



VETBIONET

Veterinary Biocontained facility Network for excellence in animal infectiology research and experimentation

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Animal infectious disease research, social impact and contributions to the EU bio-based economy: Animal Infectious Disease Research in COVID times

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Executive Summary

The VetBioNet project (Veterinary Biocontained facility Network for excellence in animal infectious disease research and experimentation) is focused on supporting high quality research in animal infectious disease. VetBioNet is meeting this aim through a comprehensive network of well-established high-containment (BSL3) research facilities, research institutes, research organisations and industry partners which brings together leading experts in the fields of epizootic and zoonotic diseases. The network is not only facilitating research projects but also the development of novel technologies, process and policies that can support animal infectious disease research.

As well as the laboratory studies, an important aspect of VetBioNet's work is to explore some of the cross-cutting issues that relate to the responsibilities of researchers, examining some of the potential impacts of this work, as well as the policies that can affect research in animal infectious disease. One of these cross-cutting aspects is the societal dimensions and impacts of animal infectious disease research, as such this report explores the construction and types of these societal impacts. This aspect is discussed in order to clarify the role and remit of this research area and the aim of the analysis presented is to set out an understanding of societal impact in the context of animal infectious disease research. This discussion of societal impact is framed by our collective global experience of the COVID-19 pandemic.

Understanding of social impact is influenced by one's disciplinary approach to social impact and hence social impact is a difficult concept to define. There are many different definitions that are shaped by the issue or activity that is being discussed. Commonly, social impact can be characterised as the effect on members of a society or communities which results from an activity or action. Social impacts are often discussed in terms of consequences that can be predicted or analysed qualitatively or quantitatively. With such a broad understanding of social impact, the way in which social impact can then be considered is notably broad as well. In terms of characterising the types of social impact, it can be useful to set out some categories, it can also be valuable to ensure that any definition of social impact is clear about what categories or effects are not included within a definition or an evaluation. Therefore, it is important to note that this work does not examine economic impact assessment but focuses on social impact criteria.

Economic aspects can be defined as having social dimensions, however social impacts can be defined as those aspects that are not about measuring monetary indicators and conducting detailed quantitative measurements. There are some definitions of social impacts that span across some of the economic aspects but in this work, social impact is defined broadly and economic impact criteria will not be used.

Building on a defined approach to considering the societal implications of research, this report comprises of three sections; i) the societal impact of animal infectious disease research, ii) an analysis of the perspectives of researchers within VetBioNet on some aspects of societal impact and responsibilities and iii) a discussion of the key action areas that may inform research in this area and which can inform the extension of this area of research work. The overarching approach and the exploration of 'ways forward' may also support reflection in other areas of work across new research funding programmes. This report has highlighted the social impact aspects that are important for animal infectious disease research and in particular the work of VetBioNet. These societal areas cover Health and wellbeing; Animal health and wellbeing; Impacts on human rights; Education and professional development improvements; Effects on innovation and enterprise pathways; Public policy changes; Biota wellbeing; Societal development and harmonisation; Sustainability effects and impacts on societal values and norms.

Although different aspects and levels of social impact have been demonstrated across these identified societal areas, it is important as part of a post COVID-19 pandemic plan to identify 'action' priorities. It is important for the VetBioNet community going forward to identify the aspects that can support longer term impact and can help other researchers and networks consider wider impact. So, drawing on the OECD's development of impact imperative, four impact areas have been identified for animal infectious disease research: financial aspects of research; research supported innovation; research-related policy and research data.

Considering these four impact aspects in future research actions should support societal impacts. Within these four action areas, one of the key aspect that has been identified relates to researchers' wellbeing. This issue of researchers' wellbeing can be seen to relate to wider research policy and as such should not be underestimated in terms of an issue that needs attention. Therefore, this issue of wellbeing may need much more focus and resources going forward, particularly if important societal impacts are to be realised from animal infectious disease research.

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1. Introduction

The VetBioNet project (Veterinary Biocontained facility Network for excellence in animal infectious disease research and experimentation) is focused on supporting high quality research in animal infectious disease. VetBioNet is meeting this aim through a comprehensive network of well-established high-containment (BSL3) research facilities, research institutes, research organisations and industry partners which brings together leading experts in the fields of epizootic and zoonotic diseases. The network is not only facilitating research projects, but also the development of novel technologies, process and policies that can support animal infectious disease research.

1.1 Cross-cutting aspects in animal infectious research

As well as the laboratory studies, an important aspect of VetBioNet's work is to explore some of the cross-cutting issues that relate to the responsibilities of researchers, examining some of the potential impacts of this work, as well as the policies that can affect research in animal infectious disease.

One of these cross-cutting aspects is the societal dimensions and impacts of animal infectious disease research, as such this report explores the construction and types of societal impacts that arise from this area of research.

In order to clarify the role and remit of the analysis presented here it is important to set out an understanding of societal impact in the context of this work. This discussion is also framed by our collective global experience of the COVID-19 pandemic. The pandemic has in some ways re-framed aspects of our societal discussion of the role of research and the role of animal infectious disease research.

1.2 Societal Impact analysis

There are many ways to construct societal impact and any approach to social impact is influenced by the 'why', specifically why an individual or organisation wish to consider social impact and what they will do with that information. Understanding of social impact is also influenced by the disciplinary approach to social impact and hence social impact is a difficult concept to define. There are many different definitions that are shaped by the issue or activity that is being discussed.

Commonly, social impact can be characterised as the effect on members of a society or community, which results from an activity or action. Social impacts are often discussed in terms of consequences that can be predicted or analysed qualitatively or quantitatively. Social impacts also cover implications or consequences that can result from private sector or public sector activities that affect how citizens live their lives, both personally and professionally as well as how they plan, identify and imagine their lives individually and in connection to others as a member of society.

With such a broad understanding of social impact, the way in which social impact can then be considered is notably broad as well. The societal consequences of the actions of an institution can be defined as very far reaching and be considered on a number of levels and in terms of a range of direct and indirect effects. In terms of characterising the types of social impact, it can be useful to set out some broad categories, it can also be valuable to ensure that any definition of social impact is clear about what categories or effects are not included within a definition or an evaluation. As such it is important to distinguish between what is economic impact and economic impact assessment and what is social impact and social impact assessment.

Economic impact assessment involves the identification, analysis and potential evaluation of monetary and fiscal effects or consequences. Examples of these aspects would include:

- Impacting on investment capital
- Income generation
- GDP changes
- Shareholder value of corporates
- Tax revenue generation
- Salaries levels changes

All of these economic aspects can be defined as having social dimensions, however social impacts can be defined as those aspects that are not about measuring monetary indicators and conducting detailed quantitative measurements. There are some definitions of social impacts that span across some of the economic aspects. However, in this context and work, social impact will be defined broadly and economic impact criteria will not be used.

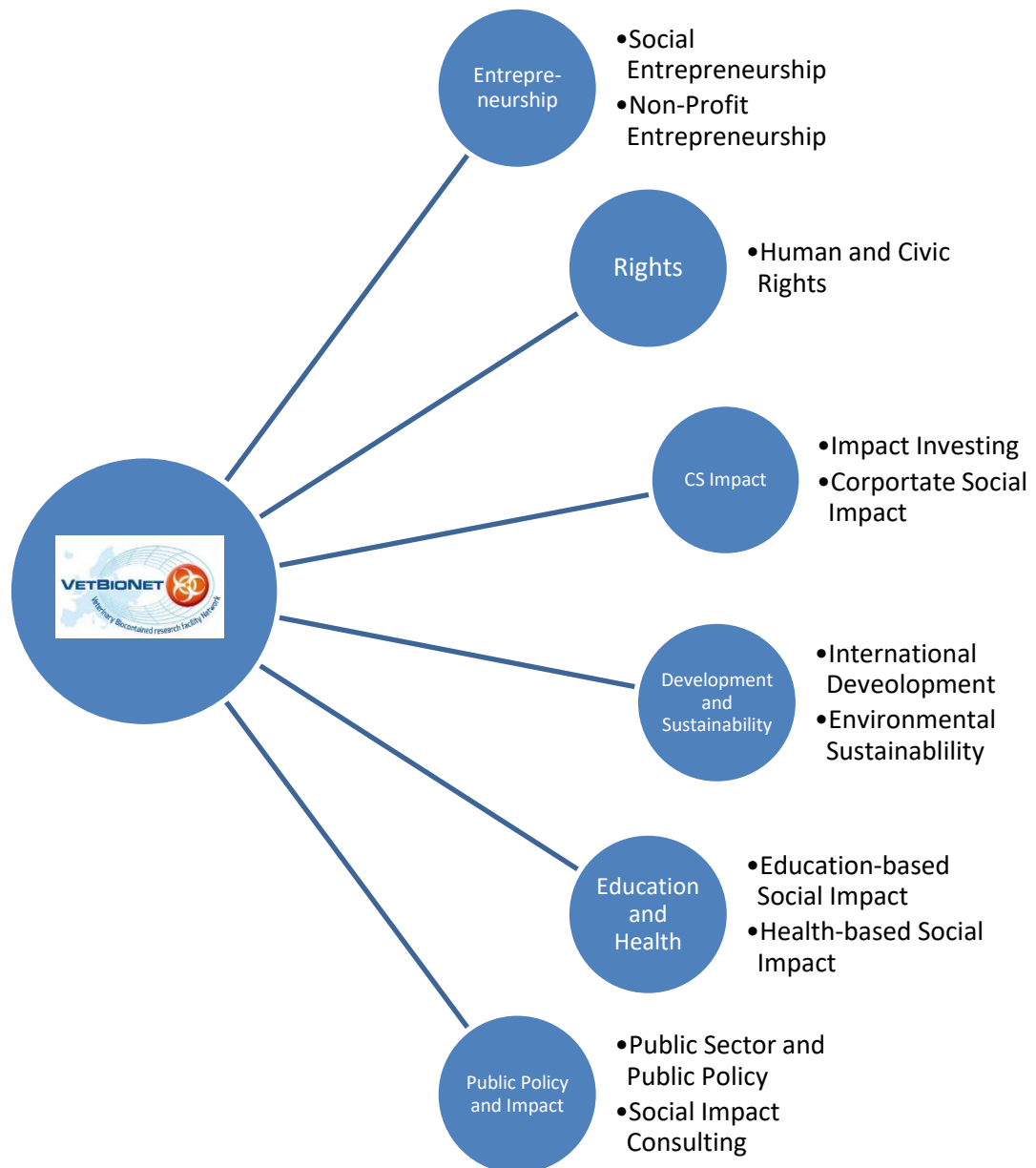


Figure 1: Characterising Social Impact (adapted from Brun, et al., 2016)

Therefore, social impact for animal infectious disease research can be deemed to include some of the following criteria (adapted from Williams et al, 2014; Heun et al 2001):

1. Human health and wellbeing
2. Animal health and wellbeing
3. Impacts on human rights
4. Education and professional development improvements
5. Effects on innovation and enterprise pathways
6. Public policy changes
7. Biota wellbeing
8. Societal development and harmonisation
9. Sustainability effects
10. Impacts on societal values and norms

These criteria will form the basis of the discussion of social impact in terms of animal infectious disease research. Each of these criteria will be discussed to different degrees in relation to this research area.

1.3 Work presented here

Building on a defined approach to considering the societal implications of research, this report comprises of three sections; i) the societal impact of animal infectious disease research, ii) an analysis of the perspectives of researchers within VetBioNet on some aspects of societal impact and responsibilities and iii) a discussion of the key action areas that may inform

research in this area and which can inform the extension of this area of research work. The overarching approach and the exploration of ‘ways forward’ may also support reflection in other areas of work across new research funding programmes.

This work is novel and as such, it is intended to support wider analysis, discussion and reflection in this dimension of animal infectious disease research.

2. The societal impact of animal infectious disease

This discussion of social impact will draw on the ten criteria outlined above and these will be discussed in terms of animal infectious disease research.

2.1. Framing the analysis

One approach to framing the discussion of social impact is use an approach to map the types of impacts that are identified from this area of research. The ten criteria will be discussed below and the various dimension of each of the criteria will be explored. Initially, a table is included (Table 1), which sets out some of the overarching issues. Each of these ten criteria are then discussed in turn below.

What is also important to consider about the discussion of these criteria is that some of the elements of social impact are about the direct impact and others are about the process of doing or managing research and how changes in a process can affect a possible impact within the field of animal infectious disease.

Examining Societal Impacts and Animal Infectious Disease		
1	Human health and wellbeing	<p>Social benefit is linked to the issue of public health and protection of the population from zoonotic disease through better characterisation and understanding of the aetiology of disease and potential transmission.</p> <p>The social benefit from animal infectious disease research, which focuses on identifying, characterising and responding to animal infectious disease, comes from reducing disease burden in animal populations, in particular farm animal populations. Reducing</p>

		<p>disease burden can result in direct and indirect economic benefits.</p> <p>Reducing farm animal disease can also have an indirect benefit for farmers' mental health and wellbeing.</p> <p>Negative impacts on researchers working in this research area particularly if they are working in BSL3 or BSL4 conditions. For example, direct risks from exposure to the virus or bacteria and indirect through the working conditions and perceived risks.</p> <p>Some specific types of animal infectious disease research can raise questions and concerns in terms of negative social impact. For example, 'gain of function' experiments raise key questions about the dual use and misuse of this type of research and the need for a wider management of risks.</p>
<p>2</p>	<p>Animal health and wellbeing</p>	<p>Animal infectious disease research results in direct benefits to animals through greater understanding of disease, improved diagnosis and improved treatment of animals.</p> <p>Animal infectious disease research can also significantly impact animals directly through animal use as animal models. Some areas of research can result in significant impacts on experimental animals through the use of animals in <i>in vivo</i> experimentation, such as the use of Challenge Tests.</p> <p>Some areas of animal infectious research can result in a transition away from <i>in vivo</i> experimentation or can result in the development of monitoring tools which can directly refine the experience of research animals.</p> <p>The outcomes of research, such as the developments of vaccinations, may have direct and indirect impact on animals through protection of farm animals from disease transmission. In turn, research may affect animal health programmes and the management of farm animals which may result in movement restrictions that can affect their welfare.</p>

<p>3</p>	<p>Impacts on human rights</p>	<p>Animal infectious disease research can generate knowledge and create tools that can both enhance and limit human choices.</p> <p>Reduction of the incidences of and freedom from disease is a fundamental human right and infectious disease research can provide empowerment for individuals and groups, particularly any marginalised group, which is an important social impact.</p>
<p>4</p>	<p>Education and professional development improvements</p>	<p>Research directly produces knowledge and supports the development of new technologies and tools. Research programmes can also develop and run training schemes and education approaches that can result in positive social change.</p> <p>The very process of doing work can highlight societally important issues that may be directly or indirectly related to the research work and the research programme. Animal infectious disease research requires a high level of training and commitment. During the COVID-19 pandemic, many researchers made a significant commitment to deliver research and took on heavy workloads. Although this research area can be claimed to create significant benefit, there can be a negative and sustained burden on researchers to deliver in this research area especially when there is a zoonotic emergency.</p> <p>A research topic and the ways of working within a research network cannot only create new ideas and support productivity but it can also result in negative impacts that can affect researchers' mental and physical wellbeing.</p>
<p>5</p>	<p>Effects on innovation and enterprise pathways</p>	<p>Research programmes can have direct impact on innovation pathways and can produce innovations that have an impact way beyond the original research areas.</p> <p>Research programmes can connect researchers and ideas across both the private and public sectors to find new uses of the outcomes of animal infectious disease research.</p>

		Investment in large-scale infrastructure can support and initiate research outcomes and innovation, and can help to translate new knowledge into applications.
6	Public policy changes	<p>Evidence produced from animal infectious disease may play an important role in one health policy-making.</p> <p>Research data generated from a large animal infectious disease network could affect animal control and containment strategy, such as domesticated avian flock controls.</p>
7	Biota wellbeing	<p>Animal infectious disease research can have a direct impact on the environment due to the way in which high containment research needs to be conducted.</p> <p>Animal infectious disease research can also have indirect implications for the biota through controls that may need to be put in place to reduce the spread of an animal infectious disease.</p>
8	Societal development and harmonisation	<p>Although animal infectious disease research funded by the European Commission focuses on issues across Europe, the focus of the research is on international infectious diseases. A better global knowledge of animal infectious disease not only benefits EU citizens, but can result in positive impacts at a global level.</p> <p>Animal infectious disease research is directly in line with the Sustainable Development Goals (SDGs).</p> <p>Research that focuses on zoonotic diseases that have significant impact on human and animal health and wellbeing, as well as diseases that have notable economic benefit in low income countries, provides important global impact. This type of impact can have significant implications for vulnerable low-income communities.</p> <p>Building research networks beyond the EU particularly, in terms of collaboration with non-EU researchers who work with zoonotic diseases that can affect low-income communities, can raise local and national research capacity. This is not only important in terms of the capacity to respond but also in terms</p>

		of the importance of building an interconnected and fair international collaboration network.
9	Sustainability effects	<p>Due to the strict conditions of BSL2 to BSL4 conditions and protocols, this can mean that animal infectious disease research can use and waste a wide range of materials.</p> <p>In addition, animal infectious disease control strategies outside the laboratory can require extensive use of materials to sterilise and to minimise the spread of disease.</p>
10	Impacts on societal values and norms	<p>The type of research that is conducted and the way in which it is conducted can have an impact on societal values and norms.</p> <p>The use of live animals in scientific research is widely debated in terms of the ethics of animal use. Issues raised can include the validity of using animal models, the transparency of animal research, etc.</p> <p>The way in which VetBioNet conducts its research also has implications. For example, societal impacts can result from changes in research culture and research practice. This could both have a negative and positive impact on the research community and wider society.</p> <p>Being transparent as a researcher can be seen to be important to support societal norms and values, so the way in which researchers are transparent about their work particularly when using animals in research can be an important issue and have societal impact.</p> <p>The way in which research uses animals can be an important aspect. This issue is in addition to considering animal welfare. The way in which research practices can instrumentalise animals can have a wider impact on how members of society consider their responsibilities to animals.</p>

Table 1: Mapping Societal Impacts related to Animal Infectious Disease Research

2.2. Societal impacts related to the VetBioNet activities.

The mapping approach to frame the discussion of social impact is used below and the ten types of impacts are discussed for this area of research.

Issue 1 - Human health and wellbeing

Social benefit is linked to the issue of public health and protection of the population from zoonotic disease through better characterisation and understanding of the aetiology of disease and potential transmission.

The social benefit from animal infectious disease research, which focuses on identifying, characterising and responding to animal infectious disease, comes from reducing disease burden in animal populations, in particular farm animal populations. Reducing disease burden can result in direct and indirect economic benefits. Reducing farm animal disease can also have an indirect benefit for farmers' mental health and wellbeing and well as the overall economic to their farming businesses.

Negative impacts on researchers working in this research area, particularly if they are working in BSL3 or BSL4 conditions, can be direct risks from exposure to the virus or bacteria and indirect through the working conditions and perceived risks. Working in a research area that has clear benefits and can reduce human harms can be very rewarding but even with such a sense of purpose working in an environment that is highly controlled and regulated can have an effect on overall personal wellbeing and researchers mental health. It is therefore important to review and look for ways to support positive working environments or to look at ways to limit individuals' exposure to stressful ones.

Some specific types of animal infectious disease research can raise questions and concerns in terms of negative social impact. Lines of research such as 'gain of function' experiments raise some key questions about the dual use and misuse risks. It is important to conduct detailed risk / benefit analysis of these lines of research.

Issue 2 - Animal health and wellbeing

Animal infectious disease research results in direct benefits to animals through greater understanding of disease, improved diagnosis and improved treatment of animals.

Animal infectious disease research can also significantly negatively impact animals directly through their use in *in vivo* experimentation such as in 'Challenge Tests'. However, some areas of animal infectious disease research can result in a transition away from *in vivo* experimentation or can

result in the development of monitoring tools which can directly refine the experience of research animals.

The outcomes of research such as the development of vaccinations may have direct and indirect impact on animals through protection of farm animals from disease transmission. In turn, research may affect animal health programmes and the management of farm animals which may result in movement restrictions that can affect their welfare.

Issue 3 – Impacts on human rights

Animal Infectious Disease research can generate knowledge and create tools that can both enhance and limit human choices.

Reduction of disease incidence, diminishing human suffering and facilitating freedom from disease are fundamental dimensions of core human rights. Infectious disease research can provide empowerment for individuals and groups, particularly any marginalised group, which is an important social impact.

Issue 4 – Education and professional development improvements

Research directly produces knowledge and supports the development of new technologies and tools. As well as fundamental knowledge and new health-related tools, research programmes can also produce training and education approaches that can result in positive social change.

The very process of doing this type of research work can highlight societally important issues that may be directly or indirectly related to the research practice and the research programme. Animal infectious disease research requires a high level of training and commitment. During the COVID-19 pandemic, many researchers made a significant commitment to deliver research and took on heavy workloads. Although this research area can be claimed to create significant benefit, there can be a negative and sustained burden on researchers to deliver in this research area especially when there is a zoonotic emergency. This highlights the need to think about the impact on individual professions and an important professional group. If working as a professional in this area is seen as a stressful career choice this can affect retention of staff and the recruitment of early career researchers. This could lead to an erosion of expertise which in turn is a negative social impact in terms of society's preparedness to deal with emergence of infectious disease outbreaks.

A research topic and the ways of working within a research network cannot only create new ideas and support productivity but it can also result in negative impacts that can affect researchers' mental and physical wellbeing. It is important these important impacts on wellbeing are identified, analysed and addressed.

Issue 5 - Effects on innovation and enterprise pathways

Research programmes can have direct impact on innovation pathways and can produce innovations that have an impact way beyond the original research areas.

Research programmes can connect researchers and ideas across both the private and public sectors to find new uses of the outcomes of animal infectious disease research. This can create opportunities for investment of capital and expertise that can support further innovation pathways and potentially speed up the technology development process.

Investment in large-scale infrastructure can support and initiate research outcomes and innovation and can help to translate new knowledge into applications.

Issue 6 - Public policy changes

Evidence produced from animal infectious disease may play an important role in one health policy-making. Animal infectious disease research by its very nature leads to understanding of zoonotic transmission. Further research in this area supports a transition to One Health thinking, an approach that is increasingly supported at national and international levels.

Research data generated from a large animal infectious disease network could affect animal control and containment strategy and provides the supporting evidence that justifies what can be difficult decisions, such as domesticated avian flock controls.

Issue 7 - Biota wellbeing

Animal infectious disease research can have a direct impact on the environment due to the way in which high containment research needs to be conducted and how waste materials may be managed that can have impacts on the wider biota.

Animal infectious disease research can also have indirect implications for the biota through controls that may need to be put in places to reduce the spread of an animal infectious disease, such as reagents and disinfectants. These chemical controls can be used directly to reduce disease spread and pre-infection as part of a precautionary plan to prevent animal infectious diseases.

Issue 8 - Societal development and harmonisation

Although animal infectious disease research funded by the European Commission focuses on issues across Europe, the research encompasses international infectious diseases. Greater overall knowledge of animal infectious disease not only benefits EU citizens, but can and should result in positive global impacts.

Animal infectious disease research is directly in line with and supports the Sustainable Development Goals (SDGs).

Research that focuses on zoonotic disease that has significant impact on human and animal health and wellbeing, as well as diseases that have notable economic benefit, in low-income countries provides important global impact. This type of impact can have significant implications for vulnerable low-income communities.

Building research networks beyond the EU particularly, in terms of collaboration with non-EU researchers who work with the zoonotic disease that can affect low-income communities, can raise local and national research capacity. This is not only important in terms of the capacity to respond but also in terms of the importance of building an interconnected and fair international collaboration network.

Issue 9 - Sustainability effects

Due to the strict conditions of BSL2 to BSL4 conditions and protocols, this can mean that animal infectious disease research can use and waste a wide range of materials. This also relates to the management and location of high containment facilities as well as the resource use associated with these sites. These issues highlight the value of focusing on provide cutting edge modern facilities that allow transnational access so that resource and land use can be managed in a sustainable manner.

In addition, animal infectious disease control strategies outside the laboratory can require extensive use of materials to sterilise and to minimise the spread of disease, this also relates to direct impacts on the biota

Issue 10 - Impacts on societal values and norms

The type of research that is conducted and the way in which it is conducted can have an impact on societal values and norms.

The use of live animals in scientific research is widely debated in terms of the ethics of animal use. Issues raised can include the validity of using animal models, the transparency of animal research, etc.

The way in which VetBioNet conducts its research also has implications, for example societal impacts can result from changes in research culture and research practice. This could both have a negative and positive impact on the research community and wider society.

Being transparent as a researcher can be seen to be important to support societal norms and values, so the way in which researchers are transparent about their work particularly when using animals in research can be an important issue and have societal impact.

The way in which research uses animals can be an important aspect. This issue is in addition to considering the animal's welfare. The way in which research practices can instrumentalise animals can have a wider impact on how members of society consider their responsibilities to animals.

3. Characterisation VetBioNET perspectives on impact

3.1. Perspectives from the VetBioNet team

It is valuable to explore researchers' perspectives and characterisations of impact. How do those conducting the research frame aspects of impact? As such, a survey with VetBioNet was conducted to connect characterisations of social impact in relation to animal infectious disease research with perspectives of the VetBioNet community on aspects of impact. The survey took place in June – July 2021. This was during the time of pandemic challenges and many of the VetBioNet were very busy as result of the changes in workload, research focus and due to the implications of the restrictions at that time. The survey was circulated and completed online and covered several topics including aspects of the benefits and impacts of VetBioNet and wider animal infectious disease research.

3.2. Methods

The following section sets out details of the methods and approaches used for the survey.

Questionnaire Design

To make efficient use of time during the pandemic, an online questionnaire was designed to determine network members' perspectives on a number of topics. The survey was designed to work in conjunction with current characterization of social impact, however, this questionnaire was more extensive than this topic with questions on five themes. The themes were: Societal Impact of Animal Infection Disease Research, Concepts of

Sentience, Welfare and Sentience, Sentience and Culture of Care and Transparency, Public Engagement and Sentience. In the context of this deliverable only the responses to Theme 1 Societal Impact of Animal Infectious Disease Research are reported. A series of open and closed questions were included in the survey. The survey was designed to take approximately 20-30 minutes to complete and comprised of 7 questions, of these questions seven of these relate to the discussion of societal impact (see Table 2), with additional opportunities to expand on their comments. Table 2 outlines the questions included in the survey. As this survey was collecting data on individuals’ perspectives, ethical review was required and sought. This survey activity was therefore submitted for review by the University of Nottingham, School of Sociology and Social Policy Research Ethics Committee (SSP-REC) and received a favourable ethical opinion (2021). The survey was conducted using a Microsoft Forms survey hosted by University of Nottingham so that work was compliant with the University of Nottingham’s data security policy and the UK Data Protection Act (2018).

Data Sampling and Collection

In summer 2021, members of VetBioNet were invited to take part in the survey and sent a participant information sheet and a link to the survey. Table 2 sets out the example questions.

Table 2: Example list of questions answered by VetBioNet researcher participants

Background
1. What is your role within your organisation, in general terms?
2. Approximately how long have you worked in this field of animal infectious disease?
3. What do you see as the overall value of this area of research work?
4. What made you decide to work in this area?
Theme 1- Societal Impact of Animal Infectious Disease Research
5. From your perspective, what is the most significant societal benefit from Animal Infectious Disease Research?
6. Do you think the research community does enough to communicate about the value and contribution of this research area?

7. Please can you list at least 3 societal benefits from the VetBioNet research work

Due to the wider ranging nature of the experience and knowledge of the members within the research network and the COVID-related issues, the decision was made that there could be a range of questions that provided the opportunity to examine a range of topics. Rather than directing more specific questions to individuals. This has meant that all data has been collected anonymously, however if any respondent included a comment that may have identified themselves then these aspects were removed to ensure and protect anonymity.

Response Rate and Analysis

As previously mentioned, the survey was conducted during the pandemic. Taking this constraint into consideration, seventeen responses were received from the VetBioNet community. The responses were downloaded once the survey closed and the data was collated by question. Due to the sensitive nature of the work involved in this research, additional effort was made to review the responses and preserve the anonymity of the participants, as mentioned above. All survey results provided through Microsoft Forms were anonymised, and privacy was considered to be of the utmost importance. However, as the participants were accessed via VetBioNet, it may prove difficult to ensure complete anonymity as this is a limited data pool and members of the network may know each other and it could be possible that other members of the network may recognise the speech patterns of individuals when quoted. These ethical issues have been analysed and managed appropriately with full consent of the projects' management team who reviewed the survey and gave gatekeeper permission in advance for circulation of the survey. Due to the number of responses and the diversity of the qualitative responses no statistical analysis was conducted so descriptive reporting is provided in this report.

3.3. Perspectives on aspects of research value and impact

As highlighted, several aspects were explored with the VetBioNet members. The issues of value, communication and impact are discussed below.

When asked to reflect on the overall value of animal infectious disease research, all seventeen participants located the value of their work in terms of preventing and combating infectious disease. Several of the respondents extended this value and linked their work and this research area to direct impacts and benefits for humans and animals summed up by the participant phrase (P6) "generating a "healthier" life for animals and humankind". Reflection on impacts were also provided by some members with references

to food security. Two respondents highlighted the importance of positive impacts on animal welfare. As well as focusing on prevention of disease, some of the members also linked the notion of value to One Health and public health approaches.

When asked to reflect on the societal benefit of animal infectious disease research, a range of direct impacts were listed alongside a range of management and process benefits. The importance of animal-oriented impacts were stated, such as:

P4 - "More sustainable animal husbandry (better animal welfare)"

P5 - "Recognising disease for better animal welfare"

P6 - "Create healthier life for livestock"

Some of the respondents included these animal-orientated aspects alongside other societal impacts, for example:

P9 - "Zoonotic potential, food security, and animal welfare"

As with discussions of value, the role of this research has in identifying, preventing and treating infectious disease was emphasised by the majority of respondents:

P1 - "Establishment of the basis to combat infectious diseases through development of diagnostics, epidemiological model, vaccines, biosecurity measures"

Economic benefits were specifically stated by only a minority of respondents, with the role of this area of research in identifying and documenting animal disease highlighted as an important issue for "safe trade". The role of this work in policy-making was also referenced, with research supporting "evidence-based governance of preventive strategies for 'one health' (human, domestic animals, and wildlife)" (P7).

The VetBioNet members were asked to reflect on the way in which the research community communicates about the value and contribution of this research area and where they should do more to relay the nature and value of this research area to others. Over 75% of respondents felt that more needs to be done. The respondents highlighted that communicating about science can require special skills and so more could be done to support researchers to discuss these issues. Although it was felt that publics are aware of the overarching importance of this work, "The importance of animal infectious disease research (in the broader sense) for safeguarding Public Health (prevention and control of zoonotic diseases) is probably clear to everybody" P14. However, it was indicated by a number of respondents that "the general public does not understand the links" between this research area and farming and food production. For example, P14 stated

"...when it comes to epizootic/production diseases, I think that the importance of veterinary research for animal health and welfare and a responsible and economically viable agriculture is not sufficiently communicated to the public." Further communication approaches were perceived to be needed.

VetBioNet members were asked to list a least three societal benefits from this area of research. Several topics clearly emerged and these emphasized and further complemented the respondents' earlier reflections. Specifically, these aspects were stated by several respondents:

Supporting Understanding

- Better knowledge and understanding of animal infectious disease
- Prevention of the spreading of infectious animal diseases

Supporting good practice in research

- Coordination of infectious diseases research to manage risks and produce important benefits
- Better use of expensive research infrastructures
- European harmonization practices to improve research and manage resource use
- Facilitating greater awareness and accessibility of infection research to the wider scientific community
- Promotion of the Replacement, Reduction and Refinement of Animal use in experimentation
- Providing Transnational access of high containment infrastructures to support collaborative and efficient research practices
- Exchange of experiences and skills and improvement/fostering of highly professional animal experimentation knowledge

Supporting the development of treatments and prevention measures

- Accelerated discovery and development of vaccines against diseases like COVID-19
- Developing novel diagnostic platforms for disease detection

Supporting Wider Impacts

- To support more sustainable animal husbandry
- To support international food systems
- Supporting and advancing the important area of work in comparative medicine
- Supporting and advancing the important area of work in One Health
- Providing knowledge and concepts of biosafety and biosecurity for wider research and public health
- Global relevance for wider issues such as international travel and trade, climate change, urbanisation
- Providing evidence for policy-making
- Development of new technologies and tools that supports economic growth and employment

All of the responses to the questions, highlight that researchers are aware and reflective regarding the societal impact of their work and finding further ways to support the realization of some of these impact goals will be important for this research area going forward.

4. Characterisation of societal impact and key action areas

4.1. Why reflecting on societal impact is important

It is important to recognise that society and the research environment are now very different from the world that existed pre-COVID when VetBioNet

was funded. In this post-pandemic world, it is therefore important to review and potential re-evaluate a number of aspects of animal infectious disease research when we think about this work in terms of social impacts. This section builds on the issues discussed earlier but also places these issues in the context of a post-COVID research environment.

One way to examine the area of animal infectious disease research in light of a post-COVID pandemic world is to consider what may be needed going forward and in the future.

As indicated at the start of this document, many organisations have considered aspects of social impact. Recently, a number of organisations have discussed how social impact can play a more central role in the work that is planned and conducted. The Organisation for Economic Co-operation and Development (OECD) has proposed (2019) that it can be important to invest in social impact realisation. In a recent report, the OECD has suggested that social impact investing provides economic support to organisations with the explicit aim to support social and, or, environmental needs. A research investment is intended to have an impact, but by considering an explicit social return, this can potentially support important societal change. This is a shift for organisations such as the OECD, as this approach still considers economic investment and development, but is orientating towards achieving social outcomes. This approach of course is in line with the ethos and aims of the Sustainable Development Goals.

Using this approach, the OECD have proposed that there should be four action areas when considering how to facilitate impact. These impact areas are; Financing, Policy, Data and Innovation.

4.2. Modelling for understanding key action areas

Considering the OECD (2019) framework in relation to animal disease research and what this may mean for key actions for this research area, it is valuable to first highlight what is the nature of these four impact areas before discussing them in terms of animal infectious disease.

The four areas, Financing, Policy, Data and Innovation, are set out in Figure 2, Social Impact Investment. These impact areas have been developed by the OECD as high-level impact management principles, which can be used with other approaches. The aim of this framework is to get those actors who drive change through mobilising expertise and providing investment to consider positive impacts to build stronger systems, and to understand and evaluate their impact both in terms of the potential positive and negative impact on people, communities and the planet.



Figure 2: Social Impact Investment (OECD, 2019)

Each of these action areas are discussed below in terms of potential for future animal infectious disease research. It is also important for the VetBioNet community to identify the aspects that can support impact and can help others consider that impact and how they can facilitate important work in this area of research. Drawing on the OECD’s development of impact imperatives (OECD, 2019), key action areas for impact are: (1) financial aspects of research; (ii) research supported innovation; (iii) research-related policy and (iv) research data. Each of these areas need to be actively engaged with for the activities of consortia such as VetBioNet to have the societal impact that is hoped for from this work.

4.3. Financial Aspects of Research Action Area

When considering the financial aspects in terms of action areas, in terms of important areas of social impact, in order to support collaborative research

that can characterise existing and new animal infectious disease, it is important that there are maintained and significant levels of funding. VetBioNet is an infrastructure funding instrument, highlighting the financial support needed to maintain this type of research. Research on BSL3 and BSL4 classified animal infectious disease organisms requires significant capital investment to maintain facilities and animals. Consistency and capacity are important in this field not just in terms of facilities but also in terms of the maintenance and support of highly specialised staff. This therefore requires high capital investment that is secured for not just years but decades. Many national governments provide this financial underpinning, but EU finances provide opportunities to harmonise and support synergise that ensure that research capacity in animal infectious disease research across the EU is more than the sum of the individual parts. An important part of these research activities is also to look for alternative experimental approaches that do not use live animals, for example finding ways to move away from Challenge Tests. These 3Rs (Replacement, Reduction and Refinement; Russell and Burch [1959]) related areas of work are progressing, but much more funding with an associated long-term commitment is needed. Therefore, across the board continued EU level funding is vital to maintain and synthesise the most out of the EU research capacity.

Within this area of research, secured and significant funding levels can result in a 'Portfolio' effort. If research projects are conducted through or under a broad research programme where data and results are shared in an open way, then this can result in portfolio benefits. More importantly, if animal infectious disease projects are linked under a network or programme, then additional financial support for cross-cutting services (for example, for database services, access to new monitoring tools, etc) can provide significant added value. In other words, a small amount of cross-cutting funding can result in significant benefits for the researchers at a low cost and this in turn, can support more significant impact.

The recent pandemic has highlighted the value of financial flexibility, and so, having that flexibility at a time of COVID was important to mobilise resources and to carry out experiments quickly at a time of an emerging animal infectious disease. VetBioNet provided this type of financial flexibility through mobilising an 'Emergency Research' fund. Providing established financial support and a flexible fund that can be mobilised quickly will be a key support mechanism and action area for future planning. Providing financial stability is not only important for the research itself, but it is also important for providing the appropriate supporting services and infrastructure to quickly mobilize people, governance processes and support mechanism at a time of emergency.

4.4. Research Supported Innovation Action Area

Supporting innovation is a key action area. It is important to identify innovation pathways and opportunities to move basic and fundamental research into new innovations, such as diagnostics, vaccines, etc., but also to support the development of innovation pathways. This requires more than short-term investments, as pathways to impact can take 5 to 15 years to realise. The COVID-19 pandemic has highlighted that we can reduce these pathways in the field of infectious disease for vaccine development. It is therefore important to consider how this can influence current innovation practices.

The VetBioNet team has demonstrated innovation in the development of new *in vitro* approaches, this not only helps to reduce financial costs of research programmes, but it also supports the 3Rs by replacing the use of animals in *in vivo* experiments and reduces the overall use of animals through the use of cell-based approaches.

Innovation within a research area can also be focused on improved processes within the research, and this is seen with the important innovation around the behavioural monitoring techniques that can support animal wellbeing impacts.

Further areas of innovation that potentially need further development and innovation support are related to new collaborations outside the EU. Exchanges with non-EU countries particularly low-income countries, which have a number of challenges with animal infectious disease issues, can support these countries to identify, analyse and respond to infectious disease challenges. Collaborative practices and supporting capacity building with potential impacts is an important area of innovation. However, collaborations can also support different ideas of innovation when researchers are used to working in low resource settings and these unique forms of innovation can benefit all, as such these collaborations are important not just in terms of fair collaboration, but also in terms of supporting innovation.

4.5. Research-related Policy Action Area

Supporting the development and review of animal experimentation legislation is an important area. VetBioNet has contributed to this through the development of a policy and regulation support deliverable (D4.4).

An additional key policy area is the current drive to increase transparency. There are now new requirements to provide Technical Summaries, however further action is needed on understanding the nature, opportunities and challenges of transparency. It will be important to further explore the impact of greater transparency on this research area.

Policy also transcends to the way in which research is conducted and the recent pandemic has highlighted the need to support research culture and researcher wellbeing in critical areas. It could be argued that animal infectious disease research is a critical area, but does this create additional societal responsibility and could it result in work-related stress for individual researchers. More work on the impacts of ways of working in this research area needs to be discussed and analysed.

4.6. Data Action Area

A key action area is the generation and management of data. There is increasing focus on new guidance and data management approaches such as FAIR. VetBioNet has created data sharing platforms and has catalogued the research work and the results.

Future actions need to consider on how Data Sharing Platforms can, not only be created, but be maintained after funding has finished. Unless there are mechanisms for continue maintenance of these data sets and opportunities to update sharing and integration approaches, then important resources may have limited value, which has a direct impact on long term impact opportunities.

5. Conclusions and Recommendations

This report has highlighted the social impact aspects that are important for animal infectious disease research and in particular the work of VetBioNet. These areas cover Health and wellbeing; Animal health and wellbeing; Impacts on human rights; Education and professional development improvements; Effects on innovation and enterprise pathways; Public policy changes; Biota wellbeing; Societal development and harmonisation; Sustainability effects and Impacts on societal values and norms.

Although different aspects and levels of social impact have been demonstrated across these areas, it important as part of a post COVID-19 pandemic plan to identify action areas. It is important for the VetBioNet community going forward to identify the aspects that can support longer term impact and can help other researchers and networks to consider wider impact. Discussions on impact have been ongoing across the activities of VetBioNet and these have already and will further inform VetBioNet's sustainability plans. So, drawing on the OECD's development of impact imperative, four impact areas have been identified for animal infectious disease research: financial aspects of research; research supported innovation; research-related policy and research data.

Considering these aspects in future research actions should support societal impacts. Within these action areas, the aspect which relates to researcher's wellbeing, which can be seen to relate to research policy, should not be underestimated and this area may need much more focus and resources going forward if important societal impacts are to be realised from animal infectious disease research.

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