Implementation of a One Health approach to control of Zoonotic Diseases in Croatia and the United Kingdom

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THE UNIVERSITY OF ZAGREB FACULTY OF VETERINARY MEDICINE

INTEGRATED UNDERGRADUATE AND GRADUATE UNIVERSITY STUDIES IN
VETERINARY MEDICINE

MASTER'S THESIS

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Implementation of a One Health Approach to Control of Zoonotic Diseases in Croatia and the United Kingdom

Zagreb, 2024

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This paper contains 44 pages, 6 figures, 0 tables, 75 literature citations

ACKNOWLEDGEMENTS

I would like to take this opportunity to thank Professor Ljubo Barbić for introducing me to the concept of One Health in the elective class 'Zoonoses', and for subsequently agreeing to be my mentor. I have greatly enjoyed getting stuck into this topic and expanding my knowledge under your guidance. I would also like to thank the Veterinary Faculty staff for giving me this opportunity, and for the last six years of tuition.

I would like to thank Professors Folnožić and Vince, for providing us with many laughs over the years, and a lot of support. Aside from being fantastic teachers, you have earned a place in my heart for being the first Professors to know my name.

To Dr Kristina Lućić, and all the staff at Dumovec - thank you for your tutelage, all the games of Monopoly, the famous Christmas parties, and moreover, for accepting me and including me in every opportunity. I had so much fun working with you.

Dr Jon Geller, you deserve a round of applause. THANK YOU for calling me on a Tuesday and inviting me to Ukraine on Thursday. Thank you for bringing us to 'FoCo, CO', and inviting us to work with the Street Dog Coalition. You have given me so, so many wonderful opportunities. You are a huge inspiration to me, and I am excited to work together again in the future. Special mention for suggesting Sofia and I go line-dancing with cowboys, because that was truly a life-changing experience.

The last six years have brought with them some very high, highs, and some very low, lows. I am so grateful to have 'grown up' in this city, and in this country. The smell of cigarettes and coffee will forever remind me of my home here. I have made friends that have become family, and without whose constant companionship and comfort during both the good times, and the bad, I would be absolutely lost. When I remember these years, I am sure they will be coloured by the fondness of nostalgia, and not the horror and rage upon hearing that we have to spend *yet another* freezing morning testing pregnant cows… in *Bjelovar*.

If I could thank every friend or family member who pushed me to keep going when it all felt insurmountable, this document would turn into a novel. To everyone who ever picked up the phone to me crying down the other end, or took me out to coffee on the bad days, or shared a drink and a laugh – *thank you so very much.* This moment is also for you.
Here's to the end of this adventure. I'm sure there will be many more to come.

In loving memory of Tiani Meredith.

ABBREVIATIONS

1. WHO - World Health Organisation
2. US CDC - US Centre for Disease Control and Prevention
3. OHC - One Health Commission
4. AMR - Antimicrobial resistance
5. SARS - Severe Acute Respiratory Disease
6. WNV - West Nile Virus
7. FAO - Food and Agriculture Organisation
8. WOAH - World Organisation for Animal Health
9. UNICEF - United Nations Children's Fund
10. TZG - Tripartite Zoonoses Guide (FAO, OIE, WHO, 2019)
11. BSE – *Bovine Spongiform Encephalopathy*
12. AMA - American Medical Association
13. JRA - Joint Risk Assessment
14. MCM - One Health Coordination Mechanism
15. U.K. – United Kingdom
16. HAIRS - Human Animal Infections and Risk Surveillance Group
17. POST - The Parliamentary Office of Science and Technology (U.K.)
18. DEFRA - Department for Environment, Food and Rural Affairs
19. APHA - Animal and Plant Health Agency
20. UKZADI - U.K. Zoonoses, Animal Disease and Infections Group
21. GHSI - Global Health Security Index

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1. INTRODUCTION

PITT and GUNN (2024) define One Health as "an approach to investigating infectious diseases which acknowledges that humans, animals, plants and the environment are closely interlinked." The concept of One Health is derived from that of "One Medicine" - a school of thought which can be traced back in its origins to Rudolf Virchow and his studies of *Trichinella* transmission (GYLES, 2016). One Medicine, in its infancy, was based on the relatively simple idea that human and animal medicine were one and the same (GYLES, 2016).

One Medicine, in more recent years, has slowly been incorporated into a far bigger ecosystem: One Health. Initially a subdivision of veterinary public health, the One Health concept has grown to incorporate divisions of its own, on a governmental and global scale. ZINSSTAG et al (2011) state that this move away from One "Medicine" to One "Health" was driven partly by the clinical connotations of the word "Medicine"; One "Health" is a term better reflective of the wider social implications encompassed by the field.

Today, the World Health Organisation (WHO) defines One Health as an approach to public health that recognises the interdependence of human societies, animals, and biological ecosystems. The aim of such an approach, in the broadest sense, is to have a better grasp on disease control: "from prevention to detection, preparedness, response and management." (WHO, 2024).

Being a fairly abstract concept, it is important to explore multiple definitions of One Health: how the underlying theory is defined, and how it may impact various societal outcomes. The US Centre for Disease Control and Prevention (US CDC) and the One Health Commission (OHC) share the following definition of One Health: "One Health is defined as a collaborative, multisectoral, and transdisciplinary approach—working at the local, regional, national, and global levels—with the goal of achieving optimal health outcomes recognizing the interconnection between people, animals, plants, and their shared environment" (USDC, OHC, 2024).

Another definition comes from the One Health Global Network: “One Health recognizes that the health of humans, animals and ecosystems are interconnected. It involves applying a coordinated, collaborative, multidisciplinary and cross-sectoral approach to address potential or existing risks that originate at the animal-human-ecosystems interface” (ONE HEALTH GLOBAL NETWORK, 2024). Figure 1 provides a visual representation of the three facets of One Health.

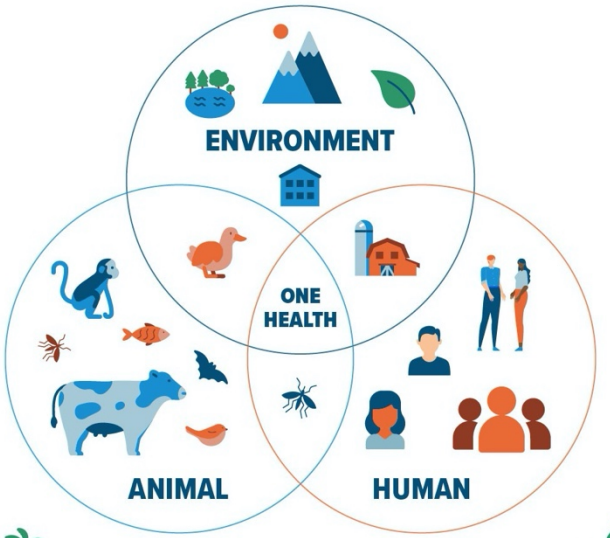


Figure 1. The 3 key domains of One Health
(PREZODE, 2022); URL:
https://prezode.org/about/the-one-health

At the centre of One Health lies multidisciplinary, multi-level coordination between different areas of government and between different health-related modalities. This, inherently, is an incredibly complex issue - how to ensure efficient communication between the multiple layers of government, and even between governments internationally?

In the context of veterinary medicine, the One Health approach is applicable to three main areas: antimicrobial resistance (AMR), zoonotic disease, and, in a wider sense, ecology and environmental degradation (DHAMA et al, 2013). Whilst this review focuses on measures

implemented to control zoonoses, it is important to keep these broader themes in mind when considering any One Health related issue.

A zoonose, or, zoonotic disease, is defined as any infection or disease that can be transferred from animals to humans (WHO, 2020). Whilst multiple classifications of zoonotic disease exist, in the context of medicine, the most frequent division of such diseases is based on aetiology. CHOMEL (2009) provides the following breakdown of the various causal agents of zoonotic disease: viral, bacterial, parasitic, mycotic, or prion-based. Whilst the most well-known agents of zoonotic disease are usually bacterial or viral (such as organisms from the *Brucella* genus, or *Lyssavirus* as the causal agent of rabies), there are multiple agents and forms of zoonotic disease that can pose a risk to human health (HOREFTI, 2023).

A more comprehensive classification, based on the maintenance cycle required for zoonotic disease transmission, is also provided by CHOMEL (2009): orthozoonoses, cyclozoonoses, pherozoonoses, and saprozoonoses. Examples of orthozoonoses, or direct zoonoses (including mechanical or fomite transmission) are rabies and *Brucellosis* (CHOMEL, 2009; LEAL-FILHO et al, 2022). Cyclozoonoses are those that rely on an intermediate host, including *Taeniasis* and *Echinococcosis* (LEAL-FILHO et al, 2022). Pherozoonoses, or, metazoonoses include *Arboviruses* and *Lyme disease (Borellia burgdorferi)* – diseases in which the causal agent must first incubate in an invertebrate host, before infection becomes viable (CHOMEL, 2009; LEAL-FILHO et al, 2022). Finally, saprozoonoses are those which require both a vertebrate host, and a developmental site which is non-animal (LEAL-FILHO et al, 2022). A key example of a saprozoonose would be *Listeria* (CHOMEL, 2009). This review will focus mainly on approaches to emerging pherozoonoses (including *arboviruses*) and orthozoonoses – including novel and emerging *coronaviruses*.

Zoonotic diseases, as one of the main global public health threats - see the recent example of the COVID-19 pandemic- have thus become an area of major governmental scrutiny. This has highlighted the important role veterinarians play at the interface of human-animal health and has pushed the importance of the One Health agenda to the forefront of policy making. As such, resources and strategic guidelines have become essential for contingency planning and pandemic preparedness.

The One Health initiative and subsequent implementation of various One Health approaches was first used in 2003 in connection to an outbreak of Severe Acute Respiratory Disease (SARS), and the H5N1 Highly Pathogenic Avian Influenza epidemic around the same time (ŠEHOVIĆ, 2017; MACKENZIE and JEGGO, 2019). The rapid transmission of the novel *coronavirus* proved shocking to those working in healthcare – for example, one infected hospital worker transmitted the infection to sixteen others in just one night (MICHELSON, 2005). This epidemic served to emphasise the risk posed by novel and emerging, or re-emerging diseases in a world becoming increasingly internationally connected.

Partially in response to these emerging threats, the 'Manhattan Principles' were devised by the Wildlife Conservation Society. These principles were influenced by experts in the medical, as well as veterinary fields, all committed to the idea of making One Health a more accessible concept (BOUSFIELD and BROWN, 2011). The Manhattan Principles clearly state the connection between human and animal health, as well as the possible impact of emergent zoonoses on the food chain, and in the production of food for human and animal consumption. Wildlife was acknowledged as a key vector for emerging infectious disease, zoonotic disease transmission, and the possible impact that exposure to wildlife could have on public health globally. BOUSFIELD and BROWN (2011) cite outbreaks of the zoonotic diseases West Nile Virus (WNV), Ebola Haemorrhagic Fever, SARS and Avian Influenza as drivers to the creation of the Principles.

The Manhattan Principles are displayed in Figure 2: (BOUSFIELD and BROWN, 2011):

Box 1: The Manhattan Principles

We urge the world's leaders, civil society, the global health community and institutions of science to:

1. Recognize the essential link between human, domestic animal and wildlife health and the threat disease poses to people, their food supplies and economies, and the biodiversity essential to maintaining the healthy environments and functioning ecosystems we all require.

2. Recognize that decisions regarding land and water use have real implications for health. Alterations in the resilience of ecosystems and shifts in patterns of disease emergence and spread manifest themselves when we fail to recognize this relationship.

3. Include wildlife health science as an essential component of global disease prevention, surveillance, monitoring, control and mitigation.

4. Recognize that public health programs can greatly contribute to conservation efforts.

5. Devise adaptive, holistic and forward-looking approaches to the prevention, surveillance, monitoring, control and mitigation of emerging and resurging diseases that take the complex interconnections among species into full account.

6. Seek opportunities to fully integrate biodiversity conservation perspectives and human needs (including those related to domestic animal health) when developing solutions to infectious disease threats.

7. Reduce the demand for and better regulate the international live wildlife and bush meat trade not only to protect wildlife populations but also to lessen the risks of disease movement, cross-species transmission, and the development of novel pathogen-host relationships. The costs of this worldwide trade in terms of impacts on public health, agriculture and conservation are enormous, and the global community must address this trade as the real threat it is to global socio-economic security.

8. Restrict the mass culling of free-ranging wildlife species for disease control to situations where there is a multidisciplinary, international scientific consensus that a wildlife population poses an urgent, significant threat to public health, food security, or wildlife health more broadly.

9. Increase investment in the global human and animal health infrastructure commensurate with the serious nature of emerging and resurging disease threats to people, domestic animals and wildlife. Enhanced capacity for global human and animal health surveillance and for clear, timely information-sharing (that takes language barriers into account) can only help improve coordination of responses among governmental and non-governmental agencies, public and animal health institutions, vaccine or pharmaceutical manufacturers, and other stakeholders.

10. Form collaborative relationships among governments, local people, and the private and public (i.e. non-profit) sectors to meet the challenges of global health and biodiversity conservation.

11. Provide adequate resources and support for global wildlife health surveillance networks that exchange disease information with the public health and agricultural animal health communities as part of early warning systems for the emergence and resurgence of disease threats.

12. Invest in educating and raising awareness among the world's people and in influencing the policy process to increase recognition that we must better understand the relationships between health and ecosystem integrity to succeed in improving prospects for a healthier planet.

Figure 2. The Manhattan Principles (BOUSFIELD and BROWN, 2011)

Following the outbreak of SARS in 2003, and the subsequent creation of the Manhattan Principles, the realisation that previously unknown zoonotic pathogens could emerge without warning and threaten economies, health, and security across the globe, highlighted the lack of preparedness of many countries for such an event (MACKENZIE and JEGGO, 2019). The need for rapid alert and response systems, as well as systems for communicating effectively both nationally and internationally, was made abundantly clear. Finally, the need for global coordination and participation in One Health schemes became apparent.

To illustrate the shift in global thinking, following the creation of the Manhattan Principles, is the following example of the response to the epidemic of Highly Pathogenic Avian Influenza in 2003. The United Nations Secretary General appointed a coordinator for disease monitoring, and subsequently formed a collaboration with the WHO, Food and Agriculture Organisation (FAO), World Organisation for Animal Health (WOAH, formerly OIE), United Nations Children's Fund (UNICEF), and the World Bank (MACKENZIE and JEGGO, 2019). This serves as one of the first examples of a One Health approach being implemented and used to control and monitor a zoonotic disease threat. In the years following that event, the need for a comprehensive guide to responding to such crises, as well as providing a framework for implementing standardised procedures, became apparent.

The "Tripartite Zoonoses Guide" (TZG) was developed in 2019 by the FAO, WHO, and WOAH to provide guidelines for implementing a One Health approach. This guide was designed to be used by any government in any country, and included topics such as disease surveillance methods, a guide to information sharing between sectors, and how to perform a thorough risk assessment for zoonotic disease threats, with the aim of making the One Health approach more accessible on a global scale.

2. LITERATURE REVIEW

2.1 The Tripartite Guide to Addressing Zoonotic Diseases in Countries

2.11 - Overview of the TZG

Zoonotic diseases are predominantly transmitted at the animal-human-environment interface (MAGOURAS et al, 2020). The borders of this interface, in a rapidly changing and globalising world, are becoming ever-narrower (DEBNATH et al, 2021). Thus, the risk of zoonotic disease exposure and transmission is increasing - factors such as deforestation, increased demand for products derived from wildlife, and narrowing of biodiverse habitats are all contributing to the increase in prevalence of various diseases (DEBNATH et al, 2021). Previously, threats were broadly limited to agricultural, veterinary, or animal healthcare workers living or working close to these borders. Now, a much wider group of people have become exposed to both emerging and existing disease threats (SAHU et al, 2020), largely driven by explosive human population growth, and the subsequent need for cheap living accommodation (MAGOURAS et al, 2020).

2.12 - Barriers to implementation

Based on the definition of One Health provided by the US CDC, which promotes interconnectedness on multiple levels, One Health approaches must incorporate multiple sectors. However, this does not always translate to the immediate coalition of all relevant disciplines. For example, the approach may be limited to human or agricultural sectors working together, and bypass the veterinary sector. This is not an ideal scenario for a true One Health initiative, but in many cases is the best outcome, as true coalition is hard to implement and organise.

As such, there are multiple barriers faced by governments exploring the idea of One Health. The main obstacles faced by such parties are outlined in the Tripartite Guide as follows (TZG, 2019):

- Insufficient political will or lack of commitment in relevant sectors

- Scarce human and financial resources
- Poor national infrastructure/ extenuating national circumstances, such as war or political unrest
- Insufficient ability to identify common goals
- No strong national governance, reflected in poorly adapted goals and frameworks
- Difficulties in communication and coordination between sectors
- Failure by countries to provide proof of success of such methods

Other barriers to the One Health approach include resistance by the medical community, despite political and public endorsement of the scheme from influential bodies including the WHO, Public Health England, and the American Medical Association (MACKENZIE and JEGGO, 2019). Multiple parties have suggested that the One Health concept be incorporated into medical school curricula, thus teaching this approach as an essential, rather than optional aspect of public health and infectious disease control (ALLEN-SCOTT et al, 2015; NATTERSON-HOROWITZ et al, 2017). This idea would allow graduating medical professionals to incorporate the values of One Health into their practice going forward, and perhaps pave the way for future medical doctors to understand One Health as part of a necessary, global fight against emerging diseases.

A more complex barrier to governmental acceptance of the One Health approach is the fiscal aspect - reluctance by various governmental bodies to partake in the One Health initiative may be due to financial concerns. The costs of interdepartmental coordination, and the implementation of new schemes, may appear at first to be too great to be worth any longer-term benefits. However, an inciting factor may the costs incurred in the diagnosis and treatment of zoonotic diseases. NARROD et al (2012) stated that even in the period between 2002-2012, more than USD $200 billion globally was spent combating zoonotic diseases, a figure which includes both the passive and active costs involved. Thus, reducing these costs over time should be an attractive prospect for world economies.

The TZG evaluates such costs versus benefits and concludes that overall, whilst increases in expenditure to coordinate a One Health approach will be great at first, saving across multiple areas is possible. One example detailed in the TZG is sample testing. Provided that human medical professionals and veterinarians are willing to coordinate such tests, savings

could be made by identifying repeated - and unnecessary – actions (TZG, 2019). Another example is that of vaccinations - intervening in one sector, for example, veterinarians vaccinating animals against rabies, incurs costs only in that sector, however, the benefits are sown by both the veterinary and public health sectors (TZG, 2019).

2.13 - Pre-existing Frameworks

The Tripartite Guide suggests that countries should use pre-existing frameworks to guide their implementation of the One Health approach. Such frameworks could include: the WOAH standards, Sustainable Development Goals, and International Health Regulations. Figure 3 depicts the Sustainable Development Goals.

Figure 3. Sustainable Development Goals (United Nations, 2015; URL: https://sdgs.un.org/goals#icons)

The outlined goals require stakeholders and multiple governmental bodies to work together in multiple disciplines. Countries already endorsing such goals are therefore good candidates for the One Health approach. SINCLAIR (2019) states that achieving, or, keeping in mind these goals is a critical part of any One Health approach: the direct link between the themes expressed in the Goals, for example food scarcity and sustainable city building, and human, animal, and environmental health, is clear. Sustainable practices going forward, aligned with both the Sustainable Development Goals and the One Health approach, could therefore include stricter controls on wet markets selling animal or bushmeat products, or ecological surveys conducted prior to urbanisation (HALABOWSKI and RZYMSKI, 2021; PEROS et al, 2021).

2.14 - Strategic Outline, the MCM, and Emergency Preparedness

The Guide is proposed to be used initially for the control of a few, key zoonotic diseases or "activities that are regarded as high risk or priority" (TZG, 2019). By focusing only on one or two key areas and targeting the approach towards the area of highest risk, resources and infrastructure can be redirected accordingly, as well as providing officials with the ability to respond promptly to any areas identified as inadequate. An example of progressive assimilation of the One Health approach into national framework is given in the TZG as the control and monitoring of Highly Pathogenic Avian Influenza, and Severe Acute Respiratory Syndrome in the Asia-Pacific region, as previously mentioned in the Introduction of this review – when the outbreak of the disease resulted in a change to policy at the national level (ŠEHOVIĆ, 2017; MACKENZIE and JEGGO, 2019; TZG, 2023).

The first step in implementing the One Health approach, as determined by the TZG, is the formation of a One Health Coordination Mechanism, or "MCM." The MCM is a formalised group, responsible for communication and coordination across sectors - either in response to an emergency event or as part of the initial process (TZG, 2019). Those included in the group should include technicians, policymakers, and strategists, from different areas of government. The MCM is responsible for delegating leadership roles and defining subgroups in the relevant areas. Other responsibilities of the MCM include mapping existing infrastructure and

stakeholders, as well as keeping up to date with relevant trends in emerging and existing diseases. The involved personnel should therefore be representative of multiple disciplines.

There are six key areas that should be the point of initial focus for the MCM, once established (TZG, 2019):

1. Contingency plans for an emergency situation
2. Surveillance and monitoring of disease threats
3. Investigations and follow-up reporting of outbreaks or isolated cases of disease
4. Joint risk assessments
5. Risk management and reduction
6. Engagement with the relevant communities and involvement of all relevant workforces

The Guide states that in countries without existing coordination mechanisms, the priority for those involved in implementing a One Health approach should be given to whichever sector will decrease risks to human and animal health most rapidly. This includes infections with potentially fatal consequences for public health, such as a rabies assessment and vaccinations for humans and animals in countries without such a system in place (TZG, 2019).

The next phase should focus on preparation for an emergency event. Per this logic, simulations are a key part of coordinating a One Health approach. Emergency situations should be practised for the purpose of identifying weaknesses within the proposed chain of command or task force. As a real-world example, the responses to the COVID-19 pandemic were widely regarded as poor and ill-timed, as many countries were simply not prepared for such an event (AARESTRUP et al, 2021). Those involved in the MCM must plan for circumstances involving widespread public panic, an unknown emergent pathogen, and the possibility lack of warning for such an event. Emergency planning must be differentiated from strategic planning, which is mostly focused on outlining goals and the necessary steps to achieve them, as opposed to a rapidly deployed emergency strategy (TZG, 2019). It is, however, important to aim towards a framework which includes both.

2.15 - Surveillance

A strong surveillance system is the central tenet of infectious disease prevention (VRBOVA et al, 2010). The Guide suggests that humans, animals, vectors, and the environment should be part of a national, or even international, surveillance and monitoring scheme (TZG, 2019). There are multiple types of surveillance: indicator-based (for known pathogens), event-based (for emerging threats and those that pose a threat to country borders), active surveillance, and passive surveillance. Excellent surveillance systems usually include coordination with the private sector; use of private laboratory services and privately working medical and veterinary professionals (BORDIER et al, 2020).

VRBOVA et al (2010) highlight the influence that lack of communication regarding surveillance data has on disease prevalence, citing the outbreak of swine-origin influenza A H1N1 as an example of poor outcome due to insufficient correspondence between sectors. HATTENDORF et al (2017) outline three core aims of zoonotic disease surveillance: the early detection of a threat, the ability of a location to demonstrate freedom from a disease, and the monitoring of known endemic disease for the purpose of estimating prevalence, and monitoring changes in disease trends over time. By participating in multiple forms of surveillance, countries can participate in information sharing, and possibly contribute to predictions in the landscape of emerging and re-emerging infectious diseases. Involving multiple sectors in such surveillance – including animal owners as well as veterinary staff, forms part of an integrated One Health approach.

2.16 - Risk Assessment

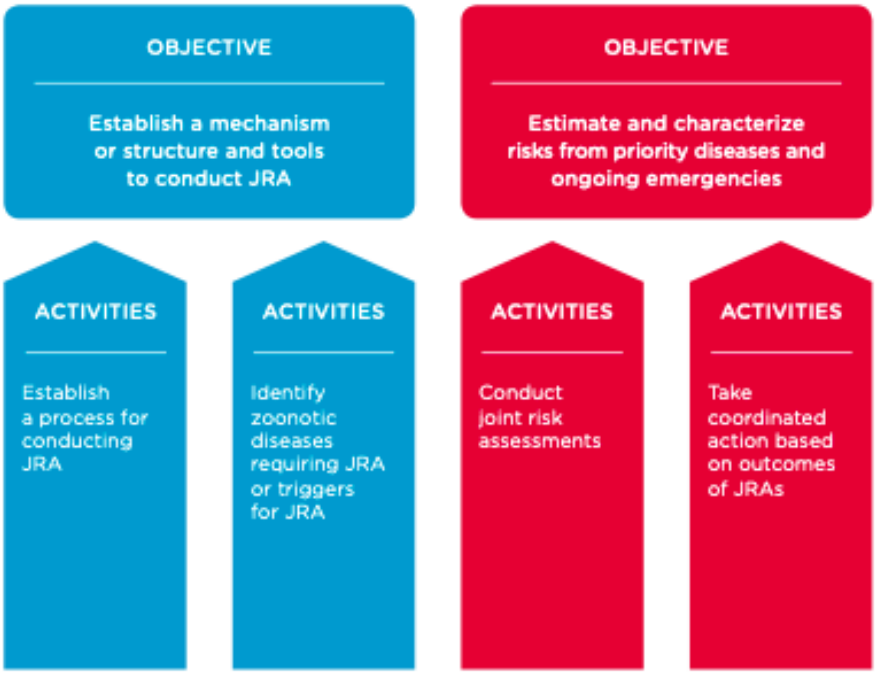
‘Risk’ as a concept, can be divided into two aspects: likelihood, or, the estimated probability or chance that a situation will happen; and impact, which refers to the severity of the consequences of a situation (WHO, 2020). Risk assessment is perhaps the most important step in implementing the One Health approach. By performing a thorough risk assessment, countries can prioritise which diseases are most important in terms of impact on human health. From there, plans can be established to begin surveillance and monitoring, making use of resources across multiple sectors.

Risk assessments rely on current, available knowledge (WHO, 2020), thus information sharing between sectors is a crucial part of proper preparation for an emergent disease event. KELLY et al (2017) share several examples of the use of a risk-based One Health approach, the main focus being the PREDICT project, based in the USA. The PREDICT programme employed experts across multiple disciplines to perform comprehensive risk assessments and surveillance strategies, aiming to target disease threats at their source, rather than simply reacting to an event (KELLY, 2017). Results showed that by working together, experts increased their knowledge base significantly and were able to successfully target surveillance towards specific emerging diseases (KELLY, 2017).

Risk assessments can be performed with varying degrees of intensity, depending on the severity of the threat. Contributing factors to the scale of the assessment include how vulnerable a country is to a disease crossing its borders, and how devastating the outcome would be if such an event were to occur (TZG, 2019). The Guide suggests a "Joint Risk Assessment'' (JRA) be performed in the event of a disease emergence which would require, for example, military intervention, or that of other public service sectors – including those diseases which would require the mass slaughter of livestock (TZG, 2019).

Figure 4, taken from the TZG, outlines the objectives and activities necessary for a JRA. Risk assessments should have a clear objective – for example, identification of the aetiological agent of a disease - and include the necessary corrective measures to mitigate a threat. The assessment should be a standardised process and include representatives from all sectors involved. This process, with regards to zoonotic diseases, could include veterinarians, epidemiologists, and agricultural workers.

6.5.6 Joint risk assessment for zoonotic disease threats



Example framework for joint risk assessment for zoonotic disease threats

Example Process Indicators:

- coordination/oversight and technical processes for JRA in place;
- standardized jointly-developed risk assessment tool(s) for zoonotic diseases adopted;
- number of JRAs conducted for priority zoonotic disease events or outbreaks per year.

Example Performance Indicators:

- proportion of JRA outcomes and recommendations used in decision making;
- number of improvements to surveillance system made in response to gaps identified by JRA teams.

Figure 4. Example framework for a JRA (TZG, 2019).

The One Health Coordination Mechanism, or, MCM, are responsible for performing an initial risk assessment for a country, and for responding to any queries or incidents regarding zoonotic diseases. They determine who, and from which sector, must go into the field to investigate such events, and decide upon an appropriate response, including making the locally affected community aware of any zoonotic hazards, and explaining the necessary precautions that must be taken to mitigate disease risk (TZG, 2019). At this stage, members of the public and private sector may be notified and employed to help explain the situation to members of the public. How this risk is communicated to the public, and the source of the publicly available information, including the way in which it is presented, directly influence how the public react to such an event, including compliance with any necessary measures (COVELLO, 2006).

The TZG provides a list of possible strategies that may be used by the MCM to reduce zoonotic disease risk. These methods encompass the One Health concept, as they incorporate medical, agricultural, and veterinary practices. Figure 5 depicts these strategies; they include increasing human biosecurity in areas close to wildlife populations, immunisation of animals, and changes to land-use in high risk areas. The example risk reduction practices outlined, are clearly influenced by both the Sustainable Development Goals, and the Manhattan Principles.

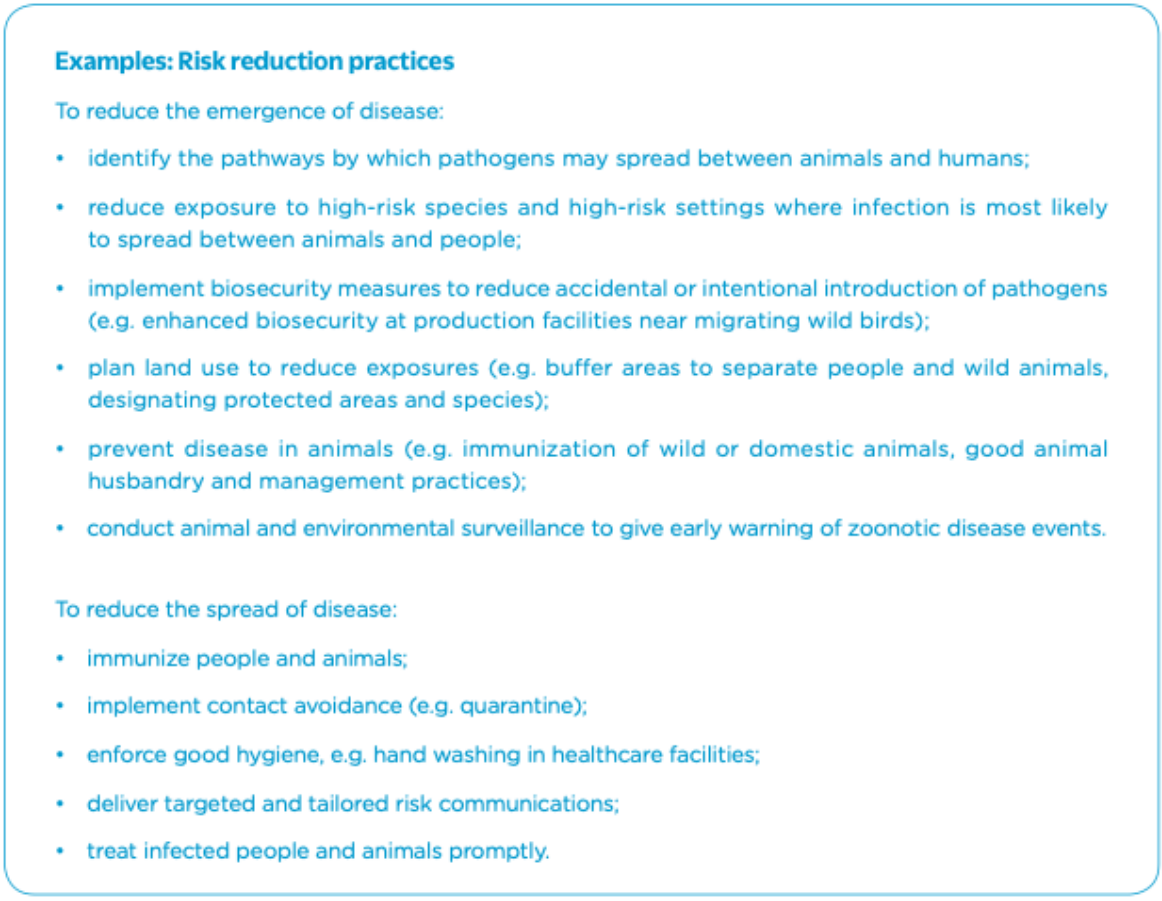


Figure 5. Examples of risk reduction practices in the implementation of a One Health approach (TZG, 2019*)*.

Finally, the Guide provides real-world examples of successful use of the TZG. An example from the United Kingdom references the enquiry into *Bovine Spongiform Encephalopathy* (BSE) in the year 2000, which in turn led to the creation of the Human Animal Infections and Risk Surveillance Group –"HAIRS" (TZG, 2019).

The next section of this review will focus on the subsequent work of HAIRS, and how the group has incorporated the One Health approach into the surveillance, reporting, and management of emerging and existing diseases in the U.K.

2.2. Exploring One Health in the U.K.

2.21 - HAIRS, an Overview

The Human Animal Infections and Risk Surveillance Group (HAIRS) was established in the U.K. in 2004 (U.K. HEALTH SECURITY AGENCY, 2015). Initially, its role was to coordinate multiple agencies across the government, to identify emergent and present disease threats in the United Kingdom (U.K. HEALTH SECURITY AGENCY, 2015). Since then, the group has expanded and works closely with U.K. Health Security Agency, the Department for Environment, Food and Rural Affairs (DEFRA), the Animal and Plant Health Agency (APHA), and at least 13 other governmental bodies. Despite not being formally titled as such, HAIRS provides a good example of a One Health MCM: a body which responds to threats, performs risk assessments, and organises responses accordingly. The group specifically focuses on diseases which are, or have the potential to become, zoonoses. Reports relating to threats and recent outbreaks are published regularly and made publicly available. An example of how HAIRS coordinated a response to the recent increase in the number of *Brucella canis* cases in the U.K. is outlined below.

2.22 - HAIRS Risk Assessment: *Brucella canis* (U.K. GOVERNMENT, 2023)

In 2020, reports of *Brucella canis* in dogs imported from Eastern Europe began to circulate in the U.K. HAIRS subsequently conducted a review of the risk posed to the U.K. human population, by using an “impact algorithm.” An example of the algorithm used by HAIRS is provided in Figure 6. Similar to the suggested format proposed in the Guide, the algorithm ranks the potential risk based on severity, risk to human health, and zoonotic potential.

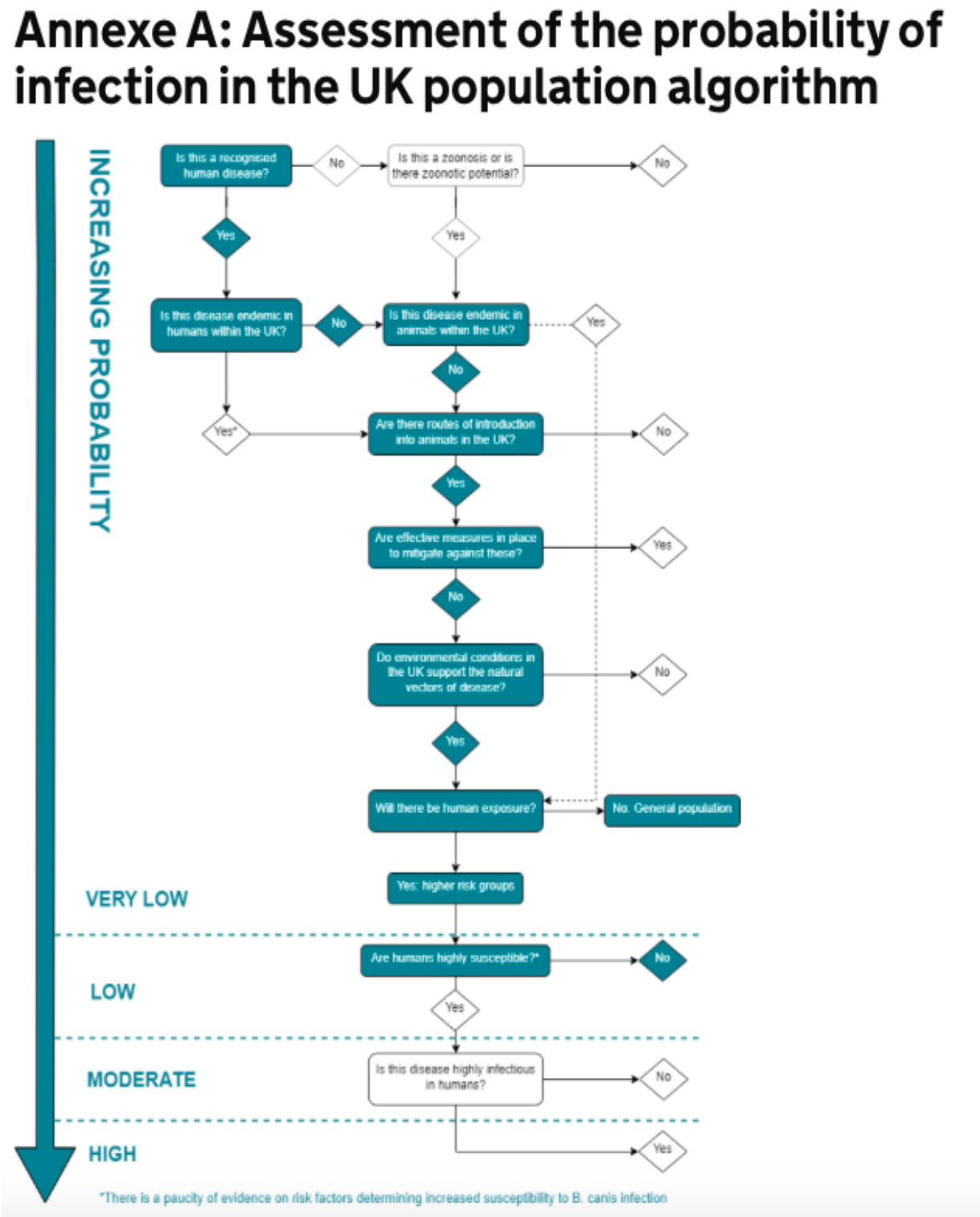


Figure 3. Algorithm assessment for the probability of infection in the U.K. (U.K. GOVERNMENT, 2023).

Brucella is not currently classified as endemic to the United Kingdom. However, worldwide, it is responsible for major economic losses and significant human morbidity (BOSCHIROLA et al, 2001). Whilst *Brucella melitensis* is known for displaying the highest level of pathogenicity in terms of propensity for human infection (SELEEM et al 2010), *B. canis* also has mild zoonotic potential and is known to be endemic in areas such as the southern United States (RASOOL et al, 2023).

In July 2023, 2 confirmed human cases of *B. canis* were identified in the U.K. One individual was asymptomatic, and the second was presented to hospital displaying generalised clinical symptoms (U.K. GOVENRNMENT, 2023). After performing a risk assessment using the algorithm in Figure 6, the risk of the general population contracting *Brucella canis* was deemed 'very low' (U.K. GOVENRNMENT, 2023).

Following the increase in seropositive *Brucella* cases in imported dogs, coupled with the added urgency of confirmed human infections, HAIRS worked with multiple agencies to draft a response. The decision was made to temporarily ban imports of cats and dogs from Belarus, Romania, Poland and Ukraine, as well as the introduction of mandatory pre-export testing for animals being charitably rehomed (U.K. GOVENRNMENT, 2023). Such a response is a good example of how HAIRS could be viewed as an MCM, per the TZG guidelines. The risk was assessed and discussed by those in the group, and changes were made as a result. These included an increase in biosecurity for personnel working with imported animals, and stricter border controls and checks for animals entering the U.K. (U.K. GOVENRNMENT, 2023).

Medical professionals working with humans, however, had a different response. Due to the underdiagnosis and underreporting of human *Brucella*, combined with varying and usually mild clinical signs (DI BONAVENTURA et al, 2021), few changes were made to existing protocols. However, *Brucellosis* in humans has historically proved difficult to treat effectively, due to the ability of the pathogen to survive in host macrophages (BOSILKOVSKI et al, 2021). Thus, despite the relatively low risk of human infection, it is in the best interests of human epidemiologists and clinicians to share information and to be informed of any changes in the prevalence of such zoonoses. The current lack of an efficient vaccine poses another barrier to successful eradication of this disease (BOSILKOVSKI et al, 2021), rendering *Brucella* a good case study of a One Health approach to disease management.

The conclusion of the assessment was to encourage use of personal protective equipment by veterinary staff in cases with any degree of suspicion for *Brucella* infection, as veterinary staff are, in general, at higher risk of contracting the disease due to increased exposure to the pathogen (ZHOU et al, 2020). However successful HAIRS has been thus far in implementing a One Health approach, it would not be possible for such a relatively small group to function alone. The next section of this review will explore some of the other groups based in the U.K. working towards implementing a One Health approach.

2.23 - "Preventing Emerging Zoonoses" (POST, 2022)

Whilst HAIRS often acts as the main body responsible for risk assessment of emerging zoonotic diseases, there are other groups functioning under the umbrella of One Health in the U.K. These include: the U.K Zoonoses, Animal Disease and Infections Group (UKZADI), the Advisory Committee on Dangerous Pathogens, and the One Health High Level Expert Panel, which operates internationally (POST, 2022). UKZADI is responsible for monitoring zoonotic trends, whilst the Advisory Committee focuses on supplying up-to-date advice regarding treatments and prevention of pathogen exposure (POST, 2022).

Several key areas are identified and linked to One Health and the emergence of novel, or existing zoonoses. One example provided is the increasing number of interactions between domestic animals, livestock, and wildlife (POST, 2022). Global trends in land-use over the last century have significantly reduced biodiversity and the number of truly wild spaces left worldwide. This also applies to the U.K.

Livestock, and, occasionally, pets, now have a much higher chance of interacting with wild species, widely thought to be due to urban encroachment on green or wild spaces (GLIDDEN et al, 2021). This presents a problem as wildlife commonly act as a vector for a phenomena known as "zoonotic spillover." Zoonotic spillover is defined as being the "transmission of pathogens from wild animals to humans" (ELLWANGER and CHIES, 2021), and the prevalence of these events is understood to be increasing as a result of the narrowing animal: human interface (DEBNATH et al, 2021). SHAHEEN (2022), states that up to 75% of emerging infectious diseases are of zoonotic origin, a concerning number when considering the

rapid exposure of multiple people to novel or unknown pathogens, at the borders of wild and urban landscapes (SHAHEEN, 2002; ASOKAN et al, 2011).

In a targeted, One Health approach, the text specifies that the aforementioned groups in the U.K. dedicated to such events (including HAIRS and UKZADI) aim to reduce the number of domestic and wild animal interactions, and to promote sustainable wildlife trade. In the period 2014-2018 the U.K. government held multiple international conferences on the topic with the aim to develop existing international policies further towards sustainability (ESMAIL et al, 2020).

The Animal and Plant Health Agency (APHA) in the U.K. has also committed to a One Health approach. In a manner similar to HAIRS, APHA deals with biosecurity threats and responds to possible zoonotic threats (POST, 2022). Similar to the surveillance goals outlined in the TZG (governments should employ both active and passive surveillance strategies), APHA has committed to performing veterinary checks and inspecting health certificates on any animal imported into the U.K., as well as making use of data collected by private laboratories (POST, 2022). The inclusion of private sector bodies is a key part of an interdisciplinary, multisectoral One Health approach (BORDIER et al, 2020).

The combined efforts of multiple task-forces and delegated groups throughout the U.K. have demonstrated their commitment to a One Health approach. This includes performing the activities outlined in the TZG - risk assessment, response to threats, and surveillance of existing and emerging diseases.

2.24 – Emergency Preparedness in the U.K.: “Operation Cygnus”

The ability of a country to respond promptly to a public health emergency relies on two main factors: preparedness, and resource capacity. Whilst resource capacity is something unique to every country, preparedness and simulation of an emergency event is one aspect that can be practised and tailored, according to weakness made evident in the process. As previously discussed, emergency preparations and simulations are one of the first steps a country must perform when applying a One health approach.

Evidence to support the U.K.'s commitment to performing the steps outlined in the Guide include the following example. In 2016, the U.K. government organised "Operation Cygnus", a 3-day exercise which recreated an outbreak of a novel influenza pandemic (DEPARTMENT OF HEALTH AND SOCIAL CARE, 2020). Overall, nearly 1000 individuals from multiple governmental and medical departments were involved in the exercise (DEPARTMENT OF HEALTH AND SOCIAL CARE, 2020). Several key areas of improvement were identified in the after-action report, most notably a lack of a clear chain of command between multiple agencies, as well as a lack of service capacity to contend with a sudden surge in hospitalised patients (DEPARTMENT OF HEALTH AND SOCIAL CARE, 2020).

Despite the willingness of U.K. government to simulate emergencies, and devote resources to preparation, Operation Cygnus was largely deemed as being ineffectual, as the recommended "remedial steps" were never implemented (SCALLY et al, 2020). The lack of post-simulation changes to the emergency response structure rendered widespread criticism of the way the COVID-19 pandemic was handled in the U.K (POLLOCK and COLES, 2021), and begs the question: is the U.K. truly committed to using a One Health approach to prepare for another such event? This review will now explore some of the ways in which Croatia has utilised a One Health approach.

2.3 - Exploring One Health in Croatia

Croatia's approach a One Health system differs to that employed by the U.K. As described, the U.K. focused on the creation of multiple, highly specialised groups, inclined to target some specific facet of One Health such as surveillance, biosecurity, or risk mapping. Croatian literature, however, provides an insight into what appears to be a specialised approach to zoonotic disease threats, with specific diseases at the centre of each intervention. The first case study outlined below relates to the Croatian One Health response to the increasing prevalence of West Nile Virus in certain areas of the country.

2.31 – “Emerging trends in the West Nile Virus epidemiology in Croatia in the One Health context 2011-2020” (VILIBIC-CAVLEK et al, 2021)

West Nile Virus (WNV) is widely considered to be a re-emerging pathogen (BARBIĆ et al, 2013; VILIBIC-CAVLEK et al, 2021). WNV belongs to the family *Flaviviridae*, as part of the Japanese encephalitis antigenic complex (WHO, 2017). The transmission cycle of the virus frequently includes bites from infected mosquitoes and poses a serious threat to both human and animal health, as multiple vertebrate species are susceptible to infection (BARBIĆ et al, 2013). Despite the diverse range of hosts, the number showing identifiable clinical signs remains relatively few: with humans and horses being overrepresented, in addition to avian species serving as the reservoir hosts (BARBIĆ et al, 2013).

Although a known zoonose, WNV was for a long time considered to be of little importance in human medicine due to the frequent mild, subclinical nature of infection (HABARUGIRA et al, 2020). However, West Nile Virus does have the potential to develop into a neuro-invasive disease, occasionally proving fatal (RICCO et al, 2021). VILIBIC-CAVLEK et al (2021) state that although rare, the neuroinvasive form of the disease has diverse clinical presentations, including encephalitis, meningitis, or poliomyelitis.

As early as 2002, the random testing of horses as sentinel animals for WNV occurred in Croatia (BARBIĆ et al, 2013). The continued testing of horses for WNV seropositivity was eventually incorporated into a passive *flavivirus* surveillance programme, introduced by the Croatian Ministry of Agriculture, Fisheries and Rural Development in 2011 (VILIBIC-CAVLEK et al, 2021). This proved a timely intervention, as in 2012, the first “outbreak” of WNV was documented as 7 individuals presenting with neuroinvasive symptoms were hospitalised (VILIBIC-CAVLEK et al, 2021).

Passive surveillance of certain sentinel animals (horses, birds and poultry) resulted in the cohesive cooperation of veterinarians and medical doctors and promoted information sharing between disciplines, which is, of course, a key part of the One Health approach. In a 2023 study, VILIBIC-CAVLEK et al emphasised the need for future monitoring of known vectors of zoonotic disease, including ticks, mosquitos, and sandflies (VILIBIC-CAVLEK et al, 2023) – a programme which would need the cooperation both veterinarians and forestry

workers. Whilst multiple programmes for surveillance and monitoring of vector-borne diseases exist in Croatia, re-emerging diseases pose a significant threat, particularly due to surrounding countries reporting similar increases in such diseases (VILIBIC-CAVLEK et al, 2023). For this reason, potential collaboration with international faculties of medicine and science would prove beneficial both in terms of decreasing risk and incorporating a One Health approach.

Despite the described surveillance not taking place under the umbrella of a formalised interdisciplinary task-force, this is still an example of One Health in action. As technological and medical advancements are made, methods to monitor, assess, and treat zoonotic diseases will continue to be shared between sectors.

2.32 - "Emerging trends in the epidemiology of COVID-19, the Croatian One Health perspective" (VILIBIC-CAVLEK et al, 2021)

CÓRDOBA-AGUILAR et al (2021) state that the novel coronavirus which emerged in late 2019 (SARS-CoV-2) was first transmitted as a result of humans consuming wild animals, and by increased proximity to such animals in, for example, wet markets selling them. Referring back to the Manhattan Principles, of which number 13 stated that it was necessary to reduce and better regulate the wildlife trade, the reason for such a goal is made pertinent in the light of more than 500,000 cases of coronavirus reported in Croatia alone (VILIBIC-CAVLEK et al, 2021).

By analysing human, animal, and environmental data relating to COVID-19, VILIBIC-CAVLEK et al (2021) utilised a One Health approach in a review of COVID-19 data. This proved helpful in providing a more comprehensive understanding of virus epidemiology as it was discovered that seroprevalence in domestic animals was much higher if the animals were in close contact with their owners (VILIBIC-CAVLEK et al, 2021) - this differs from the expected traits of a coronavirus, and played a key role in increasing the understanding of the disease transmission cycle. Retrospectively analysing data from crises such as the COVID-19 pandemic renders health professionals able to identify gaps in data, and plan future strategy accordingly. The TZG promotes after-action reports as key components to implementing targeted approaches to disease control – and, crucially, to recognising differences in disease outcome and the different challenges faced by different medical disciplines.

2.33 - “Zoonoses and Vector-Borne diseases in Croatia, a Multidisciplinary Approach” (MARKOTIĆ et al, 2009)

MARKOTIĆ et al (2009) state that of the numerous emerging infectious diseases in the global human population, more than 60% are of zoonotic origin. Inciting factors such as changes to global climate and ecosystems, explosive population growth, and the increase of poverty and social inequalities are referenced as drivers of this increase in emerging infectious diseases (MARKOTIĆ et al, 2009).

As relates to emerging infectious and vector-borne diseases, MARKOTIĆ et al (2009) suggest the integration of multiple experts, including veterinarians, public health specialists, forestry scientists, and laboratory workers, into a formalised group. They (MARKOTIĆ et al, 2009) posit that by sharing technology and expertise, the ever-growing threat of novel zoonoses might be able to be mitigated somewhat, or, at the very least, dealt with in the most comprehensive way possible. As early as 1893, Croatia proved its commitment to sharing knowledge and expanding the existing knowledge base, in the creation of the Institute for Immunology, which then, and to this day, explores the immune basis of emerging and existing infectious diseases (MARKOTIĆ et al, 2009).

In 2007, the Centre for Emerging and Re-emerging Infectious Diseases was created by the University Hospital for Infectious Diseases (Dr Fran Mihaljević), as part of a collaboration of both national and international bodies; including the Faculty of Forestry, the Veterinary Faculty, as well as input from Europe and the United States (MARKOTIĆ et al, 2009). The Institute aimed to improve diagnostics, elevate research methods, and organise education of target populations (MARKOTIĆ et al, 2009). As part of a dedicated One Health initiative, the Centre established links with multiple institutions around the globe. These connections include various biomedical centres in the USA, Finland, Bosnia and Herzegovina, and Slovenia, in addition to the existing multiple faculties within Croatia (MARKOTIĆ et al, 2009).

The Croatian approach to One Health discussed thus far indicates a well-connected, international association between multiple facilities. Compared to the United Kingdom, Croatia appears to have published more research into specific zoonoses, including West Nile Virus and COVID-19. On the other hand, despite intensive and successful scientific activities in the field

of One Health in Croatia, there is still a lack of joint authorised bodies or institutions that would coordinate and promote this approach at a national level. The current favourable situation carries risks, as it is based on the scientific work and promotion of the One Health approach by a group of researchers that is not sufficiently and officially supported by policymakers at the state level.

The U.K., however, seems more focused on preparation strategy and instigation of guidelines as stated by bodies such as the WHO. The next set of comparative data to be examined is that from the Global Health Security Index, which will provide an insight into how successful these strategies have been.

2.4 - The Global Health Security Index

2.41 - Overview of the GHSI scores for both countries

The Global Health Security Index (GHSI) was created in 2021, in partnership with the Nuclear Threat Initiative and the Johns Hopkins Centre for Health Security. The GHSI marked the first assessment of health security in 195 countries, and rankings across multiple parameters relating to health and security categories were produced, including the topic of zoonotic disease (RAVI et al, 2020). The results of the study found that none of the studied countries were sufficiently prepared, as relates to a potential pandemic, for an emerging disease threat (RAVI et al, 2020). For the purposes of this review, four of the questions from the GHSI, pertaining to zoonotic diseases, will be assessed in the context of the One Health approach.

1. "Is there national legislation, plans, or equivalent strategy documents on zoonotic disease?" (GHSI, 2021)
    a. Croatia, **YES**
    b. United Kingdom, **YES**

The U.K. implemented the Animal Health Act in 1981, followed by more specific legislation in late 2007. Published guidelines providing details for the roles and delegations of personnel, in the event of an outbreak of zoonotic disease show the preparedness of the U.K at a national level for such an event.

In Croatia, the Veterinary Law was passed in 2013, with the stated aim of increasing monitoring of zoonotic diseases; including specified bacterial, parasitic, and viral agents such as *Lyssavirus,* organisms of the *Brucella* and *Listeria* genera, and the protozoa *Cryptosporidiosis.* The Ordinance outlines which agents are to be monitored continuously, and which are to be monitored only in the event of an outbreak. As part of the European Union, Croatia has improved methods of zoonosis control, in the Animal Health Act (Official Gazette 152/2022). This is in accordance with Regulation (EU) 2016/429 of the European parliament and of the Council of 9 March 2016, on transmissible animal diseases and amending and repealing certain acts in the area of animal health ('Animal Health Law'). In addition, new or updated programmes are introduced each year at national level to monitor and control certain zoonoses that pose a significant risk to public health, depending on the current epidemiological situation in Croatia.

In regard to One Health and national legislation, both countries have Ordinances in place to deal with the outbreak and monitoring of zoonotic diseases. Whilst U.K. legislation is more oriented towards the coordination of people and ensuring a cohesive chain of command, Croatian legislation is more focused on defining a number of key diseases to be monitored. Both approaches to One Health legislation are successful; whilst Croatia may have the advantage of a rapid warning as diseases are monitored continuously, the U.K. strategy reduces the risk of confusion and slow response in the event of such an outbreak, as individual roles are clearly outlined.

2. “Is there a department, agency, or similar unit dedicated to zoonotic disease that functions across ministries?” (GHSI, 2021)
    a. Croatia, **NO**
    b. United Kingdom, **NO**

Both countries received a score of zero in the Global Health Security Index in this category. Whilst Croatia and the U.K. do have multiple groups dedicated to surveillance and control of zoonoses, no evidence was found of any of the sub-groups formed (for example, HAIRS and UKZADI in the U.K., and the Working Group for Zoonoses in Croatia), functioning across multiple ministries. The groups function under a single ministry, despite frequent communication and information sharing between departments. In the U.K., both HAIRS and

UKZADI function under DEFRA, and in Croatia, the Working Group for Zoonoses functions under the Croatian Food Agency.

As the framework of One Health is built on interdisciplinary communication between stakeholders in different jurisdictions in governmental bodies, both countries could possibly look towards the future creation of a single, formally recognised group including representatives from the relevant ministries.

3. "Does the country have a national mechanism (either voluntary or mandatory) for owners of livestock to conduct and report on disease surveillance to a central government agency?" (GHSI, 2021)
    a. Croatia, **YES**
    b. United Kingdom, **YES**

In both countries, owners of livestock must report either suspected or confirmed cases of possible zoonotic disease, and both countries outlined the necessary steps and chain of command needed to ensure prevention of the disease spread. In the U.K., these steps involve multiple agencies – firstly the APHA representative must be contacted, followed by, if necessary, the EU Commission, and finally the WOAH, if circumstances demand. In Croatia, the Veterinary Directorate must be contacted within 24 hours of disease confirmation, followed, if necessary, by the EU Commission, and finally, again, the WOAH. This shows an integrated and multi-level approach to zoonotic disease control; and is in accordance with the multi-layered and inter-departmental communications standard set by the Tripartite.

4. "Does the national plan on zoonotic disease or other legislation, regulations, or plans include mechanisms for working with the private sector in controlling or responding to zoonoses?" (GHSI, 2021)
    a. Croatia, **NO**
    b. United Kingdom, **YES**

In this category, the U.K. had a score of 1, or yes, and Croatia a score of 0, for no evidence found. It is the only category, out of those chosen, in which differing scores were evident. In the U.K., Multi-Disciplinary Zoonoses Liaison Groups work with private sector veterinarians to investigate suspected cases of disease, and may also provide emergency vaccination services when needed. Private laboratories are also used for sample testing. The

lack of private sector involvement in Croatia is currently a barrier to the successful implementation of a One Health approach, and is an avenue which may prove useful to explore as the country continues to implement One Health strategies.

2.42 - Review of the GHSI scores

Both countries have national legislation relating to zoonotic disease, which could be considered as the "pre-existing frameworks" stipulated as necessary for implementing a One Health approach by the TZG. The lack of any cross-ministerial body for zoonoses in both countries may prove a barrier moving forward, as the Guide specifies a "One Health Coordination Mechanism", or, MCM, as a necessary part of the One Health implementation process. However, as multiple bodies in both countries are dedicated to dealing with zoonotic disease threats within various governmental departments, the leap to creating a formalised inter-ministerial body should not be an insurmountable challenge.

As the wildlife-human interface narrows, and novel diseases emerge, surveillance and reporting of diseases has significantly increased in importance. The U.K. and Croatia have schemes in place for livestock and domestic animal owners to report suspicious symptoms, as well as mortalities, to the relevant bodies. Both countries outlined a clear chain of command for this type of surveillance, which is consistent with the steps provided in the TZG. This type of clarity regarding often complex governmental hierarchies is of paramount importance when it comes to the threat of a potential, or known, zoonose, and public willingness to cooperate in such a situation is the key factor in laying the groundwork for willingness to corroborate with and implement the ideals in a One Health approach.

3. DISCUSSION

Based on the multiple definitions provided of One Health described in the Introduction of this review paper –the acknowledgement that all life on earth, whether plant, animal or human, is interconnected (PITT and GUNN, 2024) - the overreaching themes of One Health can be summarised as being interconnectedness, communication, and society. The three main divisions of One Health are human medicine, veterinary medicine, and environmental sciences (ONE HEALTH GLOBAL NETWORK, 2024). One topic which spans all these dimensions is the monitoring and control of zoonotic diseases.

With multiple factors contributing to the encroachment of society into previously wild areas, human exposure to wildlife, and thus, previously un-encountered pathogens, is increasing (MAGOURAS et al, 2020; DEBNATH et al, 2021). This is evident in the increasing prevalence of zoonoses such as West Nile Virus, SARS-Cov2, and Avian Influenza (BOUSFIELD and BROWN, 2011).

The creation of the Manhattan Principles was a key moment in the integration of One Health ideas into modern policymaking – for example, questions from the GHSI link back to these Principles in terms of wildlife and land use regulations and reporting. However, despite the outbreak of SARS in 2003 highlighting the need for efficient pandemic strategies to be put in place, the recent pandemic, plus the GHSI scores from all 195 countries analysed, show that still no country is adequately prepared to deal with another such outbreak (MACKENZIE and JEGGO, 2019).

The solution potentially lies in the adaptation of countries' existing schemes, to be orientated towards One Health. With ample resources now available, such as the TZG, the barriers to implementing such an approach are considerably lessened. However, multiple challenges currently block the widespread adoption of such policies: political apathy for such an approach, unwillingness to implement or lack of existing information sharing outlets, as well as resource-scarcity in countries with a high population density and widespread low income (ASAAGA et al, 2021).

The TZG states that a One Health Coordination Mechanism should be established as a priority. This group, also known as the MCM, should be responsible for six crucial facets of planning: emergency preparedness, surveillance and information sharing, investigation of outbreaks, execution of a Joint Risk Assessment and subsequent risk reduction, and finally, communication with the public and relevant workforces. Whilst there appeared to be no publicly available information regarding the creation of a formalised MCM in either Croatia or the United Kingdom, both countries published information regarding groups working to prepare for threats from both novel and re-emerging zoonoses. In the U.K., HAIRS, UKZADI, and APHA all work together to share information and respond to outbreaks – the example used in this review was the handling of an increase in reports of dogs seropositive for *Brucella canis*, a potential zoonose. In Croatia, the Faculties of Veterinary Medicine, Medicine, and Agronomy have worked together previously to implement surveillance strategies regarding pherozoonoses such as West Nile Virus. They have established both national and international links, which resulted in the creation of the Centre for Emerging and Re-Emerging Infectious Diseases; now a centre for surveillance, testing, monitoring, and control of multiple threatening diseases (MARKOTIĆ et al, 2009).

Another crucial area for disease prevention in the One Health Approach is conducting a Joint Risk Assessment. This assessment should include representatives from multiple disciplines, to ensure that risk is assessed from multiple perspectives. HAIRS is the body responsible in the U.K. for performing this task, and this has become a well-standardised procedure (see Figure 6: a flowchart for assessing a disease threat, provided by HAIRS). In Croatia, multiple studies (VILIBIC-CAVLEK et al, 2021; VILIBIC CAVLEK et al, 2023) show evidence of assessing, either retrospectively or currently, the risk posed by emerging vector-borne diseases, including arboviruses and coronaviruses.

Results of the GHSI were mixed, with Croatia ranking 48/195, and the U.K. ranking 07/195 (GHSI, 2021). However, in terms of zoonotic disease, both countries scored similarly, differing only in the U. K's use of private sector veterinarian and laboratory workers as both standard practice, and as an emergency contingency plan. The GHSI serves only as an indicator of preparedness, however, and the scores may not be entirely reflective of how a country would react, given a novel emergency situation. Certainly, the example of "Operation Cygnus" in the U.K. and the following failure to implement any suggested changes to the operational systems

in place (SCALLY et al, 2020; POLLOCK and COLES, 2021), sets a negative precedent for future emergency events.

4. CONCLUSIONS

In conclusion, this review has explored multiple aspects of One Health, and a few of its many definitions. Croatia and the United Kingdom have both displayed commitment to and collaboration with many areas relating to public health and the One Health approach. Using the Tripartite Guide as a loose reference for how the One Health approach should be implemented, examples of how both countries have responded to various zoonotic disease outbreaks have been compared. Croatia has a strong scheme in place for the monitoring and surveillance of zoonoses and emerging infectious diseases, despite the lack of a formalised, interdisciplinary, multi-sectorial One Health association. The U.K has multiple groups dedicated to One Health, and whilst these function across sectors and respond to threats, consistency and coherency in response to disease surveillance within the country may prove difficult, given the need for coordination of the many bodies involved.

Zoonotic diseases are one of the key areas that should be explored by global health experts, moving forward. Given the worldwide panic following the recent pandemic, the implementation of One Health approach for all willing governments should be considered; evolving technology and improvements in global communications significantly reduce barriers to this approach, and, with global pathogen surveillance and monitoring schemes in place, may even be able to predict and prevent the next threat.

This review concludes with a statement from Rudolf Virchow, regarding One Health: “between animal and human medicine there is no dividing line – nor should there be. The object is different but the experience obtained constitutes the basis of all medicine” (WIERUP, 2001).

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6. SAŽETAK

"Uvođenje pristupa "Jedno zdravlje" u nadzoru i suzbijanju zoonoza u Republici Hrvatskoj i Ujedinjenom Kraljevstvu"

Camilla Kate Barker

Organizacija za hranu i poljoprivredu (FAO), Svjetska zdravstvena organizacija (WHO) i Svjetska organizacija za zdravlje životinja (WOAH) su 2018. godine izdali zajednički tripartitni dokument (TZG) sa smjernicama koje olakšavaju implementaciju pristupa Jedno zdravlje u sve države svijeta. Ovaj dokument opisuje ključne korake za ovaj zadatak, zajedno sa stvarnim primjerima iz svijeta.

U ovom preglednom radu razmatraju se različite definicije pristupa Jedno zdravlje kao i njegove osnove i okviri navedeni u Manhattan-skim načelima te Globalnim ciljevima održivog razvoja (SDG). Unutar šireg koncepta poboljšanja globalnih zdravstvenih standarda, ideali Jednog zdravlja čine temelj na kojem se može izgraditi stabilniji i učinkovitiji zdravstveni sustav koji se mora temeljiti na bliskoj suradnji i razmjeni informacija između različitih sektora.

S obzirom na korake navedene u TZG-u i različite primjere odgovora na zoonotske bolesti u Hrvatskoj i Ujedinjenom Kraljevstvu, u ovom preglednom radu istražena je način i učinkovitost reakcije ovih država na takve događaje. U Ujedinjenom Kraljevstvu postoji više formalnih skupina posvećenih kontroli i praćenju zoonoza. To uključuje skupinu za nadzor infekcija ljudi i rizika (HAIRS) i UKZADI – britansku skupinu za zoonoze, bolesti životinja i infekcije. S druge strane, u Hrvatskoj postoje dokazi o ostvarenoj interdisciplinarnoj suradnji u odgovoru na pojavu bolesti, posebice u pogledu nadzora emergentnih zaraznih bolesti kao što je bolest Zapadnog Nila (WNV).

Indeks globalne zdravstvene sigurnosti (GHSI) korišten je za usporedbu država kako bi objektivno ustanovili razliku koji se odnose na sustav nadzora zoonotskih bolesti u obje države. Iz usporedbe ovih podataka proizlazi sličnost trenutnog stanja između Ujedinjenog Kraljevstva i Hrvatska, a razlikuje se samo po uključenosti privatnog sektora u provedbu pojedinih zadaća, poput cijepljenja ili provođenja dijagnostike.

Zaključak ovog preglednog rada je da se i Hrvatska i Ujedinjeno Kraljevstvo kreću prema unaprijeđenju zdravstvenog sustavu koji uključuje različite odrednice pristupa Jednog zdravlja.

Ključne riječi: Jedno zdravlje, Zoonoze, Ujedinjeno kraljevstvo, Hrvatska

7. ABSTRACT

"Implementation of a One Health approach to control of Zoonotic Diseases in Croatia and the United Kingdom"

Camilla Kate Barker

The Tripartite Zoonoses Guide was developed by the Food and Agriculture Organisation (FAO), World Health Organisation (WHO) and the World Organisation for Animal Health (WOAH) in 2018 with the aim of making the adoption of a One Health approach easier for countries around the world. The Guide outlines several key steps necessary for this task, along with real-world examples.

This paper first explores several definitions of One Health, as well as the frameworks surrounding the concept; such as the Manhattan Principles and the Sustainable Development Goals (SDGs). Within the wider concept of global health standards improvements, the One Health ideals form a background upon which a more stable health system can be built; one based on communication and information-sharing between sectors.

Given the steps outlined in the TZG, and using case studies of zoonotic diseases responses in Croatia and the U.K., the Review Paper explores how well both countries reacted to such events. In the U.K., multiple groups exist dedicated to the control and monitoring of zoonotic diseases. These include the Human Animal Infection and Risk Surveillance Group (HAIRS), and UKZADI – the U.K. Zoonoses, Animal Disease and Infections Group. In Croatia, there is evidence of interdisciplinary communications and responses to disease, particularly in regards to the surveillance of emerging infectious diseases such as West Nile Virus (WNV).

The Global Health Security Index (GHSI) was used to compare and contrast scores from the Index that relate to zoonotic diseases and their control in both countries. Both the U.K. and Croatia scored similarly in this respect, differing only in the use of the private sector for outsourcing of certain tasks, such as vaccination or sample testing.

The conclusion of this review is that both Croatia and the United Kingdom are moving towards a health system that incorporates multiple aspects of the One Health Approach.

Key words: One Health, Zoonoses, United Kingdom, Croatia

8. CURRICULUM VITAE

CAMILLA KATE BARKER was born in Harrogate, North Yorkshire on the 9th May 1997. Completing high school at Gateways School for Girls in 2015, with A-levels in Geography, English Literature, and Biology, she went on to study Anthropology at the University of Durham, graduating in 2018 with a Bachelor of Science (Honours) degree, Upper Second Class.

After living and volunteering with primates in South Africa and Zambia, Camilla decided to pursue a career in Veterinary Medicine, at the University of Zagreb, Croatia. Following her passion for primates, she travelled to Peru at the end of the first year of study, working in the Amazon jungle with multiple exotic species.

During the second and third year of study, Camilla was a member of the Equine Clinic at the Faculty of Veterinary medicine. In her fourth year, Camilla travelled to Romania on two occasions, to work with charitable organisations setting up veterinary care at the Ukraine border, following the outbreak of war. In addition, she completed a course titled 'Animal Birth Control and Surgery', run by the Worldwide Vet Service in Chiang Mai, Thailand; performing multiple spay and neuter surgeries, as well as taking sole responsibility for anaesthesia during operations. She also completed an internship at Jersey Zoo – the Durrell Wildlife Trust – working with multiple vets and learning valuable husbandry skills regarding exotic species.

Camilla began volunteering with the veterinary team at Dumovec animal shelter during the fifth year of study, assisting in surgeries and providing patients with treatment. During the summer, she travelled to Colorado to volunteer with the Street Dog Coalition, a charity providing veterinary services of all kinds, including internal and infectious medicine, to homeless individuals. She then completed an internship at Fort Collins Veterinary Emergency Care and Rehabilitation Hospital, learning valuable critical care skills.

Camilla also travelled to Ukraine as part of an outreach programme set up by the Street Dog Coalition and Worldwide Vets, and worked in the mobile clinic, travelling to hotspots within the country to provide on-the-go veterinary care. This included routine and emergency surgeries, as well as standard veterinary services such as treating chronic and acute illnesses.

As part of the External Practical Training, Camilla completed a three-month internship at Tullamore Pet Hospital in Tullamore, Ireland. During this time, she assisted multiple routine and emergency surgeries, and was able to take part in the management of multiple patients, both critical and stable.