

COST Action CA17110

**Standardizing output-based surveillance to control non-regulated diseases of cattle in the EU
Workshop WG4 Report**

Deliverable D4.3 A joint research agenda for development of a framework that enables objective comparison of outputs of CPs for non-regulated cattle diseases in the EU

Luis Pedro Carmo^{1,2}, John Berezowski^{1,3}, Tanja Knific⁴, Inge Berends-Santman⁵, Maria Guelbenzu⁶

¹Veterinary Public Health Institute, Vetsuisse-Faculty, University of Bern, Switzerland

²Norwegian Veterinary Institute, Norway

³Scotland's Rural College, Scotland

⁴Veterinary Faculty, University of Ljubljana, Slovenia

⁵GD Animal Health, The Netherlands

⁶Animal Health Ireland, Ireland

Introduction

The existence of many non-standardized cattle disease control programmes in Europe results in a need for the implementation of output-based surveillance methods. Widespread use of output-based surveillance will acknowledge all actions that are taken to reduce disease prevalence and will reduce the risk of disease transmission during cattle trade resulting in improved animal health and welfare. In addition, output-based surveillance is efficient in that it makes use of data that have already been collected and are available.

One of the main goals of the SOUND control project is to encourage and support the increased use of output-based surveillance in Europe. For the successful development and implementation of output-based surveillance, current challenges must be identified and solutions proposed. Therefore, Working Group (WG) 4 aimed at collating the gaps and challenges identified by the SOUND control project and developing a research agenda to advance the use of output-based surveillance for cattle in Europe.

This document provides a summary of the methods used and results obtained by WG4 in the process of developing the research agenda. A scientific publication is currently being prepared; this manuscript will present the gaps and challenges identified and the suggested research agenda in detail and will be published on the public page of the SOUND control website after acceptance.

Methods

The process followed by WG4 for the development of this research agenda consisted of: a) identifying current gaps/challenges for the use of output-based surveillance; b) proposing solutions to overcome the identified gaps. We originally planned to use of a Theory of Change (ToC) model to create the research agenda. This would have allowed us to determine the current state of affairs and suggest a process of change in order to achieve the desired level of implementation of output-based surveillance in Europe.

A ToC model would however have required extensive collaboration between SOUND control members and various stakeholders (e.g. authorities, industry representatives, veterinarians, farmers). We also planned to use transdisciplinary methods to create the ToC. Such a strategy would have allowed us to capture the perspective of various stakeholders and would have led to the identification of efficient solutions with a high degree of stakeholder acceptance. Due to the COVID-19 pandemic we had to modify our plan, as it was not possible to conduct the extensive stakeholder activities that we originally planned. Our assessment (in particular the work conducted by Tanja Knific during her STSM at the University of Nottingham) led us to conclude that because of our inability to conduct multiple rounds of stakeholder engagement the ToC model could not be used and that an alternative strategy had to be developed.

We continued with our original overall strategy (identification of gaps, followed by proposed solutions) to develop the research agenda without using a structured ToC model. We also modified our plan so that we could still collect the opinion of multiple stakeholders, using two different surveys (for further details, please consult deliverable [D4.2](#)).

Both the gap identification and the design of the research agenda were informed by multiple activities conducted by WG4:

- *Multiple workshops with SOUND control members (in-person and online) and some external invitees, in which participatory methods were used* – these events focused on the identification of information needs, defining how output-based methods are used today and how these systems could be designed in the future;
- *Short Term Scientific Missions (STSMs) and Virtual Mobility (VM) grants* – various activities were conducted within the scope of STSMs and VMs, including summarizing results from workshops, conducting literature reviews, and design and implementation of questionnaires;
- *Surveys targeting various stakeholders* – WG4 created and implemented two questionnaires (“Bottom up” and “Top Down” approaches; for further information please consult deliverable [D4.2](#)) that targeted different stakeholders in a large number of countries. These surveys allowed us to develop a better understanding of cattle trade in Europe and to have some initial insights into roles, motivations,

disease awareness and information needs from different actors in the cattle trade industry;

- *Extensive collaboration with other SOUND control WGs* – members of other WGs are experts in different aspects related to output-based surveillance (e.g. data collection, development of control programmes, surveillance activities, methodologies to assess freedom from disease) and their experience throughout the SOUND control project was very important for identifying gaps and solutions. Working group 4 maintained close collaborative relationships with other WGs during the development of the research agenda.

Gap analysis

The gaps identified by WG4 were categorized into various groups. In this section we will describe the methods identified for each category of gaps.

Control programmes

Working group 1 documented the existing cattle control programmes in the SOUND control member countries (for further details, please consult [deliverable D1.1](#) and the publication by [Hodnik et al., 2021](#)). Large differences between countries and regions in the existence and design of control programmes for different diseases were identified (see also [van Roon et al., 2020](#)). These differences highlight the valuable contribution that output-based methods can make towards safer trade and the efficiency of output-based surveillance in terms of making use of existing data.

Disease risks and their corresponding control programmes are constantly evolving. It is difficult to keep track of a country's disease risk because of the large number of control programmes in Europe and the high degree of variability between control programmes in different countries. In order to have a reliable and standardized source of information, a registry containing information about European disease control programmes should be created, kept updated and made available to stakeholders in the cattle trade. This will require discussion and negotiation to determine who should take such responsibility for maintaining the registry and who should contribute to the costs of creating and maintaining it.

This issue is linked to another gap that was thoroughly discussed in various WG4 activities: *trust*. How can various stakeholders trust in the data collected and information provided during the trade process or, for instance, the calculation of disease freedom estimates?

The creation of international standards for design prevalence to enable substantiation of freedom from diseases for infections where at the moment no design prevalence is available on European level was also identified as a challenge. We also identified the need to develop standardized case definitions for diseased animals (per infection) that can be used by different control programmes/countries. This will help to people to compare disease risks across countries. Without having a common understanding of what represents a diseased animal it is not possible to guarantee the comparability of a surveillance specificity of 100%, which is a requirement for output-based estimates of freedom from disease.

Data and international standards

Data requirements were investigated by WG2 (please consult deliverables [D2.1](#) and [D2.2](#), as well as [van Roon et al., 2021](#) and [Rapaliute et al., 2021](#) for further details on WG2's activities). Working group 4 also identified information needs for output-based surveillance methods (deliverable [D4.1](#), [D4.1 appendix](#) and [D4.2](#)).

There are large differences between countries in various aspects related to data collection, management and storage (i.e. data accessibility, format, timeliness, security, ownership, collection methods, centralized *versus* regional collection, level - animal, farm, regional, country). This in turn might have implications on the ability of different trading partners to fulfil the information needs that were identified.

It was also brought to light that data quality and standards was highly variable between countries and diseases of interest. [Rapaliute et al., 2021](#) surveyed 24 EU countries to find out if there was sufficient data to estimate disease freedom for three diseases (IBR, BVD and paratuberculosis/Johne's disease). The study reported that there was sufficient data available in 15 countries for IBR (71.5%), 14 countries for BVD (66.7%) and 11 countries for Johne's disease (36.4%). Information about the other diseases that were controlled in these countries was not estimated and remains unknown. Lack of sufficient high-quality data also impacts not only the ability to estimate disease freedom, but also impacts the trust that trade partners have in data or information provided. Since many countries have several disease control programs, the harm that can be caused by disease transmission during intra-community trade is not limited to just one or two diseases. In order to minimize disease transmission risk, farmers in purchasing countries would need to know the disease risk status for several diseases in the selling country and on the farms in that country which they are purchasing cattle from. However, most countries have sufficient high quality data for one, two or fewer diseases.

Methods

Working group 3 was responsible for identifying the methodological gaps that must be filled to allow the development of output-based surveillance. For further details about WG3's activities, please consult deliverables [D3.1](#) and [D3.3](#). In addition, a publication by Meletis et al. discussing methodological approaches to substantiate freedom from disease is currently under review.

WG3 concluded that sufficient methods are available for estimating freedom from disease (with an associated level of confidence) for regions where a disease is absent, and for estimating freedom from disease (with an associated level of confidence) on farms within regions where a disease is endemic. However there is still a methodological challenge in that it is difficult to prove disease freedom on individual farms in countries where the disease prevalence is very low (approaching zero). There are also other methods that have been developed to provide additional functionality.

A remaining methodological gap is the estimation of system sensitivity and specificity for passive surveillance. All countries are required to have a high quality veterinary service which is capable of outbreak investigation and a full service diagnostic system that can determine the aetiology of diseases in cattle with a high degree of certainty. These systems create a considerable amount of data which could be used for surveillance. However, passive data are a biased sample because they are dependent on farmers voluntarily submitting data, samples or animals for surveillance. Farmers decisions to submit can be highly influenced by many factors including trust of the authorities, value of the animal, stigma associated with having a disease and other factors. There are currently no methods that have been developed for using this data in freedom from disease estimates.

One of the challenges reported by WG3 is that standards for freedom (design prevalence and level of confidence) have not been accepted for intra-community trade. A participatory process involving farmers, traders, disease control agencies and others should be implemented that helps these stakeholders to understand the importance of these concepts and then to create agreed upon standards should be implemented.

Both the methods and the interpretation of the results are complex, which makes it difficult for stakeholders to thoroughly understand the process and the outputs of these methods. Currently, these methods can only be implemented and interpreted by highly trained specialists, at considerable cost, putting these methods out of reach for all but the largest cattle farmers. Freedom from disease estimates must be updated frequently because countries that export cattle also import cattle, which are an avenue for re-introduction of pathogen. Candidate organizations with the capacity to create and update disease freedom estimates are limited to large organizations such as industry organizations and governments.

Working groups 3 and 4 collaborated in a scientific literature review about the use of scenario tree models in animal health surveillance. A publication is being drafted. One of its main conclusions is that reporting guidelines are needed. Standardized reporting techniques in the scientific literature can help the dissemination of the methods and improve readers understanding of the methodological process.

Finally, the cost-effectiveness of these methods should be evaluated at a regional, country and EU level. For example, currently it is not known whether it is more economical for countries to implement output-based surveillance compared to standards based surveillance.

Outputs and communication

As previously described, the outputs from the methods used to substantiate freedom from disease can be quite complex to interpret. User needs will vary substantially depending on the stakeholder. This requires output-based solutions to be highly adaptable and communication of results shaped in accordance to end user preferences.

It is likely that a “one size fits all” solution will not work and different communication strategies and tools will need to be developed in order effectively communicate to different users ([Biesheuvel et al., 2021](#)). In reality not all farmers comply with the regulations which result in their being a risk of reintroducing diseases, not only for themselves but also for other farmers. How to communicate in such a way that the message is clear for all groups and types of farmers warrants networking between scientists and communication experts. Additionally, even when farmers understand the importance of following the rules set out by the disease control programme, this will not in all cases lead to compliance. This will also depend on the mindset of the farmer: their beliefs, values, morals and emotions. Complicating this is the large variety in mindsets between farmers living in different countries related to their cultural differences.

Stakeholders

Working group 4 explored the roles, motivations, knowledge and needs of different stakeholders (see deliverable [4.1](#) and [4.2](#) for additional details). It must be stressed that our work constitutes a preliminary overview and that further investigations are required to explore these further. Our results showed that there are many different elements that can influence the decision-making process of farmers regarding intra-EU cattle trade. We also concluded that the motivations, roles, disease awareness and information needs of various stakeholders vary considerably.

From the discussions held with the other WGs and our experience in the SOUND control project, it became apparent that transdisciplinary methods should be used in the development and implementation of output-based surveillance. It is critical that various actors from the cattle production and trade chains are involved in the discussions that shape the design of tools that can improve the decision-making process. Including these stakeholders in the design process will ensure that stakeholders understand these methods and their value, and will increase the likelihood that the methods will become widely accepted.

Because of the complexity of output-based estimation methods, training programs will need to be developed for both analysts who conduct freedom from disease estimations and for the stakeholders who use the information to make decisions about trade.

Research agenda

The deliverable this document addresses focused on the development of a research agenda. While some of the points mentioned below are indeed research oriented, we realized that to overcome certain gaps, changes in policy and capacity will be required. Therefore, not all the suggested actions relate to research, making this section a general agenda for the development and implementation of output-based surveillance.

Control programmes

Control programmes vary considerably between countries. To the best of our knowledge, the motivations and prioritization strategies by policy-makers who have developed these programmes has been poorly investigated. Being aware of the motivations behind this particular group of stakeholders, would contribute to the understanding of what incentives and barriers would need to be overcome for the implementation of output-based surveillance. Research to better understand these aspects, as well as the determinants of the evolution of control programmes over time, should be conducted.

Pathogens and the diseases they cause change constantly requiring constant modification of disease control programmes. Organizations planning to substantiate freedom from disease will need to be well resourced, sustainable and responsive to the changes in diseases and disease control programmes. Having an overview of this constantly changing landscape should be a priority. To meet this need the SOUND control project created an [R Shiny app](#) to document cattle control programmes and some of their characteristics. Members of the SOUND control project will try to maintain the app in the future. However, this is not a viable long-term option and more sustainable and accessible solutions that include more detailed information about the control programmes will need to be developed. To achieve

this, it will be important to know which institutions will be using this tool in order to negotiate cost for development of the app and maintenance responsibilities. Another option would be to explore whether European organizations can provide support for the maintenance of such tool.

Such a tool could be informed by a standardized output-based framework for the description of control programmes. Developing this framework will require applied research. It should consist of templates with clear descriptions of control programmes including the different surveillance strategies and testing regimes that are currently being used in Europe. The framework should identify the different stages of control for each disease, so that countries/regions can be guided with respect to the options available, so they can adopt the most appropriate ones for the situation within their country.

International standards

We also identified the need for international standards and common agreements related to various aspects of disease control programmes, including case definitions for disease, and definitions of livestock production types, livestock breeds, age categories, and others. There is a need for the creation of evidence-based design prevalences and confidence levels for disease freedom estimates. In order to ensure acceptance by stakeholders, these standards should be based on evidence and agreed upon by a broad range of stakeholders from across Europe. We recommend that a stakeholder assessment is conducted to identify which stakeholders should be included in this process.

Data

Currently there is sufficient high-quality data to estimate disease freedom for only a couple of diseases, and the data for these diseases is only available in just over half of the EU countries studied ([Rapaliute et al, 2021](#)). This same study reported that data quality and standards are highly variable across EU member states, making it unlikely that a “one size fits all” method for estimating disease freedom can be developed. An investment in data collection systems, both in terms of infrastructure and training is required before output-based surveillance can become widely accepted in Europe. Applied social science research will be required to identify barriers to data collection and to design incentives for improving data collection.

In order to make data collection improvements easier for member states, applied research will be required to develop useful and acceptable methods to simplify data collection and to provide economical user-friendly methods to automate data collection, processing, analysis

and reporting. Working group 2 developed data collection tool relevant for comparison of output-based surveillance that can be used as a starting point ([D2.2](#)).

Research investigating the tangible benefits accruing from data collection will be beneficial for demonstrating the value of investing in improved data collection systems. The results of these cost-benefit analysis will vary between countries and diseases. However, providing concrete examples that demonstrate the advantages of investing in data collection systems will help to encourage improvements. Research evaluating the costs and benefits of collecting risk factor data will be beneficial for promoting improvements in risk-factor data collection.

We propose participatory approaches that include the stakeholders who make decisions about intra-community trade in research aimed at improving data collection systems. Including stakeholders will help to educate them about the value of having better disease control data. It will also demonstrate the value of the information produced from improved data collection which can lead to systemic improvements in the data collection processes for all control programmes.

Methods

The methods currently available for estimating disease freedom are very complex to implement. Future research should investigate methods that are simpler and easier to apply and interpret or should further develop the existing models so that they can easily be used by stakeholders. In the meantime, the use of these methods will require the development of training programmes to educate analysts in all trading countries in Europe. Training should be adapted to the skill level, interest and role of different analysts, including epidemiologists, researchers or other analysts who will be designing disease freedom studies and calculating disease freedom. Training analysts will increase the capacity for output-based surveillance across Europe and will raise the level of awareness and understanding about output-based surveillance. Training should also aim to support stakeholders in how to interpret the output-based results. The communication strategy in this training should be tailored.

We suggest the development of a methodological toolbox, similar to the tools developed by the RiskSur project (<https://www.fp7-risksur.eu/>) to guide analysts in the selection of the most appropriate methods according to the circumstances.

We identified a need to develop guidelines for scientific literature reporting of output-based methods. Standardized reporting will improve common understanding about these methods, increase reproducibility of output-based surveillance techniques and ultimately promote their uptake.

Another research gap that was identified is the uncertainty in the sensitivity (Se) and specificity (Sp) estimates for passive surveillance. During our review, we verified that many of the inputs into estimates of passive surveillance Se and Sp are based on expert opinion. Research is needed to develop evidence-based methods that can create credible quantitative estimates of passive surveillance Se and Sp.

Outputs and tools

The results generated from output-based methods are still complicated and difficult for many of the people involved in cattle trade to understand and interpret. Social science research is needed to understand how to communicate outputs to end users and to develop information products that are acceptable to them. Based on the results of this research, training programmes that focus on the best communication practices, tools, and products should be developed and delivered to stakeholders in EU countries.

To help cattle purchasers to better assess the disease risk associated with trade, we suggest creating trade information checklists that provide recommendations for minimum information requirements that buyers should obtain from their trading partners. The checklists could be made available on an online website that is accessible to cattle buyers across Europe. The consortium also discussed the possibility of developing an app to inform cattle purchasers about the disease status of individual seller farms and the risk of disease introduction by conducting a specific transaction. This app could also include up to date information about all the disease control programmes in European countries, providing one website that has all disease related information needed for making decisions about cattle trade. This would require a centralized data storage and analysis platform. Access to seller's information would only be granted to the purchaser upon approval.

Cost-effectiveness

Cost-effectiveness of output-based surveillance, compared with input-based methods, will always be dependent on country specific circumstances and disease of interest. To our knowledge, macro- economic studies exploring these benefits are limited. We recommend additional research to produce more examples demonstrating the benefits of output-based surveillance in order to promote more widespread acceptance of the method.

Training and education

Training will be critical for overcoming the challenges impeding the acceptance of output-based surveillance. Training will need to be conducted at various levels and adapted

according to the target audience. There is also a need to “train the trainers”. It will be important to train not only the end users of outputs generated by these methods, but also those that are providers of animal health information (e.g. veterinarians play an important role in the dissemination of information to farmers). Social science research should be conducted to provide more detailed insights into how to raise awareness about control programmes, what the role of veterinarians is in the education of farmers and what are the routes of information flow used by different actors in the cattle production and trade chains. Based on the findings from the above research, it will be important to train veterinarians on how to better explain disease risk related to trade and control programmes to farmers. We also propose the creation of training modules for young veterinary officers in order to enhance their understanding of surveillance, epidemiology and output-based surveillance. It will also be important to raise awareness of chief veterinary officers about the importance and advantages of output-based techniques.

Trust

Trust was identified as playing an important role in various aspects related to the cattle trade process – e.g. what are the determinants of trust in data provided by sellers? How is trust built between individuals who are trade partners? And between countries? Social science research is needed to develop a better understanding of the determinants that foster trust and develop adequate strategies to promote trust between trading partners.

Transdisciplinary approaches

Transdisciplinary approaches will greatly speed the design, implementation and acceptance of output-based surveillance. We believe that the successful development and implementation of output-based surveillance will require the input from various scientific branches as well as the active participation of many stakeholders. This applies to all the research and capacity building initiatives suggested above, from developing a better understanding of the control programme prioritization to the creation of adequate tools for end-users of output-based surveillance.

Closing remarks

Working group 4 collated gaps and challenges that might be hindering the widespread implementation of output-based surveillance for cattle in Europe. We developed an agenda proposing both research and capacity points to address the challenges. Further details on our methods and results will be presented in a publication that is currently being prepared.