

Report to the Commission

Trends and sources of zoonotic infections recorded in Sweden during 1999

200-08-31



National Veterinary Institute

Swedish Board of Agriculture

National food Administration

Swedish Institute for Infectious Disease Control

INTRODUCTION	4
DEFINITIONS-	4
SURVEILLANCE AND NOTIFICATION	4
MYCOBACTERIUM BOVIS	5
TUBERCULOSIS IN ANIMALS	5
HUMAN TUBERCULOSIS CAUSED BY M. BOVIS	7
BRUCELLA ABORTUS / OVIS / SUI / MELITENSIS	7
BRUCELLOSIS IN ANIMALS	7
BRUCELLOSIS IN HUMANS	8
SALMONELLA	9
SALMONELLA IN FEEDSTUFFS	9
SALMONELLA IN ANIMALS	11
ANTIMICROBIAL SENSITIVITY IN SALMONELLA FROM 1997-1998	15
SALMONELLA IN FOOD	17
SALMONELLA IN HUMANS	18
TRICHINELLA SPIRALIS/NATIVA/BRITOVII	20
TRICHINOSIS IN ANIMALS	20
TRICHINOSIS IN HUMANS	20
CAMPYLOBACTER (THERMOPHILIC)	21
CAMPYLOBACTERIOSIS IN ANIMALS	21
CAMPYLOBACTER IN FOOD	22
CAMPYLOBACTERIOSIS IN HUMANS	23
ECHINOCOCCUS GRANULOSUS/ MULTILOCULARIS	23
ECHINOCOCCOSIS IN ANIMALS	23
ECHINOCOCCOSIS IN HUMANS	24
LISTERIA MONOCYTOGENES	24
LISTERIOSIS IN ANIMALS	24
LISTERIA MONOCYTOGENES IN FOOD	25
LISTERIOSIS IN HUMANS	26
RABIES	26
RABIES IN ANIMALS	26
RABIES IN HUMANS	27
TOXOPLASMA GONDII	27
TOXOPLASMOSIS IN ANIMALS	27
TOXOPLASMOSIS IN HUMANS	27
YERSINIOSIA ENTEROCOLITICA	28
YERSINIOSIS IN ANIMALS	28
YERSINIA IN FOOD	28
YERSINIOSIS IN HUMANS	28
VEROCYTOTOXIC E. COLI O157	29
VT E. COLI O157 IN ANIMALS	29
VT E. COLI O157 IN FOOD	30
VT E. COLI O157 IN HUMANS	31

Tables

1.1.1.	<i>Mycobacterium bovis</i>	Cattle
1.1.2.		Farmed deer
1.1.3.		Other animals
1.3.		Humans
2.1.1.	<i>Brucella abortus/meletensis</i>	Cattle
2.1.2.		Sheep, goat
2.1.3.		Other animals
2.3.		Humans
3.1.1.	<i>Salmonella</i> spp.	Feed material of animal origin
3.1.2.		Feed material of vegetable origin
3.1.3.		Compound feedingstuffs
3.1.4.		Feed material, feedingstuffs, sero and phage types
3.2.1.		Poultry breeding flocks (<i>Gallus gallus</i>)
3.2.2.		Poultry, other than breeding flocks of <i>Gallus gallus</i>
3.2.3.		Animals (poultry excluded)
3.2.4.		Animals (poultry excluded)
3.2.5.		Animals (poultry excluded)
3.3.		Food
3.3.1.		Results of official control (sero and phage types)
3.3.2.		Results of control of consignments from MS
3.4.1.		Humans
3.4.2.		Seasonal distribution, most common serotypes
4.1.	<i>Trichinella spiralis/nativa/britovi</i>	Animals
4.2.		Humans
5.1.	Thermophilic <i>Campylobacter</i>	Animals
5.2.		Food
5.3.		Humans
6.1.	<i>Echinococcus granulosus/multilocularis</i>	Animals
6.2.		Humans
7.2.	<i>Listeria monocytogenes</i>	Food
7.3.		Humans
8.1.	Rabies	Animals
9.1.	<i>Toxoplasma gondii</i>	Animals
9.2.		Humans
10.3.	<i>Yersinia enterocolitica</i>	Humans
11.1.	Verotoxigenic <i>E. coli</i>	Animals
11.2.		Food
11.3.1.		Humans
12	Demographic data	

Graphs

1	No of notified cases of salmonella in cattle 1968-1999
2	No of notified cases of salmonella in pigs 1968-1999
3	No of notified cases of salmonella in pigs 1968-1999
4	No of notified cases of salmonella in broilers 1968-1999
5	No of notified cases of salmonella in broilers 1968-1999
6	No. of laboratory reported cases of salmonella in humans 1980-1999
7	No. of reported cases of EHEC in humans 1996-1999

INTRODUCTION

This report has been produced by the Swedish Zoonosis Center at the National Veterinary Institute (NVI) in co-operation with the Swedish Institute for Infectious Disease Control (SIIDC), the National Food Administration (NFA) and the Swedish Board of Agriculture.

The report includes zoonotic infections/agents occurring in animals, humans, feedstuffs and food.

The total number of animals, herds and number of slaughtered animals in Sweden, according to species, are outlined in table 12.1 and the human population is specified in table 12.2.

DEFINITIONS-

Animal data

Monitoring: Continuous system (active or passive) of collecting data.

Active monitoring: The system is based on targeted examinations

Passive monitoring: Only notification requirement

Notification: Passive system to collect data

Compulsory monitoring programme: The monitoring is based on a legal provision

Voluntary monitoring programme: The monitoring is done on a voluntary basis

Surveillance: Specific extension of monitoring with a view to taking appropriate control measures

Survey: An investigation in which information is systematically collected for a limited time period

Screening: A particular type of diagnostic survey. The presumptive identification of unrecognised disease or infection by the application of tests or examinations which can be applied rapidly.

Human data

Outbreak :An incident in which 2 or more persons experience a similar illness after ingestion of the same type of food, or after water from the same source, or where epidemiological evidence implicates the food or water as the source of illness

Household outbreak (family outbreak):An outbreak affecting 2 or more persons in the same private household

General outbreak: An outbreak affecting members of more than one private household or residents of an institution

Single case (sporadic case): A case of an illness (irrespective of the nature of the source)

Imported case :A case where the incubation period, clinical and epidemiological data suggest that infection was acquired in another country, and where there is no epidemiological evidence suggesting indigenous infection

Domestic case : A case where the incubation period, clinical and epidemiological data suggest indigenous infection

SURVEILLANCE AND NOTIFICATION

Animals

In the part of the report where surveillance systems are described, a description is only given of specific surveillance systems. In addition to these systems surveillance is

also achieved by notification of clinical observations, laboratory findings and findings at meat inspection. In Sweden, certain diseases are compulsory notifiable already on the basis of a clinical suspicion. In such cases, an investigation to confirm the diagnosis must always be made. Of the diseases listed in directive 92/117 EEC, the

following are notifiable on such a basis: tuberculosis, brucellosis, rabies and salmonellosis. Other diseases or infections are compulsory notifiable if a laboratory confirms the finding by microbiological or other methods. The following diseases/infections listed in the directive are notifiable on such a basis: trichinosis, echinococcosis, listeriosis and isolation of verocytotoxic *Escherichia coli* serotype O157.

Only the index case in each herd or flock is reported.

Humans

There are two reporting systems for communicable diseases in Sweden:

i) Diseases that are compulsory notifiable under the Communicable Disease Act (clinical reports). The following diseases listed in the directive are notifiable on such a basis: tuberculosis, salmonellosis, trichinosis, campylobacteriosis, listeriosis, rabies, toxoplasmosis, yersiniosis and infection with enterohaemorrhagic *E. coli* sero type O157.

ii) Diseases that are compulsory or voluntary notifiable based on reports from laboratories. The diseases mentioned above are also compulsory notifiable from laboratories. Two additional diseases listed in directive 92/117 EEC (brucellosis and echinococcosis) are reported from laboratories on a voluntary basis. Figures included in the present report are mainly based on clinical reports.

Food

The responsibility for the surveillance of the food-producing industry is divided between the National Food Administration (NFA) and the local municipalities which are autonomous, and not under the supervision of the central authorities. The NFA has the responsibility for all slaughterhouses and the large scale cutting and processing plants. The NFA is also responsible for all large scale dairies, fish plants, establishments handling eggs and egg products, all large scale establishments handling food of non-animal origin and

water for human consumption. The municipalities are in general responsible for small and medium sized establishments, shops and restaurants. The two largest municipalities (Stockholm and Gothenburg) have a delegated responsibility even for large scale cutting and processing plants.

There is currently no reporting system in place, where the NFA automatically obtains results from the microbiological investigations of food and food items performed in the local municipalities. In addition to the above mentioned notification in animals (see "animals") the finding of salmonella in food is also compulsory notifiable.

MYCOBACTERIUM BOVIS

Tuberculosis in animals

Disease agent

Mycobacterium bovis and *Mycobacterium tuberculosis*

Surveillance/notification systems

Infection with *M. bovis* or *M. tuberculosis* is compulsory notifiable in all animal species on the basis of a clinical suspicion. For food producing animals, inspection at slaughter is the main surveillance system in place. Sweden fulfils the requirements laid down in Council Directive 64/432/EEC, Annex I, p.4 and p.5 amended by 98/99 /EC.

Methods used

Bacterial culture and comparative skin fold tuberculin test (*M. avium* and *M. bovis* tuberculin).

Case definition used and epidemiological unit

A case is defined as a single animal from which *M. bovis* or *M. tuberculosis* has been isolated. The herd is the epidemiological unit.

Measures taken in case of isolation of *M. bovis* or *M. tuberculosis*

Should tuberculosis in food producing animals occur, relevant measures to eradicate the disease (including depopulation of the whole herd) would be undertaken.

Epidemiological history

Sweden declared itself free from bovine tuberculosis in 1958 and is declared officially free from tuberculosis in bovine herds according to Commission Decision 95/63/EC replaced by Commission Decision 1999/467/EC, as Sweden fulfils the requirements laid down in Council Directive 64/432/EEC, Annex I, p.4 and p.5 amended by 98/99 /EC. The last case of tuberculosis in cattle was diagnosed in 1978. No cases have been reported in wildlife for more than 50 years.

Tuberculosis was diagnosed in a herd of farmed deer in 1991. The source of infection was a consignment of fallow deer imported in 1987. No spread of the infection to any other animal species has been found. A total of 13 infected deer herds have been identified and all have been depopulated. A voluntary control programme was introduced in 1994, relevant parts were outlined in the 1995 report. General movement restrictions apply for all deer herds that have not obtained tuberculosis free status. Live animals from these herds may only leave the farm if transferred directly to an abattoir.

Results of the investigations in 1999

Cattle (table 1.1.1.)

At meat inspection, two cattle (from two different herds) with suspicious lesions were investigated for the presence of mycobacteria. In one case *M. avium* was isolated and in the other case material was not available for bacteriological examination. Both herds of origin were tuberculin tested with negative result.

Farmed deer (table 1.1.2.)

In December 1999, 550 (96%) out of the 569 farmed deer herds were affiliated to the control programme.

A total of 374 herds (66%) had obtained tuberculosis-free status. Of these, 89 by at least three whole herd tuberculin tests, 254 by slaughter and meat inspection of the whole herd and 31 new herds had been established, with deer from tuberculosis free herds.

Another 176 herds (32%) were affiliated to the control program but had not obtained tuberculosis-free status. Of these herds 23 had begun to tuberculin test their deer and 19 had begun to depopulate their herd.

A total of 19 herds (3%) were not affiliated to the control program.

No infected herds were found in 1998.

In all, samples from 54 deer were examined due to suspicion of mycobacterial infection. Thirty were collected at meat inspection, 20 at autopsy (including 11 reactors) and in four cases no information was available. Bacteriological examination for the presence of *M. bovis* or *M. tuberculosis* was performed in 30 cases. None were positive, but *M. avium* was isolated from eight deer (originating from the same herd) and a mycobacteria not belonging to the tuberculosis-complex (not further typed) was isolated from another deer.

Swine, sheep and goats (table 1.1.3.)

During 1999, samples from a total of 157 pigs, collected at meat inspection, were cultured for the presence of *M. bovis* or *M. tuberculosis*. None were positive, but samples from 105 animals yielded growth of *M. avium*. One sheep, identified at meat inspection was cultured for mycobacteria with negative result.

Pets, wildlife and zoo animals (table 1.1.3.)

During 1999, samples from 3 cats, 1 badger and 8 zoo animals were cultured for *M. bovis* or mycobacteria. All samples were negative.

Human tuberculosis caused by *M. bovis*

Surveillance/ notification systems

Tuberculosis is a notifiable disease under the Communicable Diseases Act. Figures in this report are based on clinical reports and laboratory reports¹. The surveillance is mainly based on passive case findings. Screening by health control of foreign refugees and asylumseekers is recommended but not uniformly performed.

Case definition

A case is defined as a person from whom *Mycobacterium bovis* has been isolated.

Results of the investigations in 1999 and 1998 (Table 1.3.)

Only preliminary figures for 1999 is available. Two cases of *M. bovis* have been reported. One was an imported case probably infected in South America and the other case was an old person probably infected in Sweden before *M. bovis* was eradicated from the Swedish cattle population. There is no change in the trend from previous years.

The final figures for 1998 is four reported cases of *M. bovis*. Two elderly people was probably infected in Sweden before the eradication of *M. bovis* and two cases were infected abroad. It should be noted that in two of these cases *M. bovis* was isolated from urine.

Relevance as zoonotic disease

Almost all cases of infection with *M. bovis* in humans in Sweden are infected abroad. Cases also occur in elderly people infected before *M. bovis* was eradicated from the cattle population. As Sweden is officially free from

bovine tuberculosis, the risk of people contracting tuberculosis from Swedish animals is considered negligible. Although tuberculosis has been identified in 13 farmed fallow deer herds since 1991 the risk of people contracting tuberculosis from this species is considered negligible. All known infected herds have been depopulated and restrictions are laid on all herds that have not obtained tuberculosis free status.

As very few cases of human tuberculosis due to *M. bovis* occur in Sweden and person to person spread of *M. bovis* is rare, the risk of contracting bovine tuberculosis from people in Sweden is judged to be negligible.

BRUCELLA ABORTUS / OVIS / SUIS / MELITENSIS

Brucellosis in animals

Disease agent

Brucella abortus, *Brucella ovis*, *Brucella suis*, *Brucella melitensis*.

Surveillance/ notification systems

Infection with *Brucella* spp. is compulsory notifiable in all animals on the basis of a clinical suspicion. Surveillance is also based on investigations of cases of abortion. In addition serological surveys in sheep and goats are performed according to Annex A, chapter 1. section II (2) (i) of Council Directive 91/68/EEC. Serological surveys are also regularly performed in cattle and pigs. Sweden fulfils the requirements regarding *B. abortus* laid down in Commission Decision 97/175/EC.

Methods used

In cattle, several methods are used. In dairy herds, tube agglutination, complement fixation or a milk ELISA are

¹ See introduction

used. For beef cattle, swine, sheep and goats, a complement fixation test or a rose bengal plate test is used. If a clinical case is suspected, serology and bacteriology is used.

Case definition used and epidemiological unit

A case is defined as a single animal from which *Brucella* spp. has been isolated or an animal showing significant antibody titres to *Brucella* sp. The herd is the epidemiological unit.

Vaccination policy

Vaccination is not allowed

Measures taken in case of brucella diagnosis.

Should brucellosis occur, relevant measures to eradicate the disease (probably including stamping out) would be taken.

Epidemiological history

The last case of bovine brucellosis was reported in 1957. Brucellosis in other species has never been found. Sweden has been declared free from brucellosis in bovine herds, according to Commission Decision 95/74/EC, and in sheep and goats according to Commission Decision 93/52/EC as amended by Commission Decision 95/1/EEC. The conditions for an officially brucellosis-free status, as laid down in Council Directive 64/432/EEC, apply to all domestic food producing animals.

Results of the investigations in 1999 (Tables 2.1.1, 2.1.2 and 2.1.3)

A total of 3000 bulk milk samples from cattle herds were analysed with an indirect ELISA for the presence of antibodies against *B. abortus*. All were negative. Blood samples were collected from 3000 pigs and analysed with a tube agglutination test for antibodies against *Brucella suis*.

All were negative.

In all, 9335 serum samples from sheep and

goats (8914 sheep and 421 goats) were tested for the presence of antibodies against *Brucella melitensis*, using the rose bengal plate test. One sample was positive in the rose bengal plate test (1:40), the tube agglutination test (1:40) and complement fixation test for *Brucella abortus*. The sample was negative in the complement fixation test for *Brucella melitensis*. All adult sheep in the herd of origin (n=96) were tested with the tube agglutination test and complement fixation test with negative results and a clinical examination was performed on all animals. It was concluded that the herd was not infected with *Brucella*.

In addition 2120 blood samples from pigs and 1400 blood samples from cattle were analysed for the presence of antibodies with negative results.

During 1999 investigations have been performed in three cattle herds and two pig herds due to clinical symptoms (abortions) where brucellosis could not be excluded. All herds tested negative for *Brucella*.

Brucellosis in humans

Surveillance/ notification systems

Brucellosis is not a notifiable disease under the Communicable Disease Act. Figures in this report are based on voluntary laboratory reports².

Case definition

A case is defined as a person where brucellosis has been verified by laboratory investigations (bacteriology or serology).

Epidemiological history

During the last 10 years between 0-6 cases has been reported each year. A domestic source of infection has not been found in any of these cases.

Results of the investigations in 1999

² See introduction

(Table 2.3)

During 1999 no case was reported.

Relevance as zoonotic disease

There are very few cases of brucellosis in humans in Sweden. No source of infection for human cases has been found in Sweden. The risk of obtaining brucellosis from domestic sources is negligible.

SALMONELLA

The Swedish salmonella control programme is not described in detail. The part of the programme that was approved by the Commission is described in Commission Decision 95/50/EC.³

Sweden has achieved an efficient control of salmonella, despite the industrialisation of animal production. Due to the control, both red and white meat and table eggs produced in Sweden are virtually free from salmonella. Surveillance, according to the Swedish salmonella control programme initiated in 1995, indicates that the overall prevalence is below 0.1%.

Any finding of *Salmonella enterica*, irrespective of subspecies, in animals, humans, feed and food of animal origin is compulsory notifiable. See "surveillance systems" under "feedstuffs", "animals", "food" and "humans".

Action, including an investigation to clarify the source of infection, is always taken. Restrictions on animal movements are put on the farm. Restrictions are only lifted when the infection has been eliminated. Feed contaminated with *Salmonella* spp. is destroyed or treated to eliminate the contamination. Food contaminated with *Salmonella* spp. is destroyed or returned to the country of origin. See "measures taken in case of salmonella isolation" under "feedstuffs", "animals", "food" and "humans".

³ Information on the remaining parts of the salmonella control programme can be obtained from the Swedish Board of Agriculture.

Salmonella in feedstuffs

Surveillance/ notification systems

Findings of *Salmonella* spp. in the feed sector are compulsory notifiable.

Domestic feed materials of animal origin are controlled according to the present EU legislation where each consignment produced is kept under quarantine until the results of salmonella investigations have been completed. Importation of feed materials of animal origin are limited to products for the pet food industry. This material is tested for the presence of *Salmonella* before import, in the country of origin.

Major domestic producers of feed materials of vegetable origin are required to analyse their products for the presence of *Salmonella*. Imported feed materials of vegetable origin are investigated for *Salmonella* when the consignment has reached its Swedish destination or at the point of exportation.

In the feedmills, much effort is put on the hygienic conditions and the process control (HACCP). Sampling is carried out in the feedmills by investigating scrapings from critical control points in the processing equipment. Five samples (minimum) are investigated every week from feedmills producing poultry feed. For other feedmills two critical control points are investigated per week. The present monitoring system, covering more than 95% of the feed production, allows an early detection of *Salmonella* spp. in the feed mill.

Rendering plants are controlled according to the present EU legislation. Each batch has to be tested negative before delivery and environmental samples are collected in the building and from the equipment. Number of samples depends on the size of the plant and is not specified in the EU legislation

Dog chews imported from third countries are controlled for *Salmonella*. From each consignment five samples are tested. In

addition importers of dog chews are visited annually by official inspector and samples for *Salmonella* are collected.

Pet food, imported from third countries, is controlled for *Salmonella* by random sampling. Approximately 10% of consignments are tested. Number of samples is not specified. Pet food from EU countries are not controlled for *Salmonella*.

Methods used

The bacteriological method which is used to detect *Salmonella* is NMKL, 7 ed. 4; 1991. Certain serotypes are subtyped by molecular subtyping methods. Serotyping is performed by slide agglutination. Laboratories taking part in the feed control must be accredited for the method.

Measures taken in case of salmonella isolation

Action is always taken to prevent the distribution of contaminated feed or feed materials.

Feed materials of animal origin and of vegetable origin (S2)⁴ is kept under quarantine until salmonella investigations have been completed. If *Salmonella* spp. is detected, animal feed material will be sterilised and re-tested. The lot will be released if the salmonella test is negative. Feed materials of vegetable origin contaminated with *Salmonella* will be heat treated or treated with acid and tested again. If no *Salmonella* is found the lot can be used in feed production.

If positive results are obtained in the weekly sampling programme, special protocols are followed, aiming at eliminating *Salmonella* from the buildings/equipment as well as from feed/feed materials, are initiated.⁵

⁴ S2: Feed materials of vegetable origin declared by national authorities being high risk products.

⁵ These plans are specified in the proceedings from the International Course on Salmonella Control in Animal Production and Products, WHO meeting 1993, Malmö, Sweden.

Results of the investigations in 1999

(Tables 3.1.1 - 3.1.4.)

The total number of samples investigated is not available, as samples negative for *Salmonella* are not always reported.

Imported vegetable feed materials

Investigations of imported vegetable feed materials yielded 63 positive consignments (table 3.1.2.). Most isolates were obtained from soy bean, rape seed and maize derived feed materials. The most common sero types found in vegetable feed materials were *S. Derby*, *S. Senftenberg*, *S. Agona* and *S. Livingstone* (table 3.1.4.). It should be noted that *S. Typhimurium* was isolated in three cases. As the number of positive samples are influenced by the amount of feed materials imported as well as the sampling intensity it can not be concluded, based on these figures, that these types of feed materials are more often contaminated or that these sero types occurred most frequently.

Feedmills

In the HACCP control of feedmills (compounders) 7 752 samples were investigated (table 3.1.3.). A total of 4276 samples were taken after the heat treatment during 1999, of which 3 samples (0.07%) were positive. Figures in the present report includes all compulsory sampling but only the part of the voluntary sampling where analysis was performed at the NVI. Previous years, samples in the voluntary control where analysis were performed at other laboratories, were also included in the figures. Thereby the change in number of reported analysis during 1999 is not due to decreased sampling but to a change in reporting system. The sero types isolated are shown in table 3.1.4.

Control of feed for livestock.

During 1996-1999, a salmonella survey of the final product was performed. From final product intended for poultry 373 samples were analysed, pigs 274 samples and cattle 240 samples. All samples from

poultry and cattle feed were negative. One positive sample (*S.subsp.IV=44:z4,z23:-*) was obtained from pig feed. No positive sample was found in the 97 samples analysed in 1999 (table 3.1.3.).

Imported dog chews

In order to investigate the salmonella situation in imported dog chews, all consignments arriving at the border inspection post in Gothenburg during 1998 and 1999 (Gothenburg is the major BIP in Sweden for products of animal origin) were sampled. Samples were taken by official veterinarians and analyses were carried out by an accredited laboratory, in accordance with the NMKL 71:1991 procedure. In general, 5 incremental samples were pooled for analysis. Figures for 1999 have not been summarised. Compared to 1998, import from third countries have decreased. This is probably due to increased awareness of the risk of salmonella.

Salmonella in animals

Surveillance/notification systems

Poultry and eggs

Any finding of *Salmonella enterica*, irrespective of subspecies, is compulsory notifiable. Sampling strategies are outlined in the Swedish salmonella control programme approved by the EU.

Microbiological sampling of breeding flocks is carried out according to Council Directive 92/117/EEC. In addition, more frequent testing is carried out in the elite and grand parent generation. During the rearing period, sampling is done on 5 separate occasions. Tissue samples (caeca) are taken as a supplement to the faecal sampling. During egg production faecal samples are taken from the breeders every month as a supplement to the sampling in the hatchery.

The parent generation is tested during the rearing period by tissue sampling as well as faecal sampling. During egg production,

samples are taken as has been described for grand parents.

Ratite breeders are tested every third month by faecal samples.

All meat production flocks broilers, turkeys and ducks, ratites and geese are investigated by faecal sampling 1-2 weeks before slaughter. In broilers additional sampling is carried through. 30 samples of caecum tissue are collected 1-2 weeks prior to slaughter.

Pullets are tested (faecal samples) once during the rearing period, 2 weeks before moving to a laying unit. Sampling of laying flocks with more than 200 layers from establishments not placing eggs on the market and of all laying flocks from establishments placing their eggs on the market is carried out as faecal samples three times during production. All faecal samples are collected according to Council Directive 92/117/EEC. Since April 1998, flocks of egg-producing quail are sampled twice a year by faecal sampling.

Within to the control programme, neck skin samples are taken from poultry at slaughterhouses.

Cattle and pigs

Any finding of *Salmonella enterica*, irrespective of serotype, is compulsory notifiable. Sampling strategies are outlined in the Swedish salmonella control programme approved by the EU. Sampling of slaughtered animals are carried out in all abattoirs. Samples consist of intestinal lymph nodes and swabs taken from parts of the carcass where the chances of finding salmonella is considered optimal. All sanitary slaughtered animals are tested for salmonella.

Faecal samples are collected annually in elite breeding herds, gilt-producing herds and twice annually in so-called sow pools. In addition to the salmonella control programme, all weaner pig producing/integrated herds affiliated to a health control programme run by the industry, are tested by faecal samples collected annually. Samples for culture of salmonella are also taken at autopsies.

Sheep, goats and other food producing animals

Any finding of *Salmonella enterica*, irrespective of subspecies, is compulsory notifiable.

Method used

Bacteriological investigations are done according to NMKL No. 71 4th ed. 1991. A modification of ISO 6579:1993 is used, the most essential modification being the exclusion of the selenite broth enrichment step. Certain serotypes are subtyped by molecular subtyping methods. Serotyping is performed by slide agglutination.

Case definition and definition of epidemiological unit

A case is defined as a single animal from which *Salmonella enterica* of any subspecies has been isolated.

Poultry

The flock is the epidemiological unit. This is especially important as regards broilers, where 5-6 flocks may be raised annually in each house or compartment, and each flock is tested. The flock is also the unit, as regards measures taken. The strict hygiene rules that are implemented according to the Swedish prophylactic salmonella control programme makes it possible to define the flock as the epidemiological unit.

Cattle and pigs and other food producing animals

The herd is usually the epidemiological unit.

Vaccination policy

Poultry

Vaccination of poultry against salmonellosis is not allowed.

Cattle

In general vaccination is not allowed. In a few special cases, exceptions are made. The vaccine used in these cases is a crude

preparation of whole bacteria, killed with formaldehyde, of a strain originating from the herd being vaccinated.

Prophylactic measures

Poultry

Precautions must always be taken to avoid the introduction of salmonella into poultry premises. Strict hygiene rules must be enforced through the whole production chain. Such rules have been implemented by the Swedish prophylactic salmonella control programme. The programme includes:

- Rules for feed production and transport (HACCP process control, heat treatment, hygiene control).
- Hygiene rules to protect the poultry from salmonella infection from the surroundings (restrictions for visitor, rodent control, hygiene barriers etc.).
- All in - all out systems in all categories of poultry production.

Cattle, pigs and other food producing animals

An efficient control of salmonella (see "salmonella in animal feedstuffs") ensures that feed to food producing animals is virtually free from salmonella.

Measures taken in case of salmonella isolation

Poultry

All premises where salmonella is found are put under restrictions, and after destruction of the flock, the premises are cleaned and disinfected. An investigation of the feed supplier involved is also initiated. Feedstuffs are destroyed or decontaminated.

Grand parent and parent flocks are immediately destroyed if found infected, as are broilers and other meat producing poultry and layers, irrespective of serotype isolated.

Isolation of salmonella in neck skins collected at slaughter is considered to be a contamination at slaughter and will lead to

hygiene measures being taken at the slaughterhouse.

Cattle, pigs and other food producing animals

If salmonella is isolated from an animal, indicating an infection in the herd of origin, action is always taken. This involves restrictions put on the herd. Animals are not allowed to enter or leave the herd, unless for sanitary slaughter. Samples are taken in the herd, for bacteriological investigation, and a sanitation plan is instituted, involving the elimination of chronically infected animals, cleaning and disinfection, manure and sludge treatment, disinfection or treatment of feedstuffs etc. An investigation of the feed supplier involved is also initiated. Restrictions are lifted when faecal samples from all animals in the epidemiological unit (usually the herd), taken at two consecutive sampling occasions one month apart, are negative. If swabs samples from the carcasses of slaughtered animals are positive for salmonella, the carcass is considered contaminated and hygiene measures are taken at the slaughterhouse. Carcasses found to be contaminated with *Salmonella* spp. are deemed unfit for human consumption.

Epidemiological history

The Swedish salmonella control programme was initiated in 1961 and it covers all food producing animals. In 1995, certain parts of the programme, covering cattle, pigs poultry and eggs, were approved by the EU (95/50/EC) and an extended surveillance programme was initiated. Results of the surveillance show that Swedish red and white meat and eggs are virtually free from salmonella. *S. Typhimurium* DT104 was first isolated in a cattle herd in 1995. From 1995 to December 1999 a total of four cattle herds have been found infected with this type of *Salmonella*. In all four cases the strains were penta resistant. One herd has been

depopulated and the remaining herds have been cleared from salmonella by normal routine measures taken by authorities. No pig herd has been found infected with *S. Typhimurium* DT104.

Results of investigations 1999

(Tables 3.2.1, 3.2.2)

Poultry

The number of flocks investigated is outlined in tables 3.2.1 and 3.2.2. In all, 12 cases of salmonella were notified during 1999 of which 6 were layers (of which one was a broiler parent flock) and 6 meat producing flocks. Five outbreaks were due to infection with *S. Typhimurium*; phage type 40 was isolated in a turkey flock, fage type 41 in two broiler flocks and 1 flock of broiler parents. Finally fage type 195 was found in a flock of geese. *S. Enteritidis* fage type 4 was isolated in a small "backyard" farm of layers. For further information of other serotypes isolated see table 3.2.1 and 3.2.2.

At slaughterhouses, 3 580 neck skin samples were collected, mainly from broilers, but also from layers and other poultry. Two sample yielded growth of *S. Livingstone*.

Results of investigations 1999

(Tables 3. 2.3.-3.2.5.)

Cattle and pigs

A summary of all animals/herds sampled for salmonella according to the EU-approved Swedish salmonella control programme is outlined in table 3.2.3. Voluntary sampling in pig herds is also included. Sero- and phage types of all notified isolates are outlined in table 3.2.4. and 3.2.5.

Pigs

As can be seen in tables 3.2.4. and 3.2.5., the salmonella situation in pig and pork continues to be very favourable. In 1999 a total of four pig herds were considered

infected with salmonella (table 3.2.4., 3.2.5.). This is a slight increase compared to 1998 when only one infected herd was notified (figure 2). *S. Typhimurium DT 12* was isolated in one weaner pig producing herd (table 3.2.4.). The infection was detected in a faecal sample taken in the voluntary surveillance in pig herds. Additionally, two infected fattening herds were identified by trace back investigations (table 3.2.5). *S. Arizonae* was isolated from one gilt producing herd by faecal sampling according to the salmonella control programme (table 3.2.4). Despite faecal sampling of the whole herd two times with one month interval the infection could not be re-isolated in the herd of origin. For the first time in Sweden *S. Typhimurium DT 104* was isolated from a pig sample (table 3.2.4.). The isolate was detected in a pooled lymphnode sample taken according to the salmonella control programme at slaughter houses. As salmonella could not be re-isolated to the individual sample, all herds included in the pooled sample were examined by faecal sampling. All herds were negative and therefore the source of infection could not be identified. The isolate did not have an increased antibiotic resistance.

Cattle

Results of the surveillance programme at slaughter houses and cutting plants (table 3.2.3.) show that the salmonella situation continues to be very favourable in cattle. In 1999 a total of 12 cattle herds were considered infected with salmonella (table 3.2.4., 3.2.5., figure. 1). This is an increase compared to 1998 when five cases were notified. *S. Dublin* was isolated in 10 herds. In 6 cases the infection was detected at autopsy, in one case at normal slaughter and in one case from a milk sample. Furthermore, one case was detected by faecal sampling of calves due to clinical symptoms and one case was detected by trace back investigation (table 3.2.5.). This supports earlier investigations showing that autopsies (including salmonella

examinations) are important in the salmonella surveillance in cattle under Swedish conditions.

S. Typhimurium DT 15 was isolated in one beef cattle herd. The infection was detected by sampling performed at normal slaughter according to the salmonella control programme (table 3.2.4.). A penta resistant *S. Typhimurium DT 104* was isolated in a dairy herd (table 3.2.5.). Bacteriological examination was performed at normal slaughter due to macroscopical findings at meat inspection.

Sheep, goats and other food producing animals

The salmonella situation in sheep, goats and other food producing animals during 1999 was also very favourable with only a few notified cases.

Sheep

During 1999 two salmonella infected sheep herds were notified. *S. Subspec IIIb* was isolated from both herds and in both cases the infection was detected by autopsy (table 3.2.5.).

Horses

A total of five cases of salmonella were notified during 1999 (table 3.2.5.). *S. Typhimurium DT 40* was isolated in one herd, the infection was detected by bacteriological examination of synovial fluid from a foal with clinical symptoms. The same phage type was isolated from a faecal sample from a clinically infected horse. *S. Typhimurium DT 120* and *S. Enteritidis* were isolated in a herd of imported horses. The initial case was detected at autopsy. *S. Typhimurium DT 193* was isolated in a large animal clinic by faecal sampling of a foal with clinical symptoms. Trace back investigation identified an infected in-contact herd. The same sero type was also identified in three in-contact persons.

Other

During 1999 a total of 84 salmonella infected cats were reported, the majority

were infected with *S. Typhimurium* DT 40. salmonella infections in dogs were also reported in five cases. One of these, due to a penta resistant *S. Typhimurium* DT104 included five (subclinically) infected dogs and two ill people. *Salmonella* was also isolated from 11 reptiles, the most common sero type being *S. subspecies* IIIb.

Wildlife

During spring 1999 an increased occurrence of *S. Typhimurium* infected passerine birds were reported, all of them (54 birds) were infected either with phage type 40 or NST. In a zoological park, *S. Typhimurium* DT 40 and *S. Typhimurium* NST were isolated from one moose and one goat, respectively. Both cases were detected at autopsy. During 1998-1999, a survey including fecal samples from 608 wild animals and birds (moose, roe deer, hare, wild boar, canada geese and gulls) showed that *Salmonella* was not isolated in any species except gulls.

Antimicrobial sensitivity in *Salmonella* from 1997-1998

The material includes all primary isolates of *Salmonella* spp. isolated from warm blooded wild and domestic animals in Sweden. Sensitivity testing was done by use of microdilution techniques (VetMIC[®], National Veterinary Institute, Sweden). The relevant antimicrobials and dilution ranges tested are shown in Table 1 and breakpoints for resistant are given in Table 4. Only the first isolate from each animal species in each incident is included.

All salmonella

A total of 108 isolates were investigated. Fifty of these were *Salmonella* Typhimurium, 9 *S. Dublin*, 2 *S. Enteritidis* and the remainder were other serovars. Twenty-five percent of the material

originated from cattle, 24% from pigs, 21% from poultry, 18% from wild birds and 10% from pets and horses.

The distribution of minimum inhibitory concentrations (MICs) for the antimicrobials tested is shown in Table 1. Sixteen percent of the isolates, belonging to several serovars, were classified as resistant to streptomycin. The frequency of resistance to other antimicrobials was 0-6% and the majority of the resistant isolates were *S. Typhimurium*. Ten isolates (9%) were classified as resistant to at least two of the antimicrobials tested. Antibiograms of these isolates are shown in Table 2.

S. Typhimurium

The distribution of MICs of the antimicrobials tested for *S. Typhimurium* are shown in Table 3. Only 21% of the isolates were from cattle, and as much as 26% originated from wild birds and 23% from pets and horses.

The frequency of resistance compared with earlier years is shown in Table 4. The proportions of different animal sources vary between the different time periods. In the material from 1978-1986, almost all the isolates were from cattle. Since, the proportion of cattle isolates has gradually decreased. However, isolates from major food producing animals constituted 54-59% of the materials and wild birds 22-26% in all time periods after 1986.

Over the years, resistance to streptomycin has decreased. Resistance to ampicillin, chloramphenicol, tetracycline and trimethoprim-sulphonamides has increased in the last two time periods. With the exception of streptomycin, most of the resistant isolates the two last time periods were phage type DT104 with the classical resistance pattern (ACSSuT), in some cases also with resistance to trimethoprim-sulphonamides (Table 2).

Table 1. Distribution of MICs in percent of all investigated isolates of *Salmonella* (n= 108) isolated from animals in Sweden during 1997-1998¹.

Substance	MIC (µg/ml)												
	≤0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	>128
Ampicillin	-	-	-	4	69	21	-	-	-	6	-	-	-
Cephalotin	-	-	-	-	-	-	93	6	-	1	-	-	-
Chloramphenicol	-	-	-	-	-	23	68	4	-	6	-	-	-
Enrofloxacin	-	-	99	-	1	-	-	-	-	-	-	-	-
Gentamicin	-	-	-	-	56	-	44	-	-	-	-	-	-
Neomycin	-	-	-	-	5	45	45	4	1	-	-	-	-
Oxytetracycline	-	-	-	-	19	55	18	3	-	-	3	3	-
Streptomycin	-	-	-	-	-	-	2	12	23	46	8	8	-
Sulfamethoxazole ²	-	-	-	-	-	-	-	-	10	3	15	20	52
Trimethoprim-Sulfonamides ³	44	42	6	4	2	1	-	1	1	-	-	-	-

¹ Hatched fields denote range of dilutions tested for each substance. MICs above or below the range are given as the concentration closest to the range. Breakpoints are indicated as bars between MIC values.

² Concentration of trimethoprim given, tested with sulfamethoxazole in concentration ratio 1:20

³ Two isolates not tested.

Table 2. MIC in the 10 isolates of salmonella from animals during 1997-1998 in Sweden that were resistant to at least two of the antibiotics tested. Values above the breakpoint for resistant are indicated by hatched fields.

Species	Phage Animal		MIC (µg/ml)									
	type	source	Am	Ct	Ef	Gm	Cm	Nm	Tc	Sm	Su	T-S
<i>S. Typhimurium</i>	104	Wild boar*	>16	8	≤0.25	≤1	>16	2	>64	128	>128	1
<i>S. Typhimurium</i>	104	Cattle*	>16	≤4	≤0.25	4	>16	4	64	128	>128	1
<i>S. Typhimurium</i>	NT, NST	Dog	>16	≤4	≤0.25	4	>16	2	64	128	>128	8
<i>S. Typhimurium</i>	104	Cattle	>16	≤4	≤0.25	4	>16	4	64	128	>128	0.5
<i>S. Typhimurium</i>	104	Horse	>16	≤4	≤0.25	≤1	>16	2	>64	128	>128	0.5
<i>S. Typhimurium</i>	104	Horse	>16	≤4	≤0.25	≤1	>16	2	>64	128	>128	0.5
<i>S. Typhimurium</i>	104	Horse	2	≤4	≤0.25	≤1	8	2	4	128	>128	2
<i>S. Java</i>		Pig	1	≤4	≤0.25	4	4	4	1	64	>128	16
<i>S. Vejle</i>		Cattle	1	≤4	≤0.25	4	4	4	2	64	>128	0.12
<i>S. subsp.48:i:z</i>		Hen	1	≤4	≤0.25	4	4	2	2	128	>128	≤0.06

Am = ampicillin, Ct = cephalotin, Ef = enrofloxacin, Gm = gentamicin, Cm = chloramphenicol, Nm = neomycin, Tc = oxitetracycline, Sm = streptomycin, Su = sulfamethoxazole, T-S = trimethoprim/sulfamethoxazole (1/20)

* The isolates originate from the same farm, faeces from wild boar was sampled in pastures.

** not finally determined

Table 3. Distribution of MICs in percent of all investigated isolates of *Salmonella* Typhimurium (n= 50) isolated from animals in Sweden during 1997-1998 ¹.

Substance	MIC (µg/ml)												
	≤0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	>128
Ampicillin	-	-	-	-	58	30	-	-	-	12	-	-	-
Cephalotin	-	-	-	-	-	-	86	14	-	-	-	-	-
Chloramphenicol	-	-	-	-	-	24	60	4	-	12	-	-	-
Enrofloxacin	-	-	100	-	-	-	-	-	-	-	-	-	-
Gentamicin	-	-	-	-	62	-	38	-	-	-	-	-	-
Neomycin	-	-	-	-	10	50	38	-	2	-	-	-	-
Oxytetracycline	-	-	-	-	4	40	38	6	-	-	6	6	-
Streptomycin	-	-	-	-	-	-	2	2	20	56	6	14	-
Sulfamethoxazole ³	-	-	-	-	-	-	-	-	10	2	8	17	63
Trimethoprim-Sulfonamides ²	24	50	10	8	4	2	-	2	-	-	-	-	-

¹ Hatched fields denote range of dilutions tested for each substance. MICs above or below the range are given as the concentration closest to the range. Breakpoints are indicated as bars between MIC values.

² Concentration of trimethoprim given, tested with sulfamethoxazole in concentration ratio 1:20

³ Two isolates not tested.

Table 4. Percentage of resistance to antimicrobials in *S. Typhimurium* isolated from animals in Sweden during different time periods.

Substance	Breakpoint (µg/ml)	Years			
		1978-86	1987-92 ¹	1993-96	1997-98
		(n = 117)	(n =87)	(n = 87)	(n = 50)
Ampicillin	>8	2	2	8	12
Cephalotin	>16	-	1	0	0
Enrofloxacin	>0.5	-	0	1	0
Gentamicin	>16	-	0	0	0
Chloramphenicol	>8	4	2	6	12
Neomycin	>32	0	0	0	0
Streptomycin	>32	78	24	13	20
Tetracycline	>8	14	2	7	12
Trimethoprim-Sulfonamides ²	>0.5	0	1	1	8

¹ 1987 includes isolates from October-December 1986. For 1987-1988, only isolates from bovines were tested.

² Concentration of trimethoprim given, tested with sulfamethoxazole in concentration ratio 1:20.

Salmonella in food

Surveillance/notification systems

Any finding of *Salmonella enterica*, irrespective of subspecies, in food of animal origin is compulsory notifiable. Sampling strategies at cutting plants are outlined in the Swedish salmonella control programme approved by the EU. Frequency of sampling is correlated to the

capacity of the establishment. Depending on the production capacity, sampling is performed daily, weekly, monthly or biannually. Samples consist of crushed meat, trimmings etc.

Methods used

NMKL method No. 71 is used. Sometimes, if results are questioned, or in cases of export or import analysis, a modified ISO

6579:1993 is used, in which the selenite broth enrichment is excluded.

Measures taken in case of salmonella isolation

Any food contaminated with Salmonella sp. is deemed unfit for human consumption and destroyed.

If Salmonella enterica of any subspecies is isolated in food of animal origin, the origin of contamination is traced back to the contaminated carcass, and slaughterhouse or holding whenever possible. Effective cleaning and disinfection of the premises and equipment is immediately carried out in the plant. Increased sampling is carried out to verify that the salmonella contamination is eliminated.

Consignments originating from EU countries, found contaminated with salmonellae (at spot checks) are traced back if possible and destroyed or returned to the sender. Consignments originating from other countries where Salmonella enterica of any subspecies is found at border inspection points are not allowed to enter Sweden.

Results of the investigations in 1999 (Table 3.3)

Sampling at cutting plants

In all, 6 000 samples (4 973 from beef/pork and 1 027 from poultry) were collected from cutting plants. In addition 2 103 samples were collected at cutting plants supervised by local municipalities. All samples were negative.

Official control performed by municipalities

A total of 18 141 samples of different food items, from 157 of the 289 Swedish municipalities, were reported as analysed for the presence of salmonella. The samples were taken in canteens, shops, restaurants and small and medium sized establishments. Thirty-six (0.2%) positive samples were found (table 3.3.1.). The most common serotypes were *S. Senftenberg*, *S. Typhimurium*, *S. Kottbus*

and *S. London*. At least two isolates of *S. Typhimurium* DT 104 were found. As it is not known how many samples were analysed from each food item (from different countries of origin) it is not possible to evaluate which food items were most often contaminated.

Salmonella project 1999

During 1999, a salmonella project was conducted by one of the largest municipalities in Sweden. The aim of the project was to improve the control of meat in the municipality, to increase the knowledge among people who import or handle meat and to increase the knowledge about salmonella among consumers and people who work in restaurants.

A total of 212 random samples of meat were taken in 96 different restaurants, shops and meat product establishments (table 3.3). Of those samples 58 (23%) were of Swedish origin. Five (2,0%) of the samples were positive; 2 pork samples were contaminated with *S. London*, one of which also with *S. Anatum*, and two isolates were not sero typed. One sample from duck meat was contaminated with *S. Kottbus*, and one chicken with *S. Enteritidis*. All the contaminated samples originated from other EU countries.

Spot checks of consignments originating from EU

A total number of 41 consignments were found to be contaminated with salmonella when spot checks were performed on fresh meat. (table 3.3.2).

Salmonella in humans

Surveillance/ notification systems

Salmonella infection is a notifiable disease under the Communicable Diseases Act. The surveillance is mainly based on passive case findings. In addition sampling of contact persons, both with and without clinically symptoms occur in connection with Salmonella cases/outbreaks. People

with certain “risk professions” may be sampled after visits abroad. Figures in this report is based on clinical reports⁶.

Case definition

A case is defined as a person from whom *Salmonella enterica* of any subspecies has been isolated, thereby subclinically infected persons are also included in the number of cases. An investigation is performed on all cases of salmonellosis. A case is considered to be of domestic origin if the person is infected in Sweden, thereby domestic cases will also include secondary cases, to people infected abroad, as well as people infected by food items of non domestic origin. A case is considered to be of foreign origin if the investigation reveals that the person was infected abroad

Epidemiological history

The total number of reported cases during the last ten years (1990-1999) has ranged between 3562 and 5706 (figure 4).

Approximately 85% of the cases were infected abroad.

The number of domestic cases has ranged between 452 and 1215 during these ten years (the annual incidence range is approximately 5-14/100 000). A peak in domestic cases occurred in 1991 (1,215 cases). This increase was due to the spread of *S. Enteritidis* from one egg-producing poultry farm.

In 1996, an increase of cases contracted due to contact with turtles, lizards or snakes was reported. This was due to Sweden joining the EU and the import requirements for *Salmonella* on turtles, lizards and snakes being lifted. During 1996, 80 persons contracted salmonellosis (13 % of the domestic cases), 1997, 60 persons (10 % of the domestic cases), 1998, 46 persons (10 % of the domestic cases) and 1999, 43 persons (5 % of the domestic cases) due to contact with turtles, lizards or snakes. During 1990, to 1994, no more than 2 % of the domestic cases had

contact with turtles, lizards or snakes determined as the source of infection. The steady decrease since 1996 might be due to better information.

Results of the investigations in 1999

(Table 3.4.1 and 3.4.2)

During 1999, 4884 cases were reported. Approximately 80 % were infected abroad. In all, 905 domestic cases (annual incidence 10.2/100 000) were reported, along with 15 cases with unknown country of infection. The number of domestic cases is the highest reported since 1991 and a doubling compared with 1998 (453 cases). The increase of domestic cases is mostly due to a few large food borne outbreaks. Ten domestic foodborne outbreaks occurred during 1999 with a total of 406 cases. The largest outbreak occurred during the summer and involved approximately 200 reported cases. The source of infection was a cafe serving sandwich and some dishes at the West Coast of Sweden. *S. Enteritidis* was found in a mayonnaise prawn mixture and in turkey meat. The other larger outbreak occurred in a pizzeria where 87 persons contracted *S. Enteritidis* after eating béarnaise sauce.

The remaining eight outbreaks were smaller ranging between 5 and 33 ill persons. Three of these outbreaks involved *S. Typhimurium* DT104 as ethiological agent. In one of these outbreaks imported smoked turkey contaminated with *S. Typhimurium* DT104 caused clinical disease in 33 persons including two deaths. Two additional outbreaks was caused by *S. Typhimurium* DT 104, in one case (including 5 sick persons) the source of infection was unknown and in the other outbreak imported roast beef was the source of infection

The most common serotypes among cases of both domestic and foreign origin are *S. Enteritidis* and *S. Typhimurium*. *S. Enteritidis*, occurring in 2521 of all reported cases (52 %). Only 331 of these

⁶ See introduction

cases have contracted the disease in Sweden (7 % of all cases). *S.* Typhimurium occurring in 527 reported cases (11 %). 310 of these cases have contracted the disease in Sweden (6 % of all cases).

Apart from the foodborne outbreaks, 5 % of the domestic cases contracted salmonellosis due to contact with turtles, lizards or snakes (43 cases).

Relevance as zoonotic disease

Since many years approximately only 10-15% of all notified cases has been domestically acquired. Sources of domestic human infections vary.

As Swedish red and white meat and eggs are virtually free from salmonella, the risk of contracting salmonellosis in Sweden is small compared to many other countries. The normally low annual incidence of domestic cases supports this statement.

TRICHINELLA SPIRALIS/NATIVA/BRITОВI
--

Trichinosis in animals

Disease agent

Trichinella spiralis, *Trichinella nativa* and *Trichinella britovi*

Surveillance/notification systems

Trichinosis is compulsory notifiable. All slaughtered pigs (including wild boars), horses and bears are investigated for the presence of *Trichinella* (see table 12.1.).

Methods used

The magnetic stirred method for pooled samples is mainly used. When investigating samples from horses, 5g of diaphragm muscle or, in some few cases, *Musculus masseter* is analysed by the magnetic stirred method.

Case definition used and

epidemiological unit

A case is defined as an animal in which *Trichinella* spp. is found. The animal is the epidemiological unit

Measures taken if trichinosis is diagnosed

The carcass of an infected animal will be destroyed.

Epidemiological history

The main reservoir for *Trichinella* spp. in Sweden is the red fox (*Vulpes vulpes*). Approximately 10% of the fox population is estimated to be infected. All three species of *Trichinella*, i.e. *spiralis*, *nativa* and *britovi*, have been found in red foxes in Sweden.

During the last 10 years approximately 2-3 cases in pigs have been notified annually but during 1994-96, no cases were reported. The source of infection has usually been unknown, but rodents have been suspected. In 1997 and 1998 one respectively three farmed wild boar was found positive.

Results of the investigations in 1999 (Table 4.1)

During 1999, two cases were notified in pigs. One was a free living wild boar and the other was a farmed pig (cross breed domesticated pig and wild boar) originating from the same herd where a case of trichinosis was found in 1998. In addition a case of trichinosis was reported in cat and a fox.

Trichinosis in humans

Surveillance/ notification systems

Trichinosis is a notifiable disease under the Communicable Diseases Act. The figures of trichinosis in this report are based on clinical reports⁷.

⁷ See introduction

Case definition

A case is defined as a person in whom trichinosis has been verified by laboratory investigations (histopathology or serology). Cases with typical clinical symptoms could also be reported.

Epidemiological history

During the last ten years no cases of trichinosis in humans have been reported from Swedish laboratories. However, one clinical case was reported in 1991, according to the clinical report that person had contracted the disease abroad after eating pork.

Results of the investigations in 1999 (Table 4.2)

No case of trichinosis has been reported during 1999.

Relevance as zoonotic disease

The risk of obtaining trichinosis from domestic sources is negligible.

CAMPYLOBACTER **(thermophilic)**

Campylobacteriosis in animals

Disease agent

Campylobacter jejuni and
Campylobacter coli.

Surveillance/notification systems

Campylobacter is not compulsory notifiable in animals. A surveillance system exists only for broilers. It is an industry led programme whereby every flock sent for slaughter, is examined for campylobacter at the slaughterhouse.

Methods used

Cloacal swabs from 10 broilers per flock is collected and pooled, and samples are sent to one laboratory and analysed for the

presence of *Campylobacter* spp. by routine diagnostic methods. Serotyping or other subtyping methods are not routinely performed.

Case definition used and epidemiological unit

A case is defined as any sample from a sampled flock, being positive for *C. coli* or *C. jejuni*. The epidemiological unit is the slaughtered flock.

In animals a case is defined as an animal from which thermophilic *Campylobacter* spp. has been isolated.

Measures taken in case of campylobacter isolation

The intention is that if a flock is positive for campylobacter, the flock owners should introduce more stringent hygiene measures at the farm level in order to exclude campylobacter from broiler houses. If campylobacter is not found at the control at slaughter, the farmer gets better paid for the broilers from some companies.

Epidemiological history

The industry led programme, in combination with the basic requirements of the salmonella control programme, has reduced the incidence rates of campylobacter positive broiler flocks from approximately 50% in the 80s to less than 10% in the last years. The distribution of strains between *C. jejuni* and *C. coli* has been approximately 98% and 2% respectively.

The lower incidence in flocks should reduce the overall level of contamination of carcasses and thereby the risk for the consumer handling raw chickens in the kitchen.

However, in previous years the incidence of domestically acquired campylobacteriosis has not appeared to be correlated to the prevalence in broilers. The reason for this discrepancy is not clear. Although the Swedish consumption

of broiler meat has increased by 100% during the last 10-15 years, it is probable that other important sources of infection exists.

Results of the investigations in 1999 (Table 5.1)

During 1998, 3 846 flocks, with in total 64.9 million broilers (98% of all broilers slaughtered during 1998 in Sweden) were tested. In all, 355 flocks were found to be positive, representing 9.2% of all flocks slaughtered that year. The prevalence of positive flocks during 1991-1999 is illustrated in figure 3. As sub typing is no longer performed, the distribution of strains between *C. jejuni* and *C. coli* is not known, but it is believed that the situation has not changed since previous years (see "epidemiological history").

The seasonal variation in the finding of *Campylobacter* spp. in broiler flocks is illustrated in 1998 year zoonosis report. Apart from the studies in poultry, a study was also conducted in which faecal samples were collected from 741 wild animals, shot by hunters during 1998-1999. During 1998-1999 samples from 118 hares, 90 deer, 66 wild boars and 86 moose 105 geese and 104 gulls were examined for the presence of *Campylobacter* spp. Samples from 1-5 animals were pooled before culture. The estimated individual prevalences were 15 % in geese, 22 % in gulls, 12 % in wild boar, 4 % in roe deer and 1 % in moose and hares.

Campylobacter in food

Surveillance systems

There is no officially co-ordinated surveillance system for campylobacter in food. Surveillance is achieved by various projects initiated by municipalities, the National Food Administration, the Institute for Meat Research and other research institutions.

Methods used

The NMKL 119:1990 2:nd ed. is used.

Measures taken in case of campylobacter isolation

No measures are taken in case of positive findings. Should an outbreak occur, the National Food Administration decides what action to take.

Results of the investigations in 1999 (Table 5.2)

Samples collected by the NFA in official control.

In 1999 a number of 366 samples were taken at meat cutting plants and analysed for campylobacter (no sub-typing was done). Of those 241 samples were from pork, 91 from beef, 18 from broilers, 3 from moose and 13 were mixed (pork/beef) minced meat. Two samples, one from pork and one from broiler were positive.

Project performed by the NFA

Two hundred and forty-five samples from various kinds of food collected in retail stores were analysed for campylobacter (no sub-typing was done). In 102 samples from poultry 24 were positive, and from 55 samples of pork there was 1 positive. From beef (45 samples), lamb (13), and vegetables (30) none were positive. Most of the samples were of domestic origin.

Samples collected by the local municipalities in official control.

A number of 345 samples of raw meat were collected at retail level, (15 from beef, 34 from pork, 298 from poultry and 28 from other meats) and in cutting plants (21) and analysed for campylobacter. Two samples from poultry, both taken at the retail level were positive (no sub-typing was done), and none from the cutting plants. Analyses were also made in 69 meat products (3 beef, 5 pork, 49 poultry and 12 others) of which four poultry samples were positive, and in drinking

water (14), ready to eat milk products (5), vegetables (3), fish products (2) and other foods (74), which all were negative for campylobacter.

Campylobacteriosis in humans

Surveillance/ notification systems

Campylobacter infection is notifiable under the Communicable Diseases Act. The surveillance is mainly based on passive case findings. Figures in this report is based on clinical reports⁸.

Case definition

A case is defined as a person from whom *Campylobacter* spp. has been isolated.

Epidemiological history

Campylobacteriosis became notifiable in 1989. In the last ten years the total number of reported Campylobacter infections have fluctuating between 4006 – 7137 and the domestic cases 1329 – 2574 se figure 6. The reason for the year-to-year variation is unknown.

Results of the investigations in 1999 (Tables 5.3.1 and 5.3.2)

During 1999 the total number of reported campylobacter cases increased to 7137, which is the largest figure ever reported. Of these 2209 (31%) (annual incidence 24.93/100 000) were domestic cases, while 132 cases had unknown country of infection. The number of domestic cases was slightly lower compared to 1998. The increased number of imported cases is mainly due to an increased number of cases originating from Thailand and could be explained by the increased travelling to Asia.

Most reported cases are sporadic. Four domestic outbreaks occurred during 1999 including a total of 15 cases. The

suspected source of infection was unpasteurised milk (three persons), barbecued pork (three persons), barbecue (five persons) and chicken liver (four persons).

Relevance as zoonotic disease

Campylobacteriosis is the most common bacteria causing infectious diarrhoea in Sweden today. A significant part of the reported cases (30-45 %) is of domestic origin. The population etiological fractions are unknown and more knowledge is needed concerning the epidemiology of the disease to be able to decrease the number of human cases.

ECHINOCOCCUS GRANULOSUS/ MULTILOCULARIS

Echinococcosis in animals

Disease agent

Echinococcus granulosus and
Echinococcus multilocularis

Surveillance/notification systems

Echinococcosis is compulsory notifiable in Sweden. Inspection at slaughter is the only surveillance system in place.

Measures taken if echinococcosis is diagnosed

Offals from animals found infected with *Echinococcus* spp. will be destroyed. In order to prevent further cases, veterinarians at slaughter houses where reindeer are slaughtered have been recommended increased alertness, slaughter houses have been recommended not to sell uncooked offals and reindeer owners have been recommended to deworm their dogs.

⁸ See introduction

Epidemiological history

Echinococcus multilocularis

This parasite has never been reported in Sweden.

Echinococcus granulosus

Sporadic cases occur in horses

Investigations have shown that they have been imported and probably were infected abroad.

In reindeer, *E. granulosus* was shown to be prevalent during the 70s. Approximately 2% were infected. All cases occurred north of the polar circle. Based on these findings the routines at meat inspection of reindeer were revised and organs not approved for consumption had to be destroyed. During the ten years preceding 1996 no case of *E. granulosus* was found in reindeer. In 1996, 2 reindeer were found positive for *E. granulosus*. In 1997, *E. granulosus* was found in one reindeer but no case was found in 1998

In order to prevent *E. multilocularis* to be introduced into the country, imported dogs must be treated with praziquantel.

Results of the investigations in 1999 (Table 6.1)

In 1999 one case of *E. granulosus* was found at autopsy in an imported horse.

Echinococcosis in humans

Surveillance/ notification systems

Echinococcosis is not a notifiable disease under the Communicable Disease Act. Figures in this report are based on laboratory reports⁹.

Case definition used and epidemiological unit

A case is defined as a person where echinococcosis has been verified by laboratory investigations (histopathology or serology).

⁹ See introduction

Epidemiological history

Notification of echinococcosis was initiated in 1994. Between 3 and 11 cases have been reported annually, all infected abroad.

Results of the investigations in 1999 (Table 6.2)

Five cases were reported during 1999. The foreign countries where they contracted the disease are unknown.

Relevance as zoonotic disease

Currently echinococcus represents no significant threat to humans in Sweden.

LISTERIA MONOCYTOGENES

Listeriosis in animals

Disease agent

Listeria monocytogenes

Surveillance/ notification systems

There is no specific surveillance system for listeriosis in animals, surveillance is based on clinical observations. Listeriosis is compulsory notifiable in all animals.

Methods used

Histopathology, immunohistochemical methods and bacteriology.

Case definition used and epidemiological unit

A positive histopathological diagnosis in combination with clinical signs of listeriosis is defined as a case. A positive bacteriological result has to be combined with a positive histopathological diagnosis to be defined as a case. A positive immunohistochemical result in combination with histological lesions is defined as a case. The animal is the epidemiological unit

Measures taken if L.

monocytogenes is isolated

In a verified case of listeriosis, an official veterinarian is appointed to investigate the herd and try to clarify the source of infection. When appropriate, the veterinary investigation is carried out in co-operation with local public health authorities. The veterinarian is also obliged to inform the owner of the zoonotic aspects of the disease and prophylactic measures will be recommended in order to avoid recurrence of the disease.

Epidemiological history

The situation has been stable over the years with approximately 10-20 cases annually.

Results of the investigations in 1999

During 1999 34 cases of listeriosis were notified in sheep, nine cases in cattle and one case in horse, rein deer and a bird respectively. The number of reported cases of listeriosis in sheep has increased compared to previous years. The reason for the increase in number of reported cases is unknown.

Listeria monocytogenes in food

Surveillance/notification systems

There is no officially co-ordinated surveillance system for *Listeria monocytogenes* in food. Surveillance is achieved by various projects initiated by municipalities, the National Food Administration, the Institute for Meat Research and other research institutions.

Methods used

USDA 24-5 -1989 (modified) is used for quantitative analysis and NMKL 136 for qualitative analysis.

Measures taken if L. monocytogenes is isolated

Listeria monocytogenes found in food supposed not to be further heat-treated: If the number of bacteria exceeds the cut-off point (if in one sample of five, more than 100 colonies/g are found or in two or more of five samples with 10 or more colonies/g) the food will be classified as not fit for human consumption and subsequently destroyed.

Results of the investigations in 1999 (Table 7.2)

Samples collected by the industry

From fresh beef meat 643 samples (369 beef carcasses and 274 meat samples intended for minced beef) were analysed. The meat intended for minced beef was kept vacuum packed until the best-before date and then analysed. A total of 26 positive samples were found (7 from carcasses (2%) and 19 (7%) from meat intended for minced beef.

From fresh pork 638 samples (330 carcasses and 308 meat samples intended for minced pork) were analysed. The meat intended for minced pork was kept vacuum packed until the best-before date and then analysed. Of these, 10 (3%) and 15 (5%), respectively, were found positive.

From fresh lamb 280 carcasses were analysed and 6 (2%) were found positive. Samples collected by the NFA

In the official control performed in 50 meat product establishments under NFA surveillance a total of 205 samples were taken. Of those 11 (5%) were positive.

Samples collected by the local municipalities in official control

In the official control a total of 145 samples were collected and analysed for *Listeria* spp. Sixteen (11 %) were positive. Of those, two out of 15 (13%) samples from fresh meat were positive, nine out of 113 (8 %) samples of fishery products, and one sample from poultry was positive. No positive was found in 10 samples from milk products and 3 from vegetables. Of

83 samples from other products five were positive.

No quantified analysis was performed

Listeriosis in humans

Surveillance/ notification systems

Listeriosis is a notifiable disease under the Communicable Diseases Act. The figures of listeriosis in this report are based on clinical reports¹⁰.

Case definition

A case is defined as a person from whom *Listeria monocytogenes* has been isolated from a normally sterile site. Mother and child/foetus is regarded as one case.

Epidemiological history

The situation is stable, approximately 20-30 cases are reported annually. Normally, no reported cases are observed outside the vulnerable groups (immune-suppressed persons, pregnant women and elderly).

Results of the investigations in 1999 (Table 7.3)

During 1999, 27 cases were reported. Infection during pregnancy occurred in five cases. Of all cases 13 were persons older than 65 years of age. Only one person did not have other earlier known disease.

Relevance as zoonotic disease

Foodborne transmission is believed to be more important than transmission from animals. In Sweden listeriosis have practically only been relevant as a zoonotic disease in immuno suppressed people and pregnant women.

RABIES

Rabies in animals

Surveillance/notification systems

Rabies is compulsory notifiable on clinical suspicion in Sweden. Apart from this, there is no official surveillance system for rabies in animals, except the ordinary clinical surveillance performed by veterinarians. In addition, hunters are advised to notify the authorities of any animals they find which behave in such a way that rabies might be suspected.

Vaccination policy

Vaccination of animals is not allowed in Sweden except for dogs and cats going abroad.

Measures taken in case of rabies diagnosis

Should rabies occur, relevant measures to eradicate the disease would be taken.

Epidemiological history

No case of rabies has occurred since 1886 and Sweden is recognised as free from rabies. All dogs and cats entering the country (excluding animals originating from rabies free countries and EU and EFTA countries) have to be kept in quarantine for 4 months. Dogs and cats from EU and EFTA countries can enter the country after rabies vaccination and antibody titre control (according to Swedish requirements). During 1987-89 a survey was performed where 200 bats were investigated for rabies, all were negative.

Results of the investigations in 1999 (Table 8.1)

No cases of rabies occurred in animals in Sweden in 1999. Six dogs, six cats, one fox, one ferret and one squirrel were investigated. All samples were negative for rabies. Another bat survey was also performed during 1999, including 75 bats

¹⁰ See introduction

from all over the country. The bats had either been found dead or were sick and subsequently euthanised. No case of rabies was found in these bats.

Rabies in humans

Epidemiological history

Rabies is a notifiable disease under the Communicable Diseases Act. No case of rabies has occurred since in 1975 when a person contracted rabies after taking care of a puppy in India.

Results of the investigations in 1999

No cases were recorded.

Relevance as zoonotic disease

As Sweden has been free from rabies in animals since 1886 and has strict import regulations, there is no domestic rabies threat to humans.

TOXOPLASMA GONDII

Toxoplasmosis in animals

Disease agent

Toxoplasma gondii

Surveillance/notification systems

No specific surveillance system exists for toxoplasmosis in animals.

Methods used

Isolation of the agent in mice or cell culture, immunohistochemistry or serology.

Case definition used and epidemiological unit

A case is defined as an animal that is positive in any of the above mentioned tests. The animal is the epidemiological unit.

Epidemiological history

Results of investigations performed during 1987 indicate that approximately 40 % of the cats, 23% of the dogs, 20% of the sheep and 1% of the horses in Sweden have antibodies against *Toxoplasma gondii*. Earlier investigations performed in pigs indicate that the prevalence before 1987 has been as high as 10%.

Investigations performed in sheep showed that the prevalence increased with increasing age and that it was also higher in sheep living outdoors compared to sheep kept indoors.

Results of the investigations in 1999

During 1999 a serological study was performed in slaughtered pigs to estimate the risk of ingesting *T gondii* tissue cysts with raw or inadequately cooked pork. Samples were collected from a total of 807 pigs (695 fattening pigs, 110 adult pigs and two with unknown age) from 10 abattoirs selected to represent different parts of the country. The overall seroprevalence was 5.2% with 3.3% in fattening pigs and 17.3% in adult pigs. These findings are in good agreement with results of investigations in several countries including the nordic countries Denmark and Finland.

Toxoplasmosis in humans

Surveillance/ notification systems

Toxoplasmosis is a notifiable disease under the Communicable Diseases Act. The figures of toxoplasmosis in this report are based on clinical reports¹¹.

Case definition

A case is defined as a person where toxoplasmosis has been verified by laboratory examination (through isolation, PCR-technique or serology).

¹¹ See introduction

Epidemiological history

The true prevalence of toxoplasmosis is unknown. Concerning the number of reported cases, the situation is stable, in the last 10 years 4–22 cases have been reported annually.

Results of the investigations in 1999 (Table 9.2)

During 1999, 4 cases were reported, the source of infection is unknown.

Relevance as zoonotic disease

Toxoplasmosis as a clinical disease is most important in immunosuppressed persons and in pregnant women. During pregnancy the infection can be transmitted to the foetus causing death or serious injury. However, more knowledge is needed concerning the most significant sources of infection in Sweden. The main source seems to be undercooked or raw meat.

YERSINIOSIS ENTEROCOLITICA

Yersiniosis in animals

No specific surveillance systems exist for those *Yersinia* species considered as zoonotic agents.

Yersinia in food

Surveillance systems

There is no officially co-ordinated surveillance system for *Yersinia* spp. in food. Surveillance is achieved by various projects initiated by municipalities, the National Food Administration, the Institute for Meat Research and other research institutions.”

Methods used

Bacteriological examination according to NMKL 117, 3rd ed, 1996 is performed. In addition a PCR, NMKL 163:1998, may also be used.

Measures taken if *Yersinia enterocolitica* is isolated

When products that will not be exposed to further heat treatment are positive for pathogenic serotypes of *Yersinia enterocolitica*, they will be classified as not fit for human consumption and subsequently be destroyed.

Results of the investigations in 1999 (Table 10.2)

No investigations of *Yersinia enterocolitica* were reported in 1999.

Yersiniosis in humans

Surveillance/ notification systems

Yersiniosis is a notifiable disease under the Communicable Diseases Act. The figures of yersiniosis in this report are based on clinical reports¹².

Case definition

A case is defined as a person from whom *Yersinia* spp. has been isolated.

Epidemiological history

Prior to 1996, yersiniosis was only reported from laboratories. In the beginning of this decade more than 1000 cases of yersiniosis were reported compared to 558 in 1998. This decrease could be due to improved hygienic technique during slaughter of swine and/or less sampling for *Yersinia* spp. in patients.

Results of the investigations in 1999 (Table 10.3.)

In 1999, 478 cases were reported. Of these, 313 (65 %) cases were of domestic origin and 71 had an unknown country of infection. The domestic incidence was 3.53/100 000 inhabitants.

¹² See introduction

Relevance as zoonotic disease

A significant part (approximately 70 %) of the human infections are of domestic origin. To be able to decrease the number of cases, more knowledge is needed concerning the epidemiology of the disease.

VEROCYTOTOXIC *E. COLI* O157

VT *E.coli* O157 in animals

Disease agent

Verotoxin-producing *Escherichia coli* serotype O 157

Surveillance / notification system

Since 1997, approximately 2000 faecal samples from cattle are collected annually at slaughter-houses and analysed for VT *E. coli* O157. From September 1999 the monitoring is anonymous. If livestock contacts are reported in a human case of VT. *E. coli* O 157 infection, the animals are investigated by bacteriological sampling. Any case of VT *E. coli* O157 with connection to a human case of enterohaemorrhagic disease is compulsory notifiable.

Methods used

Isolation of VT *E. coli* O157 strains are made after pre-enrichment in buffered peptone water followed by immuno-magnetic separation (IMS; Dynal), and culture on sorbitol MacConkey with cefixime and tellurit (CT-SMAC). Suspected colonies are confirmed by latex agglutination and biochemistry. A PCR method is used to identify genes for VT production and *eaeA* genes. In addition, certain isolates have been subtyped by

RFLP and PFGE.

Case definition used and epidemiological unit

A case is defined as an animal from which VT *E.coli* O157 is isolated. The herd is the epidemiological unit. Case definition for compulsory notification see “surveillance/notification system”

Epidemiological history

VT *E. coli* O157 was first isolated in cattle in Sweden in 1996. In the same year, infection with *E. coli* O157 in humans in Sweden was for the first time traced to the presence of VT *E. coli* O157 in a cattle herd. Restrictions were laid on the herd and surveillance was initiated. Livestock was only allowed to leave the premises if transported directly to slaughter. Since 1996, VT *E. coli* O157 has been isolated in 20 herds.

In October 1996 findings of VT *E. coli* O157 became compulsory notifiable. Since summer 1999 only cases of VT *E. coli* O157 having a connection with a human case of enterohaemorrhagic disease is compulsory notifiable.

Earlier slaughter house surveys have shown 0.8 % (4/474) of lambs and 0.9 % (1/109) of sheep and 0.08% (2/2446) of pigs to be positive for VT *E. coli* O 157. A slaughterhouse surveys on cattle (1997 and 1998) have shown 0.4% (7/2000) were positive for VT *E. coli* O 157.

Results of the investigations in 1999 (Table 11.1)

In the annual slaughter house surveillance, 2 057 samples were taken from cattle. Of these, 15 samples (0.7%) were positive for VT *E. coli* O 157. Samples collected after September 1999 were anonymous. The prevalence among cattle older than one year was lower compared to younger animals, 0.2% (1/641) versus 1.0% (14/1391). Cattle of milk breed showed a higher prevalence compared to beef cattle. An anonymous herd-level prevalence study was conducted during autumn 1998

to spring 1999. Twenty faecal samples were collected from cattle less than 1 year age from 249 dairy herds. The samples were pooled in groups of 5 (25 grams in each pooled sample). A total of 989 pooled samples were analysed and 53 pooled samples originating from 23 different herds were positive. The overall individual prevalence of VT *E. coli* O 157 was calculated to 1.1%. The prevalence was higher in the autumn compared to the spring. No positive samples were obtained from the northern part of Sweden indicating a lower prevalence in this region. Apart from the studies on domestic animals, a study was also conducted in which faecal samples were collected from wild animals, shot by hunters. In this study, samples from 125 hares, 90 deer, 68 wild boars, 84 moose, 195 roe deer, 105 geese and 111 gulls were examined during 1998-1999. One sample from wild boar yielded growth of VT *E. coli* O 157. All samples from the other species were negative.

During 1999 a total of seven cattle herds, infected with VT *E. coli* O157 were notified. Of these, three were identified by investigations performed in connection with human EHEC cases and four cases were identified by the prevalence study at slaughter houses. In addition 17 herds with unknown identity were identified in the herd prevalence study and 11 positive samples from an unknown number of herds were found in the slaughter house surveillance.

A total of seven cattle herds were investigated to clarify if they could be the source of infection to human cases of EHEC. In three of the seven herds, VT *E. coli* O 157 was isolated. In one case where isolates from both the human case and animals were available fingerprinting has been performed. The isolates were very similar indicating, but not proving, that a common source of infection might exist. Since 1996 a total of 20 herds have been investigated and found infected with VT *E. coli* O 157. Of these six herds have been

declared free, four herds have slaughtered all animals, three herds are still under investigation and in seven herds investigations have stopped as connection with human cases did not exist.

Measures taken in infected herds with connection to clinical cases of EHEC in human

The authorities have established guidelines for the handling of infected herds with connection to cases of human disease. Any infected herd with connection to human disease will receive these recommendations. In short, the guidelines are as follows:

Movement of live animals from the herd of origin requires that each animal, prior to movement has tested negative for VT *E. coli* O 157. In the herd, samples are taken four times a year for bacteriological examination and hygiene recommendations and other measures are instituted. Animals sent to slaughter are examined for VT *E. coli* O 157.

Concerning measures taken for contaminated carcasses, see "E. coli O157 in food".

The herd is considered to be free from the infection when faecal samples from all animals in the epidemiological unit (usually the herd) taken on two consecutive sampling with one month interval are negative.

VT E. coli O157 in food

Surveillance systems

There is no routine surveillance system for *E. coli* O157 in food in Sweden. See "zoonotic agents in food". On a voluntary basis, bacteriological examination for VT *E. coli* O157 is performed on slaughtered cattle and sheep originating from infected herds.

By the 1st January 1998, it was decided that 900 carcasses of cattle would be

sampled annually. All large-scale slaughterhouses in Sweden are involved.

Methods used

Isolation of *E. coli* O157 strains is made according to NMKL 164. A PCR method is used to identify genes for VT-production and *eaeA* genes.

Measures in case of positive findings

If VT *E. coli* O157 is found in food, NFA will take necessary action to ensure that contaminated food will not reach the consumer. In the industry led surveillance programme the carcasses are not arrested pending bacteriological results.

When there is a clear epidemiological connection to human cases of enterohaemorrhagic disease caused by an infection with VT *E. Coli*, it is recommended that the animals from that holding should be slaughtered last in the day. All carcasses should be swabbed for VT *E.coli* O157 and the carcasses retained pending results. In case of positive findings the carcasses will be destined for heat treated products. The premises should be thoroughly cleaned and disinfected after such slaughter.

Epidemiological history

Until 1999 VT *E. coli* had not been identified in food of Swedish origin. One positive sample was found in imported meat in 1996.

Results of investigations in 1999 (table 11.2)

Air dried meat from an illegally slaughtered calf was considered to be the source of infection for a child hospitalised for HUS. VT1 positive *E.coli* (non O157) was isolated from the mother. The child was positive for VT2 but bacteriological examination was negative. In the meat VT1 and VT2 was found but bacteriological examination was negative. It can be

concluded that no VT *E. coli* O157 was found in the air dried meat. Furthermore on the basis of the current evidence, it cannot be concluded which serotype of verotoxigenic *E. coli* that caused disease in the child and whether the same bacteria were present in the dried meat.¹³

In the voluntary slaughterhouse monitoring, performed by the industry four of 553 (0.7%) examined beef carcasses were contaminated with VTEC *E. coli* O157.

VT E. coli O157 in humans

Surveillance/ notification systems

Since the first of January 1996, enterohaemorrhagic *E. coli* O157 is a notifiable disease under the Communicable Diseases Act. Any case where *E. coli* O157 has been isolated, including subclinically infected people is reported. HUS (haemorrhagic uremic syndrome) is not reportable in Sweden. Other serotypes of verotocytotoxic *E. coli* than O157 is reportable on a voluntary bases. Figures of *E. coli* O157 in this report are based on clinical reports¹⁴.

Case definition used

A case is defined as a person from whom *E. coli* O157 has been isolated.

Epidemiological history

Since 1988, up to three cases of infection with enterohaemorrhagic *E. coli* O157 or other sero types have been reported from laboratories annually, including persons who had contracted the disease abroad. Before 1996 figures are based on voluntary reporting from laboratories. Approximately fifty percent of the cases were infected with *E. coli* O157 and the remainder with other sero types.

¹³ 2000-08-31: Correction of paragraph from previous printed version 2000-06-27.

¹⁴ See introduction

During the autumn of 1995, and the first weeks of 1996, an *E. coli* O157 outbreak occurred in Sweden with about 120 confirmed cases. This increased the awareness of *E. coli* O157 and today most people with haemorrhagic diarrhoea will be investigated for the presence of this pathogen.

Results of the investigations in 1999
(Table 11.3.1 and 11.3.2)

During 1999, 59 cases of *E. coli* O157 were reported, 45 (76%) of these were of domestic origin and 14 (24%) were infected abroad. The domestic incidence was 0.51/100 000 inhabitants. One case of HUS due to *E. coli* O157 and four cases of HUS due to non O157 were reported. The true number of cases of HUS is unknown, as there is no mandatory reporting system for HUS in Sweden.

The decrease in domestic cases of *E. coli* O157 during 1998 (52 cases) and 1999 (45 cases), compared to 1997 (116 cases) is unknown but might be due to recommendations mentioned below (figure 7).

During 1999 one outbreak of EHEC occurred. Eleven persons were reported infected with *E. coli* O157 after a common meal, the source of the infection is unknown.

Relevance as zoonotic disease

E. coli O157 is an emerging zoonotic infection. It can not be excluded that large outbreaks may occur in the future.

Compared with other food borne infections, infection with *E. coli* O157 could be very serious, especially in young children developing HUS. The epidemiology of the disease is not fully understood. Much research still has to be performed before it will be possible to determine whether an efficient strategy for controlling *E. coli* O157 can be implemented.

As a prophylactic measure, it has been recommended that young children (< 5

years of age) should not visit cattle farms and hygiene recommendations have been issued for other visitors.

Manure handling without risk of contaminating drinking water or products as fruits, berries or is a challenge.