SOUND-control

Final progress report COST Action CA17110: Standardizing output-based surveillance to control non-regulated diseases of cattle in the EU

November 2022

Summary

The main aim and objective of the Action is to:

Coordinate, stimulate and assist with initiatives to explore and implement a widely adaptable output-based framework applicable to substantiate the confidence of freedom and costs-effectiveness in current surveillance, control or eradication programmes for endemic cattle diseases in the EU.

The Action addressed this as described below

In the SOUND-control Action, over 100 multidisciplinary researchers from 32 European countries and Canada collaborated in five working groups on the topic of stimulating output-based surveillance. Working group (WG) 1 defined key terms for the Action, e.g. cattle diseases without mandatory regulations in the EU and control programme (CP). A list of diseases within the scope of the Action was compiled and an overview of control activities in member countries for each disease (D1.1) incorporated into a digital dashboard to provide easily accessible information on status of these diseases for Action members. Through a Frontiers Research Topic, initiated by Action members, a handbook with comprehensive description of the CPs for cattle diseases in member countries (D1.3) was published. A joint effort between WG1 and WG2 led to development of a digital and open-access data collection matrix, which was used to collect quantitative data from each Action member to contribute to an output-based framework for surveillance. Methods currently existing for output-based surveillance were evaluated (D3.1) by WG3 and disseminated through webinars and several workshops. The work of WG3 also highlighted gaps that need to be addressed for implementing output-based methods. WG4 collected all gaps in output-based surveillance from the perspective of Action members, decision makers, industry stakeholders and farmers throughout Europe. The results with their implications and possible solutions were discussed and ultimately served as basis for the research agenda (D4.3) for further development and implementation of output-based surveillance. Dissemination and communication of Action work was led by WG5 and resulted in a comprehensive and active website, regular newsletters, many dissemination activities during the Action and creation of video materials related to output-based surveillance. To support and promote better understanding of topics fundamental to this Action – including surveillance, epidemiology and risk analysis – two training schools were organized and expert speakers were invited to deliver webinars on relevant topics. Material from all webinars, presentations and one of the training schools were converted to video content and published on the SOUND-control YouTube channel. All materials are made freely available to colleagues external to the Action.

Action website

WWW.SOUND-control.eu

Contents

Status MoU objectives

Research Coordination objectives

1. **Combine knowledge from numerous disciplines, including veterinarians, epidemiologists, economists, sociologists and stakeholders from governmental organizations and industry (All WG).**

Type of objective:

1a: Development of a common understanding/definition of the subject matter

2a: Building a community around a topic of scientific and/or socio-economic relevance, allowing for knowledge exchange and the development of a joint research agenda

2c: Bridging separate fields of science/disciplines to achieve breakthroughs that require an interdisciplinary approach

Level of achievement: 100%

Throughout the Action we discussed all matters that were relevant for the Action with our WG members who have a multidisciplinary background. In the Action more than 100 researchers and stakeholders participated from 33 different countries. Together we described the CPs that are in place for endemic cattle diseases in all member countries through publication of a series of papers, we developed a data collection matrix to easily collect relevant data for output-based surveillance (Van Roon et al., 2021; Rapaliute et al., 2021) and we described the methods that are available for output-based surveillance (Madouasse et al., 2022; Meletis et al., 2022a). Additionally, we identified the remaining gaps through discussions with our multidisciplinary group of researchers and identified the needs related to output-based surveillance in stakeholders and farmers within the participating countries. This has resulted in recommendations for further development (Meletis et al., 2022b) and a final research agenda (Carmo et al., 2022; Knific et al., 2022) on how to continue to move towards output-based surveillance in the future.

Handbook: https://www.frontiersin.org/research-topics/15433/global-control-and-eradication-programmes-for-cattle-diseases#articles.

Carmo et al., 2022: https://sound-control.eu/wp-content/uploads/2022/11/SOUND-control_Deliverable-D4.3_Final_v3.pdf

Knific et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/Towards-output-based-surveillance-of-transmissible-cattle-diseases_-challenges-and-opportunities.pdf

Rapaliute et al., 2021: https://www.frontiersin.org/articles/10.3389/fvets.2021.689375/full

Madouasse et al., 2022: https://sound-control.eu/wp-content/uploads/2021/12/Deliverable-3.1.-Output-based-methodological-approaches-for-substantiating-freedom-from-infection.pdf.

Meletis et al., 2022a: Output-based methodological approaches for substantiating freedom from infection. Preventive Veterinary Medicine, under review.

Meletis et al., 2022b: https://sound-control.eu/wp-content/uploads/2022/10/deliverable_3.3.pdf

Van Roon et al., 2021: https://www.frontiersin.org/articles/10.3389/fvets.2021.656336/full

2. Identify and reach agreement on the requirements (both scientific and practical) that should be met by a framework that aims at an objective comparison of the output of CPs for non-regulated cattle diseases in the EU (WG1).

Type of objective:

1a: Development of a common understanding/definition of the subject matter

1f: Achievement of a specific tangible output that cannot be achieved without international coordination (e.g. due to practical issues such as database availability, language barriers, availability of infrastructure or know-how, etc.)

2c: Bridging separate fields of science/disciplines to achieve breakthroughs that require an interdisciplinary approach

Level of achievement: 100%

The first two grant period (GP) WG meetings and a WG1 and WG2 workshop were dedicated to identifying the requirements that should be met by an output-based framework. The requirements not only depend on 'what is desired' but also on 'what is possible'. For this WG2 evaluated both data availability and data quality in the third GP. WG3 evaluated the methods that are currently available for output-based surveillance. Additionally, WG4 queried various stakeholders (e.g. farmers, academics, governmental official, industry actors) about their needs in order to trust CPs for endemic cattle diseases in other countries (Deliverable 4.1 & D4.2, for more detailed information: Cerf et al., 2022; Duarte et al., 2022; Paarlberg et al., 2022). The final requirements on both methodological and practical aspects were summarized in deliverable 3.3 (Meletis et al., 2022) and in deliverable 4.3 (Carmo et al., 2022 and Knific et al., 2022).

Deliverable 4.1: https://sound-control.eu/wp-content/uploads/2022/10/SOUND-control_Deliverable-4.1_Final.pdf

Deliverable 4.2: https://sound-control.eu/wp-content/uploads/2022/10/SOUND-control_Deliverable-4.2_Final.pdf

Deliverable 4.3: https://sound-control.eu/wp-content/uploads/2022/11/SOUND-control_Deliverable-D4.3_Final_v3.pdf

Carmo et al., 2022: https://sound-control.eu/wp-content/uploads/2022/11/SOUND-control_Deliverable-D4.3_Final_v3.pdf

Cerf et al 2022: https://sound-control.eu/wp-content/uploads/2022/10/Who-are-the-stakeholders-involved-in-the-decision-making-process-regarding-intra-EU-cattle-trade-and-non-EU-mandatory-regulated-diseases_.pdf

Duarte et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/SOUND-control-Virtual-Mobility-grant_-applying-the-top-down-approach-in-Portugal-to-better-understand-the-decision-making-process-in-the-cattle-trade.pdf

Knific et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/Towards-output-based-surveillance-of-transmissible-cattle-diseases_-challenges-and-opportunities.pdf

Meletis et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/deliverable_3.3.pdf

Paarlberg et al., 2022b: https://sound-control.eu/wp-content/uploads/2022/10/SOUND-control_-Collecting-stakeholder-data-in-the-Netherlands-for-the-top-down-and-bottom-up-approach-and-analyses-of-the-data-collected-for-the-bottom-up-approach-acros-1.pdf

3. **Identify the non-regulated cattle diseases for which control, eradication and/or surveillance are currently being conducted in the EU (WG1). The framework should be applicable to a large number of diseases, but will initially be designed for a few example diseases with considerable variation between MS.**

Type of objective:

1a: Development of a common understanding/definition of the subject matter

1b: Coordination of information seeking, identification, collection and/or data curation

1f: Achievement of a specific tangible output that cannot be achieved without international coordination (e.g. due to practical issues such as database availability, language barriers, availability of infrastructure or know-how, etc.)

Level of achievement: 100%

The cattle diseases that were included in this COST Action were defined by mutual agreement. The diseases, the country status and control efforts of each of the countries that participated in this Action are described in deliverable 1.1: Overview of cattle diseases in the European Union for which CPs are in place within Member States (MS). A series of papers on this topic was published as a handbook (deliverable 1.3). Additionally, a dedicated paper to report the results of deliverable 1.1 was published by Hodnik et al., 2021. Finally, we created and published a dashboard to enable countries to easily access and find the status with regard to control of endemic cattle diseases in the participating countries (Dashboard SOUND-control). For easy access, we created a button on our home page that is clearly visible when going to the SOUND-control website.

Link to the handbook: https://www.frontiersin.org/research-topics/15433/global-control-and-eradication-programmes-for-cattle-diseases#articles.

Dashboard SOUND-control: https://shiny.fli.de/ife-apps/SOUNDcontrol/

Dashboard SOUND-control2: https://sound-control.eu/a-shiny-app-to-present-the-results-of-wp1-has-been-developed/

Hodnik et al., 2021: https://www.frontiersin.org/articles/10.3389/fvets.2021.688078/full

4. **Evaluate the availability and quality of the heterogeneous data that is needed as an input for an output-based framework. This will be evaluated at each level of aggregation and for each of the countries involved in the SOUND-control Action (WG2).**

Type of objective:

1b: Coordination of information seeking, identification, collection and/or data curation

Level of achievement: 100%

Data-collection tools were developed through several STSMs and a workshop with WG2 members (Van Roon et al., 2021). The first draft of a tool was initially tested for two countries, and subsequently reviewed and optimized. Eventually, the data collection tool in MS Excel was digitalized with LimeSurvey software and sent to WG2 members to be tested. After a final evaluation round, in June 2020, the tool was sent to SOUND-control members representing their country. The SOUND-control members either filled the data collection tool or made sure somebody from their country provided the necessary data on cattle demographics, control programmes for IBR, BVD and Johne's disease and risk factors for disease transmission. The respondents also had to assess the quality of the data based on four criteria (e.g. timeliness, accessibility, completeness, accuracy). In total 32 countries were asked to fill the questionnaire and results were obtained from 23 countries. The data were subsequently analyzed and are published in a scientific publication (Rapaliute et al., 2021).

Rapaliute et al., 2021: https://doi.org/10.3389/fvets.2021.689375

Van Roon et al., 2021: https://www.frontiersin.org/articles/10.3389/fvets.2021.656336/full

5. **Evaluate existing methods enabling output-based comparison of CPs and identify gaps (WG3).**

Type of objective:

1a: Development of a common understanding/definition of the subject matter

1b: Coordination of information seeking, identification, collection and/or data curation

1.d: Comparison and/or performance assessment of a theory, model, methodology, technology or technique

Level of achievement: 100%

Within the Action, the methods that are or could be applied in output-based surveillance were reviewed and evaluated in WG3. During a number of STSMs the different methods were tested and a table was created to describe which method could best be applied in which situation. Based on the findings, WG3 provided a webinar for the whole SOUND-control consortium (Madouasse & Melitis 2021), organized a workshop for a wider audience at the SVEPM 2022 conference in Belfast, Ireland and during a COST Harmony training school in 2022 in Berlin. The results of this deliverable are available on the public site of the website as a summary (Meletis et al., 2020) and the workshop materials can be freely accessed on GitHub (https://github.com/LefMel/SVEPM_2022_wk). The complete results are written in a scientific paper that is currently under review (Meletis et al., 2022). Once the paper is accepted for publication, it will be linked to on our public page.

Meletis et al., 2020: https://sound-control.eu/wp-content/uploads/2021/12/Deliverable-3.1.-Output-based-methodological-approaches-for-substantiating-freedom-from-infection.pdf

Madouasse and Meletis, 2021: https://youtu.be/NYw1T2bu918

Meletis et al., 2022: Output-based methodological approaches for substantiating freedom from infection. Preventive Veterinary Medicine, under review.

6. **Encourage research initiatives that aim to take the next steps into development of innovative methodologies that tackle the gaps identified in WG3, including mathematic, epidemiologic, economic and social science methods, and facilitate the possibilities for short term scientific missions (STSMs) to combine expertise from different research areas (WG4).**

Type of objective

1.a - Development of a common understanding/definition of the subject matter

1.b - Coordination of information seeking, identification, collection and/or data curation

2.a - Building a community around a topic of scientific and/or socio-economic relevance, allowing for knowledge exchange and the development of a joint research agenda

2.b - Building a community around a new or emerging field of research

2.d - Acting as a stakeholder platform or trans-national practice community, pertaining to a certain area of socio-economical or societal application, or to a certain market sector

Level of achievement: 100%

An initial stakeholders meeting was held in Warsaw in January 2020. During this meeting experts (surveillance and animal health experts from the SOUND-control COST Action and some external experts) took initial steps towards the development of an internationally shared and agreed upon set of information needs for output-based surveillance. The COVID-19 pandemic hindered the initial plan from WG4, which included several in-person activities with stakeholders. Due to the limitations imposed by the pandemic, WG4 collected information from various stakeholders via two surveys (Deliverable 4.2, Cerf et al., 2022; Paarlberg et al., 2022). During several STSMs and VMs possibilities were explored to take the next steps in the development of output-based models. In a collaborative effort from WG3 and WG4, members from both groups worked in a review about the use of scenario tree methods for surveillance purposes. Additionally, during a number of WG3 STSMs different possible methods for output-based surveillance were explored (Ardelean et al., 2019; Meletis et al., 2019, 2020 and 2022; Delalay et al., 2022a and 2022b; Fanelli et al., 2022; Farra et al., 2022).

Deliverable 4.2: https://sound-control.eu/wp-content/uploads/2022/10/SOUND-control_Deliverable-4.2_Final.pdf

Paarlberg et al., 2022b: https://sound-control.eu/wp-content/uploads/2022/10/SOUND-control_-Collecting-stakeholder-data-in-the-Netherlands-for-the-top-down-and-bottom-up-approach-and-analyses-of-the-data-collected-for-the-bottom-up-approach-acros-1.pdf

Ardelean et al., 2019: https://sound-control.eu/wp-content/uploads/2020/04/STSM-scientific-report-2019-11-Ardelean-A-WG3-STSM3-Review-and-ranking-of-methods-for-the-estimation-of-a-probability-of-freedom-from-infection.pdf

Cerf et al 2022: https://sound-control.eu/wp-content/uploads/2022/10/Who-are-the-stakeholders-involved-in-the-decision-making-process-regarding-intra-EU-cattle-trade-and-non-EU-mandatory-regulated-diseases_.pdf

Delalay 2022a: https://sound-control.eu/wp-content/uploads/2021/12/STSM_scientific_report-_CA17110_DelalayG_2021.pdf

Delalay 2022b: https://sound-control.eu/wp-content/uploads/2022/10/Grant-report-Delalay.pdf

Fanelli et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/Application-of-a-scenario-tree-model-on-data-collected-about-Enzootic-Bovine-Leukosis-EBL-control-programmes-CPs.pdf

Farra et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/Grant-report-V2-Dima-Farra.pdf

Meletis et al., 2019: https://sound-control.eu/wp-content/uploads/2020/03/STSM-scientific-report-2019-10-Meletis-E-Evaluation-of-statistical-methods-for-the-estimation-of-a-probability-of-freedom-from-infection.pdf

Meletis et al., 2020: https://sound-control.eu/wp-content/uploads/2020/03/STSM-scientific-report-2020-01-Meletis-E-WG3-STSM2-Evaluation-of-machine-learning-methods.pdf

Meletis et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/Report.pdf

7. **Disseminate the knowledge that is achieved during the SOUND-control Action and encourage incorporation of an output-based framework both on national and European level (all WG, but specifically addressed by WG5).**

Type of objective

1.e - Development of knowledge needing international coordination, pertaining to a new or improved theory, model, methodology, technology or technique

1.g - Input to stakeholders (e.g. standardization body, policy-makers, regulators, users), excluding commercial applications

1.i - Dissemination of research results to the general public

1.j - Dissemination of research results to stakeholders (excluding specific input in view of knowledge application)

Level of achievement: 100%

In the first half year of the project, a website was developed (www.sound-control.eu) that could act as platform to disseminate the results of the Action besides all other dissemination activities. A flyer was

developed and distributed in all countries that participate in the Action. To ensure maximal exposure in the scientific community SOUND-control groups were created on platforms such as Research Gate and LinkedIn. A paper was written and accepted for publication in Preventive Veterinary Medicine, in which the project and its aim was presented in more detail (Costa et al., 2020). Several SOUND-control members presented the project to their national stakeholders and a short narrative was written in the native language of some of the COST members which was also shared with relevant stakeholders. To keep interested people updated on the progress of the Action, there was the possibility to subscribe to the annual newsletter and the project has been continuously presented through poster and oral presentations at relevant conferences. In total, five newsletters will be published and disseminated, 28 scientific publications were published and there are more to come. We created our own YouTube channel where we published a series of video materials on monitoring and surveillance, presentations of work conducted as part of this Action and webinars on selected topics related to output-based surveillance (can be accessed via the home page of our website). Finally, a summary of the results of SOUND-control will be presented to all interested stakeholders after the Action is finished through a webinar that will be recorded and saved on our YouTube channel. The website will be kept alive for the coming years and will be kept up to date with relevant news-items and by adding materials related to the work conducted as part of this Action.

Costa et al., 2020: https://doi.org/10.1016/j.prevetmed.2020.105130

Website: www.sound-control.eu

Training school on monitoring and surveillance, recording: https://www.youtube.com/-channel/UCyLLEpMF_LElyzRHpCJH4fQ, materials https://sound-control.eu/reports-publications/

Webinars and pitch presentations: https://www.youtube.com/channel/UCyLLEpMF_LElyzRHpCJH4fQ

Workshop on output-based methods: https://github.com/LefMel/SVEPM_2022_wk

Posters and scientific papers on SOUND-control: https://sound-control.eu/reports-publications/

Dashboard SOUND-control: https://shiny.fli.de/ife-apps/SOUNDcontrol/

Dashboard SOUND-control2: https://sound-control.eu/a-shiny-app-to-present-the-results-of-wp1-has-been-developed/

YouTube channel SOUND-control: https://www.youtube.com/channel/UCyLLEpMF_LElyzRHpCJH4fQ

Ebook: https://www.frontiersin.org/research-topics/15433/global-control-and-eradication-programmes-for-cattle-diseases#articles

LinkedIn: https://www.linkedin.com/groups/8740517/

ResearchGate: https://www.researchgate.net/project/COST-Action-CA17110-Standardizing-OUtput-based-surveillance-to-control-Non-regulated-Diseases-of-cattle-in-the-EU-SOUND-control.

1. **Fostering knowledge exchange on the characteristics of CPs conducted for relevant non-regulated cattle diseases in the EU in cattle (WG1).**

Type of objective

1.a - Development of a common understanding/definition of the subject matter

2.a - Building a community around a topic of scientific and/or socio-economic relevance, allowing for knowledge exchange and the development of a joint research agenda

2.e - Building capacity in the demographic inclusiveness of networks in science and technology, including representation of newly established research groups, Early-Career Investigators, the underrepresented gender and teams from countries/regions with less capacity in the field of the Action.

Level of achievement: 100%

In WG1 a lot of knowledge was exchanged between the SOUND-control members given that the main tasks of this work group involved sharing information and discussion on CPs. In the second half of our Action we published over 20 papers with a description of the disease CPs in place for cattle diseases in many of the countries participating in this COST Action. The collaboration in the writing of these articles and the results that are publicly available resulted in a major knowledge exchange that will even go on beyond the Action. Participating in this Action resulted in becoming part of a group of researchers with a shared interest in monitoring, surveillance and control of endemic diseases that will be sustained beyond the lifetime of the Action. This will provide the opportunity to keep learning from each other and collaborate in future projects.

2. **Generating a handbook or wiki page that can be accessed to acquire information on country specific CPs that are applied for non-regulated cattle diseases in the EU (WG1).**

Type of objective

1.b - Coordination of information seeking, identification, collection and/or data curation

1.f - Achievement of a specific tangible output that cannot be achieved without international coordination (e.g. due to practical issues such as database availability, language barriers, availability of infrastructure or know-how, etc.)

1.g - Input to stakeholders (e.g. standardization body, policy-makers, regulators, users), excluding commercial applications

1.i - Dissemination of research results to the general public

1.j - Dissemination of research results to stakeholders (excluding specific input in view of knowledge application)

Level of achievement: 100%

Due to the challenges related to the COVID-19 pandemic, WG1 decided to approach this deliverable by trying to push for a special topic on control of endemic diseases at the scientific journal Frontiers in Veterinary science. A proposal was submitted and accepted and during the second half of 2020 and the first half of 2021 many members of the SOUND-control consortium worked on scientific papers to describe the disease control programmes in place for endemic cattle diseases in their country. This Action resulted in more than 20 papers describing disease control programmes in cattle in the COST countries and these were collated and published as an Ebook. The link to this Ebook can be found on the Action's website. In addition, all the individual publications were also published on our website. On top of the handbook, WG1 created a digital dashboard in which all interested people can easily find which cattle disease programmes are in place in which countries. A link to this dashboard is published on the SOUND-control website.

Dashboard SOUND-control: https://shiny.fli.de/ife-apps/SOUNDcontrol/

Dashboard SOUND-control2: https://sound-control.eu/a-shiny-app-to-present-the-results-of-wp1-has-been-developed/

Ebook: https://www.frontiersin.org/research-topics/15433/global-control-and-eradication-programmes-for-cattle-diseases#articles

3. **Fostering experience on available methodologies that might be used (in an adapted form) for an objective comparison of output of different CPs and different initial situations with regard to the disease status (WG2, WG3).**

Type of objective

1.d - Comparison and/or performance assessment of a theory, model, methodology, technology or technique

2.e - Building capacity in the demographic inclusiveness of networks in science and technology, including representation of newly established research groups, Early-Career Investigators, the underrepresented gender and teams from countries/regions with less capacity in the field of the Action

Level of achievement: 100%

In WG3, members that were experienced in the application of methodologies that could be used for output-based surveillance presented their methods to the members of the Action. STSM possibilities were advertised to provide the opportunity to obtain more in-depth experience with several methods. Eventually, an evaluation of different output-based methods was conducted (Ardelean et al., 2019). Also, a thorough review on the use of scenario tree models for surveillance purposes was performed of which a publication is currently being drafted (Delalay 2022a; Delalay 2022b; Farra 2022). Additionally, the STOC free method was tested using data from the Danish *Salmonella* Dublin surveillance programme (Meletis 2022). The potential for artificial intelligence in output-based surveillance was evaluated (Meletis 2019, 2020 and 2022) and the scenario tree method was applied to the case of bovine leucosis in multiple countries (Fanelli et al., 2022). To stimulate the uptake of output-based methods, a training school was organised on the topic of scenario tree modelling from 13-15 June 2022 in Ljubljana, Slovenia. Additionally, the findings of WG3 were presented during a

SVEPM and COST Harmony workshop and all materials are made available to the general public (Madouasse and Meletis, 2022)

Ardelean et al., 2019: https://sound-control.eu/wp-content/uploads/2020/04/STSM-scientific-report-2019-11-Ardelean-A-WG3-STSM3-Review-and-ranking-of-methods-for-the-estimation-of-a-probability-of-freedom-from-infection.pdf

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Delalay 2022b: https://sound-control.eu/wp-content/uploads/2022/10/Grant-report-Delalay.pdf

Fanelli et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/Application-of-a-scenario-tree-model-on-data-collected-about-Enzootic-Bovine-Leukosis-EBL-control-programmes-CPs.pdf

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Madouasse, A., Meletis, E., 2022: https://github.com/LefMel/SVEPM_2022_wk

Meletis 2019: https://sound-control.eu/wp-content/uploads/2020/03/STSM-scientific-report-2019-10-Meletis-E-Evaluation-of-statistical-methods-for-the-estimation-of-a-probability-of-freedom-from-infection.pdf

Meletis et al., 2020: https://sound-control.eu/wp-content/uploads/2020/03/STSM-scientific-report-2020-01-Meletis-E-WG3-STSM2-Evaluation-of-machine-learning-methods.pdf

Meletis et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/Report.pdf

4. **Developing a joint research agenda that offers the possibility to further develop an output-based framework to objectively compare outputs of CPs at different levels of aggregation that is applicable to a large range of diseases and meets the requirements of a large number of EU MS (WG4)**

Type of objective

1.f - Achievement of a specific tangible output that cannot be achieved without international coordination (e.g. due to practical issues such as database availability, language barriers, availability of infrastructure or know-how, etc.)

1.g - Input to stakeholders (e.g. standardization body, policy-makers, regulators, users), excluding commercial applications

2.a - Building a community around a topic of scientific and/or socio-economic relevance, allowing for knowledge exchange and the development of a joint research agenda

Level of achievement: 100%

In January 2020 a workshop organized by WG4 was conducted to obtain knowledge on information needs that should result from an output-based framework. Following the workshop an STSM at the University of Utrecht was successfully completed; the main objective of this STSM was to summarize

the results obtained during the Warsaw workshop. Subsequently, WG4 planned to evaluate the stakeholder needs. Unfortunately, due to COVID-19 it became impossible to organize stakeholder workshops. The plan was adapted and two surveys targeting different actors in the intra-EU cattle trade were sent out in multiple SOUND-control participating countries. Working Group 4 also organized several workshops engaging members from other WGs to collect gaps related to the implementation and use of output-based surveillance. All these activities informed the research agenda developed by WG4 (Carmo et al., 2022).

Carmo et al., 2022: https://sound-control.eu/wp-content/uploads/2022/11/SOUND-control_Deliverable-D4.3_Final_v3.pdf

5. **Develop training materials that can be disseminated through seminars, workshops and conference presentations (WG5).**

Type of objective

1.f - Achievement of a specific tangible output that cannot be achieved without international coordination (e.g. due to practical issues such as database availability, language barriers, availability of infrastructure or know-how, etc.)

1.i - Dissemination of research results to the general public

1.j - Dissemination of research results to stakeholders (excluding specific input in view of knowledge application)

2.e - Building capacity in the demographic inclusiveness of networks in science and technology, including representation of newly established research groups, Early-Career Investigators, the underrepresented gender and teams from countries/regions with less capacity in the field of the Action

Level of achievement: 100%

During this Action, detailed information on the disease control programmes that are in place in EU countries for endemic infectious diseases were generated and published. Additionally, the results of our Action were disseminated through newsletters, posters that were presented on scientific conferences, articles in national farmers´ journals and through scientific publications. Materials were developed for the training school on monitoring and surveillance that are published on the website. Additionally, the training schools were recorded and all video materials are published on our own SOUND-control YouTube platform that is publicly accessible. The information and knowledge that was obtained during the different STSMs was presented to the members of the Action and the STSM reports are published on the website for all interested people. Additionally, many webinars and pitch presentations were organized throughout the Action for our members and the recordings of these were all published on our YouTube channel.

Website: www.sound-control.eu

Training school on monitoring and surveillance, recording: https://www.youtube.com/-channel/UCyLLEpMF_LElyzRHpCJH4fQ, materials https://sound-control.eu/reports-publications/

Webinars and pitch presentations: https://www.youtube.com/channel/UCyLLEpMF_LElyzRHpCJH4fQ

Workshop on output-based methods: https://github.com/LefMel/SVEPM_2022_wk

Posters and scientific papers on SOUND-control: https://sound-control.eu/reports-publications/

6. **Develop an open access platform to disseminate all knowledge and output that is obtained through SOUND-control to all interested stakeholders (WG5).**

Type of objective

1.i - Dissemination of research results to the general public

1.j - Dissemination of research results to stakeholders (excluding specific input in view of knowledge application)

2.a - Building a community around a topic of scientific and/or socio-economic relevance, allowing for knowledge exchange and the development of a joint research agenda

2.c - Bridging separate fields of science/disciplines to achieve breakthroughs that require an interdisciplinary approach

2.e - Building capacity in the demographic inclusiveness of networks in science and technology, including representation of newly established research groups, Early-Career Investigators, the underrepresented gender and teams from countries/regions with less capacity in the field of the Action

Level of achievement: 100%

Open access groups were created on LinkedIn and Research gate. Additionally, all the outputs of the Action are disseminated and freely available through our website, the SOUND-control dashboard, the published Ebook and our SOUND-control YouTube channel.

The groups can be accessed through:

SOUND-control Website: www.sound-control.eu

SOUND-control Dashboard: https://shiny.fli.de/ife-apps/SOUNDcontrol/

SOUND-control YouTube channel: https://www.youtube.com/channel/UCyLLEpMF_LElyzRHpCJH4fQ

Ebook: https://www.frontiersin.org/research-topics/15433/global-control-and-eradication-programmes-for-cattle-diseases#articles

LinkedIn: https://www.linkedin.com/groups/8740517/

ResearchGate: https://www.researchgate.net/project/COST-Action-CA17110-Standardizing-OUtput-based-surveillance-to-control-Non-regulated-Diseases-of-cattle-in-the-EU-SOUND-control.

7. **Involving specific target groups such as Early Career Investigators (ECI), under-represented gender, researchers from Inclusiveness Target Countries (ITC).**

Type of objective

2.e - Building capacity in the demographic inclusiveness of networks in science and technology, including representation of newly established research groups, Early-Career Investigators, the underrepresented gender and teams from countries/regions with less capacity in the field of the Action

Level of achievement: 100%

In our Action, there was a balanced gender representativeness, both in the core group as in the management committee. It remained a challenge to involve ECI's, but we tried to stimulate younger people to join throughout the Action, by conducting STSMs and stay on as Action member thereafter. In total 33 countries joined our Action, of which 14 have an ITC status, one is an international partner country and two (Ukraine and Kosovo) are not COST members, but were involved as NNC in our Action.

Deliverables

D1.1. Overview of non-regulated cattle diseases in the EU for which CPs are in place within MS.

Status: finished

https://sound-control.eu/wp-content/uploads/2020/07/Deliverable-1.1-version-9.pdf

Hodnik et al. 2019a: https://sound-control.eu/wp-content/uploads/2020/03/STSM-scientific-report-2019-03-Hodnik-JJ-Characteristics-of-existing-CPs-and-requirements-for-an-output-based-framework.pdf

Hodnik et al., 2021: https://www.frontiersin.org/articles/10.3389/fvets.2021.688078/full

Dashboard SOUND-control: https://shiny.fli.de/ife-apps/SOUNDcontrol/

Dashboard SOUND-control2: https://sound-control.eu/a-shiny-app-to-present-the-results-of-wp1-has-been-developed/

D1.2. Contact list of all relevant stakeholders that are involved in the application (either practical or regulatory) of CPs of non-regulated cattle diseases in each of the MS.

Status: finished

https://sound-control.eu/wp-content/uploads/2020/03/Deliverable-1.2.-Contact-list-of-relevant-stakeholders.pdf

D1.3: Handbook or wiki page describing the different CPs in place relative to the farming systems, including parameterisation, strengths and weaknesses in terms of ability to prevent new infections, ability for early detection of new cases, costs and acceptance by the stakeholders.

Status: finished

Report STSM Hodnik et al., 2019b: https://sound-control.eu/wp-content/uploads/2020/03/STSM-scientific-report-2019-08-Hodnik-JJ-Develop-a-questionnaire-to-collect-information-about-control-programmes.pdf

Ebook with all the papers that were published as part of the handbook: https://www.frontiersin.org/research-topics/15433/global-control-and-eradication-programmes-for-cattle-diseases#articles.

All the relevant papers are also published on our website: https://sound-control.eu/reports-publications/

D2.1: A data availability matrix for each of the countries that participate in the SOUND-control Action, the input parameters that are required are described and information on the availability of the data is provided, along with an assessment of its quality and regional coverage.

Status: finished

Summary of the work of WG2 with the links to the data availability matrix: https://sound-control.eu/wp-content/uploads/2022/01/Deliverable-2_2-Final-summary-of-SOUND-control-WG2-results.pdf

Tool can be accessed through:

Limesurvey: https://sound-control.eu/wp-content/uploads/2022/01/WG2-questionnaire-analysis_Deliverable2.1_260121.pdf

Google forms: https://docs.google.com/forms/d/e/1FAIpQLSebbnFS5P7_2SC6mKkWIx_lvwUt2Kd1tP4aSxs_BzaXdpF3Lw/viewform

MS word: https://sound-control.eu/wp-content/uploads/2022/01/SOUND-control-WG2-question-list.docx

MS Excel: https://sound-control.eu/wp-content/uploads/2022/01/Data-collection-tool-SOUND-control_final.xlsx & https://sound-control.eu/wp-content/uploads/2022/01/Guide-for-filling-in-the-excel-data-collection-tool_2020.04.12-1.pdf

Paper describing the development of the data collection tool: Van Roon et al., 2021: https://www.frontiersin.org/articles/10.3389/fvets.2021.656336/full.

Paper describing availability and quality of endemic infectious disease control data obtained with the data collection tool: Rapaliute et al., 2021: https://doi.org/10.3389/fvets.2021.689375

D2.2: A report, describing the methods, results and recommendations resulting from the STSM.

Status: finished

Reports:

Munoz et al., 2019: https://sound-control.eu/wp-content/uploads/2020/03/STSM-scientific-report-2019-03-Munoz-V-WG2.-Data-requirement-and-availability.pdf

Koleci et al., 2019: https://sound-control.eu/wp-content/uploads/2020/03/STSM-scientific-report-2019-08-Koleci-X-WG2-STSM2-Review-data-collection-frameworks-.pdf

Rapaliute et al., 2020a: https://sound-control.eu/wp-content/uploads/2020/04/2020-03-Rapaliute-E-Design-a-data-collection-matrix.pdf

Rapaliute et al., 2020b: https://sound-control.eu/wp-content/uploads/2022/10/STSM4WG2-SreportRapaliute.pdf

Mincu et al., 2021: https://sound-control.eu/wp-content/uploads/2021/12/STSM-scientific-report-Madalina-Mincu.pdf

Fanelli et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/Application-of-a-scenario-tree-model-on-data-collected-about-Enzootic-Bovine-Leukosis-EBL-control-programmes-CPs.pdf

D3.1: Report on comparison of different methodologies that can be applied to evaluate the quality of CPs, including an overview of the gaps for application of standardised comparison of outputs of both non-regulated and regulated diseases in the EU.

Status: finished

https://sound-control.eu/wp-content/uploads/2021/12/Deliverable-3.1.-Output-based-methodological-approaches-for-substantiating-freedom-from-infection.pdf

A scientific paper was written on this work that is in the final stages of review:

Meletis, Eleftherios, Conrady Beate, Hopp Petter, Lurier Thibaut, Frössling Jenny, Rosendal Thomas, Faverjon Celine, Carmo Luis Pedro, Hodnik Jaka Jakob, Ózsvári Lászlo, Kostoulas Polychronis, Schaik Gerdien van, Nielen Mirjam, Knific Tanja, Schulz Jana, Šerić-Haračić Sabina, Fourichon Christine, Santman-Berends Inge, Madouasse Aurélien, 2022. Output-based methodological approaches for substantiating freedom from infection. Preventive Veterinary Medicine, under review.

D3.2: Report with the results of the STSMs and subsequent material for conducting a webinar.

Status: finished

Reports:

Ardelean et al., 2019: https://sound-control.eu/wp-content/uploads/2020/04/STSM-scientific-report-2019-11-Ardelean-A-WG3-STSM3-Review-and-ranking-of-methods-for-the-estimation-of-a-probability-of-freedom-from-infection.pdf

Farra et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/Grant-report-V2-Dima-Farra.pdf

Meletis et al., 2019: https://sound-control.eu/wp-content/uploads/2020/03/STSM-scientific-report-2019-10-Meletis-E-Evaluation-of-statistical-methods-for-the-estimation-of-a-probability-of-freedom-from-infection.pdf

Meletis et al., 2020: https://sound-control.eu/wp-content/uploads/2020/03/STSM-scientific-report-2020-01-Meletis-E-WG3-STSM2-Evaluation-of-machine-learning-methods.pdf.

Meletis et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/Report.pdf

Mincu et al., 2021: https://sound-control.eu/wp-content/uploads/2021/12/STSM-scientific-report-Madalina-Mincu.pdf

Webinars provided on this topic:

Madouasse and Meletis 2021: Output-based methodological approaches. https://www.youtube.com/watch?v=NYw1T2bu918

Madouasse 2020: The STOC free model: a Bayesian Hidden Markov Model for output-based surveillance. https://www.youtube.com/watch?v=kirKrGdqI_g

Kostoulas 2020: Novel tools for test evaluation and disease prevalence estimation. https://www.youtube.com/watch?v=RvcqoWLi_cc

Workshops provided on this topic:

Madouasse, A., Meletis, E., 2022. Statistical methods for Substantiating freedom from infection. SVEPM conference 23-25 March 2022 Belfast, Ireland. https://github.com/LefMel/SVEPM_2022_wk

Madouasse, A., Meletis, E., 2022. Statistical methods for Substantiating freedom from infection. COST Action Harmony 13-15 September Berlin, Germany. https://github.com/LefMel/SVEPM_2022_wk

D3.3: Recommendations on the usefulness of current methodologies for providing standardised outputs of disease CPs, including a joint overview with recommendations on the knowledge gaps in the current methods that have to be fulfilled with a newly developed framework.

Status: finished

Meletis et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/deliverable_3.3.pdf

D4.1: Overview of the results of the brainstorm session on the needs and possibilities for developing methods for an output-based comparison of the confidence of freedom from infection that is applicable to numerous cattle diseases.

Status: finished

Carmo et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/SOUND-control_Deliverable-4.1_Final.pdf

Needs according to stakeholders and researchers

Carmo et al., 2020: https://sound-control.eu/wp-content/uploads/2020/03/STSM-scientific-report-2020-01-Carmo-LP-Identify-information-and-other-needs-to-facilitate-trade.pdf

Carmo et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/SOUND-control_Deliverable-4.1_Final.pdf and https://sound-control.eu/wp-content/uploads/2022/10/D4.1-appendix.pdf

Needs according to stakeholders

Cerf et al., 2021: https://sound-control.eu/wp-content/uploads/2021/12/VM-grant-report-Cerf-R-Who-makes-decisions-about-intra-EU-cattle-trade.pdf

Cerf et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/SOUND-control_Deliverable-4.2_Final.pdf and https://sound-control.eu/wp-content/uploads/2022/10/Who-are-the-stakeholders-involved-in-the-decision-making-process-regarding-intra-EU-cattle-trade-and-non-EU-mandatory-regulated-diseases_.pdf

Needs according to farmers

Koleci et al., 2022: https://sound-control.eu/wp-content/uploads/2022/05/STSM-Report-Koleci.pdf

Paarlberg et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/SOUND-control_-Collecting-stakeholder-data-in-the-Netherlands-for-the-top-down-and-bottom-up-approach-and-analyses-of-the-data-collected-for-the-bottom-up-approach-acros-1.pdf

D4.2: Report with the methods, results and recommendations that result of the different STSMs.

Status: finished

Summary: https://sound-control.eu/wp-content/uploads/2022/10/SOUND-control_Deliverable-4.2_Final.pdf

Biesheuvel et al., 2019: https://sound-control.eu/wp-content/uploads/2020/06/STSM-scientific-report-2019-10-Biesheuvel-M-Considering-the-application-of-a-systems-socio-ecological-approach.pdf

Carmo et al., 2020: https://sound-control.eu/wp-content/uploads/2020/03/STSM-scientific-report-2020-01-Carmo-LP-Identify-information-and-other-needs-to-facilitate-trade.pdf

Carmo et al., 2021: https://sound-control.eu/wp-content/uploads/2021/12/Development-of-Theory-of-Change-model.pdf

Cerf et al., 2021: https://sound-control.eu/wp-content/uploads/2021/12/VM-grant-report-Cerf-R-Who-makes-decisions-about-intra-EU-cattle-trade.pdf

Cerf et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/Who-are-the-stakeholders-involved-in-the-decision-making-process-regarding-intra-EU-cattle-trade-and-non-EU-mandatory-regulated-diseases_.pdf

Delalay et al., 2021: https://sound-control.eu/wp-content/uploads/2021/12/STSM_scientific-_report_CA17110_DelalayG_2021.pdf

Delalay et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/Grant-report-Delalay.pdf

Duarte et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/SOUND-control-Virtual-Mobility-grant_-applying-the-top-down-approach-in-Portugal-to-better-understand-the-decision-making-process-in-the-cattle-trade.pdf

Knific et al., 2022a: https://sound-control.eu/wp-content/uploads/2022/10/Developing-Theory-of-Change-and-research-agenda.pdf

Knific et al., 2022b: https://sound-control.eu/wp-content/uploads/2022/10/Towards-output-based-surveillance-of-transmissible-cattle-diseases_-challenges-and-opportunities.pdf

Petek et al., 2021: https://sound-control.eu/wp-content/uploads/2022/02/Grant-Report-Metin-Petek.pdf

Koleci et al., 2022: https://sound-control.eu/wp-content/uploads/2022/05/STSM-Report-Koleci.pdf

Paarlberg et al., 2022: https://sound-control.eu/wp-content/uploads/2022/10/SOUND-control_-Collecting-stakeholder-data-in-the-Netherlands-for-the-top-down-and-bottom-up-approach-and-analyses-of-the-data-collected-for-the-bottom-up-approach-acros-1.pdf

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.

Status: finished

https://sound-control.eu/wp-content/uploads/2022/11/SOUND-control_Deliverable-D4.3_Final_v3.pdf

Knific et al., 2022a: https://sound-control.eu/wp-content/uploads/2022/10/Developing-Theory-of-Change-and-research-agenda.pdf

Knific et al., 2022b: https://sound-control.eu/wp-content/uploads/2022/10/Towards-output-based-surveillance-of-transmissible-cattle-diseases_-challenges-and-opportunities.pdf

D5.1. Dissemination plan, for disseminating knowledge obtained during the SOUND-control Action to all relevant stakeholders.

Status: finished

https://sound-control.eu/wp-content/uploads/2020/06/SOUND-control_Diss.-and-comm.-plan.pdf

D5.2: The SOUND-control website is online and can be accessed. The members of the Action have internal page to share documents on a confidential basis.

Status: finished

https://sound-control.eu/

D5.3: Annual online news letters, describing all the milestones and the progress of the Action. This deliverable is due on month 12 of each of the four years.

Status: ongoing

We did already deliver what we promised i.e. an annual newsletter, one per year so four in total during the life time of our Action. However, we are currently working on a final and 5th newsletter that consists of closing reports, summaries of the final STSMs and VMs and other relevant information. So even though this is more than promised, we wanted to finish with a final newsletter, hence that is why we indicated that this deliverable is still ongoing. We plan to publish and disseminate this final newsletter before the end of 2022.

Year 1:
https://sound-control.eu/wp-content/uploads/2020/01/SOUND_control_newsletter.pdf

Year 2:
https://sound-control.eu/wp-content/uploads/2020/10/SOUND_control_2nd_newsletter.pdf

Year 3: https://sound-control.eu/wp-content/uploads/2021/08/3rd_newsletter.pdf

Year 4: https://sound-control.eu/wp-content/uploads/2021/12/SOUND_control_4th_newsletter.pdf

Final newsletter, year 4: https://sound-control.eu/wp-content/uploads/2022/11/5th_newsletter.pdf

D5.4: Open access webinars are organised, and background information and hand-outs are developed. The webinars will be organised at midterm and at the end of the Action.

Status: finished

Peyre, M., 2021. Evaluation of surveillance systems. https://www.youtube.com/watch?v=VW_KcB5I-PU&t=28s.

Knific, T., 2021. Storytelling webinar. https://www.youtube.com/watch?v=jFN2COOmn2A.

Madouasse, A., 2021. The STOC free model. https://www.youtube.com/watch?v=kirKrGdqI_g.

Steeneveld, W., 2021. Animal health economics. https://www.youtube.com/watch?v=6VJ2VcwM7vk.

Gethmann, J., 2021. Agent based model for BVDV. https://www.youtube.com/watch?v=ZGBqvdyJUkE.

Kostoulas, P., 2022: HARMONY: Novel tools for test and disease prevalence estimation: https://www.youtube.com/watch?v=RvcqoWLi_cc.

Guelbenzu, M., The New Animal Health Law. https://www.youtube.com/watch?v=wIxTRkHdvVc.

Madouasse and Meletis, 2022: Output-based methodological approaches for substantiating freedom from infection. https://www.youtube.com/watch?v=NYw1T2bu918.

Van Schaik, G., 2022. The DECIDE project: a data-driven approach for decision support to better manage endemic infectious diseases. https://www.youtube.com/watch?v=Oi7giPe1WNA

Allepuz, A., 2022. Biosecurity Enhanced through training evaluation and raising awareness (COST Action Better). https://www.youtube.com/watch?v=ME_1okFiVdc.

Rushton, J., 2022. Progress with the Global Burden of Animal Disease Programme. https://www.youtube.com/watch?v=O7AGKE6bh0g.

D5.5: Final conference is organised in which all knowledge obtained during the Action is disseminated to scientists, policymakers and other interested stakeholders. Additionally, the future prospects of the knowledge that was developed during the SOUND-control Action will be discussed.

Status: finished

The final conference was held on 19 and 20 September 2022 in Athens, Greece

https://sound-control.eu/sound-control-final-conference-19-20-september-in-athens-greece/

Additional outputs / achievements Co-authored Action publications

Juste Ramon, Balseiro Ana, Saez Jose Luis, Palomo Carmen Elduque, Rodriguez Esther Clemente, Massot Amadeo Vazquez, Escayola Ismael Esparza, Vila Anna Grau, Perez-Serrano Eva María, Martin Marta Vigo, Sanz Albert, Lligoña Núria Ribas, Fernandez Jesus Orejas, Benito Acero Gema, García Paulina Cámara, Salinas César Fernández, Aduriz Gorka, 2021. Cattle disease control programs in Spain. www.sound-control.eu. (https://sound-control.eu/reports-publications/)

Vilcek, S., Pistl, J. Mojzisova, J.: Bovine viral diarrhoea – Control programmes: principles and practical experience. University of Veterinary Medicine and Pharmacy, Kosice, 2019, pp. 160, ISBN 978-80-8077-653-4 (in Slovak language).

Training school on monitoring and surveillance: 1-3 February 2021. Online
Berezowski, J., 2021. Risk based surveillance: https://www.youtube.com/watch?v=BETnS_0svM4.

Berezowski, J., 2021. Monitoring and surveillance (part 1):
https://www.youtube.com/watch?v=5vggGBM6K2g.

Berezowski, J., 2021. Monitoring and surveillance (part 2):
https://www.youtube.com/watch?v=8MoqZTCQeIw.

Guelbenzu, M., 2021. Diagnostic tests: https://www.youtube.com/watch?v=S2WIoMv_068.

Gethmann, J., 2021. Sample size: https://www.youtube.com/watch?v=e2kC6sbO-7E.

Gethmann, J., 2021. Disease measures: https://www.youtube.com/watch?v=WHL8TRSF9vk.

Training school on scenario tree modelling: 13-15 June 2022 Ljubljana, Slovenia.
https://sound-control.eu/training-school-scenario-tree-modelling-in-ljubljana/

Workshop on methods for output-based surveillance:
Madouasse, A., Meletis, E., 2022. Statistical methods for Substantiating freedom from infection. SVEPM conference 23-25 March 2022 Belfast, Ireland. https://github.com/LefMel/SVEPM_2022_wk

Madouasse, A., Meletis, E., 2022. Statistical methods for Substantiating freedom from infection. COST Action Harmony 13-15 September Berlin, Germany. https://github.com/LefMel/SVEPM_2022_wk

Online pitch presentations by members on topics related to the Action

Santman, I., 2021. SOUND-control in two minutes: https://www.youtube.com/watch?v=t8Bi95nJssw.

Pallante, I., 2021. IBR control in Italy. https://www.youtube.com/watch?v=KAPKLO09qR0.

Irimia, E., 2021. Control of endemic diseases in Romania. https://www.youtube.com/watch?v=6gFN8IOvFsc.

Hodnik, J.J., 2021. Control of endemic diseases in Slovenia: https://www.youtube.com/watch?v=SVHPcqkHF20.

Biesheuvel, M., 2021. Understanding farmers' behavior and their decision making. https://www.youtube.com/watch?v=JYClyvsNH44.

Santman and van Roon., 2021. Output-based comparison of the confidence of freedom resulting from BVDV control programme based on ear notch testing in the EU. Application of the STOC free model. https://www.youtube.com/watch?v=12l8QAA6XPQ.

Toplak, I., 2021. Voluntary programme for the control and elimination of BVDV from infected herds in Slovenia. https://www.youtube.com/watch?v=OUnhuiZvQ1s.

Pohjanvirta, T., 2021. Suitability of nasal and deep swab sampling of calves in the M. bovis control programme. https://www.youtube.com/watch?v=1Hi8BWHj3AU.

Juste, R., 2021. Non EU-regulated cattle disease control programs in Spain. https://www.youtube.com/watch?v=N2SHAY-sNH8.

Koleci, Xh., 2021. An overview of current approaches and challenges to the control of endemic infectious cattle diseases in Albania. https://www.youtube.com/watch?v=b6pyhOBfF6s.

Polak, M., 2021. Vaccination failure in eradication and control programmes of BVDV infection. https://youtu.be/MJ5DDVSY9Xw.

Pelkonen, S., 2021. Overview of control programs for non-EU-regulated cattle diseases in Finland. https://www.youtube.com/watch?v=VaSYjfwySsI.

Santman, I., 2021. Control of endemic diseases in the Netherlands. https://www.youtube.com/watch?v=qLRxo5_FIxU&t=7s.

Publications resulting from SOUND-control

Names in bold are from people originating from ITC countries.

Publications in peer reviewed journals

1. **Costa, L., Duarte, E.L., Knific, T., Hodnik, J.J.,** van Roon, A., Fourichon, C.,**Koleci, X.,** van Schaik, G., Gunn, G., Madouasse, A., Berezowski, J., Santman-Berends, I., 2020. Standardizing output-based surveillance to control non-regulated cattle diseases: aspiring fora single general regulatory framework in the European Union. Prev. Vet. Med., https://doi.org/10.1016/j.prevetmed.2020.105130

2. Roon van, A.M., Mercat, M., van Schaik, G., Nielen, M., Graham, D.A., More, S.J., Guelbenzu-Gonzalo, M., Fourichon, C., Madouasse, A., Santman-Berends, I.M.G.A. 2020. Quantification of risk factors for BVDV in cattle herds: a systematic search and meta-analysis of observational studies, J. Dairy Sci. https://doi.org/10.3168/jds.2020-18193

3. Roon van, A.M., Santman-Berends, I.M.G.A., Graham, D., More, S.J., Nielen, Duijn van, L., Mercat, M., Fourichon, C., Madouasse, A., Gethmann, J., Sauter-Louis, C., Frössling, J., Lindberg, A., Correira-Gomes, C., Gunn, G.J., Henry, M.K., Schaik van, G., 2020. A qualitative comparison of factors influencing confidence of freedom from bovine viral diarrhea virus infection in six European control programs. J. Dairy Sci. https://doi.org/10.3168/jds.2019-16915.

4. Roon van, A.M., Santman-Berends, I.M.G.A., Graham, D., More, S.J., Nielen, M., Madouasse, A., Mercat, M., Fourichon, C., Gethmann, J., Frössling, J., Lindberg, A., Correira-Gomes, C., Gunn, G.J., Sauter-Louis, C., Henry, M.K., Duijn van, L., Schaik van, G., 2019. An Innovative Framework to Compare Probability of Freedom From Infection in Heterogeneous Control Programmes. Front. Vet. Sci. 6:133. doi:10.3389/fvets.2019.00133.

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- J. Gethmann, A. Madouasse, A.M. van Roon, J. Frössling, C. Fourichon, M. Mercat, S. More, E. Ågren, C. Sauter-Louis, G. Gunn, J. Eze, R. Humphry, M. K. Henry, D. Graham, M. Guelbenzu, M. Nielen, I.M.G.A. Santman-Berends, G. van Schaik, STOCfree: Eine neue Methode zur Bewertung der Freiheit von Infektionskrankheiten, Conference of the German Society of veterinary epidemiology, 31 August – 02 September, Oldenburg, Germany.
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Projects related to Action activities

- Frontiers special issue on non-regulated cattle diseases: Global Control and Eradication Programmes For Cattle Diseases. Edited by M. Schweizer, J. Gethmann, B. Pinior, J. Ridpath, I. Santman-Berends, N. Decaro, G. Gunn, D. Graham, S. Strain. https://www.frontiersin.org/research-topics/15433/global-control-and-eradication-programmes-for-cattle-diseases#articles.
- SNSF-ARRS Weave 2021 - Paratuberculosis in dairy cattle: communal pasture implications, economic analysis and stakeholders' engagement
- DECIDE 2021: Data-driven control and prioritisation of non-EU-regulated contagious animal diseases. https://decideproject.eu/

- Prepared 2022, proposal under review for ICRAD funding: Cross-national PREParedness Against (Re-)Emerging Zoonotic Disease: optimising information workflows to support early detection and decision making (PREPARED).

Other outputs / achievements

Another output or achievement that is resulting from this Action is that a solid network is built between the members of SOUND-control. As a result of a STSM, one STSM candidate (M. Biesheuvel) decided to pursue an international PhD position. Which led to a collaboration between the University of Calgary (Canada), the University of Nottingham (Great Britain) and Utrecht University (the Netherlands).

In the writing of the scientific papers the members within and between member countries collaborated to describe the disease control programmes in the different participating countries that resulted in publication of more than 25 peer-reviewed papers that together resulted in the handbook.

In 2021, a consortium with Slovenian (Tanja Knific, Jože Staric, Jaka Hodnik) and Swiss (Luis Pedro Carmo, John Berezowski) members of SOUND control successfully applied to a Weave grant (collaborative project supported by the Swiss and the Slovenian national funding agencies). The project is focused on the control of Johne´s disease, in particular in the implications of communal pastures, economic aspects and the engagement of various industry stakeholders for more efficient interventions. This is an ongoing project.

In March 2022, a research proposal was submitted to ICRAD in which several SOUND-control members participated (A. Malakauskas (LT), I. Santman-Berends (NL), J. Brock (IE). The proposal was accepted for submission of a second stage proposal in July 2022. The result of the second stage are not yet known.

Impacts

Description of the impact, type of impact and timing
Job prospects and possibility to use the network to change jobs. During this Action members got the opportunity to get to know each other which resulted in job changes and the start of a PhD career. In total six of our participants changed jobs and moved from the institute from one SOUND-control member to another. Additionally, one candidate became inspired after she conducted a STSM and pursued a PhD career in Canada.
Members of different countries started to collaborate in writing research proposals and also included the younger researchers in this writing process. This provided the opportunity for the younger scientists to grow and to work with more experienced researchers from different countries.
In WG1 a lot of knowledge was exchanged about disease control programmes (CPs) that are in place in different countries and awareness was created on the very different context situations in different countries. This stressed the importance of output-based surveillance and with the publications and handbook that result from this Action, countries that want to set-up CPs can have insight in what other countries are doing, why different CPs are designed in a different way and how to come in contact with people involved in CPs of interest.

Based on the results of WG2, the SOUND-control members became more aware of the differences in data registration between different countries. The developed data-collection tool was set up in such a way that quantitative information could be collected in a similar way from all 33 countries in the consortium. This information enables objective and standardized comparison between countries and provides direction to which CP fits to which country.

This COST Action created awareness that people involved in disease control in different countries can learn from each other. The project stressed the importance of having a network. Countries can definitely learn from others when setting up or improving disease control programmes.

In WG3, an evaluation was done regarding which type of output-based model is the most relevant to apply in which situation. This information is written down in a mutual publication by WG3 members and can be used as guideline when disease control efforts are evaluated.

In WG4 the needs from stakeholders were evaluated and the results create awareness that socio-economic aspects are currently not considered. Neither in input nor in output-based surveillance. However, these factors are the main drivers towards success of disease control and are thus extremely important.

In GP2 an evaluation was done among the Action members about the need of organizing training schools. Additionally, members were asked to submit topics they would like to have a training school on. Subsequently, a poll was organized on topic preferences for training schools. The results indicated most interest in a course on general monitoring and surveillance and a course on scenario tree modelling.
In total more than 20 people from all across Europe participated per course. The course on monitoring and surveillance was organized on 1-3 February 2021 online (GP3) and the course on scenario tree modeling was organized from 13-15 June 2022 in Ljubljana, Slovenia (GP4).

Dissemination and exploitation of Action results

Dissemination plan: https://sound-control.eu/wp-content/uploads/2020/06/SOUND-control_Diss.-and-comm.-plan.pdf

List with dissemination activities: https://sound-control.eu/wp-content/uploads/2020/11/SOUND-control_List-of-dissemination-and-communication-activities.xlsx

Exploitation activities

During this COST Action we have identified a need and an interest in training programmes on the topic of output-based surveillance and even broader: veterinary epidemiology and monitoring and surveillance in general. We had a wide variety of background knowledge and the ECI members and members of the ITC countries really appreciated to learn from the very experienced people in the Action.

We organized two training schools during the Action 1) monitoring and surveillance and 2) scenario tree modelling. The materials that were developed are published on the public page of our website and the video materials of the online training school on monitoring and surveillance are freely accessible for the general public. Additionally, during the COVID-19 pandemic we conducted an online inventory into topics of interest and bsequently invited guest speakers to provide a webinar.

The webinars were recorded and published on our YouTube page. We additionally created video content on the project itself, and about the experiences of STSM candidates. Finally, up to now we published 28 papers in a peer reviewed journal, we published many information on our website www.sound-control.eu and we are in the process of exploiting the results even beyond the Action as Action members are still working together to publish the results of the activities that were conducted.

Action Successes

The Action successes are numerous and are already addressed by all the information provided above i.e. the very friendly and welcoming network that we built together, all the results that were generated as part of this Action (publications, video content, conference contributions, etc.) and the opportunities that we created for younger people and people from ITC countries to be actively involved.

The most important success of the SOUND-control COST Action is that we created a very welcoming environment in which everyone was welcome and equal regardless of gender, age, experience or country of origin.

Before this Action, many of the people involved did not know each other and were not aware of all the expertise and research ambitions available throughout Europe. SOUND-control brought all these people together and supported creation of a broad extensive network of researchers not only from research intensive countries but also including enthusiastic and active participants from ITC countries. Without this COST Action these people might never get to know each other, so this is regarded as a major success of this Action.

The collaborations in this Action and the STSMs provided the younger researchers the opportunity to be part of a network, to visit another institute and to do some work in the project. This resulted in a number of very enthusiastic young researchers that became very active participants in the project. Multiple young researchers shift jobs between COST partners, another one was so enthusiastic that she quit her job and started a PhD position in another country. In agreement with the MC of the Action five younger members were promoted to co-leaders within the different WG and became part of the core group (MC approval was obtained during the annual meeting in November 2020). This provided the opportunity to researchers from the next generation to experience the coordination of a WG and managing a COST Action and will prepare them to take on leadership roles later on in their career.

Difficulties in implementing the Action

There was a large variety in commitment between members. Especially when the COVID-19 pandemic resulted in the inability to meet, this resulted with an additional challenge to keep the energy in the project and to keep people committed to our goals. We have implemented several actions to stimulate active participation by:

- Organizing regular online WG meetings

- Provide rewards for the work that is done by offering people a co-author place on publications, stimulating to collaborate online
- We conducted an inventory on topics of interest related to SOUND-control and started to organize regular webinars with invited speakers. These recordings were subsequently published online
- We wrote a proposal to start a research topic within a scientific journal which was accepted. Subsequently, our members published more than 20 papers as part of this research topic.

Nevertheless, we did observe some difficulties due to the fact that it was not possible to meet in person. It is complicated to organize online meetings with more than 30 people and have a discussion. In face-to-face meetings it is possible to make sure everyone is involved by splitting up large scale meetings in small discussion groups. In online meetings the people are less committed and feel less motivated to participate in discussions.

For several partners within some of the ITC countries, the English language was challenging leading to the fact, that communication with the consortium and participation at meetings was limited. This challenge became even more evident during the COVID-19 pandemic when we could only meet online. The language issue is often a larger challenge for older participants compared to their younger peers. However, in some countries there is a strict hierarchy and young scientists are usually not allowed to attend international meetings unless senior scientists also attend, even if they do not have a language barrier. Hence, it would be helpful to encourage countries to send young scientists.

In WG4, we initially planned to collect stakeholder needs related to output-based surveillance. In order to guarantee the acceptance and usefulness of output-based methodologies in real-life, we found it of crucial importance to consider the experience and opinions of all stakeholders involved in the cattle trade process. Our initial plan was to follow a transdisciplinary approach that encompassed several activities (e.g. focus groups, interviews) where multiple actors in the cattle trade chain would be enrolled. Unfortunately, the COVID-19 pandemic limited the possibility of conducting these activities in-person and our plan had to be adapted towards online activities and setting out online surveys instead of organizing stakeholder meetings.

The COVID-19 pandemic results in issues for the grant holder (GH). According to COST rules, the GH can claim 15 percent of the money that is spent in the Action for the costs of managing the finances. However, given the fact that COST mainly covers expenditures for travel and accommodation and the fact that due to COVID-19 we could not meet, we also did not spend much money, resulting in the inability to claim any financial compensation by the GH while they still had to do some work related to the activities that we had.

Another topic that was discussed was the reimbursement structure of COST. During our last meeting people from ITC countries and people who are at the beginning of their career (ECI) from all countries indicated that it had been a challenge for them to pay the costs of the meetings beforehand. The amounts of money needed to pay in advance for meetings and STSMs could be very high for them and this sometimes resulted in the decision to either not join a meeting at all or to not join the social dinner that was often organized. We did not resolve this challenge during our Action, but it is a point that we would like to address for future Actions. One of the main strengths of COST Action is the inclusiveness of people from all of Europe and the personal financial situation of some countries should not hamper the networking capability of our members.

Suggestions for improvements to COST framework/ procedures

The COVID-19 pandemic shows that (temporary) travel restrictions lead to major problems given that in some cases people cannot retrieve the money they already paid for travel and accommodation. Additionally, this pandemic resulted in issues for the GH given that they cannot claim any financial compensation when no money is spent. Furthermore, given the urgency of the climate situation, remote meetings should be encouraged whenever they are possible and not too detrimental to networking. It is expected by COST that the Action continues online even when there are no possibilities to meet. We believe that in such case, the GH should still be able to claim a certain percentage of the money in the WBP that was originally reserved for the GH. Another aspect is the number of contact moments between COST and the chairs. For me (Inge Santman) as an ECI it is the first time that I'm chairing a COST Action and it would be helpful to have short regular online meetings with COST where the progress of the Action is discussed and any questions that either I or COST has can be resolved. This would give more confidence to the Action chairs that the COST expectations are met. Nevertheless, I would like to stress that the people in the COST office were always very supporting and very fast to reply whenever I had a question or issue. In the first year of my Action there were some chair events where we could share our experiences. It would be very helpful if such events would be organized (online) once per year to discuss with other chairs about the possibilities to tackle the challenges that everyone is facing.

As mentioned in the previous paragraph, we believe that the inclusiveness targets within COST could benefit by offering the possibility for both ECI participants from all countries and all ITC participants to reimburse certain costs such as for example a plane ticket in advance of a meeting. In addition, perhaps COST can think of a possibility to reduce the daily allowance a bit and in return set up rules that permit the organization of a mutual dinner that is paid through the LOC. This may increase possibilities for participants with less financial means to participate and join both the meetings and the social activities. Additionally, at this moment master students cannot participate in COST Action as they are not affiliated to a University or company. However, these students do have the time and opportunity to conduct parts of the work foreseen in COST Action. In return, they can work with an international network, learn from experienced researchers and be stimulated to become valuable researchers after their study. We believe that COST should stimulate their participation, especially for students originating from ITC as this will increase their possibilities to work in research.

Sustaining the network beyond the Action

As part of WG4 we developed a research agenda on the topic of output-based surveillance. During the course of the Action we already acted and collaborated together to write and submit research proposals related to the field of output-based surveillance. The research agenda describing all the remaining gaps will act as guidance document for possible future collaborations on the topic of output-based surveillance.

There are many outputs that result from this Action that require some further work. We are still collaborating in trying to publish part of the work in peer reviewed journals and we are still in the process of presenting the projects outputs in different conferences. People from this Action are already

collaborating in follow-up projects (see paragraphs on related projects) and we are seeking for further possibilities.

Within the Action it was agreed to keep the website not only available for the coming two years, but also active with news updates and by adding new information and output on the topic of the Action.

Emerging topics/ developments in the field of the Action

Social aspects: During the whole COVID-19 pandemic it became very clear that communication and social aspects are key in creating compliance and commitment when controlling and eradicating diseases. When we evaluate the topic of disease control the focus is on eradicating diseases, monitoring the free status and preventing new introductions by controlling risk factors. In reality, not all farmers comply with the regulations which result in 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: the beliefs, values, morals and emotions. As a complicating factor, a large variety in mindset between inhabitants of different countries exists related to cultural differences. Much insight could be obtained by a COST Action given that would enable possibilities to bring social and communication experts from different countries together.

In our Action it was clear that Animal Health Economics (AHE) was an important driver for animal health decision making. The use of economic theory and methods was a major gap and the number one topic of interest for the SOUND control members. Many AHE frameworks, models and tools exist at different decision levels (animal, herd and country). However, outcomes from different countries are currently not comparable as, amongst others, different cost components are considered and different assumptions are made. Using different models can result in different decisions on animal health that may not be most optimal. It is therefore important that overarching frameworks (a model structure) will be developed in concordance with many different countries across Europe. Agreement has to be reached on which cost factors to include and on the assumptions that are required. The different existing AHE modelling structures need to be evaluated, stakeholder needs, need to be identified, and ultimately generic AHE frameworks for different diseases and species need to be developed. This is a challenging task, which would undoubtedly develop from a participatory/co-production approach where key stakeholders with varying perspectives are involved from the beginning.