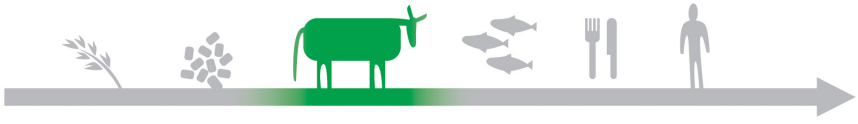
Annual Report

The surveillance programme for specific viral infections in swine herds in Norway 2019



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The surveillance programme for specific viral infections in swine herds in Norway 2019

Content

Authors
Carl Andreas Grøntvedt, Anne Bang Nordstoga, Petter Hopp

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Summary

The surveillance programme for specific viral infections in swine herds in 2019 continued to show Norway to be free from Aujeszky's disease, transmissible gastroenteritis, porcine epidemic diarrhoea and porcine respiratory and reproductive syndrome.

Since 2009, influenza A (H1N1) pdm09 virus (H1N1pdm) has been endemic in the Norwegian swine population, showing a small decline in seroprevalence the last two years. Other swine-associated influenza strains have previously not been diagnosed in Norway. Although one herd was found seropositive for H1N1 A/Swine/Belgium/1/98 and one herd seropositive for H1N2 A/Swine/Gent/7623/99 (H1N2) during 2019, virus was not detected in follow-up sampling and contact tracing did not demonstrate any additional herds with similar seropositivity. These findings are considered as false positives due to serological-cross reaction with H1N1pdm.

In 2018, porcine respiratory corona virus (PRCV) was detected for the first time in Norway, and the seroprevalence in the southwestern part of the country is now high.

Introduction

The Norwegian Food Safety Authority (NFSA) is responsible for implementing the surveillance programme for specific viral infections in swine. The national surveillance programme for specific viral infections in swine was launched in 1994 to document the status of Aujeszky's disease (AD), transmissible gastroenteritis (TGE), and porcine respiratory corona virus (PRCV) in the Norwegian swine population. Porcine respiratory and reproductive syndrome (PRRS) and swine influenza (SI) were added to the programme in 1995 and 1997, respectively. From 1997 to 1999, and again from 2015, porcine epidemic diarrhoea (PED) was also included in the programme. The Norwegian Veterinary Institute is responsible for sampling plans, laboratory investigations and reporting components of the programme.

The EFTA Surveillance Authority (ESA) has recognized Norway's disease-free status for AD since July 1 1994, and has laid down additional measures for the trade of pigs and pork to protect Norway's disease free status for AD. The additional measures are described in ESA Decision No 160/10/COL.

PRRS, TGE and PED have never been detected in Norway.

Norway recorded its first outbreak of influenza A (H1N1) pdm09 virus (H1N1pdm) in the swine population in 2009, and in the following years a stable herd prevalence indicated endemicity. In 2018, for the first time since 2010, the national herd prevalence fell below 40% to 25% (95% CI 22-30% or 138/ 534 herds), although the region of Rogaland and Agder with the highest number and density of pig herds, continued to have the highest herd prevalence at 50% (95% CI 41-58%).

In August 2018, antibodies against porcine respiratory corona virus (PRCV) were detected in seven swine herds in the county of Rogaland through the surveillance programme, and an outbreak investigation revealed PRCV specific antibodies in a high proportion (68%) of contact herds sampled. The herd prevalence for PRCV in the counties of Rogaland, Aust-Agder and Vest-Agder in 2019 was 60%. During 2018, only two herds outside these three counties tested positive for antibodies against PRCV. The first of these herds received pigs from Rogaland and the second received pigs from the first herd.

Aims

The aims of the serological surveillance programme are to ascertain the continued absence of the specific infectious viral diseases and to contribute to the maintenance of this favourable situation. The programme also monitors the status of H1N1pdm, and from 2018 also PRCV, in the Norwegian swine population.

Materials and methods

Herds and sampling

All 88 nucleus and multiplying herds as well as the central-units of all 12 sow pools were included in the programme. Blood samples (target sample size of 10 pigs) from adult swine in each herd were collected, usually at the farms, but occasionally also at the abattoirs. In addition, a selection of the remaining Norwegian swine herds was included in the programme. At the 12 largest abattoirs where more than 97% of the pig slaughter takes place, blood samples proportional to the number of sows and boars per herd were collected. The samples were randomly collected from different herds and the sampling periods were evenly distributed throughout the year. Furthermore, at the six largest abattoirs, blood samples (targeted sample size 10 pigs) were collected from 45 randomly selected large fattening herds.

Laboratory analyses

All serological analyses were performed at the Norwegian Veterinary Institute. Positive or inconclusive results in the surveillance programme were retested in duplicate with the same test method. Samples were concluded as negative if the retest gave a negative result. If the result of the retest was positive or inconclusive, a specified confirmatory test was performed. In cases of positive or inconclusive test results for confirmatory tests (except for H1N1pdm virus and PRCV), at least 20 new pigs were resampled from the herd in question. If clinical signs of disease were absent in the herd, and all resampled animals were negative for antibodies against the pathogen in question, a single positive or inconclusive sample in the surveillance programme was considered false positive.

Aujeszky's disease/pseudorabies virus (ADV/PRV)
All serum samples were tested for antibodies against ADV using a commercial blocking ELISA from Svanova (SVANOVIR® PRV gB-Ab). The test detects antibodies against glycoprotein B (previously glycoprotein II) found on the surface of the virus.

Transmissible gastroenteritis virus (TGEV) and porcine respiratory coronavirus (PRCV)
A commercial blocking ELISA from Svanova (SVANOVIR® TGEV/PRCV-Ab) was used to detect antibodies against TGEV/PRCV. The ELISA test enables discrimination between antibodies to TGEV and PRCV in serum samples.

Porcine reproductive and respiratory syndrome virus (PRRSV)
All serum samples were tested for antibodies against PRRSV using a commercial indirect ELISA from IDEXX (IDEXX PRRS X3), which detects the most (pre)dominant European and American strains of PRRSV. In cases of positive or inconclusive results, the samples were sent to the National Veterinary Institute (DTU-Vet) in Denmark for confirmatory testing using ELISA and immunoperoxidase tests for detection of antibodies against EU- and US-strains of the PRRSV and real-time PCR for PRRSV.

Swine influenza virus
A commercial competitive ELISA from IDvet (ID Screen® Influenza A Antibody Competition, Multi-species) was used to screen serum samples from swine for antibodies against influenza A virus. In cases of positive or inconclusive results, the serum samples were retested using the haemagglutination inhibition (HI) test, for the detection of antibodies against the A/Swine/California/07/09 (A/H1N1/pdm09), A/Swine/Belgium/1/98 (H1N1), A/Swine/Gent/7623/99 (H1N2) and A/Swine/Flanders/1/98 (H3N2) subtypes as described in the OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals (1). The antigens for the tests were produced at the Norwegian Veterinary Institute.

Porcine epidemic diarrhoea virus (PEDV)
All serum samples were tested for antibodies against PEDV using a commercial indirect ELISA from IDvet (ID Screen® PEDV Indirect). In cases of positive or inconclusive results, the samples were sent to the National Veterinary Institute (DTU-Vet) in Denmark for confirmatory testing using an in-house ELISA.

Results and Discussion

The mean number of animals tested per farm aggregated for the year was seven (range 1 - 50). Less than 1% of the collected samples were rejected, resulting in 3,838 individual pig samples representing 545 herds being analysed (Table 1). Distribution of sampled herds in relation to production type is given in Table 2.The proportion of herds tested positive by region are presented in Table 3. Of the 545 tested herds, 153 (28%) were seropositive for H1N1pdm (Table 1, Figure 1) and 118 (22%) were positive for PRCV (Table 4, Figure 2).

In addition, 14 samples from one herd were positive for antibodies for H1N1 A/Swine/Belgium/1/98 and one sample from one herd positive were positive for antibodies against H1N2 A/Swine/Gent/7623/99. The H1N1 seropositive herd was depopulated for other reasons. At slaughter, lung samples were collected from three pigs from the herd in question. The pigs were sampled due to cranioventral consolidation on post-mortem inspection at the abattoir, but Influenza A virus was not detected on RT-PCR analysis of the lung samples. Two fattening pig herds that had received pig from the H1N1 seropositive herd were sampled, and antibodies against H1N1 virus were not detected in 9 and 10 serum samples, respectively.

Table 1. Results from the surveillance for Aujeszky's disease (AD), transmissible gastroenteritis (TGE), porcine respiratory corona virus (PRCV), porcine epidemic diarrhoea (PED), porcine respiratory and reproductive syndrome (PRRS) and swine influenza (SI) from 1994 to 2019.

Year	Total no. of herds	Herds tested	Animals tested	H1N1pdm		PRCV		Other viruses		Diseases included
				Animals positive[3]	Herds positive	Animals positive	Herds positive	Animals positive	Herds positive	
1994	7 799	1 112	12 010	-	-	0	0	0	0	AD, TGE/PRCV
1995	7 471	956	11 197	-	-	0	0	0	0	AD, TGE/PRCV, PRRS
1996	7 045	468	4 968	-	-	0	0	0	0	AD, TGE/PRCV, PRRS
1997	6 661	512	4 925	-	-	0	0	0	0	AD, TGE/PRCV, PRRS, SI, PED
1998	6 275	491	4 695	-	-	0	0	2[1]	1[1]	AD, TGE/PRCV, PRRS, SI, PED
1999	5 761	470	4 705	-	-	0	0	0	0	AD, TGE/PRCV, PRRS, SI, PED
2000	4 827	458	4 600	-	-	0	0	0	0	AD, TGE/PRCV, PRRS, SI
2001	4 554	472	4 972	-	-	0	0	0	0	AD, TGE/PRCV, PRRS, SI
2002	4 150	492	4 899	-	-	0	0	0	0	AD, TGE/PRCV, PRRS, SI
2003	4 005	483	4 783	-	-	0	0	0	0	AD, TGE/PRCV, PRRS, SI
2004	4 006	492	4 935	-	-	0	0	0	0	AD, TGE/PRCV, PRRS, SI
2005	3 762	468	4 644	-	-	1[2]	1[2]	0	0	AD, TGE/PRCV, PRRS, SI
2006	3 339	457	4 569	-	-	0	0	0	0	AD, TGE/PRCV, PRRS, SI
2007	3 010	456	4 641	-	-	0	0	0	0	AD, TGE/PRCV, PRRS, SI
2008	2 682	487	4 845	-	-	0	0	0	0	AD, TGE/PRCV, PRRS, SI
2009	2 546	452	4 724	131	20	0	0	0	0	AD, TGE/PRCV, PRRS, SI
2010	2 441	459	4 250	940	189	0	0	0	0	AD, TGE/PRCV, PRRS, SI
2011	2 346	730	4 713	2 216	353	0	0	0	0	AD, TGE/PRCV, PRRS, SI
2012	2 213	764	4 961	2 412	378	0	0	0	0	AD, TGE/PRCV, PRRS, SI
2013	2 178	737	5 038	1 417	338	0	0	0	0	AD, TGE/PRCV, PRRS, SI
2014	2 117	622	4 083	1 138	296	0	0	0	0	AD, TGE/PRCV, PRRS, SI
2015	2 141	568	3 764	993	280	0	0	0	0	AD, TGE/PRCV, PRRS, SI, PED
2016	2 180	564	3 824	952	271	0	0	0	0	AD, TGE/PRCV, PRRS, SI, PED
2017	1 955	548	3 804	695	225	0	0	0	0	AD, TGE/PRCV, PRRS, SI, PED
2018	2 038	533	3 598[3]	473	134	126[4]	30[4]	0	0	AD, TGE/PRCV, PRRS, SI, PED
2019	1 853	545	3 838[3]	526	153	532	118	0	0	AD, TGE/PRCV, PRRS, SI, PED
Total			131 985							

[1] Two samples from one herd were seropositive for SI H3N2 in 1998 (probably infection from humans)
[2] One sero-positive sample for PRCV in 2005 (probably unspecific reaction).
[3] Maximum 5 influenza A positive samples per submission were followed up with a HI-test to identify the influenza strain.
[4] In addition to routine surveillance for PRCV, NVI also detected 238 positive pigs in 30 positive herds (27 in Rogaland, 1 in Vest-Agder and 2 in Hedmark).

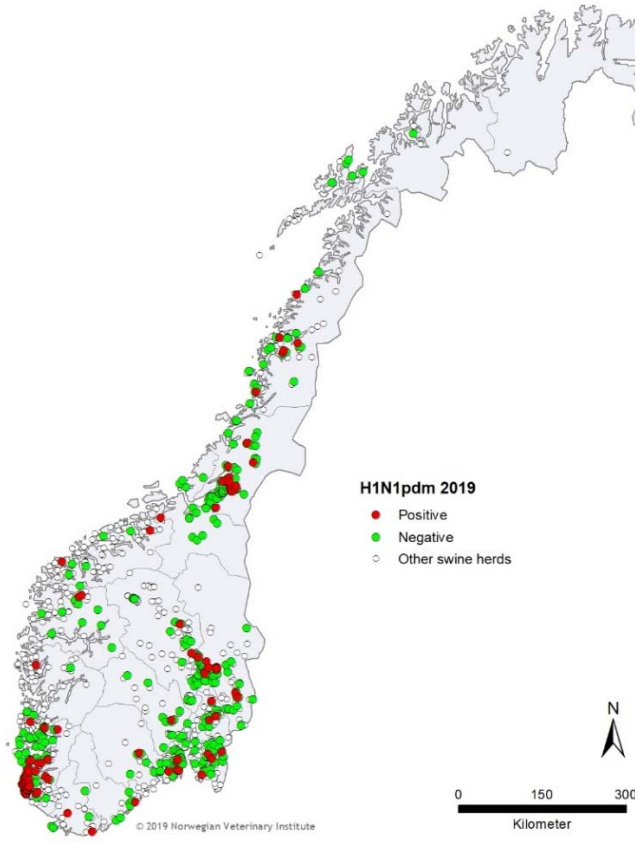

Figure 1. Serological results and geographical distribution of swine herds tested for antibodies against influenza A virus in the surveillance programme for specific viral infections in 2019.

Table 2. Distribution of swine herds in the surveillance programme 2019 according to type of production and the results for antibodies to H1N1pdm.

Category	No. of herds sampled	No. (%) of positive herds H1N1pdm	No. (%) of positive herds PRCV
Nucleus herds and multiplying herds	83	21 (25.3)	14 (16.9)
Sow pools	11	8 (72.7)	6 (54.6)
Integrated and piglet-producing herds	395	117 (29.6)	87 (22.0)
Fattening herds	56	7 (12.5)	11 (19.6)
Total herds (pigs)	545	153 (28.1)	118 (22)

Table 3. Number of herds tested and percentage of herds positive for H1N1pdm per region in 2019.

Region	Total herds	No. of herds tested	No. of herds tested positive	Percentage of herds tested positive (95% CI)
Finnmark/Troms/Nordland	113	31	6	19.4 (7.5 - 37.5)
Trøndelag/Møre og Romsdal	363	122	24	19.7 (13.0 - 27.8)
Hordaland/Sogn og Fjordane	139	26	5	19.2 (6.6 - 39.4)
Rogaland/Agder	556	155	90	58.1 (49.9 - 65.9)
Buskerud/Vestfold/Telemark	158	57	7	12.3 (5.1 - 23.7)
Oslo/Akershus/Østfold	186	52	8	15.4 (6.9 - 28.1)
Hedmark/Oppland	337	102	13	12.7 (7.0 - 20.8)
Total	1 853	545	153	28.1 (24.3 -32.0)

The results from the surveillance programme in 2019 showed that Norway has maintained its freedom of disease status for AD, TGE and PRRS virus infections in the national swine population since the surveillance started in 1994.

Porcine respiratory coronavirus (PRCV) is a variant of transmissible gastroenteritis virus (TGEV). PRCV likely emerged naturally and subsequently spread rapidly in the European swine populations during the early 1980's, causing mostly unapparent infections and ameliorating TGE through immunological cross-protection (2).

Based on surveillance data from this and previous years, it is likely that the introduction of PRCV to the Norwegian pig population occurred during 2018. The outbreak investigation conducted by the NFSA further showed that the virus spread rapidly to a high proportion of herds connected by trade of live pigs, but also to herds located less than 3km from PRCV antibody positive herds (Table 4, Figure 2). The route of introduction to Norway was not identified. Based on the epidemiological features of PRCV and data from other countries, it appears likely that PRCV will become endemic in the Norwegian pig population. In 2019, a total of 25 of 390 (6.4%) herds outside Rogaland and Agder were seropositive against PRCV, and the national herd seroprevalence was estimated to 21.7%.

Table 4. Number of herds tested and percentage of herds positive for PRCV per region in 2019.

Region	Total no. of herds	No. of herds tested	No. of herds tested positive	No. of herds tested inconclusive	Percentage of herds tested positive (95% CI)
Finnmark/Troms/Nordland	113	31	0	0	0.0 (0.0 – 11.2)
Trøndelag/Møre og Romsdal	363	122	5	6	4.1 (1.3 – 9.3)
Hordaland/Sogn og Fjordane	139	26	2	1	7.7 (0.9 – 25.1)
Rogaland/Agder	556	155	93	7	60.0 (51.8 – 67.8)
Buskerud/Vestfold/Telemark	158	57	3	1	5.3 (1.1 – 14.6)
Oslo/Akershus/Østfold	186	52	4	1	7.7 (2.1 – 18.5)
Hedmark/Oppland	337	102	11	2	10.8 (5.5 – 18.5)
Total	1 853	545	118	18	21.7 (18.3 – 25.4)

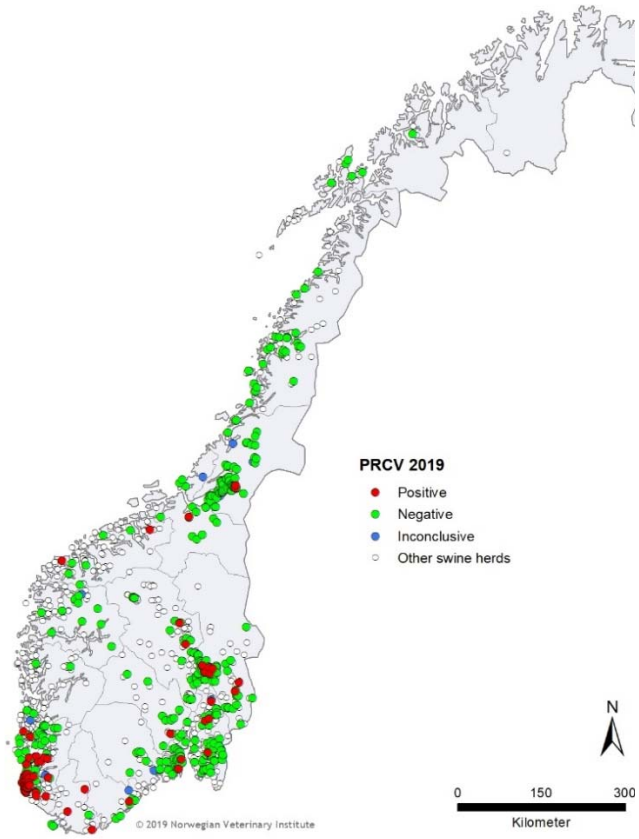

Figure 2. Serological results and geographical distribution of swine herds tested for antibodies against porcine respiratory coronavirus in the surveillance programme for specific viral infections in 2019.

With regards to influenza A, studies have shown that the H1N1pdm virus was most likely introduced to pigs by humans infected with the same virus (3, 4). The herd seroprevalence for H1N1pdm has decreased from 41% in 2017 to 28% in 2019, however the reasons for this decline are not known. The decline from 2017 in herd prevalence was across all four production types and across all counties (Tables 2 and 3). The herd prevalence in Rogaland/Agder region, the densest pig farming area in Norway, remains the highest at 58% indicating a continued endemic situation. Except for H1N1pdm, the Norwegian swine population tested negative against other strains of influenza A virus that are endemic in most pig producing countries, with the exception of two herds found seropositive against H1N1 and H1N2 during 2019, respectively. The cause of seropositivity in these herds could not be established, but further investigations did not demonstrate seropositive contact herds and influenza A virus could not be detected in samples from lung lesions in one of the herds. We consider that the most probable explanation are serological cross-reactions with H1N1pdm, leading to false-positive results for H1N1 and H1N2. Cross-reactions between these influenza-strains in the HI test have been reported previously (5).

Swine influenza A H1N1pdm infection in Norwegian pig herds have mainly been subclinical or with mild clinical signs in a small proportion of the herds (3, 6, 7). A longitudinal study from a Norwegian boar testing station published in 2014 showed that infected growing pigs had reduced feed efficiency due to poorer feed conversion ratio and as such increased the time before being sent to market (8).

In the recent years, the number of herds in the Norwegian swine production has stabilized while the average herd size has increased. The pork production by tonnage has remained relatively stable. In 2011, the sampling procedure for conventional herds with sows, changed from 10 samples collected in randomly selected herds to individual animals being collected at the abattoir. Therefore, the mean number of samples per herd decreased, while the fraction of the total pig herd population sampled increased from 19 % in 2010 to 31 % in 2011. Since 2014, this proportion has been between 26% and 30%, while the mean number of samples per herd has decreased.

Farmed wild boars and pigs kept as pets were not included in the programme. These populations are small and have little to no contact with the commercial pig population. There is a small, but increasing wild boar population mainly in an area along the Swedish border in the southeast of Norway. A wild boar health surveillance was conducted during 2019 and is reported separately.

Apart from AD, the EU has not approved additional guarantees against other swine viral infections when importing pigs into Norway. To protect the swine population against disease-related risks, Norway has its own national guidelines for the trade of live swine and pork products.

In conclusion, the surveillance programme for specific viral infections in 2019 documents Norwegian pig herd's favourable health status by demonstrating that Norwegian pig herds remained free from the serious infectious diseases: AD, TGE, PRRS and PED. It also documents that SI other than H1N1pdm were not detected in the pig population, with the exception of seropositivity against H1N1 and H1N2 in two herds most probably caused by false-positive cross-reactions.

Acknowledgement

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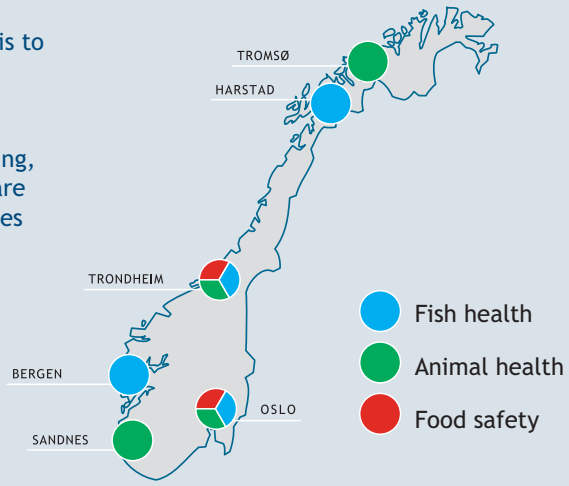

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