

Disease Surveillance Strategies in Swine

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Pig production systems in the Nordic countries

The volume and the structure of pig production in different Nordic countries is described in table 1. The volume of the production is clearly largest in Denmark countries, and 80% of the Danish production is exported. The infrastructure in Denmark and Sweden is similar with respect to the proportional number of nucleus and multiplying herds. Finland and Norway still have a relatively high number of nucleus herds. The pig population in Iceland is minor, excluding nucleus or multiplying herds. There is no export of pigs or pig products from Iceland. Therefore no official disease surveillance programs have existed until today. However, import of pigs to Iceland has been very strictly ruled. The latest imports took place in 1994 and

1996 from Norway and Finland, respectively. It is believed that the health status of Icelandic pigs is similar to that of Norway and Finland. Random sampling of pigs from the majority of herds during 1993-1999 supports that suggestion with respect to the epidemic pig diseases.

National surveillance systems of List A and List B diseases (OIE)

Today, all Nordic countries are considered free from Aujeszky's disease (AD), transmissible gastroenteritis (TGE), classical swine fever (CSF), and swine vesicular disease (SVD). The aim of the surveillance for these diseases is to document freedom from disease within the national pig populations. The numbers of samples analysed annually for these diseases, and the strategies for collection are shown in table 2.

Table 1. Approximate numbers of different kinds of pig herds, total number of sows and annual number of pigs slaughtered in Nordic countries in 1998.

	Denmark	Sweden	Finland	Norway	Iceland
Nucleus herds	60	40	150	110 ^b	-
Multiplying herds	230	150	20	85	-
Conventional herds					
- farrowing	2.800	5.100	2.300	500	-
- farrowing-to-finishing	5.500	760	1.400	3.400	54
- finishing	10.000	5.800	1.800	2.000	-
- sow pool systems	-	30	8	1	-
Total no. of sows (thousands)	1.000	274	185 ^a	65	4
Annual no. of pigs Slaughtered (mill.)	21	3.9	2.2	1.3	0.065

^a Gilts older than 200 days of age included

^b Aspirant herds included

Table 2. Approximate numbers of annual surveillance samples analysed for serum antibodies to the causative agents of Aujeszky's disease (AD), transmissible gastroenteritis (TGE), classical swine fever (CSF), and swine vesicular disease (SVD) in Nordic countries. In 1998, these countries were considered free of all these disease.

	Denmark	Sweden	Finland	Norway
AD	30.000 ^a	5.000 ^b	9.800 ^c	4.700 ^d
TGE	1.500 ^e	3.000	9.800	4.700
CSF	30.000	3.000	2.900	-
SVD	3.000	3.000	2.600	-

^a A systematic sample comprising 10% of boars and 5% of sows slaughtered or exported for slaughter; in border areas all boars and 10 % of sows intended for slaughter are sampled.

^b A systematic sample from slaughtered sows and fatteners.

^c The sample comprises all boars slaughtered annually, all sows slaughtered during April and May (corresponding to 10% of total sows slaughtered), and a systematic sample (n=3000) from fatteners.

^d All elite breeding and multiplying herds (n=200), and a stratified random selection (n=290; fattening herds Under-represented) of the rest of the pig herds are tested; samples are collected first and foremost from sows.

^e Samples from exported live animals.

AD has never been reported in Finland, Norway and Iceland. Denmark and Sweden have eradicated the disease in 1991 and 1996, respectively. The AD free status has been confirmed by the EU commission and by the EFTA's Supervisory Authority (Norway). An annual surveillance for the disease are required in each country.

TGE has never been reported in Denmark, Sweden, Norway or Iceland. In Finland, two cases of TGE of foreign origin were found in 1981. The infection was immediately eradicated. Finland and Norway have been granted additional guarantees relating to TGE by the EFTA's Supervisory Authority. These decisions require an annual surveillance of the disease and reporting of the results.

The surveillance for CSF and SVD in Denmark, Sweden, and Finland is based on deci-

sions of the EU commission.

Salmonella infections in pig Denmark

Aim of the surveillance and organisation

The aim of the Danish *Salmonella* surveillance program is to reduce the prevalence of *Salmonella* in slaughter pig herds and pork. Target population includes all herds producing more than 100 slaughter pigs per year. The number of such herds is about 16000. A permanent program, launched by the Danish Ministry of Agriculture, was established in 1995. The compulsory program is administered by the Danish Meat and Bacon Council.

In addition to surveillance and control of *Salmonella* in breeding and multiplying herds and in finishing herds, the program involves control of *Salmonella* in feed stuffs, and control measures at the abattoirs. These parts of the program are beyond the scope of this paper.

Sampling

Meat juice samples are collected at random from each herd participating in the program. Between eight and sixty meat samples are collected from each herd every quarter of the year. The sample size is predetermined by the number of pigs delivered for slaughter.

The system is based on the identification of each herd by a unique code (the Central Herd Registration; CHR) that identifies a herd as the smallest epidemiological unit of trace-back within a given geographical location. Each year, all farmers are obliged by law to inform the CHR register about ownership, herd type and number of pigs. The per-herd systematic sampling frequency is based on a monthly update from Central Zoonoses Register (Zoor), which is part of the CHR register. Zoor receives monthly information of the number of pigs slaughtered per herd, and of the actual samples obtained. Around 800 000 meat juice samples are examined annually at the Danish

Veterinary Laboratory.

Tests and testing procedures

An indirect enzyme-linked immunosorbent assay (ELISA) based on a combination of the lipopolysaccharide (LPS) antigens O:1, 4, 5, 6, 7, and 12 is used. This ELISA (Exiqon, Denmark) is presumed to be able to detect O-antigens from at least 93 % of all serovars presently occurring in Danish pigs. In experimental studies using *S. typhimurium* and *S. infantis*, the sensitivities have been >95 % and the specificities 100%, respectively. Using results obtained with serum as the gold standard, relative sensitivities from 0.81 to 0.89 have been demonstrated when meat juice samples have been analysed. The results of the examination are summarized monthly for individual herds. Based on the proportions of sero-reactors during the last three months, the herds are assigned to one of three levels. Level 1 herds have no or very few sero-reactors. Level 2 herds have a relatively high proportion of sero-reactors (from >50% in the smallest to >10 % in the largest herds), whereas level 3 herds have an unacceptably high proportion of seroreactors (>50 % for most herd sizes). Both the herd owners and the slaughter companies are informed monthly about the *Salmonella* level of the herds.

Consequences in the case of assignment to level 2 or 3

Herds assigned to levels 2 and 3 are requested by the slaughter company to seek advice on how to reduce the prevalence of *Salmonella*. A sufficient number of faecal samples must be collected and analyzed in order to clarify the distribution of *Salmonella* in the herd. Based on the results obtained, the herd owner, a veterinarian, and a pig consultant elaborate a herd-specific intervention plan. The recommended measures of the control of disease spread are implementation of all-in/all-out practices in growing and finishing barns, cleaning and dis-

infection between batches, and strict control over the risks to introduce external sources of *Salmonella*.

The slaughter companies collect a penalty per pig delivered if the plan is not elaborated and received by the slaughter companies within 35 days. If a herd remains in level 2 or 3 for more than 6 months, the owner must again seek advice on how to reduce the *Salmonella* prevalence in the herd. In addition, a slaughtering fee is charged to all herds assigned to level 3 for more than 6 months. The fee would be collected until the herd is reassigned to level 1 or 2. All changes in levels are approved by the Danish Veterinary Service. The slaughter companies update ZOOR about compliance regarding advisory visits.

Current status

The prevalence of seropositive meat juice samples varied between 4% and 7% from 1995 to the end of 1997. A significant decrease was observed from October 1997, to June 1998, reaching a minimum at 2.3%. Since then, the number of seropositive meat juice samples has remained below 3%. The percentage of herds designated at level 2 and level 3 have ranged from 2.4% to 4.3% and 1.1% to 2.3%, respectively. From February 1998 the number of level 2 herds has remained below 3% and the number of level 3 herds has varied between 1.2 % and 1.8%.

From June 1995 to August 1998, about 25% of the herds (3955 out of 16000) have been required to seek advice on how to reduce the *Salmonella* prevalence in the herd. In 1747 herds (44% of the total surveyed), the high prevalence of *Salmonella* lasted more than six months. In 233 herds (5,9%), the *Salmonella* has been so persistent that five to seven requirements to seek advice have been required. In order to reduce the number of herds with chronic *Salmonella* problems, teams of "second opin-

ion” advisers have been established. Severe penalties are placed on herds that do not follow the advice of these teams.

Sweden, Finland and Norway

Aims of the surveillance and organisation

Sweden, Finland, and Norway have a similar national *Salmonella* control program. The aims of those programs are to maintain a low prevalence of *Salmonella* in pigs and pig products, to provide reliable recording for the *Salmonella* status in the pig populations and to prevent increased occurrence of *Salmonella*. *Salmonella* infections in pigs have always been notifiable in these countries. The national programs were introduced in 1995.

In addition to surveillance of *Salmonella* in intestinal lymph nodes at abattoirs, the programs involve surveillance for *Salmonella* by faecal samples in nucleus, multiplying herds (Sweden and Norway) as well as in sow pool herds (Sweden). In Finland, all boars intended for semen collection centres are individually examined for *Salmonella*.

In the national programs, *Salmonella* is also controlled in cattle and poultry, and in fresh meat of cattle and swine. Moreover, great efforts are made within feed industries aiming not to introduce *Salmonella* to the animals by feed. In addition, both in Sweden and Finland there are voluntary slaughter company activities aiming at certifying herds free from *Salmonella*. However, these parts of *Salmonella* control are beyond the scope of this review.

The affiliation to the surveillance program is compulsory in each country. In Sweden and Finland, the costs of sampling and analyses are paid by the industry and the pig producers. Confirmatory analyses are paid by the Animal Health Authorities. In Norway, all costs of the program are paid by the Norwegian Animal Health Authority. Follow-up of the control program is carried out by the national veterinary

institutes in each country.

Samples from live animals are collected by the local official veterinarians. At the slaughterhouses, samples are collected by the meat inspection team under the control of an official veterinarian. The analyses are performed by the municipal food control laboratories and by the slaughterhouse laboratories. All *Salmonella* isolates are confirmed and typed by the national reference laboratories. Animal Health Authorities (provincial veterinarians and local official veterinarians) are responsible for the measures taken at *Salmonella* findings.

Sampling of faecal samples from pig herds

In Sweden, faecal samples are collected from 50 individual sows. At laboratory 10 cultivations are made, each representing a pool of 5 samples. In Finland, two pooled faecal samples are collected from 10 pens with animals aged 5 weeks to 6 months. In Norway, pooled faecal samples (representing at least 5 individuals in each pen) are collected from 3 to 20 pens with animals aged 2-6 months.

Sampling of intestinal lymph nodes at abattoirs

The total number of individuals tested in each country is calculated to be sufficient to detect *Salmonella* at a prevalence level of 0.1 % in the whole pig population with a confidence interval of 95%. The targeted annual sample size in Sweden and Finland is 6000, and in Norway 3000. In Sweden, the daily sample size is equal at all major slaughterhouses ($n = 11$). In Finland and Norway, sampling is stratified to all slaughterhouses and systematically distributed evenly over the year. The numbers of pigs to be sampled at each slaughterhouse is pre-determined by the number of pigs slaughtered during the previous year. The number of slaughterhouses comprising about 99% of pigs slaughtered is 12 and 30 in Finland and Norway, respectively. All other establishments are treated as one slaugh-

terhouse. The minimum number of samples collected annually in each slaughterhouse is 59. In each country, five lymph nodes are always pooled before the bacteriological examination.

Tests and testing procedures

The nucleus and multiplying herds are tested once a year. The sow pool herds (Sweden) are tested twice a year. The surveillance at slaughterhouses is continuous. Bacteriological examinations are performed according to the Nordic Committee on Food Analysis (NMKL) Method No. 71 (1991). In Finland, also ISO-method 6579 (1990) can be used. All positive samples are confirmed and serotyped by national reference laboratories.

Consequences of a positive test result

All *Salmonella* isolations lead to restrictions at the farm imposed by the official veterinarian, aiming to prevent transmission to other herds and to prevent contamination of food products. Individual faecal samples are taken from sows and boars and from pens with growing and finishing pigs. If *Salmonella* is demonstrated, actions are taken to eliminate the infection from the herd. In addition, an investigation aiming at finding the source of the infection or contamination is initiated. Special hygienic measures are undertaken at the abattoirs when animals from a *Salmonella* infected herd are sent to slaughter.

The restrictions of a previously *Salmonella* infected herd may be removed when individual faecal samples from all sows and boars, and pooled samples from all pens with growing and finishing pigs are tested twice with an interval of at least 30 days and no *Salmonella* is detected. In herds with fattening pigs the restrictions are released when all animals have been slaughtered and the premises have been disinfected according to the instructions of the official veterinarian.

Table 3. Summary of the national *Salmonella* control program in pig herds in Sweden, Finland and Norway during 1995-1998 (number of positive samples / total number of samples).

	1995			1996			1997			1998		
	Sweden	Finland	Norway	Sweden	Finland	Norway	Sweden	Finland	Norway	Sweden	Finland	Norway
Lymph node samples from												
sows and boars	2 / 1361 ^a	9 / 2725	-	3 ^c / 2009	8 / 2627	-	2 / 2614	4 / 3165	-	7 / 3074	3 / 3070	-
fattening pigs	1 / 1721 ^a	10 / 2792	4 / 3207 ^d	1 / 2699	5 / 2683	0 / 2818 ^d	6 ^c / 3382	6 / 3209	0 / 2905 ^d	3 / 3914	5 / 3247	0 / 3104 ^d
Faecal herd samples ^b from												
nucleus and												
multiplying ^e herds	n.a.	n.a.	1 / 175	0 / 191	0 / 197	0 / 185	1 / 137	2 / 139	0 / 147	0 / 167	0 / 114	0 / 178
sow pool herds	n.a.	-	-	0 / 23	-	-	0 / 30	-	-	0 / 35	-	-

^a Samples collected during weeks 19-52.

^b Sweden: 10 pooled samples per herd. Each cultivation represents 5 sows and is pooled at the laboratory; Finland: 2 pooled samples per herd. Each Cultivation represents a

^c pooled sample from 5 pens with growing/finishing pigs; Norway: 3-20 samples per herd. Each cultivation represents 5 Growing/finishing pigs in a pen.

^d In Finland only nucleus herds included.

^e Samples from sows included.

^f Two positive samples from a same herd.

n.a. Information not available.

Current status

Results of the continuous surveillance in 1995-1998 are shown in table 3. In **Sweden**, *Salmonella* has been detected in 0.04%-0.18% of the lymph node samples annually. In spite of confirmatory analyses, *Salmonella* was only demonstrated by faecal samples in one herd during 1996. During 1997, *Salmonella* was demonstrated in faecal samples of one multiplying herd.

In **Finland**, *Salmonella* has been detected in 0.10%-0.34% of lymph node samples annually. *Salmonella* has not been re-isolated in faecal samples of such herds. In 1997, *Salmonella* was found in faecal samples of 2 nucleus herds (*S. enteritidis* FT 8; *S. typhimurium* FT 1). In the latter herd, *Salmonella* could also be re-isolated once (*S. typhimurium* var. *Copenhagen*). Both herds became clean very soon.

In **Norway**, *Salmonella* was not detected in any lymph node samples or faecal samples during 1996-1998. In 1995, *Salmonella* was found in faecal samples of one multiplying herd (*S. agona*) and in 4 lymph node samples (0.12 %). *Salmonella* was not demonstrated by cultivation in these herds.

Iceland

In Iceland, 447 faecal samples were taken from 29 herds during 1991-1995. One herd has been found positive for *S. typhimurium* and the herd was slaughtered out.

Porcine Reproductive and Respiratory Syndrome (PRRS)**Denmark***Aim of the monitoring and organisation*

Isolation of PRRS-virus is notifiable in Denmark. Notification is a prerequisite for export of meat from non-outbreak herds to a few markets.

Serological monitoring of herd infection status is compulsory in nucleus and multiplying herds (n=360), and voluntary in production herds. The aim of the monitoring is to assist the trade of live pigs between herds of similar infection status. The secondary purposes include monitoring of national and regional levels of PRRS-virus infection. This information may be used to make decisions on national PRRS policies, regional PRRS policies by farmer groups, and to make decisions related to cost-benefit of eradication procedures at the farm level. A PRRS-database was developed in February 1996. The database is administered by the Danish Meat and Bacon Council, which also pays for administration and distribution of information. Farmers pay for sample collection and diagnostic services.

The monitoring of nucleus and multiplying herds is based on serum samples collected from the herds. Samples are analysed for antibodies at the Danish Veterinary Institute for Virus Research. Monitoring of production herds is based on serum samples or on meat juice samples collected at the slaughterhouses. The latter samples are analysed for antibodies to PRRS at the Danish Veterinary Laboratory.

Sampling

From all breeding and multiplying herds, 10 serum samples are collected monthly from randomly chosen growing and finishing pigs. From production herds, 20 serum samples are collected annually. Alternatively, 40 meat juice samples are collected systematically throughout the year. A unique herd code (Central Herd Registration code) provides basic herd information for any diagnostic investigation.

Tests and testing procedures

The serum samples from nucleus and multiplying herds are analysed monthly for presence of antibodies to PRRS by a blocking-ELISA

aimed at detecting antibodies to both European and US sub-types of PRRS virus. Meat juice samples from production herds are analysed for PRRS-antibodies by an indirect ELISA. A positive result indicate that the herd has been infected by PRRS-virus.

Consequences of a positive test result

A "PRRS suspect" herd status is assigned when the positive predictive value of meat juice test results exceeds the values corresponding to those obtained in 2 positive samples out of 10. Actions following assignment of "PRRS suspect" herd status include notification of the farmer, the herd veterinarian and trade organisations, and collection of 10 additional meat juice samples intended for clarification of PRRS herd status. If the herd is infected the farmer must not sell pigs to PRRS herds.

Certification

The PRRS database does not certify the infection status of the herds in legal terms. The farmer himself is responsible for providing information of the true infection status of his herd in relation to his customers. The SPF company certify the PRRS status of the herds, and if required it demands herds to participate in the PRRS database.

Record keeping

The Central Herd Register in the Ministry of Food, Agriculture and Fisheries provide basic herd information for the PRRS database. By his signature, the individual farmer represents his herd in the database. He authorises that diagnostic results from the laboratories are forwarded to the database, and that trade companies, the herd veterinarian and the swine specialists gain access to the PRRS herd infection status. The diagnostic results are kept for indefinitely unless the farmer requests removal of his herd from the database.

Current status

The estimated PRRS prevalence was 25% in nucleus and multiplying herds, 45% in farrowing and farrow-to-finish herds and 50% in finishing herds in May 1999. During 1996-1998 the estimated annual PRRS incidence was 7.5% in nucleus and multiplying herds and 8-10% in production herds, respectively.

Sweden, Finland and Norway

Aims of the surveillance programs, target population and organisation

PRRS is a notifiable disease in Sweden, Finland, and Norway, and has never been reported in any of these countries. Each country has a surveillance program aiming to document freedom from PRRS in the nucleus and multiplying herds. In Sweden and Norway, surveillance is made also in the rest of the pig population.

In **Sweden**, PRRS has been screened since 1993, and since 1998 PRRS is included in the control program of the Swedish Animal Health Service. The target population in this program includes all nucleus and multiplying herds, all boars entering the semen collection centres, pig herds in Southern Sweden, as well as sows sent to slaughter. Blood samples are collected at the herds and affiliation to the program is compulsory for the breeding and multiplying herds. At slaughterhouses, blood samples are collected by the meat inspection team under the control of an official veterinarian. All samples are analysed at the National Veterinary Institute in Uppsala for antibodies to PRRS.

In **Finland**, PRRS was screened in the entire pig population in 1996. PRRS surveillance was included in the National Health Control Program for breeding herds in 1997. In addition, all boars entering the semen collection centres are tested. Both programs are administered by the Animal Health Authority. At slaughterhouses, blood samples are collected by the meat inspec-

tion team under the control of the official veterinarian. Samples for antibodies are analysed at the National Veterinary and Food Research Institute in Helsinki. The boar samples are analysed for presence of antibodies to PRRS at the Danish Veterinary Institute for Virus Research, Lindholm, Denmark.

In **Norway**, a surveillance program for PRRS started in 1995 and all pig herds comprise the target population of the program. In addition, all boars entering the semen collection centres are tested. The program is administered by the Animal Health Authority. In pig herds, blood samples are collected by the local official veterinarians. Samples are analysed for antibodies to PRRS at the Danish Veterinary Institute for Virus Research, Lindholm, Denmark.

In each country, the surveillance is paid by the national Animal Health Authority, who is also responsible for the measures in case of interventions.

Sampling

In Swedish nucleus and multiplying herds 20 pigs are tested 1-2 times annually. The samples are collected from animals aged 5-12 months dispersed among different sections of the herd. In the Southern part of Sweden (considered to be a high risk area), 20 pigs are tested annually in 50 randomly selected production herds. In addition, 1000 randomly selected slaughtered sows from the rest of the pig herds in the country are tested annually. The total sample size varies between 5000 and 6000 samples annually.

In Finland, an annual sample size of 1300-2600 is collected throughout the year from pigs that are slaughtered from progeny testing stations (no. of stations 6, total no. of test pigs 4200 in 1998). All nucleus herds send test pigs to the stations. During 1998, 1903 samples were collected from testing stations, and 690 samples from breeding boars.

In Norway, the total group of farms from which the random selection is made consists of all pig herds receiving state support (including 82 wild boar farms). Some of the largest pig herds do not receive state support, but are still included in the program.

All nucleus and multiplying herds are investigated annually, while a random sample of 290 herds is taken from the rest of the pig herds, weighted to give the highest proportion in farrowing and farrow-to-finish herds. A higher proportion of farms is selected from counties considered to be high risk areas (south-eastern and south-western part of Norway). In farrowing or farrow-to-finish herds, 10 blood samples are collected from sows, whereas 10 finishing pigs are sampled in fattening herds. In wild boar farms, 5 samples are collected from sows. The number of herds to be tested annually varies between 470 and 510, and the total sample size is 4700-5000.

Tests and testing procedures

Samples other than boar samples are analysed for antibodies to PRRS-virus with a blocking-ELISA differing between the European and the US subtypes of the virus (IDEXX® Laboratories, Maine, USA). Boars are tested for PRRS-antibodies with an immunoperoxidase monolayer assay (IPMA).

Consequences of a positive test result

If positive reactions are detected, the herd will immediately be closed and new blood samples from at least 20 pigs of different ages will be analyzed. In case of clinical symptoms, pigs will be euthanised and sent for necropsy. A confirmed infection with the virus will initiate an attempt to eradicate the infection by "stamping out". A restriction area with a minimum of 3 km radius will be determined around the infected herd. A comprehensive epizootiologic investigation will be performed to detect the

source of the infection and the possible spread of the infection from the positive herd to neighbouring and other contact herds.

Current status

Antibodies to PRRS-virus have not been detected in any of the samples collected in Sweden, Finland, and Norway. These results, together with absence of clinical cases, support the evidence of freedom from PRRS in these countries.

Iceland

PRRS is a notifiable disease in Iceland. No clinical cases have been reported and no antibodies to PRRS-virus have been detected.

Swine Enzootic Pneumonia (SEP)

Denmark

Swine enzootic pneumonia, caused by *Mycoplasma hyopneumoniae* (*M. hyopneumoniae*), is widely prevalent in Danish swine herds. It is believed that the organism is present in all herds that are not explicitly monitored for the absence of *M. hyopneumoniae* (SPF herds). The SPF-system is an optional program that declares presence or absence of 5-6 diseases in herds. Approximately 3000 herds participate (about 25% of total production), and approximately 1000 of these herds are free from *M. hyopneumoniae*. Herd health status is controlled by veterinarians 4-12 times per year and by blood sampling (yearly sampling in production herds, monthly sampling in nucleus and multiplying herds). Conventional nucleus and multiplying herds are not required to be free from *M. hyopneumoniae*, but the trade of live pigs is assisted between herds of similar infection status. Vaccination against *M. hyopneumoniae* is common in production herds.

Sweden

The SPF herds of the country (about 1% of the

production) are controlled with respect to *M. hyopneumoniae*, and declared free from that organism. No specific monitoring program does occur within the conventional herds. Since most of the nucleus herds are known to be infected with *M. hyopneumoniae*, the organism should be regarded to be present in the production herds. The negative effects of *M. hyopneumoniae* are reduced by introducing age segregated rearing systems from birth to slaughter. During 1997, 40% of the pigs reared to market weight were raised within such systems. In addition, the efficacy of vaccinations against *M. hyopneumoniae*, and definition of optimal time points for such vaccinations, are presently evaluated.

Finland and Norway

Aim of the surveillance

Both Finland and Norway have a national surveillance program for nucleus herds, and freedom of *M. hyopneumoniae* is a presumption for those herds to sell breeding animals. The aim of the surveillance is to keep all nucleus herds free from *M. hyopneumoniae*. In Norway, also multiplying herds are included in the program. In addition, in both countries there are extensive voluntary slaughter company activities aiming at certifying conventional herds free from the infection. This trend may end up to a situation where, based on national decisions, it is possible to eradicate *M. hyopneumoniae* from the entire pig population. The serological surveillance in nucleus herds started in 1992 and 1993 in Finland and Norway, respectively, and in conventional herds in 1994 and 1997, respectively.

Organisation

Finland

The *M. hyopneumoniae* surveillance in nucleus herds is part of the National Health Control Program for such herds. The program is admin-

istered by the Animal Health Authority and it is compulsory for all nucleus herds. When joining the program, the herds have to pay for the analyses. Thereafter, analyses are paid by the Animal Health Authority. Colostrum samples are collected and sent to the analysis by the herd owners. All samples are analysed at the National Veterinary and Food Research Institute, Regional Laboratory in Seinäjoki. If antibodies are detected, provincial veterinarians and local official veterinarians are responsible for measures taken.

The surveillance of conventional herds is based on decisions of individual slaughter companies. Every slaughterhouse company administers its own health control program without any formal coordination between the different programs. Basically, the programs are based on similar control strategies as the program for nucleus herds. Most slaughterhouse companies pay the costs of the analyses, when herds are joining their health control programs.

Norway

The *M. hyopneumoniae* surveillance program for nucleus and multiplying herds is based on decisions made by the Norwegian Pig Breeding Association and The Norwegian Pig Health Service. The program is compulsory, and the costs of the program are paid by a special fund based on a tax that all farmers have to pay per kg pork delivered to the slaughterhouse. The surveillance program for conventional herds is based on decisions made by the slaughterhouse organisations, and the costs of the program are paid by the farmers and in some areas by the slaughterhouse companies.

Both surveillance programs are administered by the Norwegian Pig Health Service. Colostrum samples are collected by the farmers. Blood samples are collected at the abattoirs. Both colostrum and blood samples are analysed at the National Veterinary Institute,

Oslo. If antibodies are detected the Norwegian Pig Health Service is responsible for measures taken.

Sampling

Finland

A condition of joining with the program for nucleus herds is that colostrum samples from up to 50 sows are analysed for antibodies to *M. hyopneumoniae*. Thereafter, 15-25 colostrum samples are analysed biannually. A condition of joining with the programs for conventional herds is that colostrum samples from up to 30 sows are analysed. In most cases, no further sampling takes place unless clinical symptoms indicate *M. hyopneumoniae* infection.

Norway

The nucleus and multiplying herds were originally screened for *M. hyopneumoniae* antibodies by analyzing 60 and 40 blood samples from sows or slaughtered pigs, respectively. Biannually, 10 colostrum or blood samples from sows are collected and analysed. Conventional herds may be certified free from *M. hyopneumoniae* when a minimum of 20 colostrum samples or 20 blood samples from slaughtered finishing pigs are analysed and no antibodies to *M. hyopneumoniae* are detected. Thereafter, 10 colostrum or blood samples are analysed once a year.

Consequences of a positive result

Both serum and colostrum samples are analyzed for the presence of antibodies to *M. hyopneumoniae* by a monoclonal blocking ELISA (*Mycoplasma hyopneumoniae* ELISA[®], DAKO A/S, Glostrup, Denmark). If a nucleus or multiplying herd tests positive, confirmatory tests will take place. If the infection is confirmed, the herd can not sell breeding animals any more. An eradication program will take place after the acute phase of the infection. In Finland, such a

program is supported economically by the Animal Health Authority. If a conventional herd loses its *M. hyopneumoniae* free status, negative economical consequences will take place. The price of pigs delivered for fattening is reduced by 7-10% and 4% in Finland and Norway, respectively.

Certification

Both in Finland and Norway, all nucleus herds (and multiplying herds in Norway) are certified free from *M. hyopneumoniae*, if the requirements of the surveillance programs are met, clinical symptoms indicating SEP are not detected during the quarterly veterinary visits and the prevalence of pneumonia recorded at meat inspection remains low.

Regulated control of disease spread

In Finland, the nucleus herds are allowed to buy breeding animals from other similar certified herds. At such occasions, great attention has to be paid on common practices for the prevention of possible disease spread. In Norway, the nucleus herds have been totally closed for several years. Multiplying herds are allowed to buy purebred sows from only one single certified nucleus herd.

Current status

Finland

In 1995, all nucleus herds were screened and 4 herds were concluded to be infected. Since then, one herd has been reinfected annually. The surveillance in the nucleus herds during 1996 to 1998 is shown in table 4. During 1991, the prevalence of sow herds with antibodies to *M. hyopneumoniae* was 30% and 8% in Western and in Southwestern Finland, respectively. Since then the number of colostrum and blood samples collected from conventional farrowing herds has been steadily increasing. Today, at least one half of the total of 2 300 conventional

Table 4. Summary of the *Mycoplasma hyopneumoniae* surveillance in Finnish nucleus pig herds (n=150) during 1996-1998 (number of samples with antibodies in blocking-ELISA / total number of samples).

	1996	1997	1998
Colostrum samples	49 ^a / 4958	22 ^b / 5427	15 ^d / 3808
Confirmatory blood samples	0 / 119	18 ^c / 298	17 ^e / 345

^a 44 positive samples from 1 herd; other positive samples single positives in a herd

^b 7 positive samples from 1 herd; other positive samples single positives in a herd

^c all positive samples from 1 herd

^d 8 positive samples from 1 herd; other positive samples single positives in a herd

^e all positive samples from 1 herd

farrowing herds are certified by the slaughterhouse companies as *M. hyopneumoniae* free herds.

Norway

All nucleus and multiplying herds were screened during 1994-1996 (table 5.) Eleven of the total of 189 herds were concluded to be infected. Since then, 2 nucleus and 3 multiplying herds have been reinfected. Two of the multiplying herds were infected by breeding sows bought from one of the infected nucleus herds. Preliminary studies in about 700 conventional herds indicate that the prevalence of farrowing and farrow-to-finish herds infected with *M. hyopneumoniae* varies between 5 and 40% in different counties of Norway.

Iceland

SEP is present in the majority of Icelandic pig herds.

Progressive Atrophic Rhinitis (PAR)

In Denmark, toxin producing strains of *Pasteurella multocida*, the causative agent of progressive atrophic rhinitis, are monitored twice

Table 5. Summary of the screening of Norwegian nucleus and multiplying pig herds for Antibodies in blocking ELISA to *Mycoplasma hyopneumoniae* in blood samples during 1994-1996.

	Total no. of samples	No. of samples with antibodies (%)	No. of herds with a confirmed infection (%)
Elite breeding herds (n=110)	7101	177 (2.5)	5 (4.5)
Multiplying herds (n=79)	3078	156 (5.1)	6 (7.6)

every winter season in nucleus and multiplying herds. These herds are defined free of the disease. One herd test is based on collection of 20 nasal swab samples pooled 2 and 2 in 10 veils. Samples are analysed for *P. multocida* toxin (*Pasteurella multocida* toxin ELISA[®], DAKO A/S, Glostrup, Denmark).

In **Sweden**, toxin producing strains of *P. multocida* were eradicated from the nucleus herds during 1993-94. The nucleus and multiplying herds are defined free from infections with toxin producing strains of *P. multocida* since 1995, which also is proven by annual control. Between 5000 and 8000 nasal swab samples are analysed annually for *P. multocida* toxin by ELISA.

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