

# A successful national control programme for enzootic respiratory diseases in pigs in Switzerland

This article is dedicated to Hermann Keller, Professor Emeritus of Swine Medicine, of the Faculty of Veterinary Medicine, University of Zurich, on his 70th birthday

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## Summary

Before the start of systematic disease control, respiratory diseases in swine in Switzerland caused estimated losses of several million euros per year. In 1993, a national programme to control enzootic respiratory diseases in pigs was proposed, with the aim of reducing the incidence of clinical cases to less than 1%. Enzootic pneumonia (EP) caused by *Mycoplasma hyopneumoniae* and clinical cases of pleuropneumonia caused by any serotype of *Actinobacillus pleuropneumoniae* (APP) would be targeted, in addition to any cases with serological evidence of APP serotype 2.

This control programme was initiated in 1996, region by region, and fully implemented by 2004. Clinical, epidemiological and laboratory test results were used to identify the appropriate disease control measures. Partial depopulation was used to control EP on breeding and breeding-finishing farms. Total depopulation was implemented on all farms affected with APP and finishing farms affected with EP. Animal trade was strictly regulated during the programme and all suspected cases of respiratory disease in pigs were made notifiable.

Continued monitoring is based on clinical suspicion of infection and/or the detection of gross pathological lesions at slaughter, followed by laboratory confirmation. In 2005, the incidence of clinical cases was less than 1%. Regulations have been introduced to control the international trade in live pigs and prevent the re-introduction of respiratory diseases into Switzerland.

## Keywords

*Actinobacillus pleuropneumoniae* – Control programme – Depopulation – Enzootic pneumonia – *Mycoplasma hyopneumoniae* – Partial depopulation – Pig – Pleuropneumonia – Regional control – Stamping out – Swine – Switzerland.

## Introduction

Pig farming throughout the world is experiencing economic losses caused by endemic respiratory diseases. In Switzerland, the most significant respiratory diseases of swine are:

- enzootic pneumonia (EP), caused by *Mycoplasma hyopneumoniae*
- pleuropneumonia, caused by *Actinobacillus pleuropneumoniae* (APP) (10, 24).

In 1992, lesions consistent with EP were detected in 64% of swine herds at slaughter. Enzootic pneumonia and APP

are transmitted by direct animal contact and aerosol (15, 26), although the latter is probably of very limited practical significance for APP.

Economic losses are due to:

- reduced growth efficiency
- increased mortality
- secondary infections
- the costs of treating sick animals.

On farms affected by EP and/or APP, clinically ill animals can be treated using effective antimicrobials, such as the macrolid family of antibiotics or tetracyclin. However, this approach is not economically sustainable. Furthermore, the use of antimicrobials in livestock production is under increasing scrutiny from the public. A prophylactic approach is therefore preferable. Effective vaccines are available for EP (13) and APP (30). The disadvantage of vaccination is, however, that the infectious agent cannot be eliminated.

Alternatively, it has been shown that the causative agents of EP and APP can be eliminated from farms using full and, for EP, partial depopulation (33, 37). Partial depopulation is less expensive and its effectiveness for EP under field conditions has been shown to be comparable with that of total depopulation (38).

In Switzerland, losses due to endemic EP alone were estimated to be several million euros per year (14). In 1993, the Conference of Cantonal Veterinarians decided to launch an initially limited control programme for epizootic respiratory diseases in pigs. This regional pilot programme began in 1996 and included 730 farms. By 2004, the programme had become nationwide. In this article, the authors describe the implementation of the control programme and the current status of the Swiss pig population.

## Situation before regional control

Since 1965, the Swiss Pig Health Service (SPHS) has conducted a disease control programme which included measures against EP and APP (14). The SPHS is a private organisation, receiving financial support from the government, which offers voluntary disease control and prevention programmes to pig producers. The number of farms participating in the SPHS scheme has gradually increased over the years. In 1994, a premium was introduced for high-health feeder piglets sold by SPHS farmers. In 1995, a total of 3,113 farms were included in

the SPHS (16). These farms accounted for 85% of the breeding and multiplying farms in Switzerland and contained 89% of all sows. The total number of pig farms in Switzerland was 14,813 (Agrarpolitisches Informationssystem Database, as of 31 May 2002).

All farms participating in the SPHS programme were monitored for respiratory diseases, including EP and APP. The following approaches were applied:

- regular herd visits and clinical examination of livestock (twice per year)
- strategic mixing of feeder pigs from different sources, followed by clinical examination
- monitoring of gross pathological signs at slaughter.

Nucleus herds were monitored annually, using serological testing, until 2000. Partial depopulation was routinely used to eliminate EP from infected farms. In addition, SPHS farms were subject to increased biosafety measures and trade restrictions.

Despite such measures, SPHS farms were frequently reinfected with EP and, to a lesser extent, APP. This demonstrated the limited efficacy of applying control measures to individual farms. The annual incidence of EP in SPHS farms was 2% to 4% (16), with regional differences and local maximum incidences of up to 12% (18). Stärk *et al.* (25) showed that the health status of neighbouring farms and their geographical distance from the farm under observation was a significant risk factor for EP infection, confirming similar observations in other countries (8, 28). This evidence suggested significant aerosol transmission of EP, indicating that an integrated approach across an entire region was necessary to control the disease. The virtual simulation of an EP control programme targeted at a pilot region demonstrated that such an approach was practical under Swiss conditions (16).

Thus, the control programme was initiated in 1996, region by region, with five percent of pig farms included in the first year of operation. By 2000, 55% of farms had been included and more than 75% by 2001. The programme was fully implemented by 2004, when all remaining control-free areas were integrated into the scheme.

## Regional control programme: methods

### Organisation and legal basis

The control programme was led by the Swiss Veterinary Services. A taskforce was created, early in the process, comprising:

- the Veterinary Services
- veterinary specialists
- pig producers
- laboratories licensed by the Veterinary Services for EP and APP diagnosis.

This taskforce addressed practical problems which emerged during the implementation of the programme and proposed solutions, which were then approved by the Conference of Cantonal Veterinarians and the Federal Veterinary Office. Most cantons delegated part or all of the field work, including farm visits, sampling and co-ordination, to the SPHS. Sampling and diagnostic costs were covered by the Veterinary Services. Losses due to reductions or halts in production, as a consequence of partial or total depopulation, were covered by the producers. If new outbreaks of EP or APP occurred after the end of the programme, producers were compensated for animals which had to be culled by the Veterinary Services.

The legal basis for this regional control programme was provided by the Federal Ordinance of Epizootics (27), which was amended in 1995 to include articles specifying case definitions, methods of diagnosis and control measures for infected farms. The diseases EP and APP were classified as 'diseases to be controlled' throughout the entire area of Switzerland. The Federal Ordinance allowed cantonal Veterinary Services to take measures against infected farms. After May 2003, all suspected cases of epizootic respiratory disease were notifiable to the Veterinary Services. The objective of this nationwide programme was to control EP and APP by the end of 2004. Vaccination was not allowed at any time during the programme.

## Case definitions

Epizootic respiratory diseases in swine in Switzerland include cases of EP caused by *M. hyopneumoniae* and pleuropneumonia caused by APP.

As a result of mass screening, the case definition used during the control programme was different from the definition used after the programme was fully completed. During the mass screening, a case of APP was defined as: a farm that was not a member of the SPHS and returned a positive serological result for the presence of antibodies against APP serotype 2. For EP, a case was defined as: a farm that was not a member of the SPHS and did not have previous tests confirming the absence of EP.

After the programme was completed, the case definition for APP was limited to: clinical cases caused by any serotype and serological evidence of serotype 2. The case definition was intentionally limited to these cases because several serotypes of APP are known to be circulating in Switzerland without causing any clinical signs or economic losses (Federal Veterinary Office, Berne, unpublished findings). The case definitions used after completion of the programme are listed in Table I. For EP, a so-called 'mosaic diagnosis' was developed. This means that the case definition was based on the results of a series of investigative approaches, including clinical, laboratory and epidemiological findings.

## Diagnostic tests

In regard to APP, serological screening was conducted for serotype 2 only (CHEKIT® APP-2-Test, Dr Bommeli, AG, Berne). Twenty to 30 samples were collected from each farm. A farm was classified as 'APP-suspect' if at least three animals tested positive by serology for the presence of antibodies against the serotype. Such farms were then re-examined or 'followed up', using bacteriological investigation of lung or tonsil samples. If more than six animals returned a positive serological result, the farm was classified as APP-positive without any additional testing. No mass screening was conducted for EP (see below).

All diagnostic tests were conducted in laboratories licensed for EP and/or APP diagnosis by the Veterinary Services. A total of nine laboratories were involved. Suspected samples were confirmed by the National Reference Laboratory.

**Table I**

**Legal definitions of suspected and confirmed cases of epizootic respiratory swine diseases in Switzerland (27)**

Type of case	Enzootic pneumonia	Pleuropneumonia caused by <i>Actinobacillus pleuropneumoniae</i>
Suspected case	Clinical signs and/or detection of typical gross lesions at slaughter and/or positive serological results and/or suspect histological results and/or epidemiological suspicion	Clinical suspicion and/or detection of typical gross lesions at slaughter and/or serological results that are not clearly interpretable and/or epidemiological suspicion
Confirmed case	[Positive histological result and agent detection] or [Indicative histological result or indicative agent and positive clinical, epidemiological or serological results]	Isolation of causative agent in combination with clinical signs or positive serological or bacteriological results in nucleus herd

## Regions

Two pilot areas in the cantons of Berne and Aargau were initially targeted by the programme in 1996 (Fig. 1). The objective was to develop the most effective sequence of activities and interventions in the field (36). Switzerland was divided into regions for EP and APP control. The control programme was implemented throughout a chosen region in the same year. When selecting regions, pig density, human and laboratory resources and epidemiological factors, such as the risk of aerosol transmission along the border of an area, were considered. In addition, the topography of hills and valleys and types of vegetation (e.g. forests) were also taken into account.

## Control methods

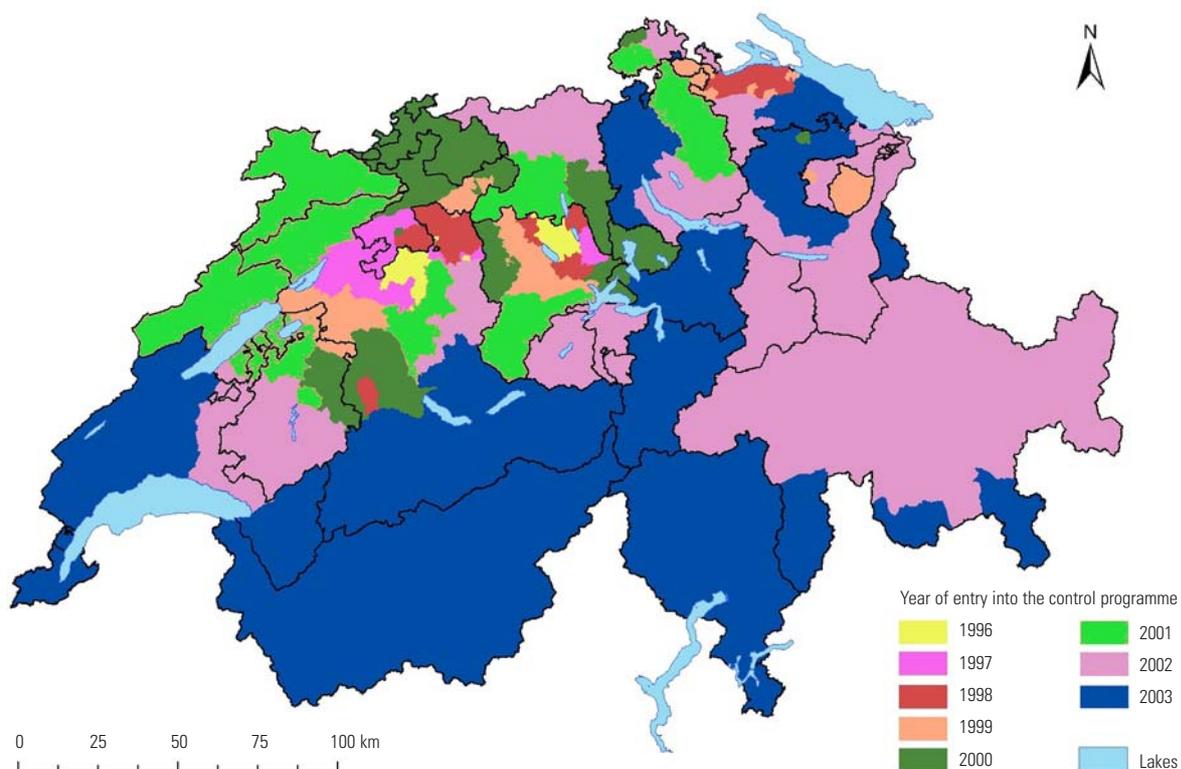
The procedures applied in a controlled region are described below.

The Veterinary Services informed all pig farmers and veterinarians in the area and the control procedures were explained at regional meetings. Farms that were members of the SPHS and showed no signs of infection during routine monitoring were classified as being free from EP and APP and did not have to apply additional measures.

All other farms were visited and inspected for clinical signs of respiratory disease (i.e. coughing). Samples were collected for serological screening against AP. Farms were classified as APP-infected, based on the results of the serological test and – when required – additional bacteriological investigation (see above). Total depopulation (or a ‘stamping-out’ policy) was applied to all farms classified as being infected with APP. After depopulation, an interval of two weeks was applied before restocking. All rooms were cleaned and disinfected.

In the case of EP, farms which were not members of the SPHS were assumed to be EP-infected, unless they could provide evidence that proved otherwise. No screening test was applied. Partial depopulation was used on breeding and breeding-finishing farms, i.e. no animals aged less than ten months were allowed on the premises for a minimum period of two weeks. During this time, the empty styes were cleaned and disinfected and all gilts and sows were treated against EP, using predominantly oxytetracyclin, chlortetracyclin or tylosin. Total depopulation was used on all finishing farms.

All activities in the controlled region were synchronised. The two-week period in which only adult animals were present on partially depopulated farms was calculated to



**Fig. 1**  
Regions of Switzerland and the year in which they were included in the control programme for epizootic respiratory diseases in pigs

coincide on all farms in the area. This two-week phase was scheduled to occur in the second half of August in each control cycle. The entire control cycle lasted for one year, from when farmers were first informed that their region had been enrolled in the programme until completion of the partial depopulation process in that region.

Trade in animals was strictly regulated during the control programme. Pigs were given special eartags in the initial phase to identify their farm of origin in the controlled region. Each shipment of pigs was accompanied by a specific form documenting their health status. All transport companies and dealers transporting live pigs were subject to a specific code of practice on hygiene precautions and time intervals to be applied between batches of pigs with a different health status.

### Surveillance

After control measures were implemented in a designated area, any new suspected cases that arose had to be notified to the Veterinary Services. Case detection was based on:

- clinical monitoring by veterinarians and farmers
- monitoring of gross pathological lesions at slaughter by meat inspectors
- serological monitoring as applied by the SPHS on nucleus breeding farms.

On suspect farms, clinical, epidemiological and laboratory investigations were conducted to confirm the presence of disease. If the test results were positive, the farm had to re-apply partial or total depopulation, depending on whether the disease agent was EP or APP, respectively. In cases where neighbouring farms were at risk of aerosol transmission, infected finishing pigs were instantly removed to decrease infection pressure. These pigs were taken to isolated units until they reached slaughter weight. Suitable farms were identified for this purpose throughout the country and were centrally managed.

## Regional control programme: results

### Incidence of cases

Between 1996 and 2004, all pig farms were gradually included in the control programme (Table II). Progress was measured by examining the incidence of cases, as defined in Table I.

In the first pilot region, the incidence of infection after one year was 3.1% (18). By 1999, the incidence of outbreaks in

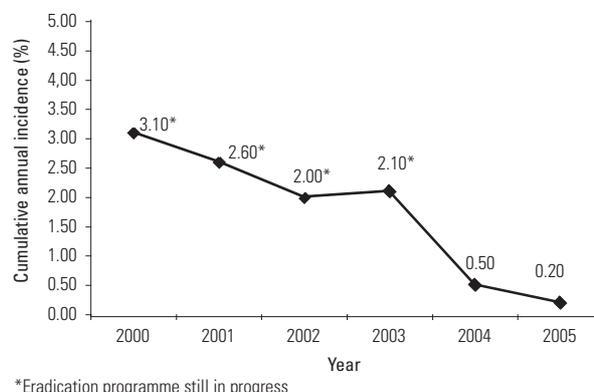
**Table II**  
Annual progress of a national control programme for epizootic respiratory diseases on pig farms in Switzerland

Year	Number of farms in the programme	Cumulative % of total number of farms
1996	730	4.9%
1997	1,013	11.8%
1998	1,095	19.2%
1999	2,267	34.5%
2000	2,919	54.2%
2001	3,213	75.8%
2002	2,911	95.5%
2003/2004	All remaining farms	100.0%
<b>Total</b>	<b>14,813</b>	<b>100.0%</b>

the controlled areas was 2.6% and 0.1% for EP and APP, respectively (11). The annual cumulative incidence of EP cases by farm type and in relation to the increasing population at risk was analysed in 2003 (35). A consistently decreasing trend in the annual incidence of EP was observed (Fig. 2).

Analysing the incidence of infection by year after depopulation by annual cohorts demonstrated two trends (35). The risk of infection decreased for each year after control measures had been undertaken in a region. For example, in the cohort processed during 1999, the incidence decreased from 3.3% in the first year after controls were implemented to 1.7% in the fourth year. This means that the risk of re-infection was highest in a region shortly after this region had entered the programme.

The risk also decreased for later cohorts entering the programme. For example, the infection risk in the fourth



**Fig. 2**  
Cumulative annual incidence of cases of enzootic pneumonia during and after regional control in Switzerland

year after controls were implemented decreased from 3.3% for the cohort of 1996 to 1.7% for the cohort of 1999. In 2004, a total of 56 cases of EP were reported (an incidence of 0.5%) and in 2005, 22 cases were identified (an incidence of 0.2%). The incidence of APP cases was very low throughout the control phase and remained low thereafter: ten cases in 2004 and five in 2005.

### Risk factor analysis

An analysis of the seasonal distribution of EP outbreaks was conducted. Earlier described peak frequencies in cool and humid months (25) were no longer observed. This may be related to changes in husbandry systems in Switzerland over the last few years, resulting in better ventilation. It may also reflect a decreasing significance of aerosol transmission, again as a result of the decrease in infection pressure.

The significance of known risk factors, such as farm size, pig density and farm type, was confirmed during the control programme (11, 35). In addition, farms that were part of multi-site production systems had a higher risk of infection (35). These farms had separate, sometimes multiple, sites for dry sows, for weaning and for feeder and finishing pigs. These sites were sometimes at a considerable distance from one another, of up to several kilometres. The farms did not practise segregated early weaning. Enzootic pneumonia outbreaks in such farm systems always included multiple farms, which were sometimes located in different cantons. Managing these outbreaks was difficult because of the large number of animals involved. The increased risk on these farms was most likely due to the high number of animal movements and the related risk of disease introduction, despite the regulations and precautions governing animal trade.

The most influential risk factor for introducing disease, once control measures had been introduced, was animal trade. In the first pilot area, the majority of outbreaks (53%) were caused by the purchase of subclinically infected animals from outside the controlled region (18). A similar result was found in a case-control study conducted during the control programme, in which 69% of outbreaks were caused by animal movements (11). In the same study, an increased risk of infection was found to be associated with the following factors:

- the type of farm (i.e. the risk was higher in finishing farms)
- the number of farms from which animals had been purchased
- the proximity of the parking sites of the animal transporters (11).

These risk factors also indicate the importance of the frequency of animal movements and the way in which trade is conducted.

### Quality of diagnostic tests

A recurring issue during the programme was the quality of diagnosis, both for EP and APP. For the APP enzyme-linked immunosorbent assay (ELISA) for serotype 2 (CHEKIT® APP-2-Test, Dr Bommeli, AG, Berne), the cut-off point at which a herd was classified positive was selected to maximise both sensitivity and specificity. On the assumption that 40% of animals in an infected herd would be sero-positive, and assuming conservative values for single-test performances of 0.5 for the sensitivity of the test and 0.8 for the specificity, a cut-off point of six animals resulted in a herd-level sensitivity of 0.83 and a specificity of 0.9. In addition, herds with more than two positive serological results were treated as suspect, to further improve sensitivity. Thus, the probability of both false-positive and false-negative results was minimised, using the test available at the time.

In 2003, the various tools used to diagnose EP were re-evaluated (24). The tests considered were:

- observation of gross macroscopic lesions
- histopathology
- immunofluorescence.

It was shown that, in the light of epidemiological evidence in the field, both gross pathology and histopathology had a low specificity (51%) but a high sensitivity (77% to 89%). Immunofluorescence, on the other hand, had a reasonable specificity of 74% but a sensitivity of only 62%. Based on these findings, it was confirmed that a serial combination of diagnostic tests was justified and it was recommended that more than one animal per farm be tested.

Despite such epidemiological challenges, the progress of the control programmes was smooth and steady and the response of the producers generally positive. However, there were some individual cases – mainly APP-infected farms requiring total depopulation – where there was resistance from the farmers. In a few cases, where the conflict could not be resolved and the farm was a closed farm in a geographically isolated location, the farm was put under movement restrictions and disease control measures were postponed for up to several months. Insurance companies offered private insurance to all farms to cover losses caused by infection after the control programme had been completed.

## Discussion

In North America and many countries in Europe, programmes to create pig herds which were free of EP and APP were begun decades ago (e.g. 1, 22, 29) and are now well established. However, regional control measures were first implemented in Switzerland and Scandinavia. Published reports on regional eradication programmes are available for Finland (12, 21) and Norway (17). In one region of Finland, 388 herds, in total, were serologically screened for EP (21). Twenty-two herds were found to be infected and subject to partial depopulation. A follow-up screening of slaughtered pigs demonstrated that three herds were infected with *M. hyopneumoniae*, two of which were finishing herds with a continuous flow system. In Switzerland, all the pig farms throughout the country were included in the programme, > 14,000 farms in total. The incidences of EP and APP were reduced to < 1%. The objective of the Swiss programme was to obtain farms that were free from clinical disease but not necessarily free from the disease agents.

For EP, partial depopulation was used. This procedure has been shown to be effective (37). However, prolonged shedding of *M. hyopneumoniae* may result in residual, undetected infection (7). Heinonen *et al.* (12) assessed the efficacy of different variants of partial depopulation in an EP eradication programme in Finland. They showed that, in small herds, partial eradication may be achieved, even when animals aged less than nine months are kept on the same farm. The possibility of some residual subclinical infection cannot, however, be completely excluded. In future, the health status of pig herds in Switzerland will be confirmed using improved diagnostic tools, such as polymerase chain reaction (PCR) (see below).

Reliable diagnosis is the basis for every successful disease control programme. False-positive cases must be avoided to prevent unnecessary disruptions in production, while false-negative results are problematic because they help to perpetuate infections. Therefore, laboratory tests must be both sensitive and specific. In the case of EP, diagnosis cannot be achieved using a single diagnostic approach. Instead a 'mosaic diagnosis', which combines several tests, is required. This combined approach is necessary because it is not possible to maximise sensitivity and specificity within one test. Thus, a serial combination of a sensitive and a specific test can improve the overall diagnostic performance. A further factor to be considered is the apparent variability of virulence between *M. hyopneumoniae* field strains (32). Particularly difficult to diagnose are chronic cases, where only a few pigs are mildly affected. Some farms with residual infection may remain infected if diagnostic tools to identify such premises are not improved (18).

A promising advance in diagnosing EP is the PCR assay (3, 4, 31). A real-time PCR assay with two different target sites was evaluated as the new 'gold standard' (best possible) test for EP diagnosis in Switzerland. This test was used to examine bronchial swabs from lungs, as part of the national surveillance programme (6). At the herd level, this real-time PCR was able to detect 100% of clinically affected farms, achieving a within-herd prevalence of > 90% of lungs testing positive for the disease. In clinically doubtful cases, the PCR test achieved very good results, with 100% specificity and a sensitivity of 85%. Furthermore, the PCR test can be applied to live animals, using nose swab material, thus allowing acute infection to be detected in coughing animals and carrier animals (34). As a consequence, since 2005, histopathology and immunofluorescence are no longer used in EP diagnosis in Switzerland. Instead, the PCR test is routinely applied on suspected farms, using nose swabs from coughing swine. However, the introduction of a test with higher sensitivity, such as PCR, makes it more likely that currently unnoticed subclinical infections will be identified in the future. This may lead to a temporary increase in the reported incidence of EP cases.

Enzyme-linked immunosorbent assay was used for serological screening as part of the Swiss APP control programme. However, commercial kits are only available for a few serotypes. In Switzerland, serology was used only to detect serotype 2, since this serotype was known to have clinical relevance. However, serotypes 3, 7 and/or 12 have also since been found. Serological results were found to be non-specific, due to cross-reactions between *Actinobacillus* spp. serotypes, and therefore difficult to interpret. Non-specific results may also have been caused by a new, non-pathogenic *Actinobacillus* species: *A. porcitosillarum* (9). A herd classification scheme was developed, based on a field validation study, to optimise specificity at the herd level. A herd-level cut-off point of two positive results was introduced to identify suspect farms. Confirmation of this diagnosis required the isolation of the disease agent, unless more than six animals tested positive for the presence of APP, by serology. Repeated sampling was sometimes required to reach the final diagnosis.

The situation is further complicated by the fact that different serotypes of APP circulate in Switzerland. Until now, serological tests were not able to identify and differentiate all the serotypes. However, recently a new generation of ELISA tests became available, based on the detection of antibodies directed at the exotoxins produced by APP (so-called Apx exotoxins) (19). Specifically, ApxIV is produced by all 15 serotypes and is specific for APP infection (23). An indirect ELISA was developed and tested with field isolates in Switzerland (5). The validation of the test revealed a specificity at the individual animal level of 100% and a sensitivity of 93.8%. During field validation, it was demonstrated that up to 80% of multiplier herds and

up to 40% of nucleus herds return positive results when using this test (20). These results confirm that the approach used in the control programme did not target the elimination of all APP serotypes, but only those that cause clinical disease.

Regional control of respiratory diseases is a major logistical challenge. When using an area-by-area approach, it is necessary to minimise the risk of disease introduction from those areas where disease controls have not yet been implemented. Zellweger *et al.* showed that the risk of infection in a controlled area decreased continuously each year after controls were implemented and also across cohorts of controlled farms in different years (35). This is thought to be due to reduced infection pressure as more and more surrounding areas become infection free. When identifying areas for control, it is important to avoid the risk of airborne transmission from contiguous, non-controlled areas. One useful approach is to take advantage of natural obstacles to airborne spread, such as hills and forests.

Further risk factors, such as the transit or parking of transport vehicles, need to be considered because of possible airborne transmission (11). Animal movements must be meticulously monitored. Purchasing livestock from farms with a different health status should be avoided at all costs. However, as breeding or multiplying farms may be subclinically infected for a considerable time, the purchase of animals that turn out to be infected cannot always be avoided. Farms operating with multi-site production systems, with regular animal movements between sites, were shown to be at significantly increased risk of infection. This may be linked to specific management practices used in such systems in Switzerland. Additional biosafety measures should be implemented to reduce the general infection risk on these farms.

Co-operation and communication between all stakeholders was a key factor for success in the regional control efforts described here. Information on the planned control programme needs to be provided well in advance to producers (i.e. at least one year before implementation). In the experience of the authors, detailed procedures for each farm should be agreed in writing. A similar point was made by Heinonen *et al.* (12). Veterinarians, veterinary officers and companies involved in the pig trade must co-ordinate their activities. When introducing compulsory control programmes, the national Veterinary Services must take the lead. Although simulation models of the disease control programme had shown that only the large, aerosol-producing farms in a region needed to be processed simultaneously, this approach was not acceptable to farmers. All farms in the chosen region were therefore included in the programme at the same time.

After implementation of the respiratory disease control programme, the health status of all farms should continue to be monitored to ensure that no residual infection remains. Monitoring is based on clinical diagnosis but primarily on the detection of gross pathological signs at slaughter. In the presence of other respiratory diseases, such as influenza, meat inspectors must be specifically trained to detect the typical lesions of EP and APP. In one area of Switzerland, 1,356 suspected cases of EP were investigated in 2003, but only 17 cases were confirmed; however, the total cost of these epidemiological and laboratory investigations was more than 300,000 euros (P. Infanger, personal communication). As a consequence of this, in 2004, a threshold of 10% of lungs with specific lesions per slaughter batch from each farm was implemented to reduce the number of investigations caused by false-positive results at slaughter checks. Heinonen *et al.* (12) recommended a minimum herd-level prevalence for EP of 10%, to avoid false-positive classifications.

A cost-benefit analysis was conducted on a small subgroup of farms in Switzerland (18). This study showed that the 'break-even' point of the programme (i.e. where costs were recouped by savings) was reached within three to twelve months. The positive support from pig producers indicates that they considered the economic benefits made the programme worthwhile. Similar observations were reported by Rautiainen *et al.* (21), who recorded an increase in mean daily weight gain from 799 grams to 875 grams on finishing farms. A full assessment of all economic aspects of this programme has not yet been conducted. However, some indirect benefits are well known, such as the reduced need for antimicrobials to treat respiratory diseases. Arnold *et al.* (2) analysed annual prescription data on the in-feed medication of finishing pigs from a single canton between 1996 and 2001. This analysis documented a reduction of substances used to treat bacterial pneumonia in pigs (e.g. tylosin).

The ultimate goal of a disease control programme is the documentation of the absence of the causative agent. This can be attempted when older animals with antibodies against EP and APP (from the period before control measures were implemented) are no longer in the herds. Serological mass testing has been used for this purpose by Rautiainen *et al.* (21) after the completion of an eradication programme. At present, however, Switzerland is not seeking infection-free status but aiming to maintain the absence of disease.

To achieve this, a legal framework for eliminating the disease, which includes compensation for the farmer/producer, is necessary. In addition, regulations on the international trade in live animals are crucial. Accordingly, Switzerland has developed new import

regulations. All imported live pigs must be kept segregated, under clinical surveillance, in addition to fulfilling all other requirements on their health status (for details see: [www.bvet.admin.ch](http://www.bvet.admin.ch)). Moreover, imported live pigs are mixed with EP- and APP-free sentinel pigs, which are then tested for seroconversion after 28 days. The importation of animals vaccinated against EP and/or APP is forbidden. Such strict precautions are necessary if the investments made by the Veterinary Services, as well as the pig producers of Switzerland, are not to be placed in jeopardy.

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## Un programme réussi de lutte contre les maladies respiratoires enzootiques des porcs en Suisse

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### Résumé

Jusqu'en 1993, les maladies respiratoires des porcs entraînaient des pertes estimées à plusieurs millions d'euros par an en Suisse. En 1993, un programme de contrôle national a été proposé pour lutter contre les maladies respiratoires enzootiques des porcs ; son objectif était de ramener l'incidence des cas cliniques à un taux inférieur à 1 %. Le programme portait sur la pneumonie enzootique à *Mycoplasma hyopneumoniae* ainsi que sur les cas cliniques de pleuropneumonie dus à *Actinobacillus pleuropneumoniae* (quel que soit le sérotype) et sur les cas confirmés par sérologie d'infection due au sérotype 2 d'*A. pleuropneumoniae*.

Le programme de lutte, lancé région par région à partir de 1996 est devenu pleinement opérationnel en 2004. Les résultats des examens cliniques, épidémiologiques et des tests de diagnostic en laboratoire ont servi à définir les mesures de lutte appropriées. La dépopulation partielle a été la méthode employée pour lutter contre la pneumonie enzootique dans les élevages porcins et les parcs d'engraissement et de finition. Une dépopulation totale a été mise en œuvre dans toutes les exploitations où *A. pleuropneumoniae* avait été décelé ainsi que dans les parcs de finition atteints de pneumonie enzootique. Les échanges d'animaux ont fait l'objet d'une réglementation rigoureuse pendant la durée du programme et il a été rendu obligatoire de déclarer toute suspicion de maladie respiratoire porcine.

Les activités de suivi permanent ont porté sur les suspicions cliniques et/ou la détection de lésions anatomopathologiques macroscopiques à l'abattoir qui devaient faire l'objet d'une confirmation au laboratoire. En 2005, l'incidence des cas cliniques était inférieure à 1 %. Des mesures réglementaires ont été prises pour contrôler les échanges internationaux de porcs vivants et éviter ainsi la réintroduction de maladies respiratoires porcines en Suisse.

### Mots-clés

Abattage sanitaire – *Actinobacillus pleuropneumoniae* – Dépopulation – Dépopulation partielle – *Mycoplasma hyopneumoniae* – Pleuropneumonie – Pneumonie enzootique – Porc – Porcin – Programme de lutte – Prophylaxie régionale – Suisse.

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## Erradicación de las enfermedades respiratorias enzoóticas de los cerdos mediante un programa de control nacional en Suiza

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### Resumen

Según las estimaciones, hasta 1993 las enfermedades respiratorias de los cerdos ocasionaban varios millones de euros de pérdidas anuales. Ese año se propuso un programa nacional de control de las enfermedades respiratorias enzoóticas en porcinos para reducir la incidencia de los casos clínicos a un porcentaje inferior al 1%. El programa lucharía contra la neumonía enzoótica por *Mycoplasma hyopneumoniae*, los casos clínicos de pleuroneumonía provocada por todos los serotipos de *Actinobacillus pleuropneumoniae* (App), así como los casos en que se detectasen indicios serológicos de presencia del serotipo 2 de App.

La aplicación del programa de control, que comenzó a ejecutarse, región por región, en 1996, se terminó en 2004. Se utilizaron pruebas clínicas, epidemiológicas y de laboratorio para determinar las medidas de control de la enfermedad adecuadas. Para controlar la neumonía enzoótica en las fincas de cría y de engorde final se procedió a una despoblación parcial. Las explotaciones infectadas por App y las fincas de engorde final afectadas por neumonía enzoótica se despoblaron totalmente. Durante la aplicación del programa, se reglamentó estrictamente el comercio de animales y se impuso la notificación obligatoria de todos los casos de sospecha de enfermedad respiratoria en cerdos.

La vigilancia permanente se basa en la sospecha clínica de infección y/o la detección de lesiones patológicas de importancia en el matadero, y la posterior confirmación de laboratorio. En 2005, la incidencia de los casos clínicos fue inferior al 1%. Se aprobaron reglamentaciones para controlar el comercio internacional de cerdos en pie y evitar la reintroducción de enfermedades respiratorias en Suiza.

### Palabras clave

Actinobacillus pleuropneumoniae – Cerdo – Control regional – Despoblación – Despoblación parcial – Mycoplasma hyopneumoniae – Neumonía enzoótica – Pleuroneumonía – Porcino – Programa de control – Sacrificio sanitario – Suiza.



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