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Input parameters and scenarios, including economic inputs

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Geographical locations of the farms are the core in these models. We used geographical data, number of animals and specification of herd types for the 50,853 herds in the Danish Husbandry Register (CHR) in 2007. For each herd, the daily probability of moving animals, to another herd or to the abattoir, was calculated as the sum of all registered movements off the herd in the period from October 1, 2006 to September 30, 2007 divided by 365. Swine movements originated from the Movement database for swine and cattle and sheep movements from the Danish Cattle database.

From an infected herd, disease was simulated to spread via direct contacts (movements of animals), indirect contacts (trucks and persons) and local spread (mice, birds, airborne spread in limited distances). Furthermore, in some scenarios airborne spread was included.

For all contact types, when a contact was simulated to take place, a receiving herd needed to be found. The distance, in which the receiving herd should be found, was calculated from movement data for animals and from data from trucks and abattoirs for movements to slaughter and milk tankers. For persons visiting herds, we used a combination of expert opinions, data from other countries and survey data. Local spread was simulated within a distance of three kilometers around infected herds, with a decreasing probability of spread with increasing distance.

All epidemics were simulated to be detected on day 21. When an epidemic was detected, a three day national stand still was initiated. Furthermore, infected herds were depopulated and a 3 km detection zone and a 10 km surveillance zone were implemented around all infected herds. Within the protections zones, all herds were simulated to be clinically surveyed twice, first within 7 days after implementing the zone, and second 21 days later.

Sheep within the zone were simulated to be tested. Within the surveillance zone, all herds were simulated to be clinically surveyed within 7 days, and sheep within the zone were simulated to be tested within 7 days and again before lifting the zone. Herds, which had received animals from an infected herd, were simulated to be traced and depopulated. Herds delivering animals to an infected herd were simulated to be traced and surveyed.

In the alternative scenarios, extra control measures were added to the basic measures.

Basic control measures in the models

<i>Detection</i>	<i>Day 21</i>
<i>Detected herds</i>	<i>Depopulated</i>
<i>Protections zone</i>	<i>Movement restrictions for 30 days</i>
	<i>Surveillance *2</i>
	<i>Sheep tested *2</i>
<i>Surveillance zones</i>	<i>Movement restrictions for 30 days</i>
	<i>Surveillance *1</i>
	<i>Sheep tested *1</i>
<i>Traced forward</i>	<i>Depopulated</i>
<i>Traced backwards</i>	<i>Surveyed</i>
<i>3day national stand still – animal movements</i>	

Extra measures were depopulation or vaccination in ringzones of varying radii around infected herds.

In alternative scenarios, we tested the effect of depopulating in zones of 500, 1000 and 1500 meters from infected herds. Depopulation was started on day 14 after detection of the first herd, or after detecting 10, 20, 30 or 50 infected herds. In some scenarios, we excluded hobby-type farms¹ from depopulation in zones. The resources for depopulation were estimated to 4,800 swine and 2,000 ruminants a day. Resources for depopulation in zones was shared with depopulation of infected and depopulation of traced herds, however zone depopulation would be number three on the resource list. All herds depopulated in zones would be tested before slaughter. The probability of detection was assumed to be 50% from day 0 to day 8 after the herd was infected, and increased to 1 after day 8.

In the vaccination scenarios, herds within the vaccination zone were simulated to be vaccinated 14 days after detection of the first herd or when 10, 20, 30 or 50 herds were infected. All herds within the zones were simulated to be vaccinated. We used vaccination zones of either a 1, 2, 3 or 5 km. In some scenarios, hobby herds were not vaccinated. In one scenario, no sheep were vaccinated, and in another scenario no swine were vaccinated.

The outputs from the epidemiological models were used as inputs in an economic model to calculate costs and losses for each epidemic.

The costs of an epidemic were divided into direct and indirect costs. The direct costs consisted of surveillance, depopulation, cleaning and disinfection, empty stable, compensation, national standstill, and vaccination costs. The indirect costs included losses incurred from restrictions on exports to EU and non-EU countries. The total costs were calculated as the sum of the direct and indirect costs. Costs were calculated per iteration, and summaries were thereafter calculated.

Alternative scenarios

	<i>Zones</i>	<i>Starting point</i>
<i>Depopulation</i>	<i>500, 1000 and 1500 m</i>	<i>14 days 10, 20 30 and 50 herds</i>
<i>Suppressive vaccination</i>	<i>1, 2, 3 and 5 km</i>	<i>14 days 10, 20 30 and 50 herds</i>
<i>Protective vaccination</i>	<i>1, 2, 3 and 5 km</i>	<i>14 days 10, 20 30 and 50 herds</i>
<i>Depopulation or vaccination – not in hobby farms</i>	<i>As above</i>	<i>14 days 20 and 50 herds</i>
<i>Vaccination not in sheep OR swine</i>	<i>1, 2, 3 and 5 km</i>	<i>14 days</i>
<i>Enlarged protections zone</i>	<i>Increased to 5 km</i>	
<i>Enlarged surveillance zone</i>		<i>Increased to 15 or 20 km</i>
<i>+ Airborne spread</i>	<i>1000, 1500m 2, 5 km</i>	<i>20 and 50 herds</i>

¹ (sheep herds <40 animals, swine herds <20 sows and <100 finishers, non-milking cattle herds <25 animals)