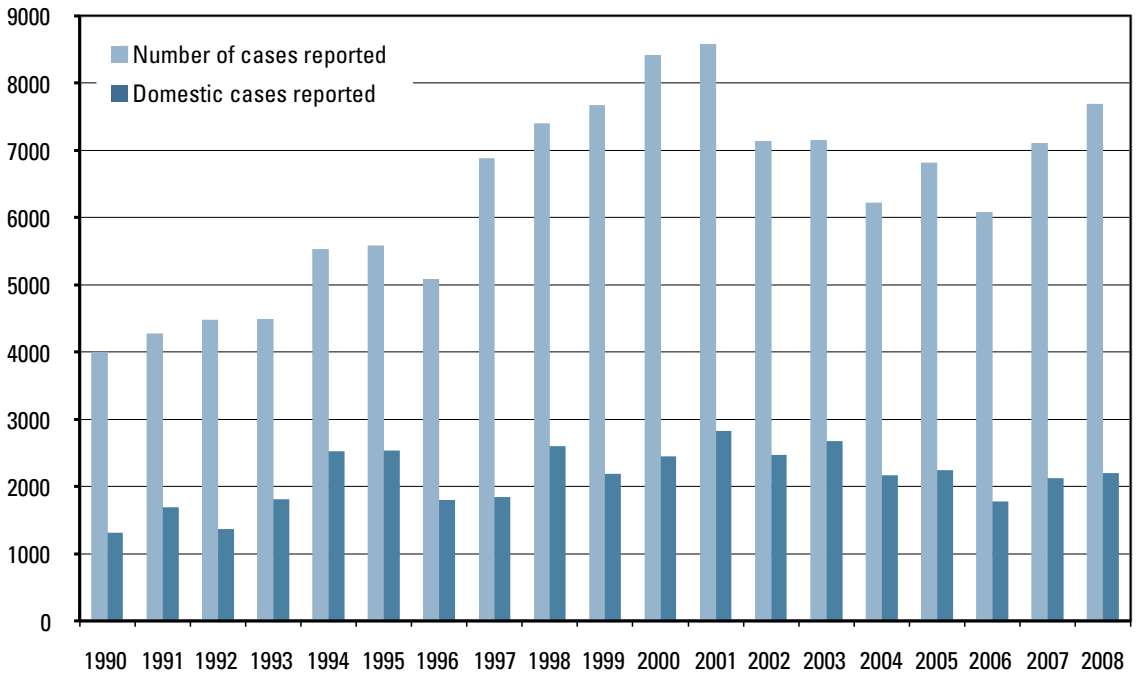


Figure. 2. Percentage of *Campylobacter* positive broiler flocks at slaughter 1992-2008

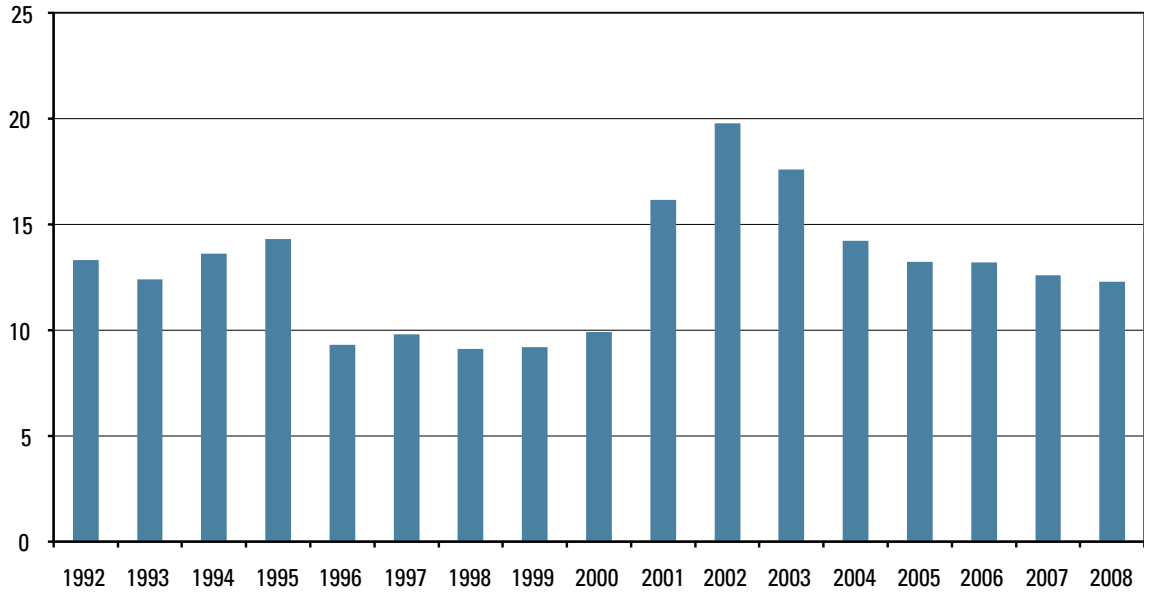
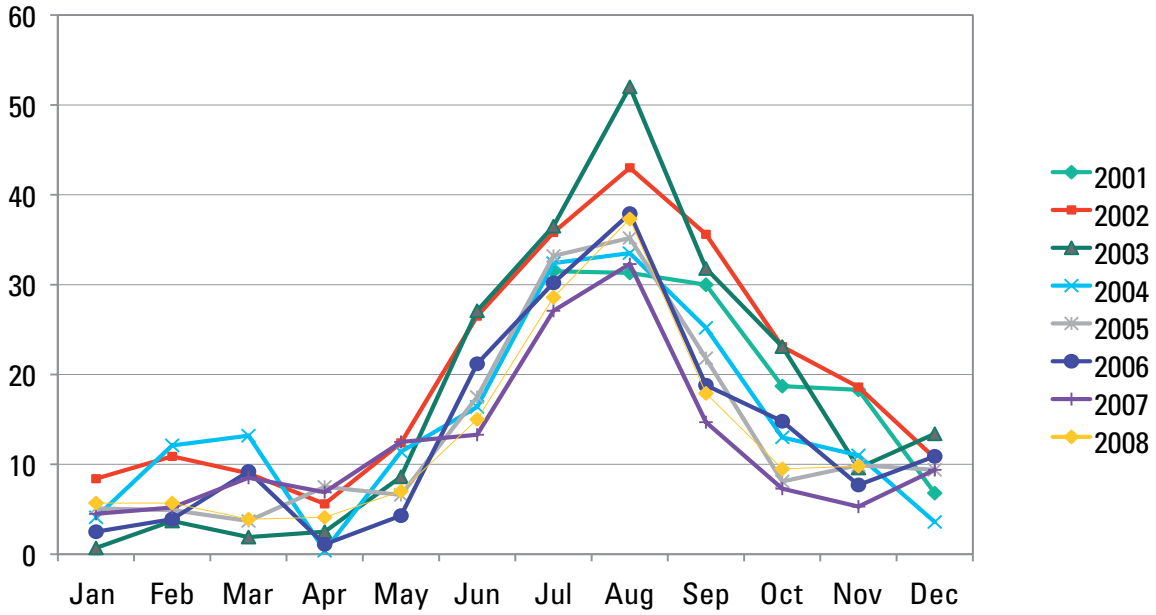


Figure. 3. Seasonal variation of the prevalence of Campylobacter in broilers at slaughter (cloacal samples 2002-2005, caecal samples 2006-2008)



poultry. In 2008, the 14 holdings which often have problems with *Campylobacter* were visited to find measures to reduce the infection. These farms had either deficiencies in biosecurity routines or closely situated livestock holdings or high populations of wild birds in the neighborhood. Attempts to control the infection in some of these broiler houses with fly control were started in 2008.

TRENDS AND EPIDEMIOLOGY

Campylobacter is the main bacterial cause of human diarrhea in Sweden.

The number of reported cases during the last decade has varied between around 6000 and 8600. Of these, approximately 1800-2800 (30-45%) were domestic cases. There is a pronounced seasonal

variation with most cases reported by the end of the summer. During the first years of the 21st century, the number of *Campylobacter* cases decreased but between 2006 and 2008, an increase of 27% was observed. This was mainly caused by the increase in the number of people infected abroad (35%).

Since 2001, the prevalence of *Campylobacter* positive slaughter batches of broilers has decreased from 20% to about 12%. However, this decrease has not led to a decrease in domestic human incidence. One reason for human illness could be imported poultry meat; for instance, the import of chicken meat has increased. Other major sources should also be investigated.

4. Echinococcosis

Echinococcosis is caused by tapeworms belonging to the genus of *Echinococcus*. Although the genus contains several species, only the species of *E. granulosus and multilocularis* exist in some European countries. The life cycle of these parasites requires two hosts: a definitive and an intermediate host. Humans are dead-end hosts of these parasites and may become infected by accidental ingestion of the eggs.

4.1 Alveolar echinococcosis

Human alveolar echinococcosis is a serious zoonosis caused by *Echinococcus multilocularis*. The definitive hosts of this parasite are mainly foxes but also raccoon dogs, dogs, cats, coyotes and wolves. Small rodents and voles serve as intermediate hosts. The main host, the fox, contracts *E. multilocularis* mostly from eating rodents.

INCUBATION PERIOD

The incubation period for developing alveolar echinococcosis in man is between 5 and 15 years.

DISEASE

Humans

In humans, alveolar echinococcosis may develop into a serious, potentially fatal disease characterized by tumor-like lesions in the affected organ. Because of the long incubation period the disease is most frequently seen in adults. The most common site of localization is the liver but other organs can also be affected. Symptoms depend on the site and size of the lesion.

Animals

In the definitive animal host, the infection is asymptomatic.

SURVEILLANCE

Humans

Echinococcosis has been notifiable according to the Communicable Disease Act since 2004.

Animals

E. multilocularis is notifiable in animals. Since 2001, some 200-400 foxes per annum have been examined for *Echinococcus*. At meat inspection, all animals are controlled for cysts.

CONTROL

Sweden, Finland, UK, Ireland and Malta are free from *E. multilocularis*. Since 2004, all imported dogs from extraneous countries must be treated with anthelmintics by a veterinarian prior to entering. This regulation will be maintained till 2015. Control in endemic areas is extremely difficult. Strategies include control of populations of definitive and intermediate hosts. Deworming strategies for dogs and wild animals have been developed. Education of people in hygienic measures (e.g. washing hands, rinsing berries and vegetables) is also a key control measure.

RESULTS IN 2008

Humans

To date, no domestic cases of alveolar echinococcosis have been reported in Sweden.

Animals

In 2008, 244 culled foxes from different parts of Sweden were tested and found to be negative for *Echinococcus*.

TRENDS AND EPIDEMIOLOGY

E. multilocularis has never been detected in Sweden, but has been found in foxes in Europe from Denmark and the Baltic countries in the north to

Italy in the south, including the Alp countries as well as the Netherlands and Belgium. The prevalence of this parasite seems to be on rise in Europe, partly due to increasing fox and raccoon dog populations, and due to the increase in urban fox populations.

4.2 Cystic echinococcosis

Cystic echinococcosis is caused by *E. granulosus*, for which the domestic dog and wolves are the most frequent main hosts. Eggs of the parasite are passed in feces to the environment where they can infect intermediate hosts such as cattle, horses and wild ruminants. The eggs develop into the larval stage (hydatid cyst) mainly in the liver and occasionally in other organs of the intermediate host. The main hosts get infected when they consume organs containing larval cysts.

INCUBATION PERIOD

The incubation period for developing cystic echinococcosis ranges between several months to years.

DISEASE

Humans

In humans, the main site of localization of cystic echinococcosis is the liver. However other organs might also be involved, such as the lungs, heart or brain tissue. Infected patients may remain asymptomatic for years or permanently. Clinical signs of disease depend on the number of cysts, their localization and pressure exerted on surrounding organs or tissues.

Animals

In animals, the infection is usually asymptomatic.

SURVEILLANCE

Humans

Echinococcosis has been notifiable according to the Communicable Disease Act since 2004.

Animals

All animals are inspected for cysts during routine meat inspection at the abattoirs.

RESULTS IN 2008

Humans

In 2008, 13 cases of echinococcosis were notified, which is about the same number as for previous years. Of these, 5 infected persons were women and 8 were men, predominantly aged between 20 and 50 years old. All cases were reported to have been infected in other countries.

Animals

E. granulosus was not detected in any animals in 2008.

TRENDS AND EPIDEMIOLOGY

E. granulosus has not been detected in Sweden in animals since the late 1990's, when it was reported in reindeer in the northernmost regions of Sweden, bordering on Norway and Finland. The parasite is prevalent in some European countries, e.g. Finland where it has been detected in wolves, elk and reindeer.

5. EHEC/VTEC

Verocytotoxin producing *Escherichia coli* (VTEC), also known as shiga-toxin producing *E. coli* (STEC), are causative agents of a serious human illness. EHEC (enterohemorrhagic *E. coli*) infection caused by VTEC occurs world-wide. More than 380 different VTEC serotypes have been associated with human illness but most outbreaks and severe illnesses are caused by serotype O157:H7. Other common serotypes causing gastrointestinal illness are O26, O103, O111 and O145. Cattle are the main reservoir of VTEC associated with human disease although other animal species also may acquire the organism. The infectious dose is low, probably just a few bacterial cells. Not only foods of bovine origin but also other food items have been implicated in outbreaks. The infection can also be transmitted through direct or indirect animal contact, via environment or person-to-person transmission.

INCUBATION PERIOD

The incubation period varies from 2-7 days.

DISEASE

Humans

VTEC infection is associated with asymptomatic infection, non-specific diarrhoea, bloody diarrhea and hemolytic-uremic syndrome (HUS). The illness often starts with severe abdominal cramps, followed by watery diarrhea, which may become bloody. Most patients recover fully. Approximately 7-10% develop HUS, which is characterised by acute renal failure, thrombocytopenia, and micro-angiopathic hemolytic anemia. Severe complications are most common in children less than five years and elderly people. HUS may lead to renal transplantations, permanent renal failure or death.

Animals

Animals usually do not develop a clinical disease.

SURVEILLANCE

Humans

EHEC infection has been notifiable in humans since 2004.

Animals

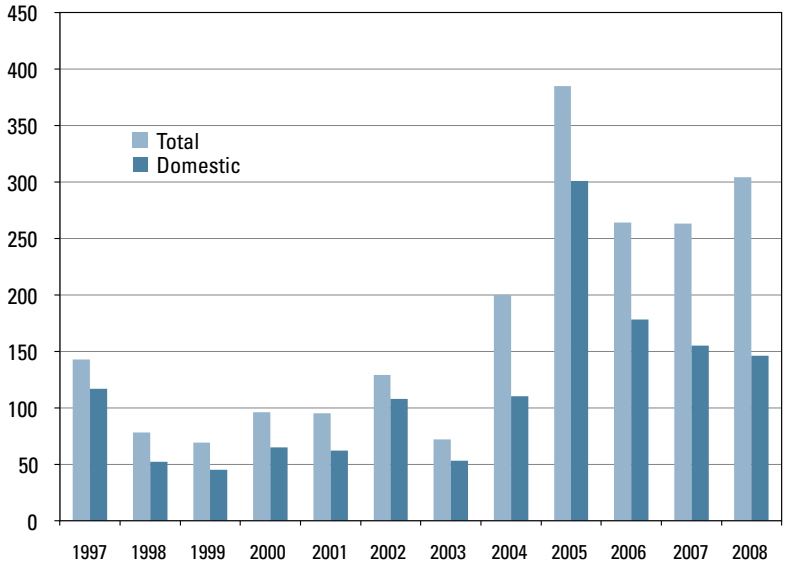
In 1996 VTEC in animals became notifiable. Since 1999, findings of VTEC associated with human VTEC infection have been notifiable.

In 1996, VTEC O157 was first isolated in Swedish cattle. Between 1997 and 2002 annual prevalence studies of VTEC in slaughter cattle were conducted. Since, prevalence studies have been performed every third year. The aim is to detect a prevalence of 0.1% with a 90% confidence level. In each study, about 2000 cattle fecal samples were randomly selected from 15 abattoirs responsible for about 90% of cattle slaughtered. A baseline study on cattle carcasses was done in 2006-2007 and a prevalence study in sheep was done at nine slaughterhouses in 2007-2008.

CONTROL

National guidelines were established in 1997 and were most recently revised in 2008. The aim is to minimize the spread of VTEC to humans and animals. The recommendations give general guidelines to all farms, special guidelines to farms associated with human infections, and to laboratories. If a County Medical Officer suspects an association with a human VTEC infection to a farm, the veterinary officer will be informed. A request to the SJV will be made for sampling suspected animals. Sampling is mainly targeted on young cattle because they more often shed the bacterium. Drinking of unpasteurised milk should be avoided. Strict hygiene in the kitchen by avoiding cross-contamination between food to be heated and raw vegetables is essential.

Figure 4. Notified cases of VTEC in humans during 1997-2008



RESULTS IN 2008

Humans

In 2008, a total of 304 cases of EHEC infection were reported (Figure 4). This is an increase of 16% compared with the previous year (263 cases). This was due to an increase in imported cases as the number as well as the proportion of domestic cases decreased. Of these 304, around half (48%) were reported as infected in Sweden. In 2008, the countries from which most cases were imported were Turkey, Egypt and Mexico. Normally about 65-85% of the cases are domestically acquired, but the proportion of domestic cases seems to be decreasing.

Gender distribution was relatively even with slightly more women than men. Half of the domestic cases were under 20 years and a fifth were children under 5 years. In 2008, two children died of complications but the source of infection could not be found. Deaths caused by EHEC infection are otherwise rare.

As in previous years, the domestic cases were mostly reported from southern Sweden (counties of Skåne, Västra Götaland, Halland and Östergötland). Incidence was highest in Halland, a county in southwestern Sweden.

During 2008, the majority of reported cases were sporadic or occurred in small clusters. These clusters were linked to other family members, a kindergarten or a restaurant, but in most cases, the source of infection was not found. The most common source of infection in these cases was unpasteurized milk or meat products from the suspected farm.

Of the domestic cases, from which EHEC were isolated, the most common type was O157:H7, which caused 57 cases. The second most common type was O145, which caused a nursery outbreak, followed by O26, O103, O91 and O121. Cases of EHEC infection are usually reported with a clear seasonal summer peak. In 2008, however, most cases occurred in September.

Animals

In the prevalence study done in 2007-2008, 492 fecal and 105 ear samples were taken from sheep. VTEC O157 was detected in 9 (1.8%) fecal and 2 (1.9%) ear samples. In cattle, the first studies showed a prevalence of about 1%. In the study done in 2005-2006, prevalence of VTEC O157 in fecal samples was 3.4%. This increase may be due to a more sensitive detection method. In addition, 15 farms were investigated for a suspected link between animals, farms and human cases, and in five investigations the same subtype was found in humans and animals.

TRENDS AND EPIDEMIOLOGY

Sweden has among the highest incidences of human VTEC in the EU. The majority (60%) of the human infections are domestic. The highest incidences are in the counties where VTEC infected cattle are more common, i.e. in southern Sweden. Because detection methods have changed, the results of the different prevalence studies cannot be directly compared and it is therefore difficult to determine whether the situation has changed. The established recommendations have not decreased the number of human cases. Effective measures to decrease the animal prevalence are being investigated

6. Listeriosis

The genus *Listeria* contains several species but only one zoonotic species *Listeria monocytogenes*. *Listeria* bacteria are widely distributed in the environment, such as in soil, silage and water. They can survive for long periods in the environment and tolerate disinfection and also grow at refrigeration temperatures. These properties make elimination of *L. monocytogenes* difficult. The main sources of listeriosis are contaminated food products, such as smoked or marinated vacuum-packaged fishery products, meat products and soft cheeses or other ready-to-eat foods with long self-life. The infection can also be transmitted from infected animals to humans or via person-to-person contact.

The environment and animals serve as important reservoirs of the pathogen.

INCUBATION PERIOD

The incubation period of listeriosis varies from 3-70 days, the average being about 21 days.

DISEASE

Humans

Listeriosis can be manifested either as a milder non-invasive form or as a severe invasive disease. The non-invasive form is mainly febrile gastroenteritis. A severe form mostly occurs in immunocompromised persons, the newborn, pregnant women and elderly people. Symptoms in the invasive listeriosis are septicemia, meningitis and meningoencephalitis. For those with severe infection, the fatality rate is high (20-40%). In Sweden, outbreaks have been associated with vacuum-packaged fish (1995-1996) and with cheese made of raw goat milk (2001).

Animals

L. monocytogenes can infect a wide range of animal species, both domestic and wild. Animals may be asymptomatic carriers and shed the organism. Animals, especially sheep may develop clinical symptoms, such as neurological symptoms, abortions, mastitis or septicemia.

SURVEILLANCE

Humans

Listeriosis is notifiable in humans.

Food

No official control program exists. Sampling is performed by local authorities, mainly at retail level but also at production units. Sampling performed in industry is not normally reported to the authorities.

Animals

Listeriosis is notifiable in animals but there is no active surveillance system. Notifications are based on clinical cases and laboratory notifications. The Swedish Board of Agriculture (SJV) can decide whether epidemiological investigations are needed.

CONTROL

L. monocytogenes is destroyed by heating (pasteurization and cooking). The bacterium is able to grow at refrigeration temperatures, in vacuum packages and at modified atmosphere. *L. monocytogenes* is also capable of adhering onto different types of surfaces. Food products may become contaminated during processing. If *L. monocytogenes* is established in a food processing plant, it is difficult to eliminate.

Risk groups, which include pregnant women and other immunocompromised persons, are advised not to consume smoked or marinated fish products or packaged meat products with prolonged shelf life without heating. Soft cheeses and unpasteurized milk should also be avoided.

RESULTS IN 2008

Humans

Sixty cases (0.64 cases/ 100,000 inhabitants) of listeriosis were reported, which is slightly more than last year (56) and the highest number since 2001 (67) (Figure 5). Of these 60, 55 were domestic and for the 5, country of infection was unknown. Most cases were reported in men (60%). The incidence was highest in the north (counties of Jämtland, Västernorrland, Västerbotten and Norrbotten). The reason for this is not fully investigated.

Of the domestic cases, one third died within 3 months after onset of disease, but the role of listeriosis is difficult to assess because most cases were often suffering from other diseases or were elderly.

As in previous years, mostly older people were infected. Two small children were infected with *L. monocytogenes*. One was infected at birth and the other child with a serious underlying disease was infected at the age of two years. Only one pregnant woman was reported and both the child and the mother survived and recovered.

No outbreaks of listeriosis were reported.

Food

L. monocytogenes was detected in 21 of 153 (13.7%) samples of smoked fish at retail level. None of the 67 samples of meat products yielded *L. monocytogenes.*

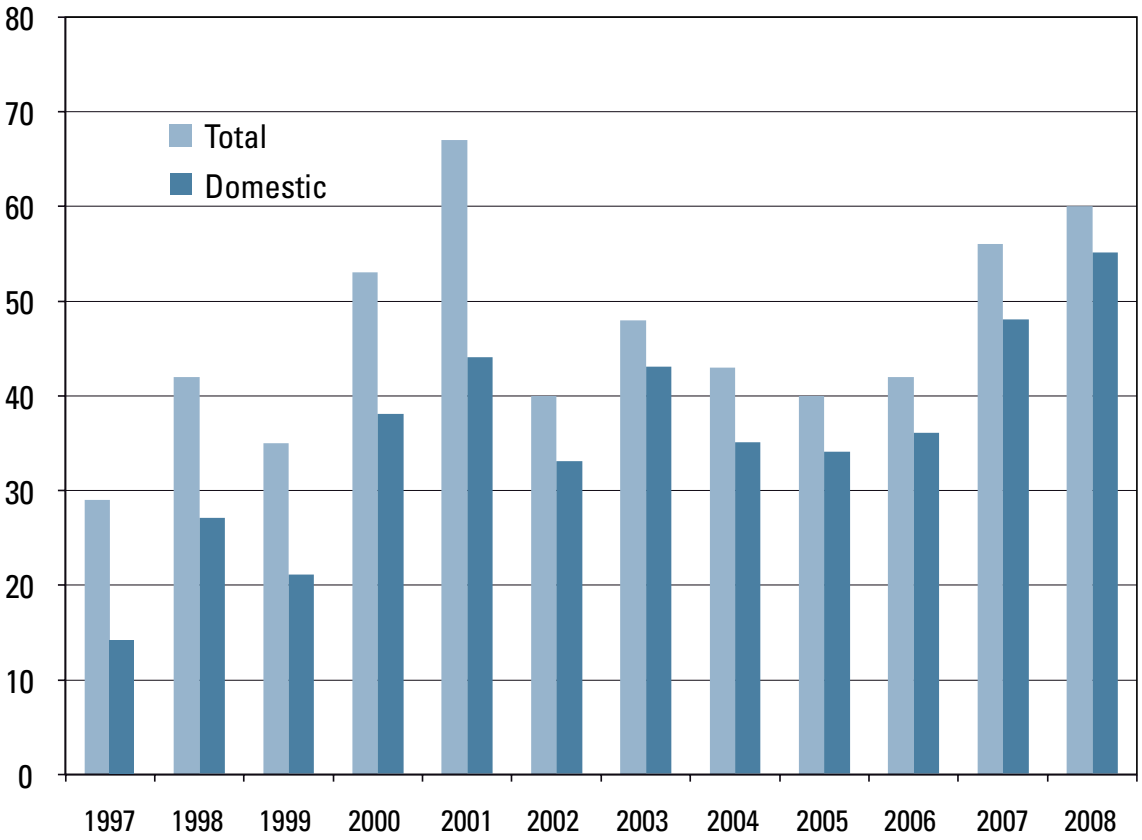
Animals

In 2008, *Listeria monocytogenes* was notified in 27 sheep, 8 cattle, 2 goats, 1 horse and in 1 dog.

TRENDS AND EPIDEMIOLOGY

Since the late 1990's the incidence of listeriosis has increased. A similar increasing trend has been observed in some other European countries. The reason for this is not elucidated. The infection is mainly domestic. Because most cases are sporadic tracing of sources is difficult.

Figure 5. Notified cases of listeriosis in humans in 1997-2008



7. Nephropathia epidemica (NE)

Nephropathia epidemica (NE) is caused by Puumala virus, which is likely the most prevalent hantavirus in Europe. The virus is excreted from its natural reservoir, the bank vole, via saliva, urine and feces, and transmission to humans often occurs in an aerosolized form.

INCUBATION PERIOD

The incubation period varies from 2 to 6 weeks.

DISEASE

Humans

The clinical picture is characterized by a sudden onset with fever, headache, back ache and abdominal pain. In the acute phase, the kidneys are affected and internal hemorrhaging may occur.

Animals

In bank vole, the infection is subclinical.

SURVEILLANCE

Humans

NE in humans has been notifiable according to the Communicable Disease Act since 1989.

Animals

NE is not notifiable in animals.

CONTROL

As far as possible, bank voles should be kept away from places where people stay.

When performing risk activities such as cleaning, cutting wood or renovating houses in risk areas, one should avoid stirring up and inhaling dust. Careful hand hygiene is recommended.

RESULTS IN 2008

In 2008, the number of NE cases (569) was substantially lower than that in 2007 (2195), but NE was still among the most notified zoonoses (Figure 6). A majority of cases were reported during the first six months, which could be explained by the large number of bank voles during the autumn of 2007. During 2008 the bank vole population crashed, which led to a reduced number of human cases as expected.

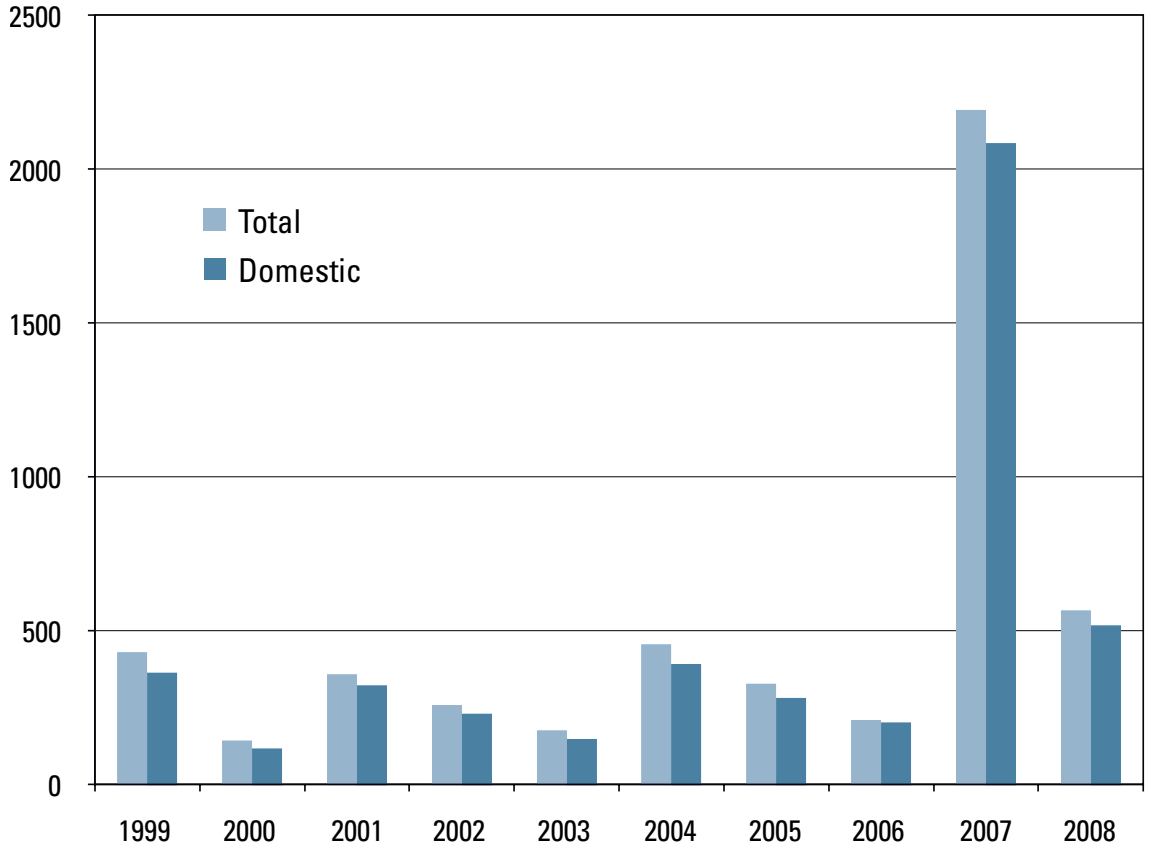
Most cases were aged between40 and 60 years and 54% were men. Almost all cases had acquired their infection in Sweden, except a few who fell ill after visits to Norway and Finland. The four northernmost counties reported 87% of the cases, but a few persons were also infected outside the endemic area, one case as far south as at the west coast of Lake Vättern.

TRENDS AND EPIDEMIOLOGY

Most cases of NE occur during autumn and winter, showing a positive correlation with bank vole abundance in the autumn. The number of NE cases has increased over the years but with a considerable interannual variation coupled to the 3-4 year population cycles of the bank vole. During the last decade both the peaks as well as troughs have been higher. The increase may be explained by for example better recognition of clinical symptoms, improved diagnostic tools and milder winters with a more unsettled and less protective snow cover for the bank voles.

With a few exceptions all the reported NE cases are infected in Sweden. Approximately 90% of all the cases are found within the endemic northern counties (Norrland, Västerbotten, Västernorrland and Jämtland). Cases are also reported from outside this region, but they are often “imported” from the endemic area and found during the summer as a consequence of holidays in the north.
A majority of the cases are between 40 and 70 years. There is an overrepresentation of men.

Figure 6. Notified human cases of Nephropatia epidemica in Sweden in 1999-2008



8. Psittacosis

Psittacosis is caused by *Chlamydophila psittaci*, an intracellular bacterium. The infection occurs worldwide. The main reservoir is in birds. The organism is excreted in feces and nasal discharges. Birds may become carriers of the organism and shed it for years without any symptoms. People acquire the infection mainly via inhalation of contaminated dust or through contact with infected birds. In birds, the infection is transmitted via contact or via ectoparasites or via contaminated equipment. *C. psittaci* may persist in dry fecal secretions for months.

INCUBATION PERIOD

The incubation period is usually between 5 and 14 days.

DISEASE

Humans

In humans the symptoms often include fever, headache, rash, myalgia, chills and upper or lower respiratory tract disease. Respiratory symptoms are often mild. The disease is usually mild or moderate, but can be severe especially in untreated elderly persons.

Animals

Birds commonly develop symptoms when stressed or when the immune system is depressed. Symptoms in birds range from an asymptomatic infection to conjunctivitis, sneezing, pneumonia and generalized infection. Adult birds recover from the infection whereas mortality can be up to 90% among young birds.

SURVEILLANCE

Humans
Psittacosis in humans is notifiable according to the Communicable Disease Act.

Animals
C. psittaci is notifiable in animals. No active surveillance exists. Notifications are based on clinical findings or other investigations.

CONTROL

Control of psittacosis is very difficult. The organism is able to survive for long periods in the environment. As the organism exists in both domestic and wild birds, eradication is impossible. Diagnostic methods are not sensitive enough.

RESULTS IN 2008

Humans
In 2008, psittacosis was notified in 11 persons of whom 8 were infected in Sweden (Figure 7). All cases were between 50 and 80 years old and included three women and eight men. Probably, several of them became infected while feeding wild birds or cleaning birdfeeders.

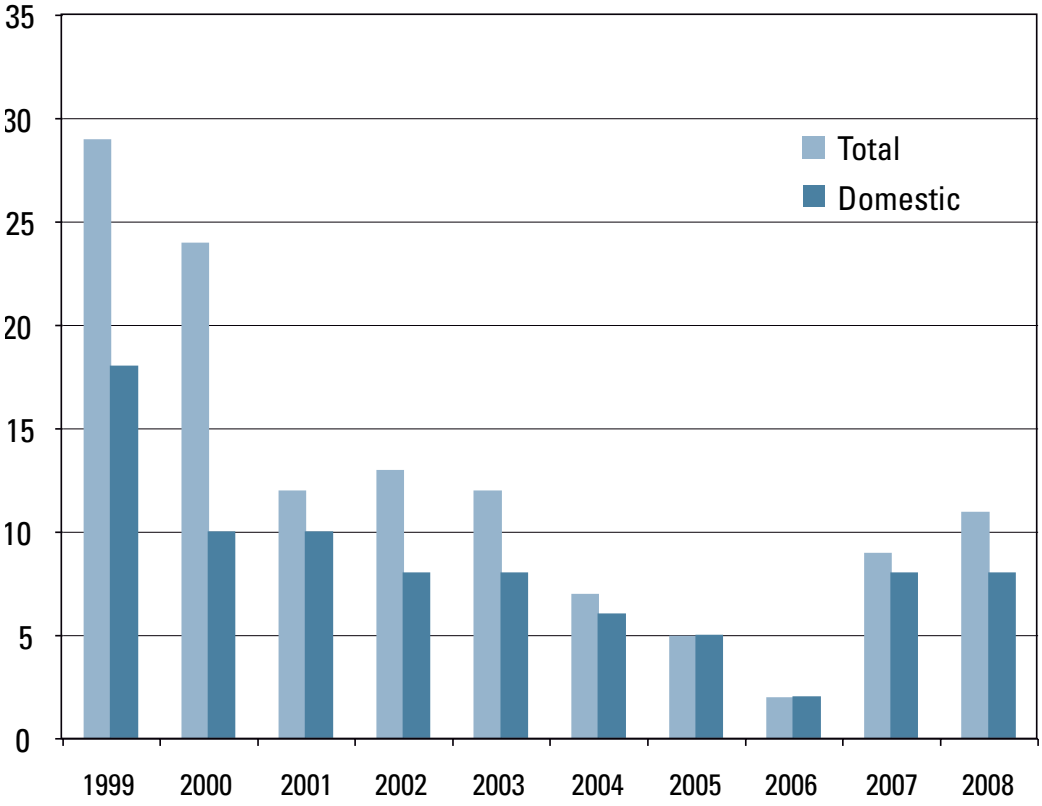
Animals
No cases were reported in animals in 2008.

TRENDS AND EPIDEMIOLOGY

The number of human psittacosis cases has gradually decreased from about 50 cases yearly during the 1990's to about 10 cases yearly during the last decade.

At present *C. psittaci* does not occur in Swedish poultry. Occasional cases have been reported in cage birds. *C. psittaci* is common in wild birds.

Figure 7. Notified cases of psittacosis in humans in Sweden in 1999-2008



9. Q-fever

Q-fever is caused by *Coxiella burnetii*, a strictly intracellular bacterium. Cattle, goats and sheep are the primary reservoirs of the organism but the organism has also been recognized in other animals, e.g. pets. *C. burnetii* is highly infectious and can survive for longer periods in the environment. Transmission routes can be by air contaminated with bacterial aerosols or unpasteurized milk or direct contact with infected animals or contaminated animal products. Outbreaks in humans have occurred during recent years in several European countries, e.g. Germany, UK, Slovenia and the Netherlands.

INCUBATION PERIOD

Incubation period varies depending on the number of organisms inhaled but is usually 2-3 weeks.

DISEASE

Humans

In humans the infection can vary from asymptomatic or flu-like illness to acute pneumonia. Liver complications and abortions occur. Most patients recover but some may develop a chronic illness.

Animals

In animals, the infection is often asymptomatic but can lead to abortions.

SURVEILLANCE

Humans

Q-fever has been notifiable according to the Communicable Disease Act since 2004.

Animals

The disease is notifiable in animals. No active surveillance exists in animals.

CONTROL

Vaccination may be used in the control. *C. burnetii* is able to survive for long periods in the environment because of its tolerance to heat, drying and many disinfectants, and the organism is difficult to eradicate.

RESULTS IN 2008

Humans

During 2008, seven cases of Q-fever were notified, which is slightly more than in previous years. The infected persons were all infected abroad.

Animals

In 2008, a serological bulk tank milk survey was performed in 1000 randomly selected dairy cattle herds. A total of 85 herds were serologically positive for *C. burnetii*. The prevalence of antibodies was thus 8.5% (CI 6.8-10.4%). The prevalence was highest on the Isle of Gotland and in the most southern county (Skåne) (Figure 8). A cluster of serologically positive herds was also seen in Northern Sweden.

TRENDS AND EPIDEMIOLOGY

Since Q-fever became notifiable in humans in 2004, one to three cases have been reported annually until 2008, when an increase could be observed. In the 1980's and the 1990's, only a single sporadic domestic case was reported every decade. As for several other diseases, the incidence of the disease in humans seems to be underestimated.

Serological studies performed in the 1990's showed antibodies among 0.3% of sheep and 1.3% of cattle. The organism has also in occasional cases been isolated in placenta and hay.

10. Rabies

Rabies is caused by a rhabdovirus belonging to a family of Lyssaviruses. Rabies can infect all warm-blooded animals. Rabies occurs worldwide with some free areas. Rabies is transmitted through contact with saliva, typically via animal bites. Most cases are caused by classical rabies. The reservoir animal species of classical rabies in endemic countries are wild animals such as foxes or stray dogs. In addition, bats in Europe may carry another type of rabies virus called European Bat Lyssa virus.

INCUBATION PERIOD

The incubation period of rabies is usually 3-6 weeks, but may vary from five days to one year.

DISEASE

Rabies virus infects the central nervous system of humans and mammals. Early symptoms of rabies are nonspecific, consisting of fever, headache, and general malaise. As the disease progresses, neurological symptoms appear and may include insomnia, anxiety, confusion, slight or partial paralysis, excitation, hallucinations, agitation, hypersalivation and difficulty swallowing. Without post-exposure treatment the disease leads to death within days of the onset of symptoms.

SURVEILLANCE

Humans

Rabies in humans is notifiable according to the Communicable Disease Act.

Animals

Rabies is notifiable on suspicion in animals. Sweden has been free from rabies since 1886. Passive surveillance in bats and other animals have been ongoing for several years. In 2008, an active surveillance of rabies in bats was started.

CONTROL

In endemic countries, vaccination of the reservoir animals such as dogs and wild foxes has given good results. Persons at risk are vaccinated.

RESULTS IN 2008

Humans

No human cases were reported during the year.

Animals

All tested animals were negative for rabies.

TRENDS AND EPIDEMIOLOGY

During the last decades, two persons have been hospitalized for rabies in Sweden. In 1974, a Swedish man fell ill after having been infected in India and in 2000 there was a case imported from Thailand. Both patients had most probably been infected by rabid dogs.

Since Sweden has been free from classical rabies, the risk of acquiring the disease from Swedish animals is negligible. The possibility that EBLV is present in Sweden but has not yet been detected must be considered. The risk of being infected with EBLV is however still considered very low.

11. Salmonellosis

Salmonella are among the most important bacterial zoonoses. The genus is divided into two species: *S. enterica* and *S. bongori*. *S. enterica* is further divided into six subspecies. Most *Salmonella* belong to *S. enterica* subspecies *enterica*. More than 2400 different serovars belonging to this subspecies have been described. *Salmonella* can infect reptiles, all warm-blooded animals as well as humans. The reservoir is in the animal population. *Salmonella* is able to survive in the environment for a considerable time.

INCUBATION PERIOD

The incubation period is normally between 1 and 3 days but can vary from 6 hours to 10 days.

DISEASE

Humans

Human salmonellosis is characterized as an acute gastrointestinal illness. The symptoms can range from asymptomatic and mild to more severe. Most patients recover from the illness spontaneously but sequelae such as reactive arthritis occur in approximately 1-15% of the patients. Moreover, prolonged symptomless excretion of the pathogen is common.

Animals

Salmonella can infect reptiles and all warm-blooded animals. Infection in animals is often asymptomatic. However, *Salmonella* can cause clinical illness with symptoms of diarrhea, abortions, fever and lead to death.

SURVEILLANCE

Humans

Salmonella infection is notifiable in humans. Trace of the source of infection is performed for all reported domestic cases.

Swedish *Salmonella* Control Program

Control of *Salmonella* in Swedish animal production chain was started more than 50 years ago. A severe domestic outbreak of S. Typhimurium that involved more than 9000 people in 1953 prompted the need for a control program. The aim of the Swedish control program is that animals sent for slaughter and animal products should be free from *Salmonella*. The strategy is to prevent *Salmonella* in any part of the production chain, from feed to food of animal origin. Any finding of *Salmonella*, irrespective of serovar, is notifiable and action is always taken to eliminate the infection or contamination. Vaccination is not used in Sweden. The program is governed by the Swedish Law on Zoonosis and its regulations.

Control in Feed

Control of *Salmonella* in feed started in the late 1940's and is an essential part of the control program. The manufacturer is responsible for producing *Salmonella*-free feed. All poultry-feed has to be heat-treated and a major part of the cattle and swine feed is heat-treated too. The feed control is supervised by the Swedish Board of Agriculture which is also responsible for unannounced inspections. In feed mills, effort is put on the control of feed materials, heat treatment and prevention of re-contamination of heat-treated feed.

Since 1991, testing of final products has been replaced by sampling the feed mill according to HACCP principles. Feed materials are classified according to the *Salmonella* risk they may present: feed materials of animal origin (S1) and feed materials of vegetable origin (S2, e.g. soy bean meal and some products deriving from rape seed) and S3 (e.g. rice). All imported feed materials that are classified are tested, often before arrival in Sweden. The results of the analyses of feed material must be available before the start of the feed production. Production of these classified feed materials has to follow a hygiene program containing routines for *Salmonella* sampling. On a weekly basis, a

minimum of five samples from feed mills manufacturing compound feeding stuff for poultry and a minimum of two samples from those manufacturing compound feeding stuff for other food-producing animals must be collected at specified places based on the HACCP principles and analysed for *Salmonella*. The purpose of the weekly sampling is to make sure that *Salmonella* is not present in the production lines of the feed mill. All samples from the weekly monitoring of feed mills have to be analysed at the SVA. The manufacturers also take additional samples to guarantee the freedom of *Salmonella*.

Control in Food

Control of *Salmonella* is an important part of in-house control programs in most food enterprises in Sweden. All findings should be reported to the competent authority. Sampling at retail level is also frequent even if the number of samples has decreased from previous very high numbers.

Surveillance at slaughterhouses

According to the Swedish *Salmonella* control program samples from intestinal lymph nodes and swabs from carcass are taken from cattle and swine and neck skin samples from slaughtered poultry. Sampling is proportional to slaughtering capacity. Altogether 28,000 samples from cattle, adult swine, fattening pigs and poultry are collected annually. At cutting plants, approximately 3000 samples are taken annually from crushed meat and meat scrapings.

Control in Food-producing Animals

Salmonella control program in poultry

The program comprises a compulsory part and a voluntary part. All poultry species are included in the compulsory program, which gives the rules for obligatory sampling.

A preventive voluntary program includes all-in all-out production, hygienic measures and certain standard of bird stables, such as hygienic barriers between the clean and unclean part. Purchase of animals is only allowed from holdings affiliated to the voluntary program. Only heat-treated feed is allowed. The stables must be cleaned and disin-

fected before introduction of a new flock. The food business operator has to make an application to be accepted in the voluntary program. An official veterinarian controls the housing regularly. The producers affiliated to the voluntary program are allowed higher compensation in case of *Salmonella*. All broiler producers belonging to the Swedish Poultry Association are affiliated to the voluntary program (approximately 99% of the slaughtered broilers). The voluntary program has been in place for more than 40 years.

All breeding flocks having more than 250 birds are tested (Table 1). Grandparents of *Gallus gallus* broilers are imported in Sweden as day-old chicken. Laying hens, turkeys, geese and ducks are imported as parents. Samples consist of boot swabs taken from all parts of the stable where the birds are kept. From rearing flocks two pairs of sock samples are taken and pooled into one, five pairs pooled to two are taken from rearing flocks.

All holdings selling eggs for consumption are sampled (Table 1). All poultry flocks having more than 500 birds, irrespective of species, are tested 1-2 weeks before slaughter. The results must be available before slaughter.

Food business operators pay the costs for laboratory analyses and the visits to the holdings. Only accredited laboratories are allowed to perform the analyses. The laboratory sends the test results to the County Veterinary Officer on a quarterly basis. According to the regulations the County Veterinary Officer has to send a report on the test results of all poultry holdings to the SJV once a year.

Salmonella control program in cattle and swine herds

The program comprises a voluntary and compulsory part. The voluntary program is a preventive hygienic program aiming at decreasing the risk of *Salmonella*. The program includes the following points: cleaning and disinfection, control of rodents, hygienic measures, feed, and regulations on other animal species and pasture. Holdings affiliated to the program get higher compensation in case of *Salmonella*. The majority of all breeding holdings and many of the large dairy herds are affiliated to the program. In addition, affiliated holdings can apply for a commercial *Salmonella* insurance.

In swine, fecal samples are taken annually from breeding herds and gilt-producing herds and twice a year from sow pools. At necropsy, all calves younger than six months are tested for *Salmonella*. *Salmonella* is tested at other postmortem investigations if an infection of *Salmonella* is suspected on the basis of the macroscopic findings. All imported animals are sampled. On suspicion, herds or single animals should be tested for *Salmonella*.

Table 1. Sampling scheme for *Salmonella* in poultry

Category of poultry	Sampling frequency	Sample type	Sampling before slaughter	Official veterinarian
Breeders in rearing	1 d, 4 weeks, 2 weeks prior to rearing or moving	2 pairs sock samples	14 d before slaughter	Once a year
Breeders in production	every 2nd week	5 pairs sock samples	14 d before slaughter	3 times under production
Layers in rearing	2 weeks prior to moving	2 pairs sock samples or 2 faecal samples of 75 g	14 d before slaughter	Once a year
Layers in production	every 15th week (start at 22-26 weeks)	2 pairs sock samples or 2 faecal samples of 75 g	14 d before slaughter	Once a year
Poultry for meat production (all species)		2 pairs sock samples or 2 faecal samples of 75 g	14 d before slaughter	Once a year

Control in other animals

Animals are tested for *Salmonella* at suspicion or trace-back. Wild animals necropsied at the SVA are tested for *Salmonella*.

Measures in case of positive findings

All findings irrespective of serotype are notifiable. All suspected primary isolates of *Salmonella* are sent to the SVA for confirmation, resistance testing, serotyping and further typing.

Feed

Measures are always taken when *Salmonella* is detected. *Salmonella* positive feed materials can either be returned to the exporter, heat treated or treated with another method, such as acidification. Acidification is the most commonly used method. The feed material has to be re-tested before going into feed production. Salmonella positive feed has to be withdrawn in applicable cases from the market, reheated or disposed of.

Relevant measures should always be undertaken when positive samples are detected in the production plant. A larger sampling is made in the production line to find out where *Salmonella* is located and depending on the results of this larger sampling different kind of measures should be undertaken. If *Salmonella* is found after heat treatment, the production plant has to be thoroughly cleaned and disinfected after which environmental sampling must show negative results before production is resumed. If *Salmonella* is found before heat treatment the contaminated part of the production line is thoroughly cleaned and disinfected. Dry cleaning, followed by disinfection, is commonly practiced.

Salmonella findings in feed materials from other countries and compound feeds are reported within the Rapid Alert System for Food and Feed (RASFF) system established in the EU.

Animals

If *Salmonella* is suspected in an animal, a veterinarian is always obliged to take samples and prevent further transmission. When *Salmonella* is isolated at a laboratory the laboratory has to notify the SJV and the County Veterinary Officer. The County Veterinary Officer informs meat inspection veterinarian and others needing the information before confirmation. The isolate is sent to SVA for confirmation and further typing. SVA reports the result to the sending laboratory, SJV, the owner of the animal and regional veterinarian.

After a finding of *Salmonella* in the lymph node at slaughterhouse or after finding at necropsy or in a live animal or after finding of a resistant *Salmonella* isolate in a carcass sample, all farms of origin are tested. When *Salmonella* is confirmed on a farm, the holding is put under restrictive measures and an epidemiological investigation is always performed. A plan to eradicate *Salmonella* from the holding is designed. All *Salmonella* positive poultry flocks are euthanized irrespective of serotype. The poultry stable and all possible contaminated areas are thoroughly cleaned and disinfected. Before introduction of new birds, all environmental samples must be negative for *Salmonella*.

Animal movements to and from the holding are forbidden. In pigs, stamping out is practiced in most finishing herds. In swine breeding herds, repeated sampling is usually practiced. Reducing the number of animals, control of animal movements on the farm and hygienic measures are important. No *Salmonella* positive animals should enter the cleaned and disinfected parts of the stable. In cattle, the eradication strategy depends on the type of production and degree of *Salmonella* contamination. For other animal groups, various measures to reduce the pressure of infection can be taken, such as moving animals out on pasture during the warmer season or arranging temporary stables or calf-hoods. Negatively tested animals and those considered at low risk of being infected may be slaughtered under certain conditions, with extra hygienic measures and sampling every carcass. The restrictions are lifted when the cleaning and disinfection have been completed and *Salmonella* cannot be detected from two whole-herd samplings performed four weeks apart.

If *Salmonella* is detected in companion animals advice is given to the owners. If *Salmonella* is detected in horses, the stables and or the paddocks at risk are put under restrictions and the horse is followed up.

RESULTS IN 2008

Humans

A total of 4183 cases of *Salmonella* infection were reported (Figure 8), which is slightly more the 3933

cases in 2007. Only 16% of the cases were reported as being infected in Sweden. The proportion of domestically infected cases was significantly lower than in both 2006 and 2007. This could be explained by a decrease in major domestic outbreaks in 2008.

Domestic cases were relatively evenly distributed during the year with a smaller peak during the summer months. Slightly more women (54%) than men were notified. Children under five years accounted for 16% of the notified domestic cases.

The incidence was highest on the Isle of Gotland and in county of Örebro in central Sweden and Skåne in the south.

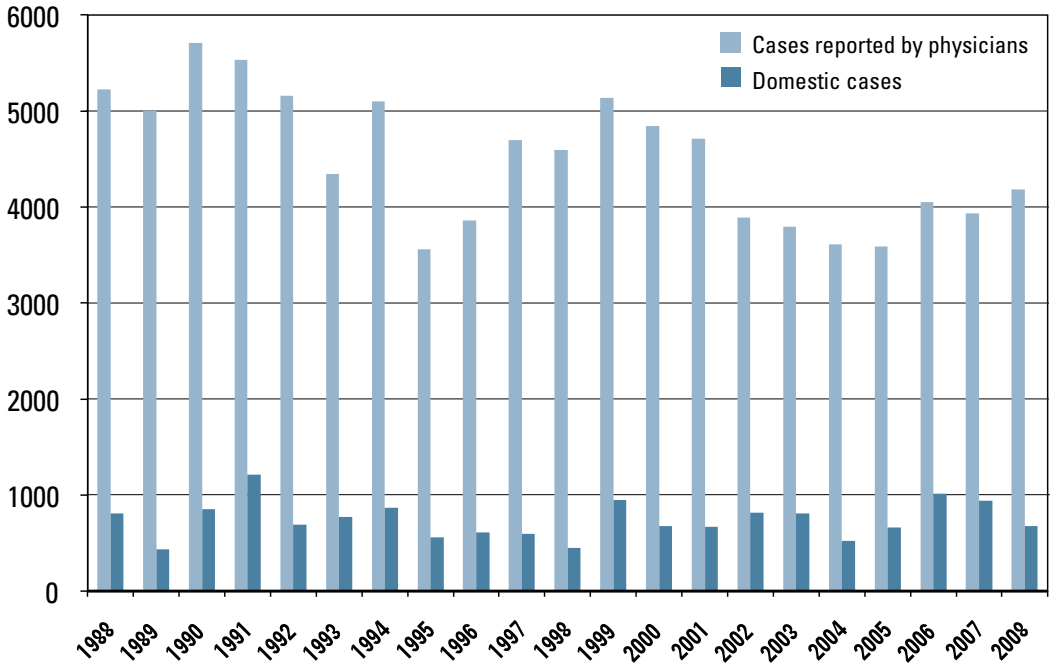
The low proportion of domestic infection is unique for Sweden compared to most European countries. This is explained by the good *Salmonella* situation in Swedish animals and food.
Thailand was, as in previous years, the country where most Swedes acquired their *Salmonella* infection. Approximately one third of the total reported cases had Thailand as reported country of infection.

The three most common domestic serotypes reported were *S.* Typhimurium (35%) and *S.* Enteritidis (13%). *S.* subspecies I accounted for 9% of the domestic cases.

During 2008, 18 small outbreaks or clusters of cases were reported with a total of 130 cases. The number of outbreaks was higher compared to previous years, but with fewer reported cases. In the autumn, an outbreak of *S.* Napoli was linked to imported Italian rucola lettuce. Two different supermarket chains withdrew the salad, but more than 10 cases could still be linked to the product. During the autumn, several cases of *S.* Thompson were notified to SMI. This particular serotype figured in a large international outbreak in 2004 with several Swedish cases. The source of the infection was also imported Italian rucola. PFGE analysis of the human isolates of 2008 showed that four cases had a *Salmonella* isolate with the similar pattern as that found in the imported rucola in 2004.

Many international *Salmonella* outbreaks involved Sweden in 2008. That year, the largest outbreak in Europe was in Denmark, with more than 1300 reported cases of *S.* Typhimurium U288. Surprisingly, only Swedes who had visited Denmark were reported in this outbreak. At the end of 2008, a Nordic outbreak of *S.* Typhimurium affecting Norway, Denmark and Sweden was investigated and the source of infection was suspected to be Danish pork sold in Swedish supermarkets.

Figure 8. Notified human cases of salmonellosis in humans in Sweden in 1988 -2008



Feed

Fifteen major feed mills produce approximately 95% of all feed consumed. In the HACCP control of feed mills, 8870 samples were taken by the industry and 509 by the authorities (Figure 9). *Salmonella* was detected in 36 samples (0.4%). Thirteen serotypes were detected; *S.* Typhimurium was the most common (n=13) (Table 2).

In addition, *Salmonella* was detected in 17 of 2197 (0.8%) samples from derived material of vegetable origin. The most common serotype was *S.* Livingstone (n=4). *Salmonella* was detected in 6 of 894 (0.7%) environmental samples from domestic rapeseed processing plants. Of these 6, 4 isolates were typed to *S.* Senftenberg. Of 2571 samples, 7 (0.3%) from processing plants for animal by-products and feed materials of animal origin were positive for *Salmonella*.

Food

Salmonella was neither detected from 4686 poultry neck skin samples (Figure 10) nor from 3280 cattle carcasses sampled (Figure 11). *S.* Dublin was isolated from one sample of an adult swine (0.04%) but not from any other swine carcass samples (Figure 12, 13). *Salmonella* was not isolated from meat scrapings (Table 3).

Salmonella was isolated from 1 of 568 samples of ready-to-eat foods, from 1 out of 403 fruits and vegetables and from 1 cheese of 27 dairy products. In addition, 2 of 20 samples of crustaceans yielded Salmonella. No *Salmonella* was isolated from 21 samples of herbs and spices, 32 samples of fishery products and 91 samples of ice cream and deserts. It should be noted that the reporting from the local authorities is far from complete.

Animals

Poultry

In total, *Salmonella* was detected in 14 poultry flocks. *Salmonella* was not detected in any breeding flocks. *Salmonella* was detected in 7 (0.2%) of 3385 tested broiler flocks (Figure 14). Four flocks were infected with *S.* Typhimurium: phage types 15a (n=1), same subtype of phage type RDNC (n=2) and another RDNC (n=1) (Table 4). One of these flocks was sampled because of clinical salmonellosis in a child of the owner family. *S.* Agona was isolated from three consecutive flocks of one holding although the infected birds were killed and the holding was cleaned and disinfected between the rounds.

Figure 9. The presence of Salmonella in HACCP control of feed mills

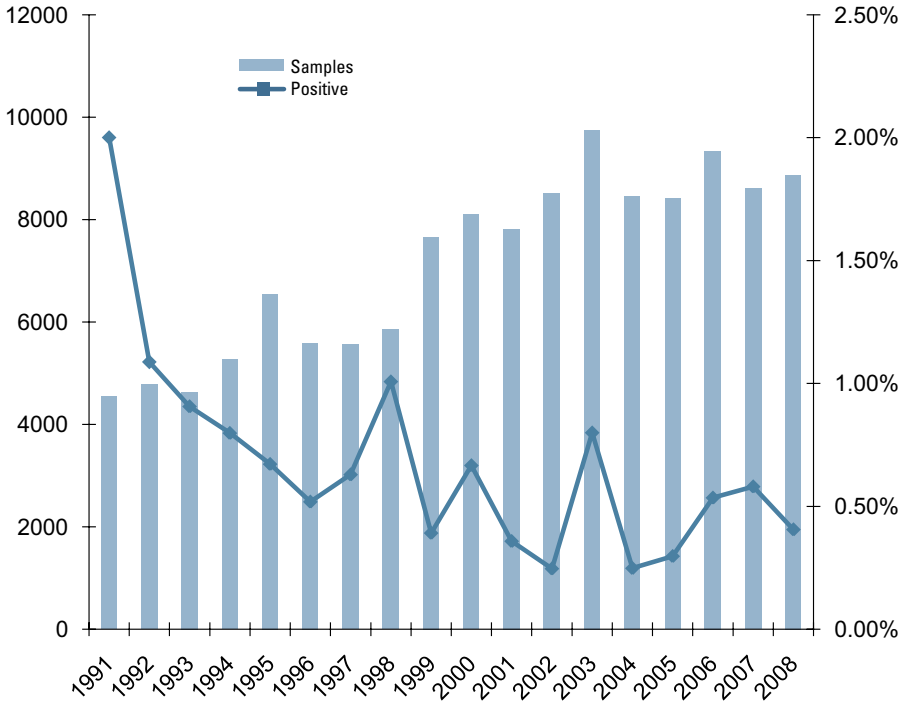


Table 2. Serotypes of *Salmonella* isolated in feed control in 2008

Serotype	Bone meal	Fish meal	Grea-ves	Maize	Poultry offal meal	Process control feed mills	Rape seed	Rape seed environ-ment	Soya bean	Sun-flower seed
S. Aarhus						1				
S. Adelaide						1				
S. Agona				1		1				
S. Corvallis										1
S. Cubana						6			2	
S. Ealing					1					
S. Eastbourne						1				
S. Enterica subsp.						3				
S. Give			2							
S. Infantis						2				
S. Lexington									2	
S. Livingstone				1		1	3	1		
S. Mbandaka						2	1	2	1	
S. Montevideo					1					
S. Oranienburg						1				
S. Reading						1				
S. Rissen									1	
S. Senftenberg	2					1		3	2	1
S. Tennessee						1				
S. Typhimurium PT 120						9				
S. Typhimurium PT 99						1				
S. Typhimurium RDNC						3				
Untyped		1				1				
Total	**2**	**1**	**2**	**2**	**2**	**36**	**4**	**6**	**8**	**2**

Figure 10. Prevalence of *Salmonella* in poultry neck skin samples at major abattoirs in 1995-2008

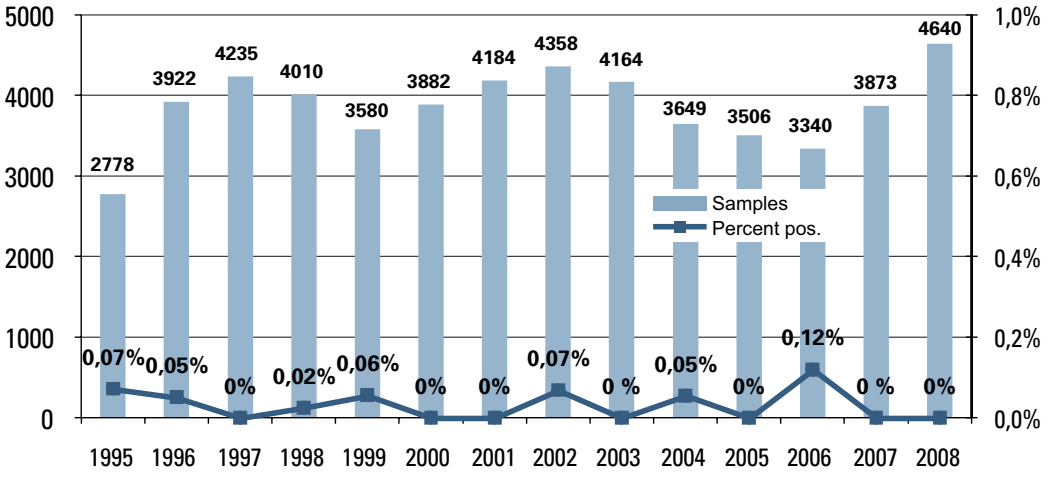


Figure 11. Prevalence of *Salmonella* in swab samples of cattle carcasses in 1996-2008

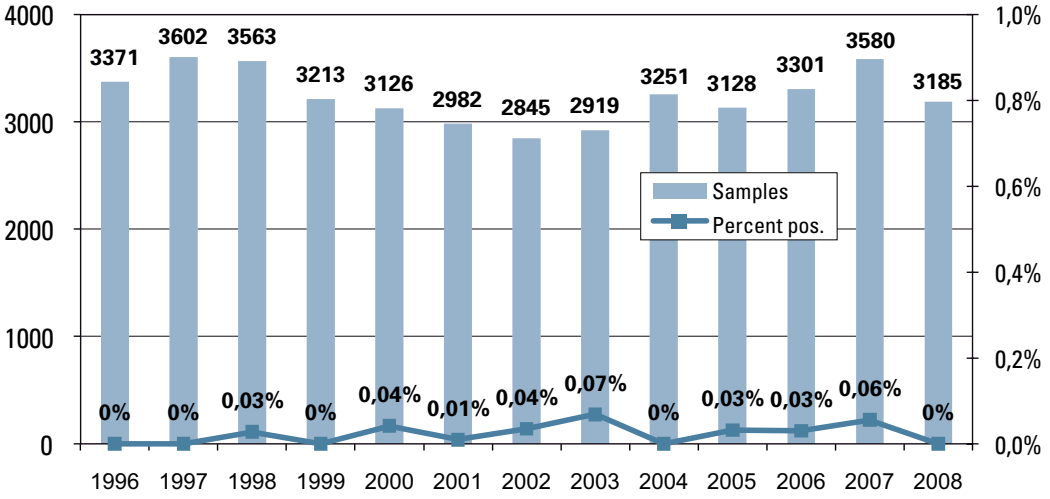


Figure 12. Prevalence of *Salmonella* in swab samples of adult swine carcasses in 1996-2008

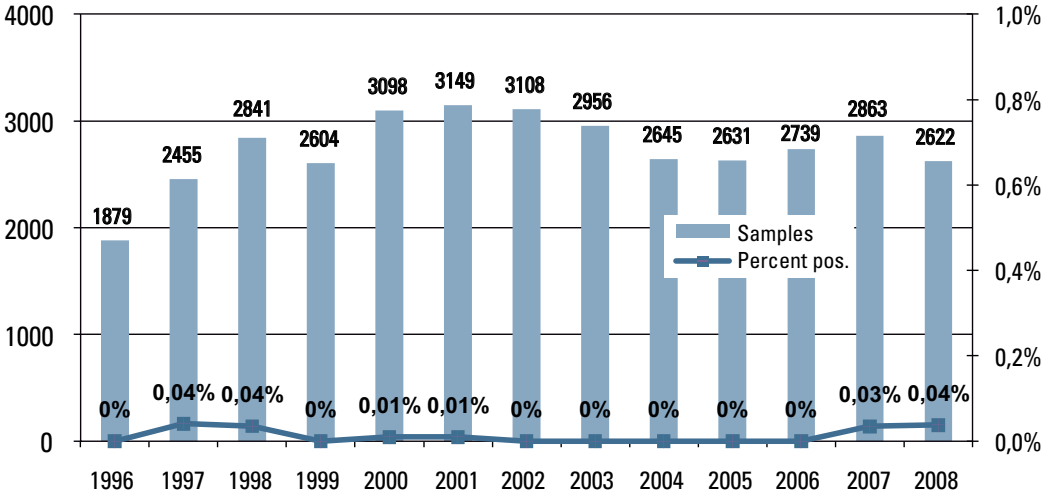


Figure 13. Prevalence of *Salmonella* in carcass swab samples of fattening pigs at major abattoirs in 1996-2008

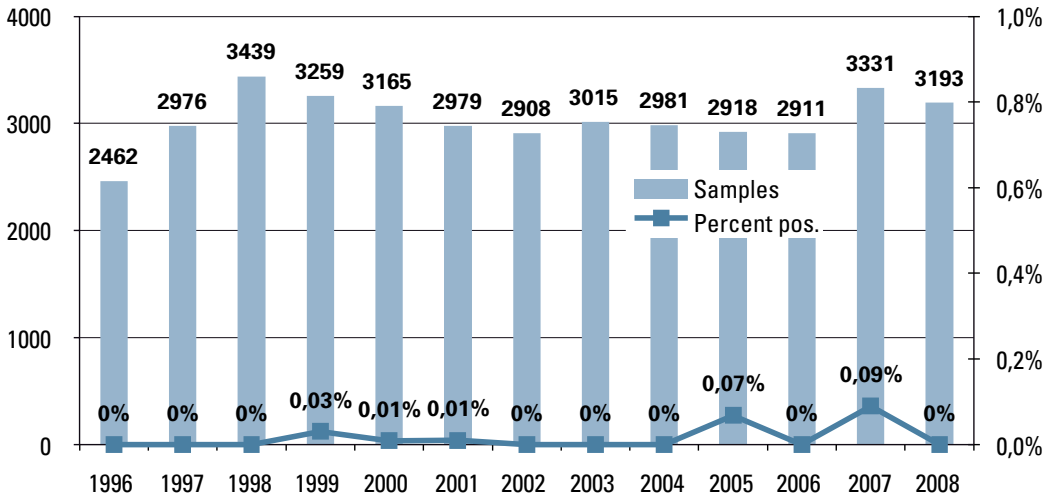


Table 3. Results from the *Salmonella* control programme at slaughterhouses and cutting plants

Animal species	Abattoir	Sample type	No. samples	Positive	Percentage (%)	Serotype
Cattle	Major	Lymph node	3215	4	0.12%	S. Dublin, S. Typhimurium PT126 (n=2), RDNC (n=1)
	Small	Lymph node	105	0	0.00%	
	Major	Carcass swab	3185	0	0.00%	
	Small	Carcass swab	95	0	0.00%	
Breeding swine	Major	Lymph node	2612	7	0.27%	S. Goldcoast, S. Newport (n=2), S. Thompson, S. Typhimurium U277 (n=2), S. subspecies I
	Small	Lymph node	13	0	0.00%	
	Major	Carcass swab	2622	1	0.04%	
	Small	Carcass swab	2	0	0.00%	
Slaughter swine	Major	Lymph node	3171	8	0.25%	S. Typhimurium PT 40 (n=5), DT 104 (n=1), U277 (n=1), RDNC (n=1)
	Small	Lymph node	16	0	0.00%	
	Major	Carcass swab	3193	0	0.00%	
	Small	Carcass swab	16	0	0.00%	
Cattle and swine		Meat scrapings	3512	0	0.00%	
Poultry	Major	Neck skin	4640	0	0.00%	
	Small	Neck skin	46	0	0.00%	
		Meat scrapings	1441	0	0.00%	

Figure 14. Incidence of *Salmonella* in flocks of *Gallus gallus* during 1996-2008, GP and P flocks included

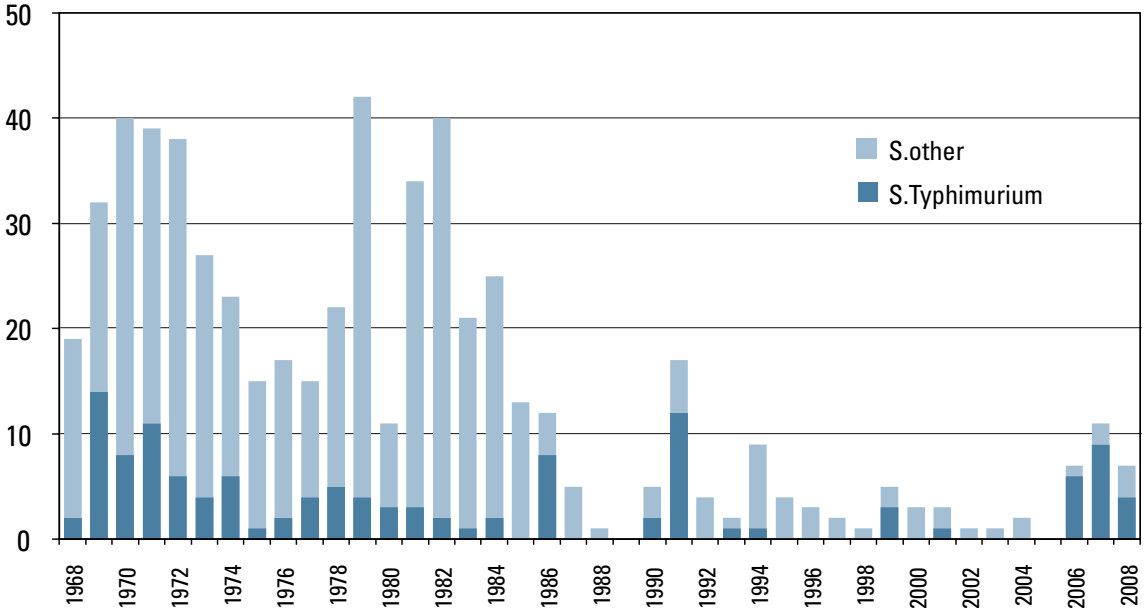


Table 4. Poultry flocks infected with *Salmonella* in 2008

Serotype	Phagetype	Species	Production type
S. Agona	not relevant	Gallus gallus	Meat production
S. Agona	not relevant	Gallus gallus	Meat production
S. Agona	not relevant	Gallus gallus	Meat production
S. Typhimurium	15a	Gallus gallus	Meat production
S. Typhimurium	RDNC	Gallus gallus	Meat production
S. Typhimurium	RDNC	Gallus gallus	Meat production
S. Typhimurium	RDNC	Gallus gallus	Meat production
S. Reading	not relevant	Turkeys	Meat production
S. Typhimurium	RDNC	Turkeys	Meat production
S. Typhimurium	RDNC	Gallus gallus	Egg production
S. Typhimurium	RDNC	Gallus gallus	Egg production
S. Typhimurium	RDNC	Gallus gallus	Egg production
S. Livingstone	not relevant	Gallus gallus	Egg production
S. diarizonae	not relevant	Gallus gallus	Egg production

Salmonella was detected in 5 (0.7%) of approximately 724 flocks of laying hens (Figure 15). *S.* Typhimurium RDNC was detected in three flocks, *S.* Livingstone in one and *S. enterica* sp. *diarizonae* in one flock (Table 3). Four of these flocks were detected in routine samplings; one flock was tested because of clinical salmonellosis in the owner family. The same phage type of S. Typhimurium was detected in the flock and the humans. *Salmonella* had not been detected in the previous samplings of that flock.

Salmonella was also detected in 2 of (0.8%) 251 turkey flocks (Figure 16). *S.* Typhimurium RDNC was isolated from one flock and S. Reading from another flock.*S.* Reading isolated in this flock was part of an outbreak affecting multiple animal species and humans.

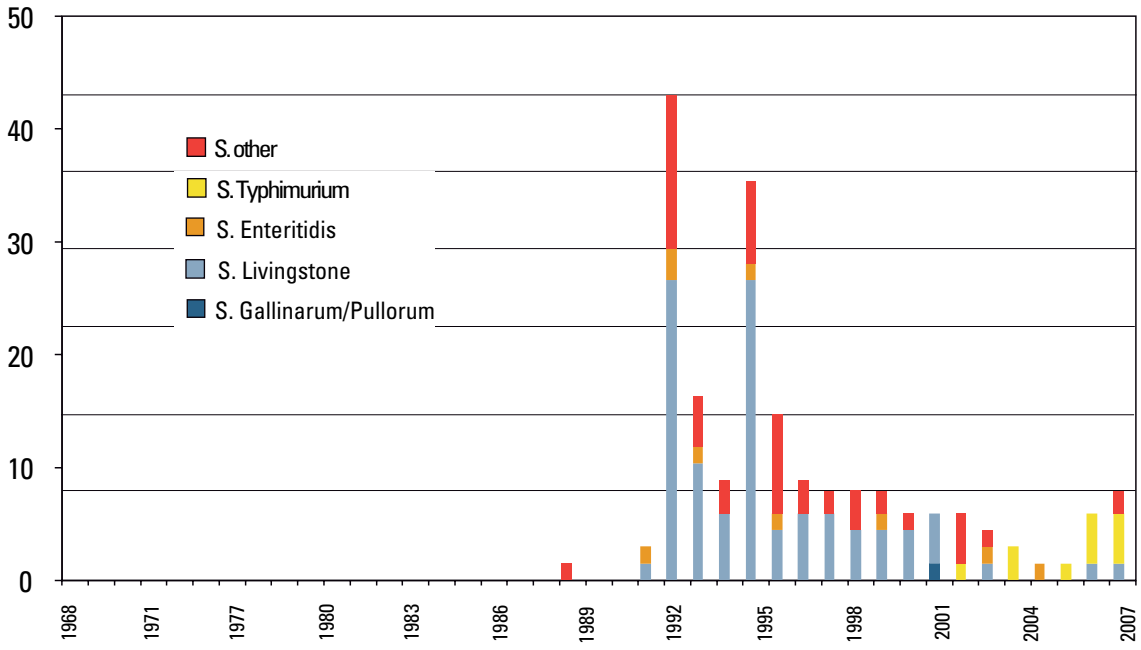
Cattle

In 2008, *Salmonella* was detected in 21 new cattle herds (Figure 17). *S.* Dublin was detected in 9 herds, *S.* Typhimurium in 7, *S.* Reading in 3 and *S.* Enteritidis in 2 herds (Table 5). Eight additional farms were under restrictive measures in 2008 due to an infection detected in 2006 or 2007. By the end of 2008, only two of these eight farms were under restricted measures. Only one of these new herds was detected after a finding in the control program performed at slaughterhouses. Most were detected after a trace-back (n=11). The herds infected with *S.* Reading were closely situated and were part of an outbreak affecting several animal species and humans.

Salmonella was isolated from 4 of 3320 lymph nodes analyzed (Figure 18, Table 3). All the findings were from high-capacity abattoirs. *S.* Dublin was isolated from 1 sample, *S.* Typhimurium DT126 from 2 and RDNC from 1 sample. *S.* Typhimurium RDNC was not detected on the farm of origin.

Salmonella was also initially isolated from nine individual animals at necropsy (Table 5). In addition, *S.* Typhimurium RDNC was isolated from one necropsied animal but not from other animals in the herd.

Fig. 15 Incidence of *Salmonella* in flocks of laying hens during 1968-2008



SALMONELLOSIS

Figure 16. Incidence of *Salmonella* in Swedish turkeys flocks in 1995-2008

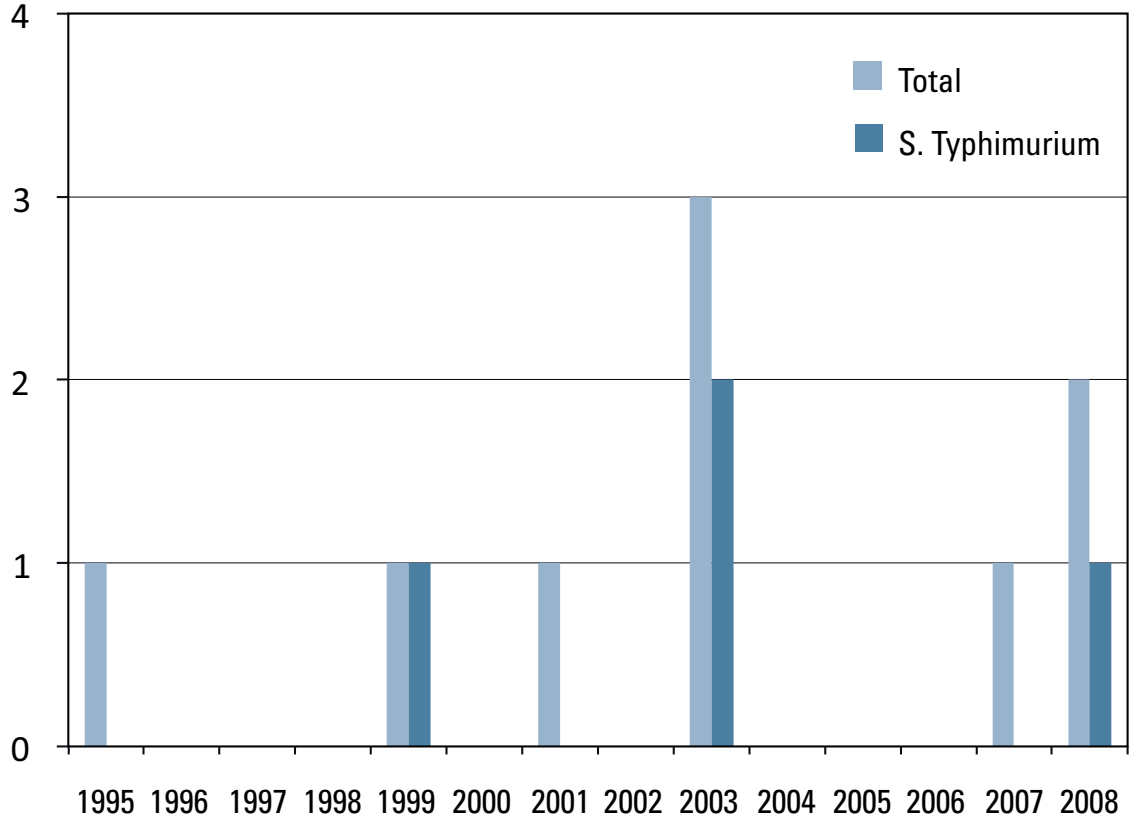


Figure 17. Incidence of *Salmonella* in Swedish cattle herds in 1968-2008

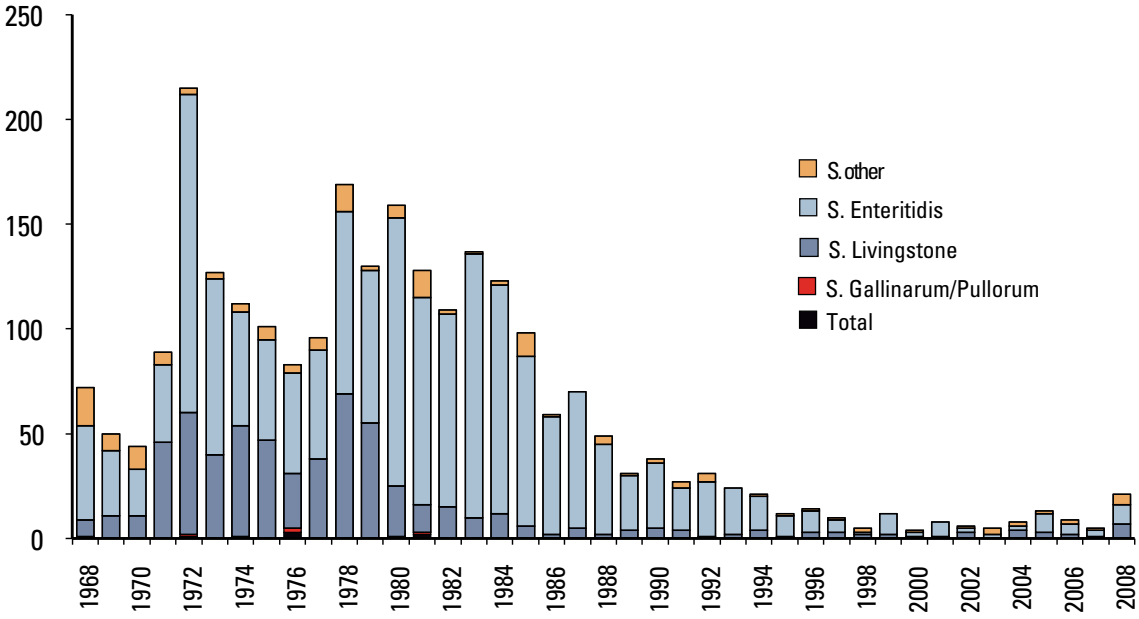


Table 5. Cattle farms infected with *Salmonella* in 2008

Primary serotype	Phage-type	Other serotypes	Production type	Restricted since	Restrictions lifted	Reason for sampling
S. Agona	not relevant	S. Typhimurium, S. Dublin	dairy	2006	2008	Other
S. Dublin	not relevant		dairy	2006	2008	Other
S. Dublin	not relevant	S. Enteritidis, S. diarizonae	dairy	2007		Slaughter line
S. Dublin	not relevant		dairy	2007	2008	Necropsy
S. Dublin	not relevant		dairy	2007	2008	Necropsy
S. Dublin	not relevant		meat	2008		Trace-back
S. Dublin	not relevant	S. Typhimurium	dairy	2008		Trace-back
S. Dublin	not relevant		meat	2008	2008	Trace-back
S. Dublin	not relevant		dairy	2008	2008	Trace-back
S. Dublin	not relevant		dairy	2008	2008	Trace-back
S. Dublin	not relevant	S. Typhimurium RDNC	meat	2008		Trace-back
S. Dublin	not relevant		dairy	2008		Necropsy
S. Dublin	not relevant		dairy	2008		Clinical symptoms
S. Dublin	not relevant	S. Typhimurium RDNC	meat	2008		Abattoir sampling control programme
S. Enteritidis	PT1		meat	2008		Necropsy
S. Enteritidis	PT1		dairy	2008		Trace-back
S. Reading	not relevant		multiple	2007		Abattoir sampling control programme
S. Reading	not relevant		meat	2008		Necropsy
S. Reading	not relevant		dairy	2008		Clinical symptoms
S. Reading	not relevant		meat	2008		Trace-back
S. Typhimurium	DT104		dairy	2006	2008	Clinical symptoms
S. Typhimurium	DT104		dairy	2007	2008	Trace-back
S. Typhimurium	DT104		meat	2008		Trace-back
S. Typhimurium	DT104		dairy	2008		Trace-back
S. Typhimurium	DT126		dairy	2008		Abattoir sampling control programme
S. Typhimurium	NT		dairy	2008		Necropsy
S. Typhimurium	PT1		dairy	2008		Necropsy
S. Typhimurium	PT151		meat	2008		Necropsy
S. Typhimurium	U277		meat	2008		Trace-back

NT= non typable

Figure 18. Prevalence of *Salmonella* in cattle lymph node samples taken at major abattoirs in 1996-2008

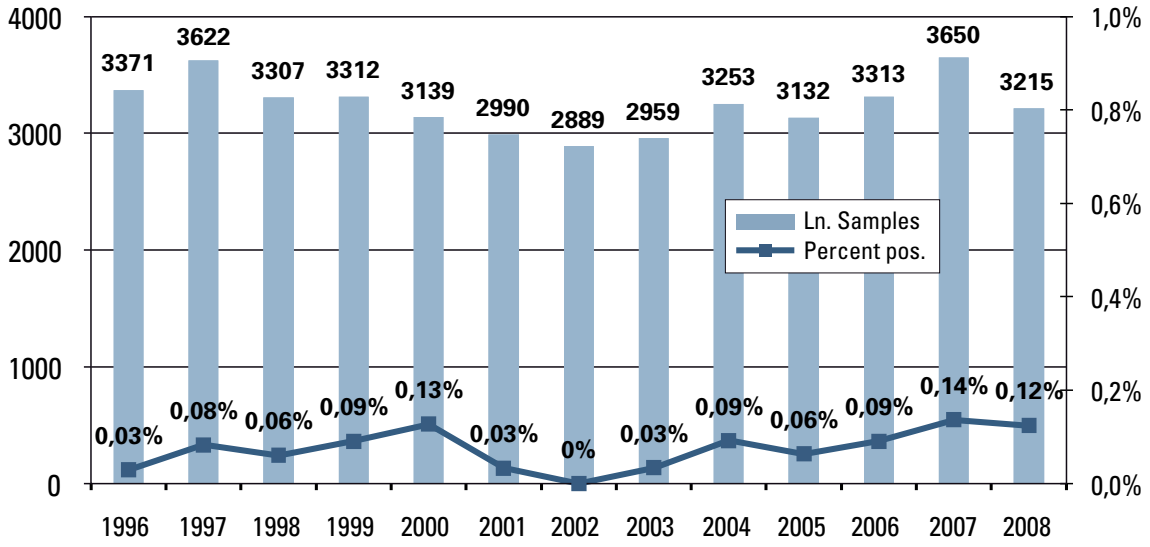


Table 6. Swine farms infected with *Salmonella* in 2008

Primary sero-type	Phage-type	Other s erotypes	Restric-ted since	Reason for sampling	Sample type
S. Infantis	not relevant	no	2007	Control programme in 2007	Lymph node
S. Infantis	not relevant	no	2007	Baseline study of slaughter pigs	Lymph node
S. Typhimurium	DT104	no	2007	Control programme in 2007 & trace-back	Lymph node & faeces
S. Typhimurium	DT120	no	2007	Control programme in 2007	Lymph node
S. Typhimurium	RDNC	no	2007	Control programme in 2007	Lymph node
S. Cubana	not relevant	no	2008	Baseline study of breeding pigs	Faeces
S. Newport	not relevant	no	2008	Control programme in 2008	Lymph node
S. Typhimurium	DT40	S. Dublin, untypable	2008	Control programme in 2008	Lymph node
S. Typhimurium	RDNC	no	2008	Control programme in 2007	Lymph node
S. Typhimurium	NT	no	2008	Control programme in 2007	Lymph node
S. Typhimurium	U277	no	2008	Control programme in 2008	Lymph node
S. Typhimurium	U277	no	2008	Baseline study of breeding pigs	Faeces
S. Typhimurium	U277	no	2008	Trace-back	Faeces

NT=non typable

RDNC=reacts but does not conform to a specific phagetype

Swine

In 2008, *Salmonella* was detected on eight new swine herds (Table 6, Figure 19). In addition, five herds were under restrictive measures due to an infection detected in 2007. In contrast to cattle, most swine herds were detected after a finding in the surveillance program of abattoirs. In one swine herd three different serotypes were detected: *S.* Typhimurium DT40, *S.* Dublin and an untypable isolate (Table 6). Furthermore, another serotype, *S.* Goldcoast was isolated from the lymph node sample of a sow. Because this is extremely unusual, extended investigation was performed but no laboratory contamination or other analytical failure could be found. Two farms were detected in the baseline study of breeding pigs. No *Salmonella* could be found when the whole herd was samples. In addition, *S.* Typhimurium was isolated from two lymph node samples in late 2007. These farms were sampled in January 2008 and found positive.

Salmonella was detected from 7 of 2625 lymph node samples taken from adult swine and from 8 of 3187 lymph nodes of fattening pigs (Figure 20 and 21). All findings were from high-capacity abattoirs.

Figure 19. Incidence of *Salmonella* in Swedish swine herds in 1968-2008

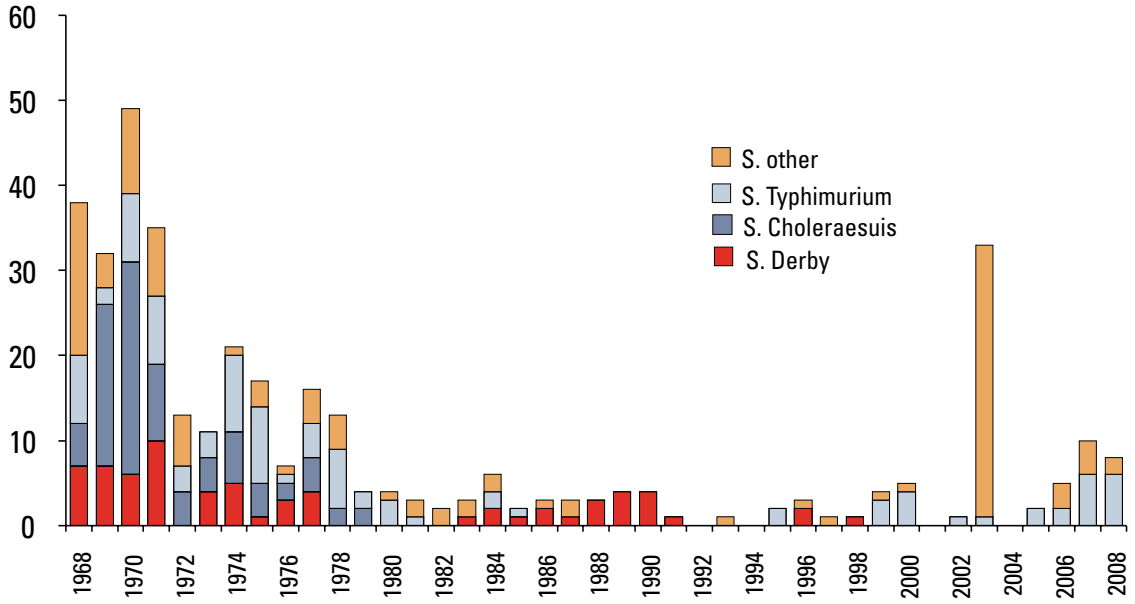


Figure 20. Prevalence of *Salmonella* in lymph node samples of adult swine, sampled at major abattoirs

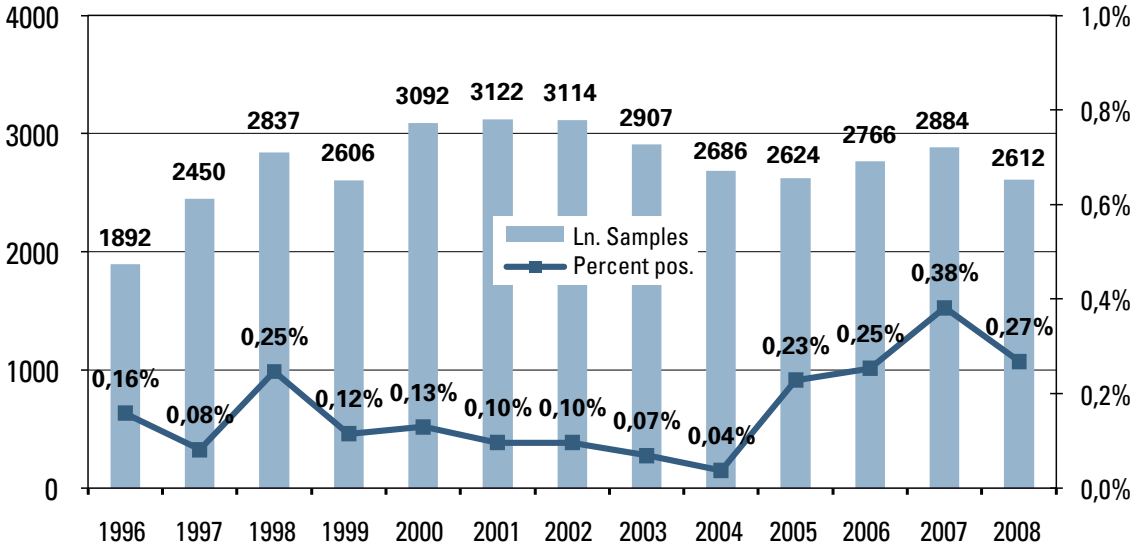
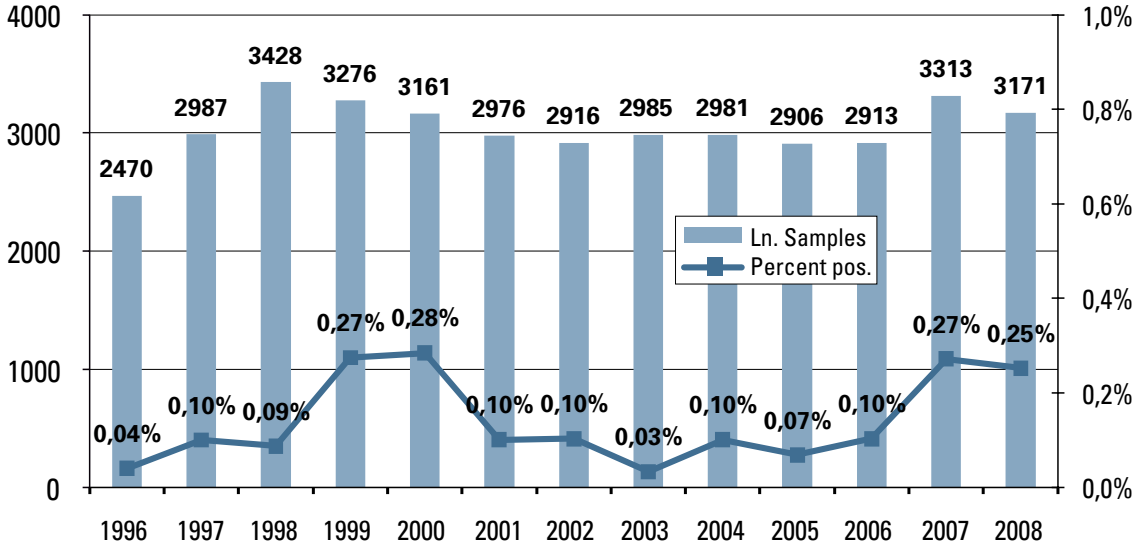


Figure 21. Prevalence of *Salmonella* in lymph node samples of fattening pigs at major abattoirs



In two cases, *Salmonella* could only be isolated from the pooled sample but not from the individual lymph node samples. These were serotype Typhimurium U277 from adult swine and RDNC from fattening pig.

Other animals

Salmonella was reported in 51 cats (Table 7). Of these, 23 were serotyped to Typhimurium and 1 to *S.* enterica sp. diarizonae. Furthermore, *Salmonella* was detected in 6 dogs, 4 horses, 5 sheep and 5 reptile pets. *Salmonella* Typhimurium was detected in 2 passerine birds and 1 gull, a new serovar Peregrinus in 3 falcons *S.* Hessarek in a woodpecker and *S.* Enterica O8 in a pool of 5 cranes. *Salmonella* was also isolated from 5 of 17 tested hedgehogs, 5 zoo animals and 1 ferret. *S.* Reading was isolated from 3 horses living close to the infected cattle herds.

TRENDS AND EPIDEMIOLOGY

The low proportion of domestic human infections is unique for Sweden, Norway and Finland compared to most European countries. This reflects the good *Salmonella* situation in domestic animals and food. In recent years, different types of green products have been either a verified or suspected source of *Salmonella* outbreaks in humans. These food products are normally eaten without heat treatment.

Most reported cases are infected abroad. In recent years, Thailand has been the country where most Swedes acquired their *Salmonella* infection.

The *Salmonella* situation in domestic animals has been very favourable. The number of infected broiler flocks, swine and cattle herds decreased in the late 1980's (Figures). Since, the number of infected broiler flocks has mainly been round 5 and the number of cattle herds has since then been between 5 and 13. Up to 5 new infected swine herds have been detected annually except for the years of 2003, 2007 and 2008. In 2003, 30 swine herds were infected with *S.* Cubana traced to contaminated feed. In 2008, the number of infected cattle herds was clearly higher than in the previous years, and in 2007, the number of infected swine and poultry herds was higher than in the previous years.

A prolonged outbreak of S. Reading in Skåne, southern Sweden affected multiple animal species and humans. This outbreak was identified in 2007 and continued despite restrictive measures and trace-back.

It is still too early to conclude whether these changes reflect a true increase, but it is important to follow the development.

Table 7. Reported cases of *Salmonella* in cats, dogs, ferrets, hedgehogs, horses, pet reptiles, wild birds and zoo animals

Serotype	Phagetype	Cat	Dog	Ferret	Hedge-hogs	Horse	Repti-les	Wild birds	Zoo ani-mals
S. Dublin	not relevant					1			
S. Dusseldorf	not relevant	1							
S. Enteritidis	not phagetyped		1						
S. Enteritidis	RDNC				1				
S. Hessarek	not relevant							1	
S. Infantis	not relevant						1		
S. Kottbus	not relevant			1					
S. Montevideo	not relevant		1						
S. Munchen	not relevant						2		
S. Peregrinus	not relevant							3	
S. Reading	not relevant		1			3			
S. Remete	not relevant								1
S. diarizonae	not relevant	1							2
S. arizonae	not relevant						1		
S. Tennessee	not relevant		1						1
Subspecies IIIb:k:1,5	not relevant								1
S. Typhimurium	PT 1				4				
S. Typhimurium	PT 40	6						1	
S. Typhimurium	PT 41							1	
S. Typhimurium	U 277	1							
S. Typhimurium	RDNC	2	1					1	
S. Typhimurium	not phagetyped	14	1						
Untyped	not relevant	26					1	1	
Total		**51**	**6**	**1**	**5**	**4**	**5**	**8**	**5**

12. Tick-borne encephalitis (TBE)

The TBE virus is spread by ticks *(Ixodes ricinus)*, which are infected when they take their blood meals at infected rodents. Larger mammals, predominantly ungulates, are important to feed the adult ticks, thereby leading to a larger tick population.

Three virus sub-types are described: Western, Siberian and Far Eastern tick-borne encephalitis virus. In Sweden, only Western tick-borne encephalitis has been found.

INCUBATION PERIOD

The incubation period of TBE is usually between 7 and 14 days.

DISEASE

Humans

In humans, a biphasic course of the disease is common. The first, viremic phase appears with fever, muscle pain, fatigue and headache and lasts for about four days. After a free interval of about a week, a meningoencephalitic phase appears in about one third of the patients. The symptoms may then include fever, headache, nausea, cognitive dysfunctions, spinal paresis, etc. The mortality is low, about 0.5%.

Animals

Animals do not develop illness.

SURVEILLANCE

Humans

TBE in humans is notifiable according to the Communicable Disease Act.

Animals

TBE is not notifiable in animals.

CONTROL

People who are living in or spending much time in risk areas are recommended TBE vaccination.

RESULTS IN 2008

During 2008, the number of TBE cases continued to increase. In total, 224 cases were reported, which is an increase of 24% from 2007.

Of the infected persons, 60% were men and the average age was 45 years.

A majority of the TBE cases (213 persons) had acquired their infection in Sweden.

Most of the cases appeared in the same geographical areas as in the previous years, but one case in the northern parts of the West coast) as well as two cases in the county of Dalarna were notified. The most unexpected observation was a case in the county of Västerbotten, where the disease had never been seen before.

TRENDS AND EPIDEMIOLOGY

The first TBE case in Sweden was reported in 1954 and during the following three decades, 10-40 cases were reported annually. From the mid-1980's a clearly increasing trend has been observed. The last years about 200 cases have been reported annually. With a few exceptions all the cases are infected in Sweden. Most of them have acquired their infection in the counties of Stockholm, Södermanland and Uppsala close to the Baltic Sea or at the eastern and middle parts of Lake Mälaren. The age distribution is wide but most of the cases are between 30 and 70 years. There is a slight overrepresentation of men. About 80% of the patients are diagnosed in from July to October.

13. Trichinellosis

Trichinellosis is caused by parasitic nematodes of the genus of *Trichinella*. Several species are included in the genus. In Europe, *T. spiralis*, *T. britovi* and *T. nativa* are the dominant causes of human infections. The parasites can be hosted by different mammals; the main reservoirs today being rats and wild carnivores and omnivores, occasionally domestic swine and horse. Humans mainly acquire the infection by eating raw or inadequately heated meat, typically cold-smoked sausage. In Sweden, the species detected include the aforementioned three as well as *T. pseudospiralis*. The infection is acquired by ingestion of raw or undercooked meat containing encapsulated *Trichinella* larvae. In the gut the larvae are released, develop into adults and mate. After mating, the female releases larvae which penetrate the intestinal mucosa and travel via the bloodstream to various organs and muscles. In muscles the larvae form cysts and may survive for years.

INCUBATION PERIOD

The incubation period varies from 5-15 days.

DISEASE

Humans

The disease can range from subclinical infection to a fatal disease. Symptoms initially involve diarrhea and abdominal pain and later muscle pain, fever, edema of the upper eyelids and photosensitivity. The disease can be treated during the early stages. Cardiac and neurological complications may occur during 3-6 weeks after infection. Trichinellosis is not transmitted between humans.

Animals

Animals rarely develop a clinical infection.

SURVEILLANCE

Humans

Trichinellosis is notifiable according to the Communicable Disease Act.

Animals

Trichinella is notifiable in animals. All slaughtered domestic pork and wild boar as well as horses and hunted wild boars and bears are tested for *Trichinella*. In addition, several species of wild animals are tested for *Trichinella*, including *e.g.* foxes, lynxes, wolves, badgers, birds and wolverines. *Trichinella*-free regions have not been created in Sweden.

CONTROL

- Control of *Trichinella* at meat inspection.
- Heating of meat.
- Rodent-free production environment.
- Freezing has been used as a control method but some species, such as T. nativa tolerate freezing

Trichinella larvae are not destroyed by fermentation of meat.

RESULTS IN 2008

Humans

No human cases of *Trichinella* were reported in 2008.

Animals

In 2008, all slaughtered domestic swine (3,015,835) and horses (3414) were tested for *Trichinella*. *Trichinella* was not detected in domestic pigs or horses. *Trichinella* spp. was detected from 1 of 27,131 wild boar samples. In Sweden, *Trichinella* has not been detected in domestic swine since 1994. *Trichinella* was detected from 1 fox, 7 lynxes and 1 wolf (Table 8).

Trends and epidemiology

The disease is extremely rare in Sweden and detected human cases are infected abroad. The most recent reported case (in 2007) had consumed wild boar sausage brought privately from Spain. The preceding case fell ill in 2003 after consumption of cold-smoked ham in the Balkans. Before that there had not been a case since 1997, which also was an imported case.

The *Trichinella* situation in Swedish animal population seems to be stable. *Trichinella* occurs in wild carnivores but the risk of getting *Trichinella* from domestic swine and horses is negligible.

Table 8. Findings of *Trichinella* in wild and domestic animals

Animal species	No. Samples	No. positives	Percentage (%)	*T.* britovi	*T.* nativa	*T.* spp.
Badgers	4	0	0.00%			
Wild birds	11	0	0.00%			
Foxes (red and arctic)	348	1	0.29%			1
Lynx	149	7	4.70%	1	6	
Otter	12	0	0.00%			
Raccoon dogs	3	0	0.00%			
Wild boars	27131	1	0.00%			1
Wolves	20	1	5.00%	1		
Lions (zoo)	4	0	0.00%			
Common seal	1	0	0.00%			
Wolverine	10	0	0.00%			
Bears	167	0	0.00%			
Total	27860	10		2	6	2

14. Tularemia

Bacterium *Francisella tularensis* is a causative agent of tularemia, a disease affecting both humans and several animal species. *F. tularensis* is found in a wide range of animal hosts and is capable of surviving for weeks at low temperatures in water, moist soil, or decaying plant and animal matter. Although different animals can be infected tularemia is typically found in small mammals such as hares and rodents.

Humans become infected through a variety of mechanisms such as handling infected or dead animals, bites of infected insects or arthropods, ingesting contaminated food or water, and inhaling aerosols of bacteria. Clinical disease is variable and dependent on the route of transmission. Human disease is usually associated with two subspecies, *F. tularensis tularensis* (type A) and *F. tularensis holarctica* (Type B), which differ in pathogenicity.

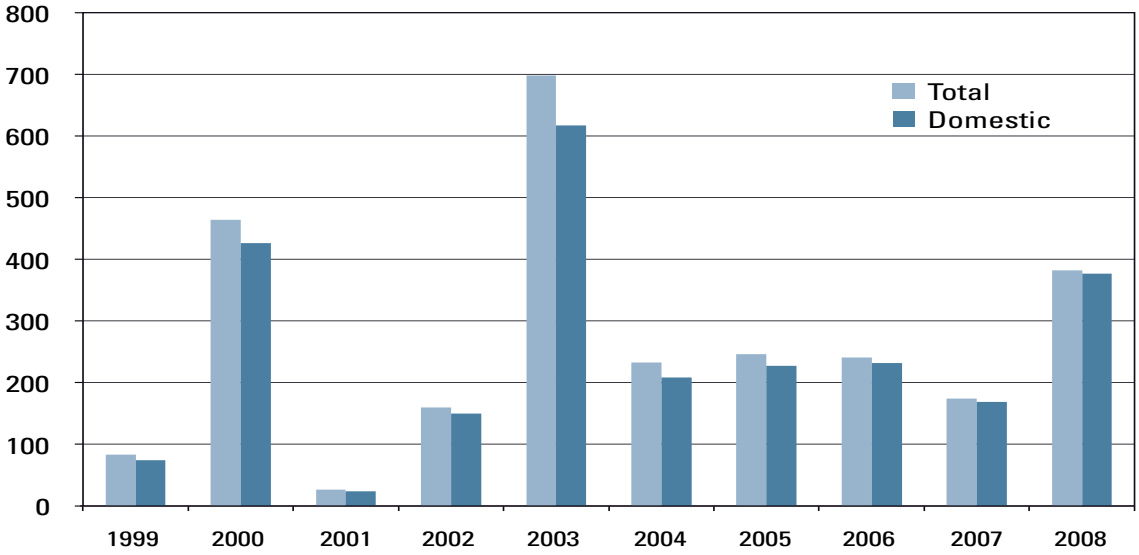
INCUBATION PERIOD

Incubation period is usually 3-5 days.

DISEASE

The clinical picture varies depending on the route of transmission, the virulence of the organism and animal species. The ulceroglandular form is the most common form in humans: respiratory, oculoglandular and oropharyngeal forms being less common.

Figure 22. Notified human cases of tularemia in Sweden in 1999-2008



SURVEILLANCE

Humans

Tularemia is notifiable according to the Communicable Disease Act.

Animals

Tularemia is notifiable in animals. No active surveillance is performed in animals. Surveillance is based on voluntary submission of fallen or euthanized diseased hares by hunters and the general public.

RESULTS IN 2008

Humans

During 2008, 382 cases of tularemia were reported, which is quite high (Figure 22).

The majority of cases were between 40 and 70 years old and 58% were men. Almost all (98%) of the reported persons had acquired their infection in Sweden.

Most of the cases were infected in the northern Sweden and especially in central Sweden (the county of Gävleborg).

Animals

In 2008, 5 of 40 analyzed European brown hares and 6 of 20 mountain hares were positive for *F. tulerensis tularensis.*

Trends and epidemiology

Sweden has reported cases of endemic tularemia since 1931. There has always been a marked variation in the number of human cases between different years, ranging from a few cases in some years to more than 2700 cases in 1967. Years with high numbers of cases are often followed by periods when tularemia is virtually absent.

The infection is more often reported in men than in women and the age group of 30-65 years is the most affected in both genders. Most of the infected persons have acquired their infection in Sweden. The numbers of tularemia increases in July, reaches a peak in August or September and then tails off by December.

Ever since the first Swedish tularemia case was reported in the 1930´s a discrete endemic center has been identified in the northern parts of central Sweden. During the last decade the epidemiology of tularemia has changed and the number of reported cases infected south of the identified endemic region has increased.

In Sweden, *F. tularensis holarctica* is endemic whereas the subspecies *F. tularensis* tularensis has not been identified. Outbreaks of tularemia have been considered to be associated with rises in rodent and hare populations, but this has not been observed in Sweden.

15. Yersiniosis

Two species of the bacterial genus of *Yersinia* are zoonotic, namely *Yersinia enterocolitica* and *Yersinia pseudotuberculosis*. *Y. enterocolitica* causes gastrointestinal symptoms in humans. Infections caused by *Y. enterocolitica* are thought to be food-borne. Swine are considered the main reservoir of *Y. enterocolitica*. Both *Y. enterocolitica* and *Y. pseudotuberculosis* are frequently found in swine tonsils and intestinal contents. *Yersiniae* are able to grow at low temperatures. *Yersinia* bacteria are widespread in nature but nonpathogenic strains are common. The most common human pathogenic variant is *Y. enterocolitica* 4/O: 3.

INCUBATION PERIOD

The incubation period is between 3 and 7 days.

DISEASE

Humans

Y. enterocolitica causes gastrointestinal symptoms in humans ranging from mild self-limiting diarrhea to acute mesenteric lymphadenitis which might be difficult to differentiate from appendicitis. Long-time sequelae including reactive arthritis, uveitis and glomerulonephritis occur sometimes. Prolonged carriage has been reported in children as well as in adults.

Animals

Swine are asymptomatic intestinal carriers of pathogenic *Y. enterocolitica* and *Y. pseudotuberculosis*. In other animals these pathogens may cause enterocolitis and lead to septicemia.

SURVEILLANCE

Humans

Yersiniosis is notifiable according to the Communicable Disease Act.

Food

No active surveillance in food.

Animals

Y. enterocolitica and *pseudotuberculosis* are not notifiable in animals. No active surveillance in animals.

CONTROL

Good slaughtering hygiene is essential in controlling *Yersiniae*. These bacteria are destroyed by heating (pasteurization and cooking) but are able to grow at refrigeration temperatures. Thus, long storage times of ready-to-eat food items should be avoided.

RESULTS IN 2008

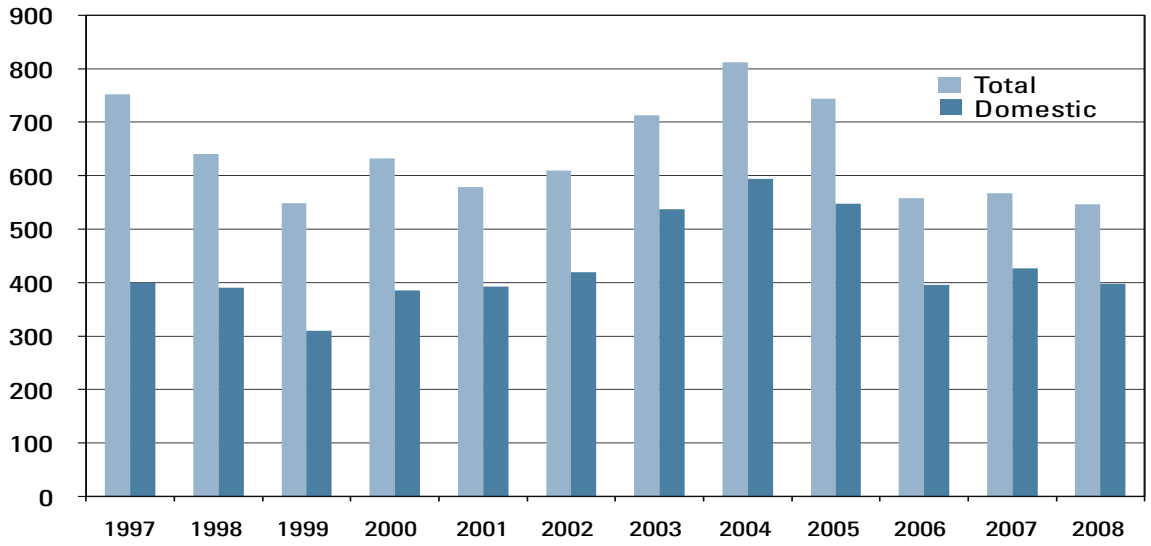
Humans

In 2008, 546 cases were notified in Sweden, of which 73% were domestic (Figure 23). The number of cases has decreased annually since 2004 when 804 cases were reported. As expected most cases were children 0-4 years.

Trends and epidemiology

Most cases of domestic origin are sporadic. During the last 10 years about 600-800 cases have been notified annually. About 70% are infected in Sweden. About 27% of these cases are children younger than 5 years. There is a seasonal variation with most cases during late summer. Clinical disease is slightly more common in men (53%) than in women (47%).

Figure 23. Notified human cases of yersiniosis during 1997-2008



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SVERIGE

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