Scientific Works. Series C. Veterinary Medicine. Vol. LXVIII (1), 2022
ISSN 2065-1295; ISSN 2343-9394 (CD-ROM); ISSN 2067-3663 (Online); ISSN-L 2065-1295

STUDIES FOR OPTIMISING THE COST OF ANIMAL HEALTH PROGRAM FOR AVIAN INFLUENZA IN ROMANIA

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Abstract

In the first half of the last century, avian influenza (AI) caused great losses in the poultry farming sector, practically all over the world, especially in Europe and it is still causes. Risk analysis, cost-benefit analysis and cost effectivennes analysis of eradication, control and monitoring program for avian influenza. Biosecurity measures in the poultry industry - applying the "all-in, all-out" policy - are able to protect for avian influenza. The first line of defense against avian influenza is the early detection of outbreaks, followed by a rapid response. This is closely linked to the communication between veterinarians, farmers and the performance of veterinary services. People who come into close contact with infected poultry, such as the families of poultry owners and workers in this sector, remain at risk. In conclusion, the risk analysis for AI identified as a major risk the location of the poultry farm in areas with a high density of migratory birds. Sensitivity analysis shows that, if more than 15% of the poultry population,are exposed to the risk of disease, the cost of the surveillance program is justified.

Key words: *Avian Influenza, risk analysis, cost-benefit analysis, cost-effectiveness analysis.*

INTRODUCTION

Through this study, we aimed an overview of avian influenza control program and his efficacy, characterise the present landscape , and predict possible scenarios, taking into account the Romanian and international status.
The main objective was to draw some suggestions and/or opinions to optimise existing AI program in Romania. Furthermore, to take a picture of all factors supporting decision-makers to improve animal welfare and, last but not least, an improvement in human well-being and health.
When the goal is to control a zoonosis, it is desirable to eradicate it as quickly as possible, in order to restore the freedom of movement of humans and/or animals.
The fact that seasonal or abnormal weather changes strongly influence many infectious diseases suggests that they will continue to be increasingly influenced by more extended climate changes (Patz et al., 2000). Climate can affect the transmission of the disease through influence on the replication and movement (and probably on the evolution) of microorganisms and their vectors.

MATERIALS AND METHODS

The materials used were the national, international and European Commission legislation in force. In addition, there are also guidelines, promoted by the awarness campains, on how the human population that may be affected by specific zoonoses should behave.
We used the data, guidelines, recommendations and/or acts, norms, regulations issued by the OIE, WHO, EFSA, EC, etc.
The European Commission has published updated rules on biosecurity and risk mitigation measures, unanimously supported by Member States (MS).
These biosecurity measures shall comply with the EFSAs` recommendations and shall, basicaly, aim to prevent the contact with carrier animals and to implement the early detection systems. Furthermore, the implementation of these measures by the poultry industry and the traditional backyard farming is critical to prevent future outbreaks of zoonotic diseases.
The Directive 2005/94/E.C. on avian influenza (AI) is based on the experiences of MS in controlling major disease outbreaks and considers the latest scientific knowledge on

avian influenza to be able to meet the challenges facing Europe today. Its primary objectivs are a better prevention and a better control of outbreaks. Food, contaminated equipment and manure must be destroyed or treated to inactivate the virus.

According to the EU legal provisions, all Member States implemented contingency plans for AI (approved by Commission Decision 2007/24/E.C.), the most appropriate measures being implemented immediately.

Preventive hygiene measures, such as cleaning and disinfection, are essential at the farm level. Disease awareness among farmers and the cooperation of all people involved in the poultry sector must ensure that the strictest biosecurity measures are applied to prevent the spread of the disease.

Each MS may decide whether it is necessary to introduce avian vaccination against avian influenza as emergency or preventive measure. However, before resorting to vaccination against avian influenza, the State Veterinary Authority must submit a detailed vaccination plan, including the appropiate surveillance measures.

Since 2003, EU Member States have had to carry out avian influenza surveillance programs to detect avian influenza virus infections belonging to the H5 and H7 subtypes in poultry, due to their potential to generate into the highly pathogenic or zoonotic form of the virus (Crawford et al, 2005).

Risk analysis of the prevention/ surveillance/monitoring program for avian influenza in Romania

As they evolve, the risk analysis of outbreaks is identifying the critical points for the early assessment and detection of fatalities, the risk factors for the introduction and spread of avian influenza virus, and is providing data for the outcome assessement of the applied biosecurity policy.

The risk of the introduction and spread of avian influenza virus remains high in breeding activites, mainly when the movement of animals, the restriction of access throughout the production cycle and/or contact with wild birds is not controled/eliminated. If poultry cannot be fenced during periods of high risk, it is recommended to prevent direct contact between wild birds and poultry by reducing the size of the outdoor area and/or using the net. In addition, food and water must be provided under a roof or horizontal fabric.

All subtypes of influenza A virus, regardless of hemagglutinin and neuraminidase, can cause infection in birds.

The risk level has been scored with 1 for the maximum probability, with 0 for uncertainty and for the highest magnitude of consequences with 5. Criteria and risk factors considered as associated with the introduction of the virus into poultry holdings include:

- direct or indirect exposure to wild birds, in particular those of the identified target species, or the existence of poultry farms near wetlands, ponds, swamps, lakes, rivers or on the shores of the sea where migratory birds may congregate on water;
- the location of the poultry holding in areas with a high density of migratory wild birds, in particular those birds which are identified as "target species" for the detection of the highly pathogenic strain H5N1 as listed in Decision 2010/367;
- the location of the poultry holding close to the resting and breeding grounds of migratory waterfowl, in particular where these areas are related to the movements of migratory birds in areas where highly pathogenic strains such as H5N1 are known to occur in wild birds;
- poultry farms reared outdoors or poultry farms where they are raised outdoors, wherever contact with wild birds cannot be effectively prevented;
- low level of biosecurity in poultry farming, including improper storage of feed and use of surface water.

At the end of 2011, according to the reports of the county sanitary veterinary and food safety directorates, in Romania, there were:

a) 269 commercial broiler farms; according to Decision 2010/367 of EC (chickens from commercial farms should not be tested);
b) 173 commercial laying hen farms;
c) 44 commercial holdings of chicken farmer;
d) 6 commercial turkey farms for fattening;
e) 2 commercial ratite farms;
f) 6 commercial pheasant farms;
g) 8 commercial quail holdings;
h) 717 risk areas ("target" localities);
i) 2 commercial palmipedes holdings.

Wild birds have a proven role in the global epidemiology of avian influenza viruses, playing a significant role in their evolution, maintenance and spread. The main wild species involved were waterfowl, seagulls and seabirds; however, the virus seems to pass easily between different species of birds.

The incidence of the infection seems to be seasonal, reaching the highest isolation rate in young birds, during the autumn. Thus, several routes of exposure of poultry to wild bird viruses have been documented or suspected to be the source of the outbreaks.

Direct exposure of poultry to wild birds is the most likely transmission event.

The identification of an avian influenza strain shall be performed utilising laboratory tests. Subsequently, a risk assessment shall be performed using the available data. At the same time, a risk analysis can be achieved with existing data on the evolution of avian influenza strains over time and the prediction of a future situation. Therefore, the risk assessment was based on existing information and its extrapolation.

The changes that may occur from a previous preliminary risk assessment for an on-site evaluation (in the outbreak) are quite diverse, with an increased likelihood of spreading a strain of avian influenza in the affected areas: from one infected farm to another. This is increasing the likelihood of an avian influenza strain spreading from an area known to be affected to an extent known as "moderate to high risk" through animal fairs, movements oflive poultry and through informal/illegal bird movements for this period.

There is always a delay in reporting human cases compared to the period between infection and their presentation for treatment.

What is the likelihood that AIV will spread from an infected farm to an uninfected farm in the affected areas?

The increase in poultry marketing activities has been associated with an increased risk of infection with the H5N1 avian influenza virus (AI) in humans and poultry (Soares Magalhaes et al., 2012). However, the presence of the avian influenza strain in poultry with subclinical evolution remains unnoticed during the period in which they are present along the market chain will not interrupt commercial activities unless effective surveillance of healthy birds and mitigation measures are taken whenever the virus is detected (Therestrial code - OIE).

Many farms/households are involved in integrated production systems for broilers, where the movement of chickens, humans and feed is the most likely source of infection between farms. Chickens for sale at animal fairs for human consumption are a significant source of infection for humans but are less likely to spread between farms. At the same time, however, there is a threaten of the virus spreading on farms through transport vehicles whenever biosecurity measures are not applied. There is an increased likelihood of the bird flu strain spreading during the winter season on an infected farm.

What is the probability that AIV will spread from a known affected area to a "moderate to high risk" area?

As the highest probability of spreading AIV to poultry is associated with their non controled movement, the areas of moderate to high risk are those where there is an increase in poultry consumption and occasional poultry trade movements. More reliable surveillance data are needed to proper assess the potential increase in the emergence of avian influenza during the holiday season when meat consumption is increased.

For some "moderate to high risk" areas, live birds subject to movement must be submited to serological tests at the farm of origin and border crossings if the situation so requires. In this way, it must be further guaranteed that poultry farms were not infected with the avian influenza strain at least a few weeks before their dispatch. This should reduce the likelihood of the virus spreading. In addition, the closure of markets may result in the emergence of traders looking for alternative destinations for poultry, which would lead to increased poultry traffic and thus to the uncontrolled spread of the avian influenza virus.

What is the probability that AIV will spread from an area known to be affected to a low-risk area?

Given that, by definition, an uninfected low-risk country or area does not trade directly with affected countries or regions, the likelihood of the avian influenza strain spreading from a known affected area to a "low-risk" area through trade it is considered unchanged. The possibility of spreading the bird flu virus, implicitly through trade, depends on the regulatory frameworks applied in low-risk counties and the level of illegal trade.

What is the likelihood of a human being infected with AIV from a potentially infected bird in the affected areas?

As poultry marketing activities may be associated with an increased risk of AIV infection in humans and poultry. This could be mitigated be mitigated by the awareness campains about. The risk is also associated to the traditional slaughter practices, leading to closer contact with live birds. In addition, poultry infection may go unnoticed without clinical signs.

Increased attention can be paid to improve biosecurity in animal fairs, especially in areas that have been previously affected. However, biosecurity and prevention measures appear to be variable and, in some cases, very limited. In addition, the effects of the temporary closure of markets in areas where the virus has been confirmed, and in particular the measures to be taken in the markets, may reduce the number of new cases.

Measures to reduce the risk of spreading the avian influenza virus from an infected farm/unit to an uninfected farm/unit in the affected areas and in an area known as a "moderate to high risk" area, are biosecurity measures for animal fairs, from the poultry sources to the market and that there are adequate surveillance systems in place.

The devastating economic consequences of influenza outbreaks appear both for the poultry industry and the national economy and for the society. Job losses can be significant; to control outbreaks, healthy birds often need to be slaughtered; the presence of highly pathogenic strains restricts international trade in live birds and poultry; public opinion can be affected, reducing both travel and tourism in the affected areas, reducing the consumption of poultry meat.

People in close contact with infected birds are at risk of acquiring bird flu as there is a potential nature of bird flu to infect the human population. Although many human cases are limited to conjunctivitis or a mild respiratory illness, some strains tend to cause serious illness. However, there is no evidence that the consumption of poultry meat or eggs could transmit the bird flu virus to humans. Therefore, as a precautionary and regulatory measure, birds that have been slaughtered as a measure to control an outbreak of avian influenza are excluded from the human and animal food chain.

Critical public health messages for the public in the affected areas are aimed at disrupting the epidemiological chain through warnings such as:

- "avoid contact with chickens, ducks or other birds, if not necessary";
- "prevent children from coming in contact with poultry and their waste or feathers";
- "poultry are not pets";
- "wash your hands with soap and water after coming in contact with poultry or their droppings in the affected areas";
- "clean the equipment - overalls, gown, shoes - outside the house";
- "seek for medical care if you are unwell."

Important public health messages for professionals and people handling sick birds or farm decontamination must be endorsed, as:

- Get vaccinated with the flu vaccine to avoid the simultaneous infection of the human flu virus and bird flu and to minimise the possibility of reassignment of the virus genes to people at specific risk of inhalation of possible infected materials.
- Do not allow people at high risk for severe complications from the flu (for example, immunocompromised people over the age of 60 or with known chronic heart or lung disease) to work in high-risk areas.
- Carry out serological surveillance of workers exposed to animals and veterinarians.

Cost-benefit analysis of the prevention/ surveillance/monitoring program for avian influenza in Romania

The literature reveals some empirical and theoretical contributions to analysing the costs and benefits of controlling and preventing animal diseases in developed and developing countries. Therefore, the different ways that have been used to quantify the costs and benefits of various disease-related control and prevention measures are critically analysed to identify an appropriate methodology for analysing the mitigation measures used to control/prevent the occurrence of highly pathogenic avian influenza.

In addition to the financial losses caused by the euthanasia/neutralization and mortality of birds, there are significant costs for measures to monitor, prevent and control AI given by zoonotic strains, such as H5N1, and for production losses, such as banning business for some time.

Indirect losses include exacerbated effects (such as price shocks and demand), trade impact, spillover effects (such as effects on tourism and the services sector), and effects in the broader society, such as job losses due to restriction of activity and staff illness. Many of these effects are related to society's reaction to the presence and risk of zoonotic AI strains (H5N1).

The cost-benefit analysis requires economic, epidemiological and demographic investigations, investigations that the Romanian veterinary services have already carried out in the implementation of the serological and virological surveillance program in the population of domestic and wild birds for the detection of avian influenza virus and at the same time complete reports as requested by the EC and the OIE regarding the financing or evolution of avian influenza in Romania.

The assessment of the political feasibility of the serological and virological surveillance program among the populations of domestic and wild birds for the identification of the IA virus was also carried out by the Romanian veterinary services and endorsed by the European institutions at the start of its co-financing project.

The assessment of the physical feasibility of the serological and virological surveillance program among the populations of domestic and wild birds for the identification of avian influenza virus was carried out at the time of submission to the EC of the application for co-financing of the program; as such, Romania, through the state institutions, has the necessary physical resources for the implementation of the program, a fact physically proven by its implementation since 2011.

Expected benefits are the elimination of zoonotic AIV from the territory of Romania - immeasurable, prevention of new cases (costs necessary to limit the spread of an outbreak and its liquidation, costs for protective equipment, etc.) - difficult to quantify due to the wild birds natural reservoir, reduction of financial impact due to the transmission of viral infection to humans (avoidance of a pandemic) - difficult to quantify;

EC is co-financing: 50% of the total annual cost of the program: € 359,275 X 50% = € 179,637.5 reimbursed annually by the EC.

We listed and quantified costs for one year generated by restrictions on the movement of animals , losses by limiting the commercial circulation of birds, by stamping-out in case of outbreaks, the necessary expenses for the repopulation, acquisition and performance of tests to determine inhibition of H5 and H7 haemagglutination (€ 42,000 X € 12 / test = € 504,000), collecting and transporting samples to the laboratory (21,000 X 0.5 € / sample = 10,500 €) , costs for virological surveillance of wild birds (€ 38,000); information materials for public awareness (€ 318,100), disinfectant materials, protective equipment, administrative costs, training, etc .(€ 200,000)

We proposed the minimum period for obtaining relevant results at five years considering the seasonal evolution of avian influenza, depending on the migration path of wild birds, the pathogenicity peculiarities of strains circulating at a given time in Romania, the early reaction of veterinary services for liquidation of affected outbreaks; as such, the results of a cost-benefit analysis over a longer or shorter period of time could alter the fidelity of the results.

Choosing and applying a discount rate:

VV = VP (1 + r) n VP = VV / (1 + r) n

r = interest or discount rate = 0%, with the benefits listed in the whole population of wild animals, domestic animals and among the human population by eliminating the costs of treatment;

n = time period (in years) = 5 years

***Selecting acceptance criteria*:**

NAV - discounted net value;

B / C - benefit-cost ratio;

IRR - internal rate of return (average yield);

VPB (Present Value Benefits); VPC (present value costs).
In year 1: VPB = € 1,709,016.88 if there were outbreaks in 10% of the entire bird population.
VPC = € 1,885,041.88
VNA = VPB-VPC = 1,709,016.88 - 1,885,041.88 = - € 176,025
VNA <0, the project is not economically feasible
B / C = VPB / VPC
B / C = 1,709,016.88 / 1,885,041.88 = 0.91
B / C <1, the project is not economically efficient
RIR = discount rate = 0%
In years 2, 3, 4 and 5:
VPB = 1,709,016.88
VPC = 1,885,041.88
VNA = VPB-VPC = 1,709,016.88 - 1,885,041.88 = - € 176,025
VNA <0, the project is not economically feasible
B / C = 1,709,016.88 / 1,885,041.88 = 0.91
B / C <1, the project is not economically efficient

Sensitivity analysis if the disease occurs only in +/- 5% of the herd

Variant: - 5%
In year 1. VPB = € 1,034,145.94
VPC = € 1,210,170.94
VNA = VPB-VPC = 1,034,145.94 - 1,210,170.94 = - € 176,025
VNA <1, the project is not economically feasible
B / C = 1,034,145.94 / 1,210,170.94 = 0.85
B / C <1 the project is not economically efficient
Variant + 5%
In year 1. VPB = € 3,396,194.23
VPC = € 2,559,912.82
VNA = VPB-VPC = 3,396,194.23 - 2,559,912.82 = € 836,281.41
VNA> 0, the project is economically feasible
B / C = 3,396,194.23 / 2,559,912.82 = 1.33
B / C> 1, the project is economically efficient

Writing and presenting the report

We assumed in performing the cost-benefit analysis:
- because some benefits are challenging to quantify, their values were considered 0;
- the 'costs' (losses) that arise due to restrictions on the movement of animals during the evolution of outbreaks of avian influenza being challenging to quantify were also considered 0;
- when there are no cases of avian influenza in Romania, they recover, and the effects cancel each other out.

In variant 1, the cost reduction benefits were applied to the risk of disease estimated at 10% of the poultry population, concluding - thus, the fact that the project is not efficient and is not economically feasible.

In variant 2, when applying the sensitivity analysis, one of the variables used was to consider that, the cost reduction benefits were applied to the risk of disease estimated at 5%. from the flock of birds, concluding that the project is not efficient and not economically feasible.

In variant 3, when applying the sensitivity analysis, one of the variables used was to consider that, the cost reduction benefits were applied to the risk of disease estimated at 15%—from the flock of birds, concluding that the project is efficient and economically feasible.

Considering the three variants presented and taking into account the fact that the evolution has explosive and zoonotic potential, as well as the seasonal manifestation , the project is feasible and efficient, significantly since the evolution of avian influenza exceeds 15% of the total bird population; even if the costs of monitoring the program are constant, they are much lower than the costs of controlling outbreaks affecting a large number of birds, such as B / C> 1 and NAV> 0.

Cost-effectiveness analysis of the avian influenza eradication, control and monitoring program

Direct costs are including activation and ongoing administrative, human and logistical resources, such as the use of enhanced personal, protective equipment, as part of alert response measures (Yock et all 2009).

Stages of cost-effectiveness analysis and its links to the decision-making process and the animal health environment (there should be a feedback loop):

a) the seasonal presence of avian influenza viruses with zoonotic potential, on the Romanian territory in wild/migratory birds and in domestic birds;

b) implementation of the program for surveillance and control of avian influenza coordinated at the central level;
c) serological and virological surveillance in domestic birds and active and passive surveillance among the population of wild birds. From the perspective of the program, only the results and costs faced by this program are taken into account, while from a social perspective, all significant results and costs are taken into account, regardless of who pays or who benefits;
d) acquisition of laboratory tests , costs of collecting, transporting and performing samples, administrative costs, costs of consumables, etc.;
f) the analysis of the estimated costs of the program and its effectiveness, in relation to the number of birds and the number of people to be protected from avian influenza as a result of early virus detection programs and biosecurity measures;
g) establishing the accuracy of the data and correcting them with fundamental values where necessary;
h) budget sizing (tailoring) for the control program of the avian influenza by obtaining all the necessary financement from the decision-makers.

Cost-effectiveness checklist:
1. *Identify the problem and establish the conceptual model.* What is the issue addressed? What is the purpose? Defining the expected result.
The problem addressed is the seasonal emergence of avian influenza in Romania among the population of wild/migratory birds and domestic birds.
The aim is to early identify the emergence of avian influenza in the wild birds through the active and/or passive surveillance and limit it spread toward the domestic poultry population. All this for the prevalence of zero cases of avian influenza among the human population in Romania.
2. *Establishing the analytical perspective.* What approach is used? The method to be used is established, whether only in terms of social impact or only in the actual program for the surveillance and control of avian influenza among the population of wild/migratory and domestic birds.
The average cost of the serological and virological surveillance program of the poultry population and active and/or passive surveillance of the wild bird population was about 720 thousand euros.
The costs of the program for the serological and virological surveillance of the poultry population, as well as for the active and/or passive surveillance of the wild bird population, include costs related to:
- acquisition and performing of laboratory tests (inhibition of haemagglutination, RT-PCR and virus isolation) ;
- sampling and samples transport ;
- warning campaign to the public and/or the biosecurity measures required for the population of domestic birds and even for the human population, etc.
During 2011-2017, on the Romanian territory, the avian influence evolved seasonally. For example, in 2015, between March and April, 118 dead pelicans were registered in the Danube Delta .
In 2016, in November, in the area of the of Constanța harbor, 4 dead wild birds were registered, one of which confirmed as being infected with the H5 subtype; in December 2016, in Tulcea County, the presence of an outbreak of avian influenza was confirmed, 191 birds being slaughtered from households; in January 2017, in Prahova County, 52 domestic birds were killed. In the wild bird population during 2016-2017, there were 21 cases identified in 7 counties (Constanța, Teleorman, Tulcea, Iași, Bacău, Giurgiu and Ialomița).
The target was to limit the impact of AIv present in the wild by the avian surveillance and control program in the poultry population, to avoid/reduce the number of outbreaks with the lowest burden of costs. The effectiveness of a such program is seen in the limited number of cases of avian influenza reported during 2011-2017 in Romania and the sporadic evolution of avian influenza in all MS during this period.
3. *Identify and estimate costs.* What elements need to be included and given real value for costs in conjunction with the avian influenza surveillance and control program for the poultry and wild/migratory bird population?

What are the alternate options? What is the source of the costs, and how robust are they?
The elements to be included are:
- laboratory investigations for HPAI subtypes (H5 and H7), as RT-PCR testing, virus isolation,
- sampling and samples transport
- administrative costs,
- travel and on-the-spot inspections in the event of outbreaks of avian influenza,
- training,
- neutralising materials,
- emergency slaughter equipment,
- consumables and protective equipment, etc.

The avian influenza surveillance and monitoring program in domestic and wild/migratory bird populations can be enlarged, including cases of human influenza and human-induced AI deaths.

4. *Identifying and estimating results.* What are the estimated results? How were they derived? In what time frame do they appear? How safe are the results?

This type of results can be quantified in the periods when there are no avian influenza outbreaks in the populations of domestic birds in Romania. However, the results are not 100% reliable as they depend heavily on active and passive surveillance of wild bird populations, the existence and continued funding for the implementation of the avian influenza surveillance and control program.

5. *Cost-effectiveness estimation and sensitivity analysis.* The cost-effectiveness calculation is made by relating the costs of the intervention to its efficiency. Performing a sensitivity analysis: how robust are the results? what are the key assumptions?

The cost-effectiveness ratio for the period 2016-2017 (Cost of intervention / Efficiency of intervention) is approximately 1 million euros / 21 cases of avian influenza identified in the wild birds population and 243 domestic birds slaughtered and neutralised in the Romanian outbreaks. Therefore, the cost for eradication the avian influenza outbreacks was, on average, 1 million euros.

Although at first glance, it may seem that from the mathematical approach, this ratio is zero, in fact, "21 cases of avian influenza identified among the population of wild birds and 243 domestic birds slaughtered and neutralised in the outbreak" tends to the desired goal (“a few cases of avian influenza to zero cases”) as such the cost-effectiveness ratio is maximum.

The efficiency of the intervention is represented by the decrease of the number of avian influenza outbreaks, these being reduced by more than 70%. Thus, in 2005-2006 on the Romanian territory, were notified 53 outbreacks in 5 commercial poultry farms and 122 households. Therefore, when reporting the program to the social impact, its effectiveness is significantly reduced because no avian virus infection in humans have been reported in Romania.

They calculate the program's cost-effectiveness for the eradication, control and monitoring of avian influenza for the period 2016-2017 to the social impact. As a result, it was found that approximately 1 million euros were spent to control disease in birds, plus 7.5 million euros, the cost of the human influenza vaccine .

The obtained results contain figures extracted from the official reports (Romanian Ec etc.) ; as such, they are robust data and present the current status on the Romanian territory.

Adapting sampling criteria to the circulation of HPAI strains would help retailoring the biosecurity measures and public awareness campaigns. The higher the number of samples analyzed - negative for avian influenza, the more it can be argued that the prevalence of avian influenza in Romania is lower.

The critical points identified are the monitoring of avian influenza in Romania, the improvement of the communication between veterinary services and public health services, the improvement of the the attitude of humans in order to ask doctors for the proper conduct, , through awareness of the risks related to "self-diagnosis" and "self-treatment".

6. *Feedback.* What are follow-up measures needed? How will the results be used/shared to help improve the program and further inform decision-makers?

It is necessary to continue the surveillance and control of avian influenza in Romania, with the appropriate funding by the institutions in charged, out/without of the EC co-financement. Communication through veterinary and public health channels is needed to make the human population aware of the risks related to outbreaks and on the measures that poultry

keepers can and may take to limit the emmergence of avian influenza. (applying minimum biosecurity measures, including in households).
Cost-effectiveness analysis requires multidisciplinary teams - veterinarians, disease control experts, epidemiologists, economists, etc. to measure the contributions of prevention and control interventions to the overall results of strategies and policies for eradicating, controlling and monitoring avian influenza.
By applying cost-effectiveness concepts and models, the allocation of limited resources can be improved during animal health programs and projects.

RESULTS AND DISCUSSIONS

Biosafety measures in the poultry industry - by applying the "all-in, all-out" principle - can protect this sector from AIV.
The first line of defense against bird flu is the early detection of disease outbreaks, followed by a rapid response. This is closely linked to the high degree of communication between veterinarians, animal owners and the performance of veterinary services.
Implementing warning systems and preventive measures is essential as part of an effective avian influenza prevention and control strategy. However, this approach must be combined with the preparation for eradicating a potential outbreak.
When AIV is detected in poultry flocks, the stamping-out is the requested policy to control and rapidly eradicate the disease .
Controlled disposal of infected birds, movement restrictions, improved hygiene, biosecurity, and proper surveillance lead to a significant reduction in the potential for viral contamination of the environment.
A more robust understanding of virus diversity and the trends of viral evolution could inforce biosecurity efforts in the bird and/or animal population where the virus could spread (Machalaba et al., 2015).
Early warning systems do not question whether the highly pathogenic strain of avian influenza exists in a population at a specific location and time. The limited frequency of the HPAI in wild birds and the apparent grouping of these cases present additional challenges in addressing this goal.
Although finding an infection with a highly pathogenic strain of avian influenza (H5N1) is statistically more likely in birds found dead, the absence of dead birds does not indicate the absence of the disease.
AIV risk is a real threat for traditional farms where the contact of domestic birds with the wild ones is open. The owners of subsistence farms live in direct contact with their poultry, a way of life that offers epidemiological oportunities for the transfer of AIV strains.
Traditional breeding must reconsider the growth of poultry in the open air, in order to limit the contact with wild birds and poultry in households must be kept away (isolated) from ducks, geese and wild birds, which are the natural host/reservoirs of the virus outside farms.
Many wild birds - shore and laguna birds - can become infected without developing any clinical signs. Therefore, poultry should not be in contact with these.
People who come into close contact with infected poultry, such as the families of poultry owners and workers in this sector, remain at risk.
The actions that can be taken to limit the spread of AIV are:
- sheltering poultry indoors, mainly in areas with a high density of wild birds;
- avoid keeping in the households the elements that can attract the wild birds;
- maintaining strict control over access to poultry and limiting it, to as few people as possible;
- avoiding the introduction of flocks of birds with unknown disease status;
- close monitoring and reporting of existing diseases and deaths in bird population to the veterinary services.

Globally, there has been evidence that there is no risk of human infection through the consumption of heat-processed poultry products, as this treatment inactivates the virus. Therefore, all measures to prevent and control avian influenza, followed by the supply chain, may be cancelled if improper handling of food by the producer/consumer.
The most common errors, with the potential to increase the risk of transmitting AIV, are:

- the slaughter of poultry in the household - due to preferences for "warm" or "fresh" meat or religious preferences and social/cultural practices ;
- the use of the same tools (knives, utensils and chopping boards) to process raw meat, without cleaning, and sanitation, to process raw products (vegetables);
- freshly cooked - even if there is no concrete evidence of the transmission of the avian influenza virus to humans through food consumption, this possibility cannot be ignored (AIV is inactivated above 70°C);
- improper waste management and improper disposal of hazardous waste, such as meat, skin, feathers, blood, bones, etc., outside homes and in open areas, poses potential risks not only to the uninformed consumer but also to people in the neighbourhood. Moreover, such a practice attracts other pets, such as the domestic pig, which acts as a host for the viral recombination of AIV.

CONCLUSIONS

Risk analysis is a technically sound and socially responsible way to assist industry, government and the general public.

The risk analysis carried for AI identified as significant risk factors the presence in the geographical area of Romania of susceptible wild species (wild birds); the direct or indirect exposure to wild birds and the presence of the poultry holding near wetlands, where migratory waterfowl may congregate.

The cost-benefit analysis for AI identified as non-quantifiable or difficult to quantify characteristics, the goals as: the „0" human AIV cases, the prevention of emmergency and reemergency, the the costs of losses imposed by restrictions on the movement of animals; the losses due to limiting the commercial movement of birds.

The cost of liquidating the outbreaks is challenging to quantify out of 13 elements included in the calculation.

Considering these variables, the sensitivity analysis shows that, compared to the risk of illness of more than 15% of the population, the cost of the surveillance program is justified, the B/C ratio being higher than 1.

By applying cost-effectiveness concepts and models, the allocation of limited resources can be improved during animal health programs and projects.

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