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VECTOR-BORNE DISEASES STAKEHOLDER MAPPING IN FINLAND:

A One Health Approach

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ABSTRACT

Anniina Kyöttinen: Vector-borne diseases stakeholder mapping in Finland: A One Health Approach
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Climate change, increasing human population, urbanization, industrialization and the gradual depletion of natural resources affects the health of humans, animals, and ecosystems around the globe. The complex and wicked health problems arising at the human-animal-ecosystem interphase, such as the (re)emergence, transmission, and management of both novel and traditional zoonoses and vector-born-diseases, requires enhanced multisectoral and multi-leveled interactions and collaboration between different One Health stakeholders.

Previous research in Finland around the topic of vector-borne diseases has primarily been focused on vector, host, and disease epidemiology: changes in disease occurrence and distribution of hosts and vectors, nationally. However very little attention has been given to stakeholder networks studies, information- and resource-sharing, nor on how different VBD actors and stakeholders interact in Finland. Thus, the aim of this master's thesis is to map and analyze the current and missing stakeholder/actor interactions and information flow related to vector-borne diseases and their management in Finland, within a One Health context. In addition, the objective is also to discuss and reflect on the future of a possible formal VBD/One Health-network in Finland and what are the chances, challenges and means of establishing one. In conclusion, this research plays a pivotal role in addressing the growing issue of vector-borne diseases nationally and globally, in addition to enhancing VBD research, management, surveillance, control and prevention in Finland.

Qualitative semi-structured interviews were chosen as the primary methodology for this master's thesis. More specifically, a qualitative research method, focusing on identifying actors, resources, multi-actor dynamics and multi-actor interactions (ARDI) was used to analyze the data. The qualitative data in this research consists of 10 semi-structured VBD/OH stakeholder interviews of Finnish professionals collected between October 2021 - December 2021.

The results of this study indicate the importance of multisectoral and multi-leveled stakeholder collaboration related to vector-borne disease research, management, surveillance, control and prevention in Finland. In total 139 potential direct and indirect VBD and One Health stakeholders were identified in this research. Twenty (20) stakeholders, from varying fields were recognized as key VBD/OH actors in Finland. The results in this study suggest that VBD/OH stakeholders in Finland are to some extent interdisciplinary and multisectoral, but the biggest emphasis among different stakeholders still remains in human health, resulting in neglect of other fields of study, especially social sciences and humanities. Currently VBD/OH networks in Finland are mostly built upon unofficial personal connections relying heavily on a few Finnish individual key experts and research projects with external funding, resulting in uncertainty in the continuity of collaborations. There also seems to be a lack of higher-level coordination of VBD/OH collaboration activities in addition to the lack of collaboration between Finnish governmental agencies and other lower-level stakeholders, mainly due to lack of fiscal and human resources. The results of this research indicate that stakeholders' collaboration with the private sector, independent agencies, NGOs, professional and scientific associations and other foundations in Finland is very limited. Furthermore, all ten interviewed stakeholders unanimously support the formation of a formal VBD/OH network in Finland to enhance stakeholder collaboration, information sharing and data management related to vector-borne diseases in Finland.

The findings of this research strongly suggest the establishment of a formal multidisciplinary and multi-leveled OH vector-borne disease expert network in Finland with higher level coordination and sufficient fiscal and skilled human resources. However, further investigations are still needed to gain a deeper understanding of formal One Health networks in Europe, private actor engagement and public-private partnerships in strengthening VBD management, in addition to investigations on (re)emerging vectors, vector-borne diseases and climate change in Finland.

Keywords: One Health, vector-borne diseases, multisectoral collaboration, stakeholders, actors, ARDI-method, Finland
The originality of this thesis has been checked using the Turnitin OriginalityCheck service.

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ABBREVATIONS

AMR antimicrobial resistance

CDC Centers for Disease Control and Prevention

CFR case fatality rate

CIRAD The French Agricultural Research Center for International Development

COVID-19 SARS-CoV-2 Coronavirus disease

ECDC The European Center for Disease Prevention and Control

EM erythema migrans

EU European Union

FAO Food and Agriculture Organization

H2020 EU Horizon 2020 Program

LB Lyme Borreliosis

OHN One Health Network

OIE World Organization for Animal Health

TBD tick-borne disease

TBE Tick-Borne Encephalitis

TBEV tick-borne encephalitis virus

THL Finnish Institute of Health and Welfare

UN United Nations

VBD vector-borne diseases

WHO World Health Organization

1 INTRODUCTION

Climate change, increasing human population, urbanization, industrialization, and the gradual depletion of natural resources affects the health of humans, animals, and ecosystems around the globe (Zinsstag et al., 2011). Because of the complexity and unpredictability of social, environmental, and global health challenges, there is a growing need for new and innovative investigation and approaches that will exceed the methods and problem solving applied in the past (Molina, 2011). In recent years, different models of integrated approaches to health, such as the One Health approach, which combines multidisciplinary thinking of the connections between the health of humans, animals and the environment (Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases, 2020) have been of particular interest.

Different integrated approaches to health and multidisciplinary collaboration could help prevent and react to emerging global health problems, such as zoonotic and vector-borne diseases (VBDs), as well as antimicrobial resistance (AMR) (Binot et al., 2015; De Garine-Wichatitsky et al., 2021; Molina, 2011; Roger et al., 2016; Zinsstag et al., 2011). Zoonoses are diseases originating in animals, which can transfer onward to humans causing infectious diseases. Currently there are more than 200 known zoonotic diseases in the world (World Health Organization, 2020b). These heterogenous health problems emerging at the boundaries of animal, human and environmental context call for collaboration among a wide range of different fields and stakeholders from the medical and social sciences to governance, ecology, agriculture, politics, and finances (Roger et al., 2016). In previous research and in this master's thesis, VBDs are seen as an important One Health topic emerging at the animal-human-ecosystem interphase (Braks et al., 2019; Little, 2013).

The World Health Organization (WHO) defines vector-borne diseases as "human illnesses caused by parasites, viruses and bacteria that are transmitted by vectors" (World Health Organization, 2020a). Vectors are most commonly arthropods: insects, such as mosquitoes, or arachnid parasitic species including ticks (European Center for Disease Prevention and Control, n.d.; Randolph, 1998; World Health Organization, 2020a). The prevention, surveillance, and control of VBDs illustrates a clear need for an integrated

One Health approach because of the complex nature of vectors and the infections they spread (Braks et al., 2019). The emergence and distribution of vectors, and consequently the occurrence of VBDs, is influenced by several different aspects, such as climatic factors, environmental conditions (e.g., land use), international travel and trade and socio-demographic changes including migration (European Center for Disease Prevention and Control, n.d.; European Centre for Disease Prevention and Control, 2019; Rocklöv & Dubrow, 2020; Schmidt et al., 2013). Hence, multidisciplinary collaboration between different fields and cross-sectional stakeholder actions are needed for societies to better understand and tackle the current changes happening in vectors, pathogens, hosts, and their living environments (Braks et al., 2019). Further development of stakeholder networks and interactions are required more than ever to promote global and public health, as well as to prevent the emerging and reemerging of pathogens, infectious diseases and zoonoses, such as the novel SARS-CoV-2 virus (COVID-19) pandemic has demonstrated to us.

In Finland there is an increasing need for multisectoral and multidisciplinary research and information sharing regarding VBDs and different integrated approaches to health. One reason behind the growing demand of VBD research is climate change, and especially the effect it has on polar regions and Nordic countries such as Finland. Loss of ice sheets and snow cover, extreme climatic events such as heavy winds and rainfall, have all increased due to global warming. It has already been detected that these changes have affected animals, biodiversity, and the functioning of ecosystems in polar regions. Negative health affects in the Arctic regions due to climate change have also been observed (Pörtner et al., 2019). Climate change and changing environmental conditions, such as temperature, rainfall, and snowfall, can all affect the prevalence and distribution of vectors, pathogens, hosts and more generally VBDs, as well as their prevention and control (Rocklöv & Dubrow, 2020; THL, 2020).

The issue of vector-borne diseases has been established lately as an important topic in the field of public and global health with previous research showing that vector-borne diseases are of growing health concern, both in Finland and globally (Dub et al., 2020; Jaenson et al., 2012; Jongejan & Uilenberg, 2004; Rossow et al., 2015; Sajanti et al.,

2017; Leino & Sane, 2019; World Health Organization, 2020). However, little is known about the current network of VBD stakeholders and actor interactions related to their management in Finland. Hence, the need for the establishment of a vector-borne disease expert network in Finland, which would include experts from different fields, has recently emerged (Finnish institute for health and welfare, 2021a). Consequently, the Finnish Ministry of Social Affairs and Health mentions the necessity to conduct a national VBD stakeholders mapping and the need of enhanced collaboration between stakeholders in their Climate Change Adaptation Plan for the upcoming years 2021–2031 (Ministry of Social Affairs and Health, 2021).

My aim is to map and analyze the current and missing stakeholder/actor interactions and information flow related to vector-borne diseases and their management in Finland, within a One Health context. Furthermore, focus is given to why a multi-stakeholder and integrated approaches to health, such as a One Health approach, is necessary to promote the overall wellbeing of humans, animals and ecosystems related to VBDs in Finland. In conclusion, this research plays a pivotal role in addressing the growing issue of vector-borne diseases nationally and globally, in addition to enhancing VBD research, management, surveillance, control and prevention in Finland. Finally, I will produce recommendations for the implementation of a national multidisciplinary vector-borne disease expert network in Finland.

2 LITERATURE REVIEW

This literature review consists of two major sections. The first section is a general overview of vector-borne diseases globally (section 2.1), subsequently diving deeper to vector and vector-borne disease epidemiology and surveillance mechanisms in Finland (section 2.2 and 2.3). In the second main section of the review, essential concepts, and different theories relevant to integrated approaches to health will be introduced (section 2.4 and 2.5). I will present in detail the concepts of One Medicine and One Health and discuss more briefly about other ecological approaches to health. Going through all the different novel frameworks is over the scope of this master's thesis, though I will discuss the main barriers integrated approaches in human, animal and ecosystem health are facing today, and what are some of the recommended propositions for the future. Finally, I will introduce the different stakeholders in One Health and look at current literature on One Health networks and stakeholder mapping (section 2.6). A summary of the interlinkages between integrated approaches to health and VBDs will also be provided (section 2.7).

Detailed steps for how I conducted the scoping review and literature search are presented in Appendix 5.

2.1 Vector-borne diseases globally

Vector-borne diseases are caused by infectious pathogens: bacteria, viruses, and parasites, and transmitted by vectors to hosts. According to the World Health Organization (WHO), VBDs are accountable for more than 17% of the total amount of human infectious diseases globally and cause over 700 000 annual deaths, being a major reason for mortality and morbidity around the world (World Health Organization, 2020a). Demographic, environmental, and social factors affect the distribution of VBDs, since their disease transmission relies on different living organisms: vectors. The most common vectors are hematophagous insects and other infected arthropod species which consume the blood of humans and animals. A fundamental property of a vector is its risk of becoming infected with a pathogen while having a blood meal from a primary host. Later, the vector can transmit the infection onwards to other animals and humans, who subsequently become new hosts of the disease pathogens (World Health Organization, 2020a). The reservoir hosts (animals) of these diseases are well adapted to the pathogens

they carry and symptoms usually occur only when the pathogen is transmitted to an unusual host, such as another animal species or a human (Vapalahti, Kainulainen, Järvinen, Hautala, Oksi, Kantele, 2020).

Another important aspect of vectors and hosts is their ability to carry pathogens from one location to another, spreading VBDs geographically. Increasing international travel and trade, migration, climate change and socio-demographic changes, in addition to changes in land use and agriculture are affecting the distribution and spread of VBDs globally (European Centre for Disease Prevention and Control, 2019; Rocklöv & Dubrow, 2020).

Besides being a growing problem to human and animal health, VBDs pose a risk to environmental health and economic security (Jongejan & Uilenberg, 2004). Climate change and environmental conditions such as temperature, rainfall and snowfall, can all affect the prevalence and distribution of VBDs, as well as their prevention and control (Rocklöv & Dubrow, 2020; THL, 2020). Human activity, continuous emission of greenhouse gases and consequent global warming has already affected the transmission and expansion of VBDs worldwide, and most probably changes will continue to happen, and even worsen, in the future (Rocklöv & Dubrow, 2020; Sormunen et al., 2020).

The warming climate and subsequent ecosystem changes pose a global threat of both old and new disease pathogens and vector species, as the vectors, pathogens and their hosts emerge and spread geographically farther north and also to larger areas in Finland (Culverwell et al., 2021; Rocklöv & Dubrow, 2020; Sormunen et al., 2020), because vectors generally thrive in warmer climates (Rocklöv & Dubrow, 2020). According to recent studies, tick expansion has already been documented in Finland and other European countries (Bugmyrin et al., 2019; Jaenson et al., 2012; Sormunen et al., 2020).

2.2 The epidemiology of vector-borne diseases in Finland

Globally, mosquitoes are the most significant vectors for pathogens causing VBDs in humans and animals (Culverwell et al., 2021), while in the Finnish setting both mosquitoes and ticks are relevant as they can cause clinically significant infections (Seppänen, 2011). Overall, of all the endemic arthropod-borne infectious diseases in

Finland, the most significant ones, clinically, are Lyme Borreliosis, Tick-Borne Encephalitis, Tularemia and Pogosta-disease. The distribution of all these diseases in Finland seem to have expanded to new geographic areas during recent years, due to human activity and climate change (Rummukainen, 2020; Seppänen, 2011). These diseases, their primary vectors, mode of surveillance in Finland and annual number of human cases are represented below in Table 1. Other endemic vector-borne pathogens in Finland include Inkoo-virus transmitted via mosquitoes, tick-borne anaplasmosis, Rickettsia Helvetica- and Uukuniemi-virus, in addition to bunyaviruses and bartonelloses, but the clinical significance of these diseases is lesser, or in some cases, still remain unknown (Seppänen, 2011; Vapalahti, 2020). This further emphasizes the need for novel investigation and research in the field of VBDs in Finland.

Table 1. Major vector-borne diseases in Finland, their pathogens, vectors, mode of surveillance, and the approximate number of annual human cases

Disease	*Pathogen*	*Primary vector(s) in Finland*	*Mode of surveillance in Finland*	*Approx. number of annual human cases*
Lyme disease	bacterium *Borrelia* spirochete	Ixodes ticks	Avohilmo[1] NIDR[2]	6500
Tick-borne encephalitis	*Flavivirus*	Ixodes ticks	NIDR	60-150
Pogosta disease	*Sinbis* virus	*Culex* and *Culiseta* mosquitoes	NIDR Avohilmo	median 55 (8-1311)[3]
Tularemia	bacterium *Francisella tularensis*	*Culex* and *Aedes* mosquitoes	NIDR Avohilmo	median 109 (7-926)[4]

[1] clinical or syndromic surveillance= Avohilmo
[2] lab-based surveillance= National Infectious Diseases Register (NIDR)
[3] Huge annual variations in occurrence numbers. Between years 1995-2021 the calculated median is 55 cases, and the annual variation is between 8 to 1311 cases
[4] Huge annual variations in occurrence numbers. Between years 1995-2021 the calculated median is 109 cases, and the annual variation is between 7 to 926 cases
(Finnish institute for health and welfare, 2022a)

Information sourced from: (Feuth et al., 2020; Finnish institute for health and welfare, 2020b, 2021c, 2022a; Jounio & Renko, 2009; Rocklöv & Dubrow, 2020; Sane et al., 2010, 2012; Seppänen, 2011; Thelaus et al., 2014; Vuento, 2020).

2.2.1 Mosquito-borne diseases in Finland

Forty-three different mosquito species are present in Finland, all of which are potentially able to transmit several mosquito-borne diseases (Culverwell et al., 2021). The two mosquito-borne diseases with the biggest public health relevance in Finland are Pogosta disease and Tularemia.

Firstly, the Sinbis-virus *(Togaviridae: Alphavirus)* causes an infection known as Pogosta disease in Finland, accounting for approximately 55 reported annual cases during regular disease years and up to 1311 cases during epidemic years, depending on disease cycle. Late summer mosquitoes (*Culex* and *Culiseta*) spread the virus from birds, (more specifically fowls, assumed to be the reservoir hosts of the Sinbis-virus) to humans. (Finnish institute for health and welfare, 2019, 2021a, 2022a; Sane et al., 2010; Sane, Kurkela, Vaheri, Vapalahti, 2009). Disease presentation is heterogenous, with asymptomatic infection in most cases. However, the most common clinical symptoms include fever, rash and joint pain, which can later develop into chronic joint symptoms among a minority of patients (Sane, Kurkela, Vaheri, & Vapalahti, 2009).

Previously Pogosta disease incidence has been following a 7-year cycle with larger epidemics in 1995 (n=1311) and 2002 (n=597) and a lower number of cases in the 2009 (n=106) and 2016 (n=31) epidemics (Finnish institute for health and welfare, 2022b). In 2021, an unprecedented total of 566 laboratory confirmed clinical cases were reported to the Finnish National Infectious Diseases Register (NIDR) with majority of the cases occurring between August and September 2021 (Finnish institute for health and welfare, 2022b; Suvanto et al., 2022). Previously the highest Sinbis-virus incidences have been recorded in the hospital districts of north Karelia and east Savo, though since the 2009 epidemic there has been an occurrence of cases geographically throughout Finland. (Finnish institute for health and welfare, 2022b; Sane et al., 2010). As majority of the infections caused by the Sinbis-virus are mild or asymptomatic and therefore not diagnosed, the number of actual cases annually is most likely larger than reported

(epipulse notification issued on data, from Finland ECDC national point emerging and vector borne diseases, 2021; Finnish institute for health and welfare, 2021c; Seppänen, 2011).

Secondly, the bacterium *Francisella tularensis* causes Tularemia, another vector-borne disease of public health relevance in Finland (European Centre for Disease Prevention and Control, 2017; World Health Organization, 2007). Four subspecies of *F. tularensis* are currently known of which Type B, *F. tularensis holarctica*, is found in Finland and the northern hemisphere. This subtype is less virulent and also causes a milder clinical manifestation of the disease, compared to the most virulent subtype, Type A, circulating in Northern America (European Centre for Disease Prevention and Control, 2017; World Health Organization, 2007).

In Finland the spread of Tularemia has been associated with mosquitos and other biting arthropods: ticks, blackflies and horseflies (Seppänen, 2011; World Health Organization, 2007), causing infrequent, short and local epidemics during late summer and early autumn (Jounio & Renko, 2009). Other routes of transmission, besides vector-borne transmission, are: intake of contaminated food or water, inhalation of aerosolized contaminated dust and being in close contact with infected animals (European Centre for Disease Prevention and Control, 2017; Hammer et al., 2022). Several animals can serve as reservoir hosts for the pathogen and the number of rodents, especially moles, have been connected to the Tularemia incidence in Finland (Finnish institute for health and welfare, 2018).

Tularemia is a bacterial zoonosis mostly infecting animals, though approximately 10-1000 (median 109) human cases in Finland are reported yearly (Finnish institute for health and welfare, 2020a). Early phase diagnostics of Tularemia is based on clinical symptoms which are: ulceration of the site of the mosquito bite, enlarged lymph nodes and fever. Antibiotic treatment is started prior to laboratory blood tests. Fifty percent (50%) of cases are asymptomatic, hence many cases are left undiagnosed. Later diagnostics of Tularemia relies on measuring serum antibody levels. (Jounio and Renko, 2009; Rummukainen, 2020; Seppänen, 2011).

2.2.2 Tick-borne diseases in Finland

Ticks are geographically present almost everywhere in Finland; the greatest tick distribution being in Åland and the smallest in northern Lapland with only few occasional findings (Seppänen, 2011). Hence, Finland holds the most northern border of tick distribution in the whole of Europe. This makes tick-borne disease (TBD) related research in Finland of global importance as well (Laaksonen et al., 2017).

There are two different tick species that are of significance in Finland: *Ixodes ricinus* and *Ixodes persulcatus* (Laaksonen et al., 2017; Sormunen et al., 2020). One of the most important host animals for tick species in Finland are white-tailed deer, therefore the incidence of tick-borne infections is also related to changes in deer populations in Finland. Other animals that can work as host animals for ticks in Finland are, for example, the red fox, the European hare and the mountain hare (Dub et al., 2020). Furthermore, the two tick-borne diseases with the biggest public health relevance in Finland are Lyme Borreliosis (LB), also known as Lyme Disease, and Tick-Borne Encephalitis (TBE). Transmission of these diseases to humans happens during the blood meal of an infected tick (Boulanger et al., 2019).

Firstly, Lyme Borreliosis is caused by the infection of bacterial spirochete *Borrelia burgdorferi*, which in a recent study was found in approximately 50% of all adult ticks and 25% of nymphs in Finland (Sormunen et al., 2020). According to national surveillance, the annual number of LB cases in Finland is approximately 6500 including microbiologically confirmed LB cases and outpatient LB cases in public and private health care (Finnish institute for health and welfare, 2021d; Sajanti et al., 2017). The transmission risk of LB increases considerably if the tick is not quickly removed and stays intact on the skin for a couple of days (Vapalahti, Kainulainen, Järvinen, Hautala, Oksi, Kantele, 2020).

In Finland, early LB is diagnosed and treated based on clinical symptoms, while late-stage LB is confirmed using serologic tests (Seppänen, 2011). The early clinical symptom of Borreliosis is most commonly the skin lesion: *erythema migrans* (EM), which appears around the area of the tick bite (Seppänen, 2011; Stanek et al., 2012). For those who do not manifest EM, symptoms include an unspecific fever without cough, cold or diarrhea

(Seppänen, 2011). At a later stage LB can lead into more serious symptoms including neuroborreliosis, arthritis and a skin disorder known as *Acrodermatitis chronica atrophicans*. In some rare cases Borrelial lymphocytoma, Cardiac Lyme borreliosis and/or ocular symptoms may occur (Seppänen, 2011; Stanek et al., 2012). Antibiotic treatment is recommended in the early phase to prevent the manifestation of later more severe symptoms (Stanek et al., 2012).

Secondly, Tick-Borne Encephalitis (TBE) is another tick-borne disease of public health relevance in Finland caused by a *flavivirus.* The tick-borne encephalitis virus (TBEV) is found in both of the *Ixodes* tick species present in Finland (Jääskeläinen et al., 2010; Tonteri et al., 2015). One percent (1%) of all *Ixodes* ticks in disease endemic areas in Finland carry the TBEV. Traditionally risk areas for TBE in Finland have been Åland, Turku archipelago, as well as other coastal areas, in addition to the areas between Saimaa and the eastern border of Finland, though in recent years geographic expansion of the disease has been confirmed (Finnish institute for health and welfare, 2023; Tonteri et al., 2015; Vapalahti, Kainulainen, Järvinen, Hautala, Oksi, Kantele, 2020).

During a tick bite, the TBEV infection is transmitted very rapidly within minutes from tick saliva into human's bloodstream (Vapalahti, Kainulainen, Järvinen, Hautala, Oksi, Kantele, 2020). In some cases, a TBE infection can also occur while consuming TBEV-contaminated unpasteurized dairy products (Offerdahl et al., 2016). In Finland TBE diagnosis is confirmed using serological tests (Seppänen, 2011) and, according to Finnish national surveillance, approximately 60-150 microbiologically confirmed cases of TBE are reported annually (Finnish institute for health and welfare, 2020c, 2022a). It is also acknowledged that the number of TBE cases have been increasing substantially both in Finland and other European countries during the past 30 years (Finnish institute for health and welfare, 2022a; Süss, 2008; Tonteri et al., 2015).

While most TBE cases are asymptomatic, the clinical manifestation of the disease depends on the infecting TBEV subtype (Růžek et al., 2010). Five subtypes of TBEV are currently known, of which the European and Siberian subtype are found in Finland (Jääskeläinen et al., 2006, 2010). Other subtypes are: the Himalayan subtype, the Far Eastern subtype and the Baikalian subtype (Dai et al., 2018; Kovalev & Mukhacheva, 2017). In Finland TBEV usually causes a biphasic course of disease: one week incubation

period followed by fever and other unspecific infection symptoms (in majority of cases), then leading to a 3–21-day asymptomatic interval phase followed by neurological symptoms and acute viral meningoencephalitis (10-30% of cases) (Růžek et al., 2010; Seppänen, 2011). Case fatality rate (CFR) of TBE is $\leq 2\%$ (Růžek et al., 2010). Recovery can take months and for a minority of patients' permanent neurological symptoms such as paresis, hearing and balance disorders, in addition to neuropsychiatric symptoms may develop (Seppänen, 2011; Vapalahti, Kainulainen, Järvinen, Hautala, Oksi, Kantele, 2020). The Siberian subtype is presumed to cause more frequently severe clinical manifestations of TBE compared to the European subtype, also lacking the biphasic course of disease (Vapalahti, Kainulainen, Järvinen, Hautala, Oksi, Kantele, 2020).

In Finland, the treatment of TBE usually requires hospital level treatment (Vapalahti, Kainulainen, Järvinen, Hautala, Oksi, Kantele, 2020). There is no definite cure, nor national treatment recommendations for TBE at the moment. Therefore, the only effective measure against TBE infections are several doses of an inactivated TBE vaccine, and avoiding exposure to tick bites, according to general preventive TBD measures. These preventative behaviors include, amongst many, wearing long sleeve clothing when outdoors in tick endemic areas (Dub et al., 2020; Růžek et al., 2010). In Finland, the TBE vaccine is part of the national vaccination program and it is administered according to people living or having a summer house in TBE risk areas (Finnish institute for health and welfare, 2021b).

2.3 Surveillance of vector-borne diseases

The surveillance and monitoring of VBDs globally and nationally is important to determine the burden and the possible health threats they may pose in the future. Because of the complexity of VBDs, the surveillance of these diseases is not as straight forward as for many other illnesses. For successful surveillance and accurate evaluation of the burden and health threats posed by VBDs, relevant indicators must be measured and followed. For VBDs these indicators are for example: occurrence of human disease, vector abundance, presence or absence of a specific disease vector, infected vector density, as well as the amount of infected reservoir hosts in the environment. The European Center for Disease Prevention and Control (ECDC) suggests collecting pathogen-, serological-, clinical-, syndromic- and risk data for key VBD surveillance in

Europe. Moreover, multidisciplinary communication and co-operation is essential for the surveillance, early detection, warning, prevention and control of vectors, hosts and VBDs. (Braks et al., 2019).

2.3.1 Disease surveillance activities and national health registers in Finland

The following arthropod-borne VBDs are notifiable infectious diseases in Finland based on the Communicable Disease Decree: all microbiological laboratory confirmed cases of endemic VBDs (TBE, LB, Tularemia and Pogosta disease) and imported VBD cases (malaria, Dengue, yellow fever, Crimean-Congo hemorrhagic fever, Zika-virus, Chikungunya-virus, Japanese B encephalitis virus, West Nile virus and Leishmanias). These diseases must be notified and registered to the National Infectious Diseases Register (NIDR), maintained by the Finnish institute for health and welfare (THL). Clinically diagnosed VBDs are registered to the Register for Primary Health Care Visits (AvoHilmo) or National Hospital Discharge Register (Hilmo) according to the International Classification of Diseases, 10th Revision codes (ICD-10) (Dub et al., 2020; Feuth et al., 2020; Finlex, 2017; Finnish institute for health and welfare, 2020b; Sajanti et al., 2017).

2.3.2 Vector surveillance and control in Finland

In addition to monitoring the occurrence of VBDs in humans, the surveillance and control of the vectors themselves is pivotal for the successful prevention of VBDs (European Center for Disease Prevention and Control, 2021). Several European countries including Finland, shared their national vector surveillance and control activities in a recent ECDC technical report on vector surveillance and control organization. According to the study, vector surveillance for both ticks and mosquitoes in Finland was carried out by universities. Usually, the minister of health or agriculture is responsible for the surveillance of vectors in Europe. However, in Finland there is no dedicated organization or agency responsible for vector surveillance, instead it is carried out by scientific institutions, mainly the University of Helsinki and the University of Turku (European Center for Disease Prevention and Control, 2021).

Usually, the aim of vector control is to control disease outbreak and local transmission, as well as prevent invasive vector species from emerging within a country. Regarding vector control, no control measures of either mosquitoes or ticks are in place in Finland, due to lack of resources and the absence of a legal framework within which vector control can be organized. Compared with other Nordic countries such as Sweden, where the Environmental and Health Protection Boards of municipalities are responsible for vector-control (European Center for Disease Prevention and Control, 2021).

Regarding vector surveillance and control, ECDC also promotes multidisciplinary stakeholder collaboration. Currently in Finland there is no formalized One Health collaboration between public health and animal health and/or the environmental sector (European Center for Disease Prevention and Control, 2021). This emphasizes the need for future investigation regarding the different stakeholders related to VBDs and integrated approaches to health in Finland.

2.4 Integrated thinking of human and animal health

2.4.1 The history and development of the One Medicine and One Health- approaches

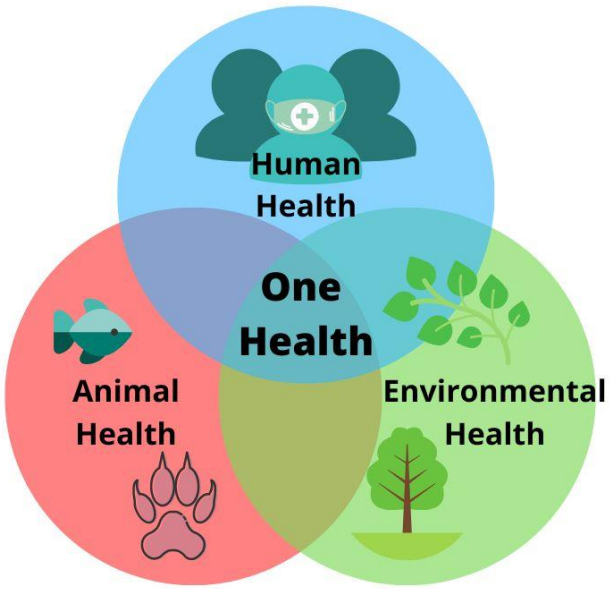
The timeline of integrated thinking regarding human and animal medicine can be first dated back to ancient scripts from Egypt, India and China, as well as healing practices of humans and animals within traditional pastoral societies herding their livestock (Driesch and Peters, 2003; Majok and Schwabe, 1996; Papyrus of Kahun, ca.1800 BC, as cited in Zinsstag et al., 2011). In Europe, it was much later in the 19th century that Rudolf Virchow noticed the link between human and animal diseases and invented the term *zoonosis* to describe the connections between humans, animals, and infectious diseases (Schultz, 2008). Over a hundred years after Virchow's time, the SARS-CoV-2 virus has caused global havoc around the world and has finally brought zoonotic diseases and the importance of integrated animal, human and ecosystem health to the center of attention, not only for scientist, researchers, and decision makers, but also for the general public.

William Osler continued the ideology of integrated thinking of human and animal medicine in the 1870s and is said to be the first person to use the phrase *One Medicine* (Dukes, 2000; Gyles, 2016). On the contrary, in the years leading up to the 20th century,

human and veterinary medicine both became their own highly specialized fields of sciences (Zinsstag et al., 2011). It was not until almost a century later in the year 1976 that Calvin Schwabe, rethought Virchow's and Osler's initial views on the topic (Schwabe, 1984, as cited in (Zinsstag et al., 2011). He described the paradigms of human and animal medicine to be similar to one another and emphasized the demand for collaboration between practitioners of human and veterinary medicine in order to tackle more effectively the issues around zoonotic diseases (Gyles, 2016; Zinsstag et al., 2011).

In the beginning of the One Medicine era, integration of human and animal health had a strong emphasis on clinical thinking and treatment of diseases (Gyles, 2016; Zinsstag et al., 2005). The addition of public health aspects such as the shift in thinking from disease treatment toward health promotion and the inclusion of environmental aspects to the One Medicine concept gradually evolved it towards the *One Health* approach known today (Gyles, 2016). In 2004, Robert Cook, William Karesh and Steven Osofsky, established the term and its principles and recommendations for a holistic approach to interlinked medicine and ecosystem health, originating from a growing global concern of emerging zoonotic diseases which could potentially cause damaging human pandemics. (Gibbs, 2014). Figure 1. presents the basic concept of One Health below.

Figure 1. Basics of the One Health concept (Anniina Kyöttinen, 2021)



Today, the One Health approach has gained wide international acceptance by several organizations and political actors such as the WHO, the World Bank, the Food and Agriculture Organization (FAO), the World Organization for Animal Health (OIE), the European Union (EU) and the United Nations (UN) (Gibbs, 2014). However, the One Health concept has also faced critique (Destoumieux-Garzón et al., 2018; Gibbs, 2014; Lerner & Berg, 2017; Roger et al., 2016), hence still evolving and broadening in its approach (Kuukka et al., 2019). Nowadays this holistic approach combines multidisciplinary thinking of the connections between the health of humans, pets, livestock, wildlife and plants in their shared living environments (Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases, 2020). The combination of veterinary medicine, global public health and ecosystem health broadens the approach of previous integrated thinking of human and animal medicine to include the health, well-being and sustainable development of entire societies (Zinsstag et al., 2011). The One Health Commission and Centers for Disease Control and Prevention (CDC) jointly define One Health as follows:

> One Health is a collaborative, multisectoral, and trans-disciplinary approach - working at local, regional, national, and global levels - to achieve optimal health (and well-being) outcomes recognizing the interconnections between people, animals, plants and their shared environment (Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases, 2020; One Health Commission, 2019).

Furthermore, the One Health Tripartite released a novel definition of “One Health” in 2021 by the One Health High Level Expert Panel (OHHLEP). This definition further extends the terminology and aims to promote a shared understanding of the One Health approach between different disciplines. The OHHLEP definition of One Health is:

> One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems. It recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and inter-dependent.
> The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the collective need for

clean water, energy and air, safe and nutritious food, taking action on climate changes and contributing to sustainable development (World Health Organization, 2021).

2.5 Present situation of integrated approaches to health and the way forward

The need for ecological approaches in health had already been acknowledged globally by the WHO in 1986 in the Ottawa Charter for Health promotion. The charter states that human life and health are closely interlinked to other ecosystems, and this should also be considered as an important component of health promotion (WHO, 1986). Nearly 30 years after the appearance of the charter, public health has still been criticized as being "ecologically blind" (Trevor Hancock, 2015 as cited in Pulkki, 2020). Due to this need, different ecological approaches to health have continued to emerge during recent years. In addition to the One Health approach described earlier, other concepts such as *Eco Health* and *Planetary Health* have also been developed and used by scientists and international agencies alike during the 21st century (Pulkki, 2020).

All the different integrated and ecological approaches in health presented earlier have their own strengths and limits, and throughout time the different concepts have evolved to better meet today's needs regarding global health problems. In recent years different solutions to remove the remaining barriers of the previously listed integrated approaches to health have been suggested by various researchers (De Garine-Wichatitsky et al., 2021; Destoumieux-Garzón et al., 2018; Kuukka et al., 2019; Roger et al., 2016).

Firstly, in order for the One Health approach to become truly inclusive of ecosystems, in addition to the health of humans and animals, research demonstrates that plant health and the understanding of ecological, evolutionary, environmental, human, social and legal sciences need to be better integrated into the approach (Destoumieux-Garzón et al., 2018; Fletcher et al., 2009). Destoumieux-Garzón et al. (2018) further highlight that the barriers separating the different fields of study in the One Health approach need to be tackled to allow effective collaborations between human and animal medicine, in addition to ecology and evolutionary and environmental sciences. Increasing multidisciplinarity

through enhanced education and training, future research, strengthening of funding and scientific cooperation, along with long-term monitoring of environmental changes are recommended by the research group (Destoumieux-Garzón et al., 2018).

Secondly, the lack of social sciences among the discussed integrated approaches to health have led researchers to examine novel and relevant *Eco-Social approaches* (Kuukka et al., 2019). The Eco-Social approach to health has its origin in social sciences and philosophy. It aims to acknowledge not only health problems, but also the root reasons behind our planet's ecosystem crisis: the anthropocentric human-nature relationship and our modern system of liberal market economy relying on continuous economic growth and consumption (Pulkki, 2020).

Thirdly, De Garine-Wichatitsky and colleagues (2021) argue that broader ecosystem approaches to health need to be implemented to the original and well-known One Health approaches, in order for them to become more comprehensive in ecosystem health. Traditionally, the collaboration between public health and veterinary medical sectors have been working fairly well, but collaboration with other fields of study and sciences is still lacking and needs to be improved (Roger et al., 2016).

2.6 Stakeholders in One Health

Schmeer (2000) defines stakeholders as actors, both persons and organizations who are "interested parties" of a promoted policy. According to Mazet et al, (2014) the stakeholders in One Health are divided into "the ultimate beneficiaries (i.e. animal, people and the environment) and the organizations that work to protect them (i.e. research institutes, government ministries, international organizations and professional bodies.)". In this master's thesis, the terms 'stakeholder' and 'actor' are used interchangeably to mean all the different persons or organizations with a vested interest in vector-borne diseases and/or One Health.

Traditionally, One Health stakeholders related to the public and veterinary health sector have been easier to identify in comparison to those related to wildlife and the environment, whom, until recently, have been under-represented. However, identifying

and engaging a diversity of stakeholders from various sectors and geographic levels (i.e. local, regional and national) of society is critical to successfully implementing the One Health approach; however, identifying all One Health stakeholders is a challenge. Together the different multisectoral and multidisciplinary stakeholders can share their information and tools, build knowledge, promote health issues to the general public and produce feedback from the field to higher level stakeholders i.e. ministries and multilateral organizations. Successful One Health interventions depend upon collaboration between a multitude of different study fields including human and animal medicine, nursing, public and environmental health, environmental sciences, ecology, conservation biology, social sciences, humanities, economics, education, engineering and public policy (Mazet et al., 2014).

2.6.1 One Health networks

Recent trends in integrated thinking of human, animal and ecosystem health have led to the rapid development of One Heath related networks around the world (Khan et al., 2018). These multi-sectoral networks work for example to improve disease surveillance and reporting, reduce morbidity and mortality, and improve outbreak responses. The downside of these networks is often the lack of political power and the ability to actually implement a One Health policy rather than solely recommending one. Research highlights the need for sustainable monetary investment, governmental support and political will in order for a regional-level One Health network (OHN) to be successful in its efforts. Moreover, it is the role of ministries and policy makers as One Health stakeholders to provide the political support to One Health policy implementation and to make sure as many sectors as possible are included in discussion and decision making. Other important stakeholders in One Health networks apart from ministries are government research and development institutions, public and private universities, non-governmental stakeholders, such as non-governmental organizations (NGOs), local communities and the private sector (Mazet et al., 2014).

Previous research of OHNs (including networks also using the terms: EcoHealth, Planetary Health and One Medicine) in Europe, Asia and Africa have established that majority of these networks work nationally or regionally with little inter-regional or

international collaboration. Around a third of all OHNs include only stakeholders of human and animal health, with far too little attention given to the representation of environmental actors. Also, the representation of local communities and private organizations (i.e. pharmaceutical, biotechnology and information technology companies) in these OHNs is very limited, while academic institutions and governmental stakeholders are better represented. According to research the most common form of collaboration between different stakeholders is ether between academia and governmental bodies or between academia, governmental bodies and NGOs (Khan et al., 2018; Mazet et al., 2014).

In conclusion, a lack of OHN monitoring, evaluation and coordination of network activities could possibly lead to ineffectiveness and overlapping of networks (Khan et al., 2018). Recent studies of stakeholders in One Health and OHNs recognize the need for enhanced OHN coordination, communication and information sharing between different stakeholders and networks, in addition to growing the engagement of environmental actors within these networks (Khan et al., 2018; Mazet et al., 2014).

2.6.2 Stakeholder analysis and VBD stakeholder mapping

Schmeer (2000) defines stakeholder analysis as a systematic process of gathering and analyzing qualitative data in order to investigate which stakeholders to consider when developing and implementing policies and programs. Stakeholder analysis can therefore be used as a tool to identify key actors (i.e. people and organizations) around a certain topic. The benefits of stakeholder analysis are: (1) to gain information on key stakeholders and (2) to determine their involvement, knowledge, goals and connections related to the specific policy at hand. Stakeholder analysis can also be utilized to plan future research and analysis, develop health related action plans, and enhance stakeholders' participation in discussions toward building a shared goal (Schmeer, 2000).

A One Health case study of stakeholder mapping of tick and tick-borne disease management in southern France (Unpublished Zortman, 2020) is a useful example of utilizing stakeholder analysis as a research tool. Zortman and colleagues noticed in their research that the lack of multisectoral communication between tick-borne disease

stakeholders could lead to the delayed detection of emerging diseases and other trends, such as changes of at-risk periods or areas (*Unpublished* Zortman, 2020). Consequently, the recent findings of Zortman et al., further confirm the importance of interdisciplinary co-operation between different disciplines and stakeholders in VBD management and surveillance, and hence also highlighting the importance of this master's thesis study, which aims to map the current and missing stakeholder and actor interactions related to vector-borne diseases and their management in Finland, within a One Health context. To date, no previous study has been reported or published on stakeholder analysis regarding VBDs and the One Health approach in Finland.

2.7 Summary: the interlinkages between integrated approaches to health and VBDs

Since the emergence and distribution of vectors, and subsequently the occurrence of VBDs, is influenced by several environmental, climatic and socio-demographic factors (European Center for Disease Prevention and Control, n.d.; European Centre for Disease Prevention and Control, 2019; Rocklöv & Dubrow, 2020; Schmidt et al., 2013), multidisciplinary collaboration and cross-sectional stakeholder action among vector-borne disease experts is needed for societies to better understand and tackle the current changes happening within vectors, pathogens, hosts and their living environments. Research confirms that changes in land use and agriculture is one of the main reasons behind the emergence and re-emergence of human pathogens of zoonotic origin, i.e. VBDs. Freshwater use, climate change and international trade and travel are also all associated with the emergence of human pathogens of zoonotic and non-zoonotic origin. (Woolhouse & Gowtage-Sequeria, 2005). Hence, human, animal and environmental health and the management of zoonoses and VBDs are closely linked to various ecosystem changes.

Globalization and the environmental and social changes happening are relatively new issues of today's human population. The changes caused by human activity to our planet can cause rapid, surprising and novel consequences with often little time left to react and adapt, hence societies can face difficulty in knowing which indicative signals to catch, interpret and manage effectively (Young et al., 2006). These indicative signals are also known as early warning signals, which indicate a major shift in a system (Bauch et al.,

2016). For instance, an early warning signal could potentially tell us if a specific VBD may be spreading to a new geographic area or if a novel pathogen may be emerging.

In recent years, vector-borne diseases have proven to be an important topic in the field of public and global health, both in Finland and globally (Dub et al., 2020; Jaenson et al., 2012; Jongejan & Uilenberg, 2004; Rossow et al., 2015; Sajanti et al., 2017; Tuija Leino and Jussi Sane, 2019; World Health Organization, 2020). Especially with the geographic expansion of ticks and their increased abundance in Finland, correlated with increased TBD cases within the past decades posing a growing national public health concern (Bugmyrin et al., 2019; Sajanti et al., 2017; Sormunen et al., 2020; Tonteri et al., 2015).

In conclusion, there has been growing discussion about the complexity of the terminology and definitions of integrated approaches to health and how different stakeholders from different disciplines understand these concepts. For a One Health initiative to be successful, all actors must understand what is being discussed and what are the key processes around One Health. Unifying terminology and the understanding of integrated approaches to health is of crucial importance because currently, siloed thinking, the lack of communication between different fields of study, and the lack of clear definitions and indicators related to environmental health poses a clear challenge and barrier to comprehensive advancement of the One Health approach (De Garine-Wichatitsky et al., 2021; Destoumieux-Garzón et al., 2018). Because of the complex nature of vectors and the infections they spread, in addition to prevention, surveillance, and control policies, VBDs illustrate a distinct need of an integrated One Health approach (Braks et al., 2019), especially within the Finnish context.

3 RESEARCH OBJECTIVES

Previous research in Finland around the topic of vector-borne diseases has primarily been focused on vector, host and disease epidemiology: changes in disease occurrence and distribution of hosts and vectors at a national level. However very little attention has been given to stakeholder networks studies, information- and resource-sharing, nor on how different VBD actors and stakeholders interact in Finland. Because of these gaps in current published research, the overall aim of this master's thesis is to map the current and missing stakeholder and actor interactions related to vector-borne diseases and their management in Finland, within a One Health context. In addition, the objective is also to discuss and reflect on the future of a possible One Health-inspired VBD network in Finland and what the chances and means of establishing one in Finland would be. The specific research questions for this research study are:

1. What/whom are the current key stakeholders/actors related to vector-borne disease research, management, surveillance, control and prevention in Finland. To what extent are these stakeholders interdisciplinary, multisectoral and multi-leveled?

2. What kind of connections and interactions take place between different stakeholders? How and to whom is knowledge and data shared? What are the main challenges for collaboration between key stakeholders?

3. What kind of stakeholder collaboration do the different VBD stakeholders wish for in the future and what are the needs for a multidisciplinary vector-borne disease expert network in Finland?

4 MATERIALS AND METHODS

Qualitative semi-structured interviews were chosen as the primary methodology for this master's thesis project to map the current and missing stakeholder and actor interactions related to vector-borne diseases and their management in Finland. The chosen methodology best allows us to reveal novel information on the topic, based on actors' and stakeholders' perspectives. The data used for this *Vector-borne diseases stakeholder mapping in Finland: A one health approach - study* was collected by individual interviews conducted during my internship at the Finnish Institute of Health and Welfare. As the data is in the form of semi-structured interviews, the analysis in this master's thesis will remain primarily descriptive, and a realistic analytical approach will be used as the philosophical background for analysis. More specifically, content analysis was used as a qualitative descriptive approach combined with aspects of the ARDI method; a qualitative research method, focusing on identifying actors, resources, multi-actor dynamics and multi-actor interactions (Elo & Kyngäs, 2008; Etienne et al., 2011).

A review protocol for this study exists and it can be accessed through the author of this master's thesis and THL. Research objectives, data collection, data analysis methods, and inclusion criteria were all specified in advance and documented into the protocol. The protocol was modified only slightly during the research for legitimate reasons (Liberati et al., 2009). Modifications were added to the semi-structured interview guide, which was altered after a period of pilot testing. The final version of the interview guide is presented in this master's thesis report.

This chapter provides an overview of the project (section 4.1), study design (section 4.2), study population (section 4.3) and data collection (section 4.4). Later in the chapter there will be more detailed discussion of the information collected (section 4.4.2) and the method of analysis used (section 4.5). At the end of the chapter ethical considerations of the study will also be explained (section 4.6).

4.1 The Project

This master's thesis was carried out during my internship at the Finnish Institute of Health and Welfare (THL) from June 2021 to February 2022. The project was conducted as part of a THL partnership within the EU Horizon 2020 (H2020) MOOD-project, coordinated by The French Agricultural Research Center for International Development (CIRAD). Therefore, the methodology chosen for this research, including forming the interview guide, was conducted together with the help of both THL and CIRAD supervisors (Finnish institute for health and welfare, 2021a). Data collection took place between October 2021 until the end of December 2021 and data analysis began as soon as the interviews progressed.

The EU Horizon 2020 program is an international research project aiming to develop means of epidemic intelligence to monitor, assess and detect early phase signals related to infectious disease emergence in Europe from a One Health point of view (MOOD project consortium, 2019). As part of the MOOD project, THL addressed local stakeholders' engagement in epidemic intelligence and risk communication related to vector-borne diseases to identify how to improve information sharing, management and risk communication both on a local and national level (Finnish institute for health and welfare, 2021a). My internship and master's thesis research are part of this work.

4.2 Study design

This master's thesis was conducted as a qualitative, semi-structured interview-based research. Content analysis was used as a qualitative descriptive approach combined with aspects of the ARDI method, the latter being used during the data analysis (Elo & Kyngäs, 2008; Etienne et al., 2011). Content analysis is a widely used methodology in nursing sciences and public health studies. It is especially used in exploratory studies and in the inquiry of phenomena with limited previous research (Elo & Kyngäs, 2008; Vaismoradi et al., 2013). Recurring patterns in textual data can be grouped according to categories or themes using codes and quantificational means in order to describe the studied phenomena (Vaismoradi et al., 2013). Hence, this qualitative research methodology enabled me to collect data of the participants' experiences and opinions on the studied topic (Godwill, 2015). The aim of this study was to gain a deeper comprehension of VBD

actors and local stakeholders and VBD management in Finland, rather than accessing masses of generalizable data; therefore, a qualitative research methodology with nonrandomized sampling was justifiable (Ghaljaie et al., 2017). Through the chosen study method, I was able to obtain data to identify the kinds of data sharing and types of collaborations the different VBD stakeholders were expecting, as well as the need for a multidisciplinary vector-borne disease expert network in Finland.

Prior to drafting of the interview guide and conducting interviews, I reviewed literature related with the research topic and received content and methodological guidance and feedback from my supervisors. The literature review allowed me to familiarize myself with qualitative research methodology, semi-structured interview methods and stakeholder analysis methods and tools. In addition, I investigated the theoretical framework of VBDs, their epidemiology and surveillance mechanisms in Finland, as well as studied the different integrated approaches to health. The literature review was necessary to construct a preliminary interview guide, which was used to direct the discussion to relevant topics during the semi-structured interviews.

4.3 Study population

Inclusion criteria for the study sample, aiming for a diverse study pool to fulfill the multidisciplinary nature of vector-borne diseases and the One Health aspect of the study, were:

- Interview participants needed to fulfill an adequate level of expertise in VBDs or related fields and needed to be considered as relevant actors of VBD management, control and/or prevention in Finland, or have knowledge of, or previous experience with, a One Health approach.

I contacted a total of 12 stakeholders via email for interview purposes. Ten positive responses were received to participate in an interview, while one stakeholder replied that the topic of the study was not relevant to their work and another did not respond, although a reminder email was sent. Ten different national-level actors and stakeholders working with vector-borne diseases and One Health-related topics in Finland were included in this study. No dropouts occurred during the study.

The study participants were recruited and contacted both prospectively and during the interview phase using the *convenience sampling* and *snowball sampling* methods. Convenience sampling is a non-random sampling method which gives the researcher the ability to pick one's sample by choosing convenient and available participants according to the research needs. Convenience sampling is a method often implemented by experimental researchers in their studies (Hibberts et al., 2012).

In the first round of interviews, I used the convenience sampling method to pick one gatekeeper actor (i.e. expert in the field of VBDs) for an exploratory interview. This participant was chosen to pilot test the suitability of the semi-structured interview guide, to gain preliminary data of vector-borne disease stakeholders and to identify more VBD actors in Finland. I used the *field-testing* technique, commonly used within semi-structured interview studies, to pilot test the interview guide (Kallio et al., 2016).

The second part of the data collection was conducted by continuing the use of the convenience sampling method and by introducing the snowball sampling method, also known as the *chain referral sampling* method (Hibberts et al., 2012). This methodology was justified because enough study participants meeting the inclusion criteria of our study could be hard to access without external knowledge of key actors (Ghaljaie et al., 2017). According to snowball sampling, the primary and subsequent participants were asked to name additional people meeting the study characteristics for the following interviews (Hibberts et al., 2012). Snowball sampling is a cost- and time-effective sampling method used to gain access to a specific study population. Normally, snowball sampling is a gradual progress and will be continued until saturation of data (Ghaljaie et al., 2017). Generally, in qualitative research the sample pool is smaller than quantitative research, however the interviews tend to last longer. Theoretical saturation is reached when no new information is gained from further interviews (Godwill, 2015). Due to the time constraints of this research, I continued sampling until 10 stakeholders had been interviewed individually.

4.4 Data collection

4.4.1 Interview guide

Semi-structured interviews are a commonly used method for gathering data in qualitative research (Kallio et al., 2016). The open framework of semi-structured interviews allows participants to communicate in a less restricted way, which enables novel information to be revealed more easily, in comparison to structured interviews or questionnaires. In addition, the method allows important exchange between the interviewer and the interviewee (Anne Galletta, 2012). It was beneficial to have enough time and flexibility in our methodology to gain novel information from the participants, hence the semi-structured interview method enabled me to conduct open discussion and conversations with the interviewed actors. It also made it possible to concentrate more on topics the participants found significant, hence diverse observations and impressions of the given topic could be revealed during the interviews (Cridland et al., 2015).

Preliminary research and background analysis are essential elements for the preparation of an adequate and practical interview guide (Krauss et al., 2009). For this master's thesis, I produced the preliminary interview guide based on a previously conducted stakeholder mapping study of tick and tick-borne disease management in southern France (*Unpublished* Zortman, 2020). The original guide produced by Zortman was first translated from French to English and then modified to better meet my research objectives and the particularities related to VBDs, their management and data/information flow in Finland. This information was based on relevant literature on VBDs in Finland, as well as their management and related integrated approaches to health, which I examined during the literature review phase of the research. Additional knowledge and tips for constructing and adapting the interview guide were also acquired from my thesis supervisors.

For quality assessment and bias management, some of the interview questions and follow-up questions of the interview guide had adaptations made to them based on a pre-pilot testing technique where the interview guide was revised internally among experts in the research team before phase one of interviews began (Chenail, 2011; Kallio et al., 2016; Majid et al., 2017). I also made minor alterations and improvements to the preliminary interview guide after the pilot test during the first expert (i.e. gatekeeper) interview. The

preliminary interview was held in house (THL) in October 2021 and lasted approximately 1h and 10 minutes. It was conducted in English together with one of my supervisors. I conducted the interview face-to-face with the interviewed, while my supervisors joined remotely via Microsoft Teams. Based on the experience of the first interview the final semi-structured interview guide was constructed. Post-field testing, the content of the interview guide remained unchanged, however some modifications concerning the form and order of the questions were applied to aide in discussion fluidity. Therefore, the gatekeeper actor was not needed to be interviewed again, and the data collected from this preliminary interview was used for the final study and data analysis. The final version of the interview guide in English and Finnish languages can be found in Appendix 1 and 2.

4.4.2 Information collected

A properly designed interview guide enhances the quality of data collection and the trustworthiness of the research (Kallio et al., 2016). For this reason, I based the stakeholder interviews on the interview guide produced by Zortman et al. in Southern France in 2020 (*unpublished* Zortman, 2020) as a framework for the interviews conducted in this master's thesis and discussions with the different VBD actors and stakeholders. The aim was to gather information in order to map the current and missing stakeholder and actor interactions related to vector-borne diseases and their management in Finland within a One Health context. The following four themes were discussed during the interviews:

- **Theme 1**: Professional domain, expertise and knowledge
- **Theme 2:** Partnerships and collaboration between actors/stakeholders
- **Theme 3:** Actor participation and the need for a network among VBDs experts
- **Theme 4:** Integrated approaches to health and the One Health (OH) approach: knowledge and experiences

4.4.3 Semi-structured interviews

Phase two of individual stakeholder interviews took place during November and December 2021, conducted independently by me. Majority of the interviews were held in Finnish language (n=8), while two interviews were conducted in English. Seven of the

interviews were held remotely via Microsoft Teams using a work computer due to Covid-19 restrictions which affected onsite work and in-person meetings. However, three face-to-face interviews were held at the THL office in Helsinki (Finland). All interviews were recorded through the Microsoft Teams platform, as well as with a company mobile phone for backup. The recordings were done with the signed and oral consent of the interviewed participants. I designed the research consent form and information sheet in Finnish language (Appendix 3 and 4) and emailed them to the participants when inquiring about their willingness to take part in the study. I sent a reminder email one week after the first email, if no response was received.

In line with Zortman's earlier case study, I used separate Microsoft Office Excel sheets to gather and organize relevant information. The Excel document contained: interview date, participant pseudonym, email address, phone number, professional institution, job title, work themes and reference of who had recommended the person for an interview. A detailed template of the Excel sheet used can be found in Appendix 6.

4.5 Data analysis

I performed an abductive content analysis on the interview data to answer the explicit research questions and to conduct a detailed analysis of vector-borne disease networks in Finland (Elo & Kyngäs, 2008). In addition, I analyzed the interview transcripts by applying the principles of the *ARDI (Actor, Resource, Dynamics and Interactions)* method (Etienne et al., 2011), used by Zortman et al. in her master's thesis on stakeholder mapping of tick and tick-borne disease (TBD) management in France (*unpublished Zortman*, 2020). Initially the ARDI method was created to be used during repeated participatory workshops together with relevant actors to share information and perceptions among multiple stakeholders and to co-construct strategies and solutions for a specific issue in a visual way. In the ARDI method, diagrams are used to visualize the interactions between different actors, their access to and use of resources and the dynamics affecting the different components (Etienne et al., 2011).

My research followed the model of Zortman's research method with some adaptations and the inclusion of the content analysis methodology. Rather than organizing a participatory workshop with actors prior to the stakeholder analysis, I instead used the

ARDI-method to identify actors and stakeholder interactions in addition to exposing dynamics, i.e., the challenges regarding interactions within the system, expressed during the individual interviews and identified when analyzing interview transcripts. I therefore used the ARDI method after conducting all the interviews to direct the data analysis phase of the research and to help produce a visual diagram from the interview data (*unpublished Zortman*, 2020).

I used a Finnish language company, for the interview transcription process. However, the first interview in English language was transcribed by myself using the help of a transcription software, Otter.ai. All other interviews (n=9) were transcribed outside of THL. I checked the transcriptions for possible mistakes by listening/watching the interview records again while simultaneously reading and editing the transcripts. Through this first step of checking and reading over the transcripts, I also familiarized myself with the whole data set. Based on the preparation phase of content analysis I chose each whole interview as an appropriate unit of analysis for my research (Elo & Kyngäs, 2008).

I started organizing the interview data by color coding by hand, using sematic codes to identify a realist and descriptive view of study participant's experiences and knowledge on VBD stakeholders and One Health-related themes in Finland. Interpretation of the data depended on the significance of the discovered data, rather than analyzing latent themes and hidden meaning from the data set. The three key steps in stakeholder analysis based on the ARDI method are the following (Etienne et al., 2011):

- Firstly, I determined the main stakeholders/actors ("A") of the current VBD stakeholder system in Finland based on stakeholders mentioned by the interviewees. I coded all stakeholders mentioned in the interview transcripts by highlighting them in blue. Based on these codes I formed a stakeholder table in Microsoft Office Excel. In the same table I also identified the sector and sub-sector that each stakeholder represented, as well as in which interview the stakeholder was mentioned. Stakeholder frequencies were also later calculated from this table to form a condensed results table of key stakeholders of VBDs and One Health networks in Finland. A detailed template of the Excel sheet used for stakeholder analysis can be found in Appendix 6.

- Secondly, I coded all interactions (“I”) between the identified actors in yellow highlights in order to produce a combined actor-interaction diagram of the key stakeholders and their connections identified during the study. For reporting the interactions between the key stakeholders in Finland, the help of a free online diagram tool, Draw.oi, was used to create a visual diagram of the findings. This diagram consisted of key stakeholders and their interactions derived from the interviews. In the diagram the interactions (“I”) between actors were presented as arrows from one actor to another and described with a verb (see details in figure 2 below).

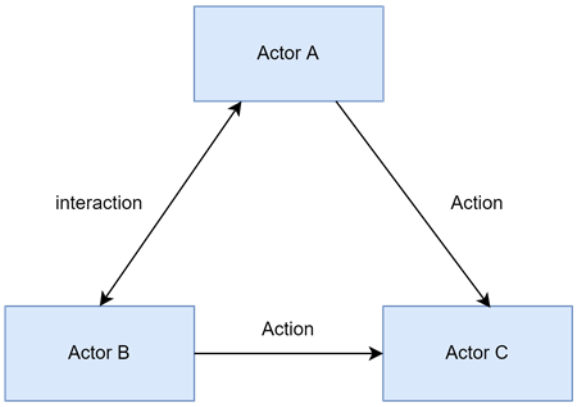


Figure 2. Theoretical visualization of an *Actor-Interaction diagram*

Actors are shown in blue colored rectangles. Interactions where both partners are active are represented with bidirectional arrows while action from one actor to another is shown with a normal arrow.

In this theoretical example "Actor A" and "Actor B" collaborate with each other. They also share a common collaborating partner "Actor C" whom they interact with.

- Thirdly, I coded all dynamics (“D”) in the transcripts in red and green, corresponding to challenges (red highlight) and promoting factors (green highlight) within actor collaboration and interaction. reporting of the final results.

After the initial coding, I read through the full interviews once again and continued the analyzing process by comparing and organizing the different codes I had composed under potential subcategories to further identify reoccurring patterns and potentially missing stakeholders. This was done by developing an analysis matrix (Elo & Kyngäs, 2008). Extracting of codes from the transcripts was done in a separate Microsoft Word file. If

missed, additional codes were derived from the transcripts during revision of the interviews based on the categories of the analysis matrix. These categories were: *(1) Interconnectedness of actors, (2) Missing stakeholders/neglect of private actors, social sciences and others, (3) Challenges for collaboration, (4) Perceived need for a VBD-network and promoting factors,* and (5) *Recommendations for a VBD network.* Codes and extracts under each subcategory were further grouped and categorized before conducting the final analysis.

4.6 Ethical considerations

4.6.1 Risks and benefits

There were no risks, damage or harm caused for the research participants, their families or other subjects involved in the research, nor the communities they presented. Participation to the study was completely voluntary. Complete anonymity could not be guaranteed to the study participants, because, in theory, one could be identified as a study participant by their field of VBD expertise in Finland, if one was already previously familiar with the subject. This is because Finland is a relatively small country and VBD experts are relatively scarce. Any harm (physical, mental, economic and social) was avoided.

The scientific value of the research is gaining novel information regarding VBD stakeholders, their interactions and VBD management in Finland. This new information significantly exceeds the non-existent risks and harms caused from the research, and the possibility of an individual study participant being recognized from the research report. No fiscal compensation was given for participation in the research.

This research clarifies the needs of a multisectoral vector-borne disease expert network in Finland. The information acquired from the research will help improve the research participants' work-life related to VBDs and data/knowledge sharing through enhanced VBD related collaboration in Finland. The novel research information obtained will possibly be beneficial to the larger community by addressing the growing issue of vector-borne diseases nationally and globally through enhancing of VBD research, management, surveillance, control and prevention in Finland.

4.6.2 Confidentiality and informed consent

Personal data was collected during the interviews for the purposes of scientific research. This information included the name (first and last), gender, professional position and the structure where the interviewee works. No special categories of personal data such as ethnicity or political opinions were collected. All personal data were processed responsibly and in accordance with the Finnish law and General Data Protection Regulation (GDPR) (Finnish National Board on Research Integrity, 2019). The Finnish institute for health and welfare acted as data controller for the study and was responsible for data protection.

We respected the privacy and confidentiality of all the study participants. Participants' names were not published in any final reports nor in any of the appendixes such as additional tables, graphs or questionnaires without separate consent. As already stated in the risks of the study, complete anonymity could not be guaranteed to any of the research participants, because in theory one could be identified by their field of VBD expertise in Finland.

All participants were clearly informed on the content of the research, processing of their personal data and their participation in the research (Finnish National Board on Research Integrity, 2019). Information sheets were sent by email to all invited participants prior to interviews. Pre-information also included contact information, research topic, information on the interviewing procedure and timing. We required an informed consent from all of the study participants for processing their data. We asked for both a written consent and oral confirmation. Oral confirmation for the research and recording of interviews were requested prior the start of the interview. All the interviewed participants attended the study on a voluntarily basis and they could refuse to participate if they wished so. A participant could also drop out of the study at any time during the research period if they requested so.

4.6.3 Ethical committee clearance

There was no need for a statement of an ethical board, nor a need for a clearance of an ethical committee, because the qualitative semi-structured interview research method

used did not intervene physical integrity or purpose any risks for the study participants, their families or the conducting researchers. All participation to the research was voluntary and based on informed consent. I did not ask any personally sensitive information during the interviews nor minors or persons with limited capacity for giving consent were interviewed. I have attempted to stay impartial, honest and open throughout the study process and upheld good research integrity. In accordance with the Finnish Constitution, I respected the dignity and autonomy of the study's human participants (Finnish National Board on Research Integrity, 2019).

5 RESULTS: DESCRIPTION AND ANALYSIS

This chapter presents in detail the data used and findings made in this research (sections 5.1-5.6). The interviewed stakeholders are presented in section 5.2, followed by a presentation of the identified key stakeholders related to VBDs and One Health in Finland (section 5.3). The full list of all potential actors is included in Appendix 7. In addition, the connections and interactions between the key stakeholders (section 5.4), challenges and hindering factors for stakeholder collaboration (section 5.5) and the perceived need and promoting factors for a VBD network in Finland (section 5.6) are also discussed. Sections 5.4 - 5.6 will include references from the stakeholder interviews to support findings.

5.1 Data documentation

The qualitative data in this research consists of 10 semi-structured VBD/OH stakeholder interviews of Finnish citizens collected between October 2021 - December 2021. The data consist of videos, audiotapes, interview transcripts (143 pages in total) and interview notes, conducted in Finnish and/or English languages. The expert interviews lasted between 36-85 minutes with an average duration of 56 minutes. The archived data may contain identifiers that have not been anonymized, however all published data has been anonymized. The dataset (D) is available by permission only from the data depositor/creator: THL, MOOD 2020 and Anniina Kyöttinen.

Five broad categories were identified from the analysis based on recurrent codes and subtopics in the dataset. These categories were:

Category 1. Professional domain, expertise, and knowledge of interviewed stakeholders
Category 2. Identified One Health and VBD stakeholders in Finland
Category 3. Connections and interactions between the key stakeholders in Finland
Category 4. Challenges and hindering factors for stakeholder collaboration
Category 5. Perceived Need and Promoting Factors for a VBD network in Finland

5.2 Category 1: Professional domain, expertise, and knowledge of interviewed stakeholders

Out of the 10 interviewed stakeholders, three were identified as medical doctors: two infectious diseases specialist and one specialist in clinical microbiology working mainly in research. In total, majority of those interviewed (n=9) declared conducting research at some level within their professional responsibilities. The stakeholders identified as researchers (n=6) specialized in fields such as: infectious diseases, virology, zoonoses virology, zoology, ecology, biology and animal health. One social scientist (ethnologist) was also included in the study pool. Five of the stakeholders were identified as being part of the same national research consortium, VECLIMIT: a vector-borne disease and climate change project funded by the Academy of Finland (1.1.2020 - 31.12.2023).

Half (n=5) of the interviewees expressed topics specifically related to ticks and tick-borne diseases to be part of their professional domain, while only one of the interviewed researchers reported working exclusively on mosquito borne diseases. One stakeholder implied working more broadly with several different VBDs, though four of the stakeholders mentioned zoonoses in general to be an important part of their work. These four actors included two veterinarians and two researchers in the domain of ecology and biology. Four stakeholders also mentioned One Health topics to be an important aspect of their jobs. In addition, an infectious diseases nurse and a leading doctor in a private medical company were contacted but never interviewed because they did not respond to the interview invitation.

Five of the interviewed stakeholders worked for Finnish universities, while three worked for different Finnish governmental agencies. Two of the stakeholders worked for a public hospital, one of which worked both for a human diagnostic laboratory and a national governmental network. In addition, one stakeholder worked also as an official contact person for one international agency, one in a private pharmacology company, and one was retired working currently as a free scholar. Also, one stakeholder was identified to be formerly working for a government ministry. All interviewed stakeholders could be attached to more than one institution. A detailed list of all the interviewed vector-borne

disease and One Health actors, their job titles, VBD related work themes, work institutions and field of research are listed in **Table 2** bellow.

Table 2. Interviewed VBD and One Health actors in Finland during 2021, grouped according to pseudonym, VBD related work themes, work institution and field of research.

pseudonym	VBD related work themes	work institution	field of research
1	TBDs (LB and TBE)	Public hospital	TBE and LB
2	TBDs (LB and TBE)	Finnish government agency Public hospital	yes, but not related to VBDs
3	VBDs virology One Health diagnostics	University Human diagnostic laboratory National governmental network	VBDs zoonotic virology laboratory methods
4	mosquitoes and mosquito-borne viral diseases	University	Mosquito-borne diseases
5	agricultural industry rodent ecology zoonoses VBD host animal ecology	Finnish government agency	rodent and game animal ecology
6	imminent infectious diseases One Health zoonoses	University	emerging infectious diseases zoonotic diseases viruses
7	TBDs and tick ecology rodent/European mole diseases and ecology	Retired	TBDs and tick ecology rodent ecology
8	human animal studies critical animal studies	University	humans and ticks in the Anthropocene (the relation of ticks, humans, and pets)
9	risk assessment zoonoses animal health One Health	National research network Finnish government agency International agency	NA
10	zoonoses One Health ticks and animals	Private pharmacology company University formerly: Government ministry Finnish government agency	zoonotic diseases among veterinarians, microbiology

5.3 Category 2: Identified One Health and VBD stakeholders in Finland

5.3.1 All potential direct and indirect stakeholders

Based on the 10 semi-structured interviews, a total of n=139 different stakeholders were identified from the interview transcripts. These stakeholders were categorized into five

different sectors: health care, research, expertise agencies, ministries/policy makers and other collaborating actors. Each sector was further divided into sub-sectors such as different medical professions, national authorities, regional or international networks, associations, and NGO's. Table 3 summarizes the potential direct and indirect VBD and One Health stakeholders identified from the interviews, based on the ARDI method, and presents their categorization in different sectors and sub-sectors. The full list of all potential direct and indirect VBD/OH stakeholders in Finland divided into sectors, subsector and number of interviews in which each stakeholder was referenced to, can be found in Appendix 7.

Table 3. ARDI stage 1: condensed list of all identified potential direct and indirect VBD and One Health stakeholders in Finland, categorized into five main sectors and further sub-sectors.

Sector	**Sub-sector**	**Stakeholder examples***
Health care	Medical specialists and clinical physicians Medical students/veterinary students Veterinarians Pharmacists Physiotherapists	Medical specialists in travel medicine, clinical microbiology, infectious diseases, epidemiology
	National authorities	The Centre for Military Medicine
	Regional hospital districts University hospitals Central hospitals Foreign hospitals	HUS HUS Helsinki University Hospital, Turku University hospital, Åland central hospital
	Public wild animal hospital	Korkeasaari ZOO wild animal hospital
	Primary health care centers Private healthcare clinics Private veterinary clinics National occupational healthcare	
	Human and animal diagnostics laboratories	HUS Diagnostic Center/HUSLAB Turku University hospital laboratory THL laboratory Movet Oy, IDEXX laboratories Oy, Patovet ay
	Private pharmaceutical and diagnostics companies	
	Patients	
	Professional associations	The Finnish Medical Association (FMA) The Finnish Veterinary Association The Finnish Medical Society Duodecim
	Scientific associations	Animal Health ETT
	NGO's	

	Regional networks	The Finnish Biosecurity Network Unofficial social media networks Åland, Turku, Helsinki tick-borne infections network (unofficial)
	International networks	The Nordic−Baltic Veterinary Contingency Group (NBVCG)
Research	Researchers Research assistants Students and student trainees Free scholars International researchers	Virologists, Biologists, ecologists, Entomologists, Parasitologists, Microbiologists, Geographers, Bioinformaticians, Zoologists, Wildlife parasitologists, Ethnologists, Environment historians, social scientists, anthropologists, immunologists
	Universities	University of Turku, university of Helsinki, Åbo Akademi
	University professors	
	University research organizations	
	International universities	National zoonoses research organization Linköping's University, Uppsala University, Jönköping University, University of Liverpool
	International research projects	NorthTick, Horizon 2020, VEO
	Scientific conferences	
	Scientific associations	The NordTick Finnish Society for Study of Infectious Diseases, Finnish Epidemiology Society (FES)
	Scientific non-profit associations	The Finnish Literature Society (SKS), Svenska litteratursällskapet i Finland r.f.
	National and regional research networks	Åland Group for Borrelia Research (ÅGBR) Helsinki One Health, One Health Finland, VECLIMIT research consortium, Turku Human-Animal studies Network (TYKE)
	Scientific publishers/papers	
Expertise agencies	Government agencies	Finnish institute for health and welfare (THL), Finnish Food Authority, Natural Resources Institute Finland (LUKE), Finnish Environment Institute, Finnish Meteorological Institute, The Finnish Wildlife Agency, Statistics Finland
	Independent agencies	Finnish Institute of Occupational Health
	International agencies	World Health Organization (WHO), ECDC, European Food Safety Authority, World Veterinary Association (WVA), The World Small Animal Veterinary Association (WSAVA)
	National research networks	Finnish Zoonosis Centre
	National governmental networks	The Centre for Biothreat Preparedness (BUOS)

	International networks	Emerging Viral Diseases-Expert Laboratory Network (EVD-LabNet)
Ministries/ policymakers	Government ministries	Ministry of Social Affairs and Health, Ministry of Agriculture and Forestry, The Ministry of Defense
	Government agencies	Social welfare and health care delegation of emergency conditions (PONK)
	Government officials	Politicians/decision makers/civil servants
	Regional networks	Health security steering group
Other collaborating actors	National authorities	Finnish Defensive Forces
	Communities	The general public, and pet owners, huntsmen
	International networks	The Nordic Council, Nordic ethnologist Facebook-group
	Private and public businesses	Agricultural industry and animal producers, Pet stores
	Media/journalists	The Finnish media
	Funders	Academy of Finland, Jane and Aatos Erkko Foundation, Government research funding initiatives, European Union

* Full list of categorized stakeholders is presented in Appendix 7.

5.3.2 Key stakeholders

Since there were several stakeholders identified with minimal influence or role in the system based on the ARDI method, a group 20 key stakeholders, directly and indirectly related to VBDs and One Health in Finland were identified from the transcripts. If a stakeholder was mentioned in half or more of the individual interviews, it was named as a key stakeholder. These stakeholders were then categorized by sector (health care, research, expertise agencies, ministries/policy makers and other collaborating actors), their domain in One Health (human health, animal health, ecology and other) and the number of interviews each stakeholder was referenced to. Table 4 presents these findings in detail.

Table 4. Key VBD and One Health stakeholders in Finland, categorized by sector, domain in One Health and the number of interviews each stakeholder was referenced to.

Sector	Key stakeholders	Domain in One Health				Number of times referenced to
		human health	animal health	ecology	other	
Research	Other Finnish researchers	X	X	X	X	10
	Individual key researcher 1	X	X	X		8
	University of Helsinki	X	X			8
	VECLIMIT research consortium	X	X	X		7
	University of Turku			X	X	7
	Ecology researchers			X		6
	Joint EU-projects	X	X	X		5
	University of Jyväskylä			X		5
	Individual key researcher 2	X	X	X		5
	International researchers	X	X	X		5
Health care	Human diagnostics laboratories	X				7
	Other clinical physicians	X				6
	Veterinarians		X			6
	Infectious diseases doctors	X				5
	Patients	X				5
Expertise agencies	Finnish institute for health and welfare (THL)	X				9
	Finnish Food Authority	X	X			7
	Natural Resources Institute Finland (LUKE)		X	X		6
Other collaborating actors	The general public	X				7
	The Finnish media				X	6

Analysis revealed the presence of 10 different stakeholders in the research category, five in health care, three among expertise agencies and two in other collaborating actors. In the biggest sector, *research*, there were some similar stakeholders present in the category which could be later combined to form a general pool of researchers from different fields and levels. These stakeholders included the most referred to stakeholder group of other Finnish researchers (n=10), in addition to ecologists (n=6), international researchers (n=5) and two individual researchers who were mentioned 8 times, as well as 5 times as

key experts in the field of VBDs and One Health. The University of Helsinki (n=8), Turku (n=7) and Jyväskylä (n=5) were the most mentioned Finnish universities. In addition, the VECLIMIT research consortium, a national research network, was mentioned by 7 interviewees. Joint EU-projects such as the H2020 VEO (Versatile Emerging infectious disease Observatory), EDEN and EDEN next were also identified in half (n=5) of the transcripts.

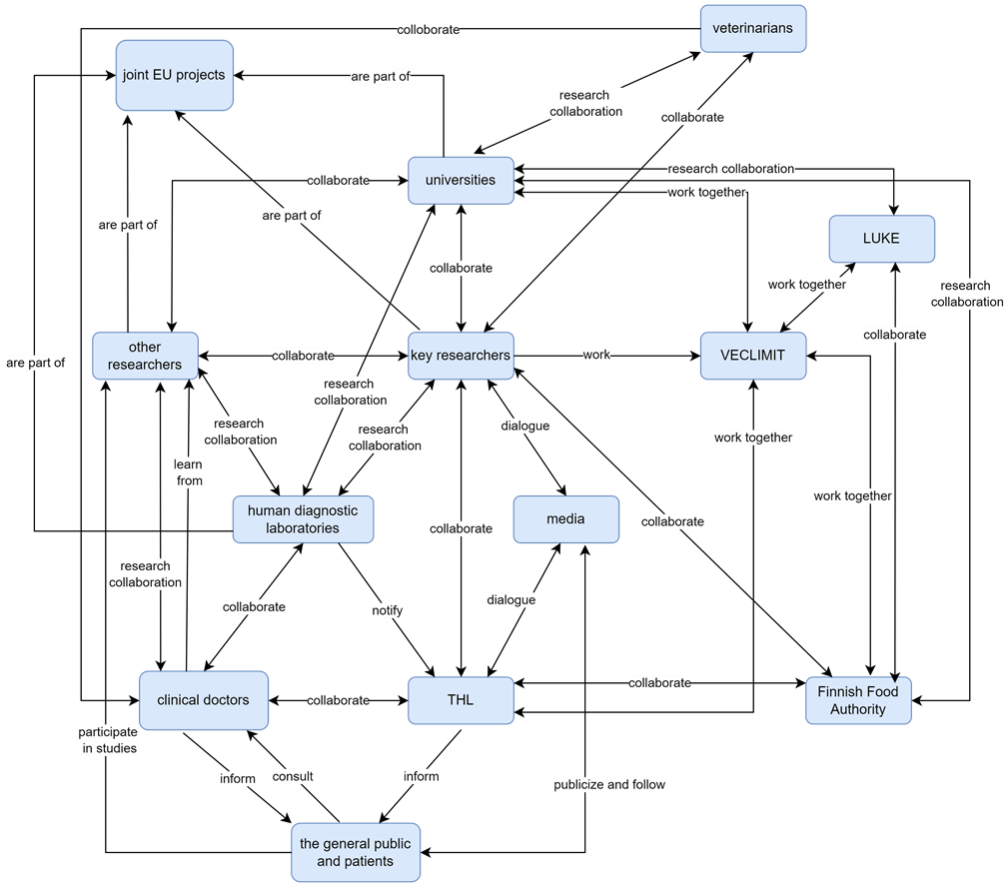
Among the health care sector, key stakeholders identified were medical specialist and more specifically clinical physicians and infectious diseases doctors (n=5). Veterinarians (n=6) were also identified as an important group as well as the most referenced human diagnostics laboratories (n=7), and patients (n=5). Concerning government agencies, The Finnish Institute of Welfare was identified in all but one interview (n=9), making it a key stakeholder in the group of expertise agencies. The Finnish Food Authority and the Natural Resources Institute Finland (LUKE) were also mentioned by several of the interviewees. These are the only actors in the list who have a direct role in national decision-making regarding VBDs and their surveillance. The general public was referenced in 7 interviews, while the Finnish media in general was mentioned in 6 interviews, being further identified as other collaborating actors. In total, out of the 20 key actors, 14 represented human health and animal health and ecology were each represented by 10 key actors, while 3 key actors represented other domains, such as social sciences and humanities. Hence from a One Health point of view, the identified VBD stakeholders in Finland broadly represented the field of human, animal and environmental health (in this case specifically ecology), while other fields of study were vastly underrepresented.

5.4 Category 3: Connections and interactions between the key stakeholders in Finland

The interconnections between the different key stakeholders in the VBD/OH system in Finland were analyzed based on the full interview transcripts. Using the ARDI method, a detailed Actor-Interaction diagram demonstrating all the interactions mentioned by the key stakeholders (key researchers, other researchers, veterinarians, clinical doctors, patients and the general public, human diagnostic laboratories, universities, media, THL,

LUKE, Finnish Food Authority, joint EU projects and VECLIMIT) was constructed and is presented in Figure 2. Based on further content analysis, special characteristics of VBD and One Health stakeholder interactions in Finland were explored. The observed recurring patterns were: personal connections in network formation, research-oriented networks, and the neglect of actors, such as private businesses, in stakeholder networks.

Figure 2. ARDI stage two: Detailed Actor-Interactions-diagram representing the interconnectedness of key VBD and One Health stakeholders in Finland during 2022. Actors are shown in blue colored rectangles while the arrows between the actors represent and describe interactions. Dual-ended arrows represent a bi-lateral, mutual interaction, whereas single arrows indicate a unidirectional action.



5.4.1 Personal connections in network formation

On enquiring about the connections and interactions between the different stakeholders in Finland, most of the actors stressed that networks are built up based on unofficial personal connections, such as between current and former colleagues, and by knowing the right people, which is shown in the following interview extracts. Networks were described to form in a snowball manner by first knowing one person who, in turn, knows someone, and so on and so forth. Analysis also revealed that individual actors were mostly interacting with other individual persons, more easily with those whom they already knew, rather than actors interacting at an institutional level through official groups or institutions. In addition, VBD and One Health collaboration and networks seem to be built around few individual key experts in Finland, who were mostly identified as key researchers in Finnish universities.

"They [interactions] always start that way, that someone knows someone who knows someone… and they are a bit like collaborative networks that are built up little by little. There is very little, really not at all, that you would just go looking to see if someone has done this kind of research, it's actually quite interesting how these are built up through friends of friends of friends (. . . .) "(respondent 6)

"I know that there has been cooperation with THL for a long time, but here we come to the fact that they are somehow personal connections, which must be there for it to work. I have also worked with [removed person name] for a long time, so from there I joined those networks. So, he has personally built them over the years, that is perhaps the special thing here, that it is very individualized from the sense, that those networks exist or are personified to only certain people." (respondent 6)

5.4.2 Research oriented collaboration and networks

Based on the stakeholder interviews, collaboration, interactions and identifiable networks between the different VBD and One Health actors were discovered to be mainly related to research activities. Nine out of the ten interviewed stakeholders brought up having stakeholder interactions related to different research projects which they were part of. The Finnish VECLIMIT project and joint EU projects such as the H2020 VEO were especially mentioned, as stated by respondent 7 bellow. Based on the analysis it seems that collaboration between the different One Health fields and VBD actors in Finland is currently established around individual researchers and research projects with external funding, which is indicated in the extracts bellow. In conclusion, VBD research

collaboration in Finland is active, but other forms of official collaboration are substantially less lively at present.

"There is little activity and it is not that established. It has been based on research projects, or individual researchers and often on research grants or other things those individual researchers get. It [collaboration] is not maintained by society and in that way continuous." (respondent 9)

"Most of this communication and interaction probably takes place within the framework of these individual research projects and with their topics, so there may not be much wider discussion outside of these projects." (respondent 5)

"For example, this climate change and vector-borne diseases project [VECLIMIT] led by [name removed], that there is already quite a network." (respondent 7)

5.4.3 Neglected actors in stakeholder networks

Based on the interviews key stakeholders', collaboration with private sector actors is very limited. Researchers at Helsinki University reported to collaborate with private pharmaceutical companies related to diagnostics and vaccine development, in addition to some other individual projects. TBE vaccine companies and private actors distributing the vaccinations were some of the private actors mentioned. Based on analysis, THL and other governmental agencies in Finland do not currently collaborate with private actors in Finland. One of the interviewees specifically emphasized the neglect of private actors, as well as the neglect of other actors such as independent agencies, NGOs, professional and scientific associations, and foundations among VBD discussion in Finland, which is further highlighted in the following extracts. All mentioned private actors and other neglected stakeholders can be found in the full list of VBD and One Health stakeholders in Finland, in Appendix 7.

"When I listed what should be in it [potential VBD network] and whose land it is related to in some way, private companies are one, which might be forgotten by the authorities, also by me when I was a civil servant for eight years. That how much expertise and perspectives can be found there, both pharmaceutical companies and veterinary companies." (respondent 10)

"I see that this field [VBDs] is very large and we don't always think of them all [actors]. These governmental research institutes and universities are quite easily involved, but then what is the role of private companies and these associations and business life in general and their links to international networks, maybe this should be underlined more." (respondent 10)

Other concerns expressed by some of the interviewed stakeholders, were the neglect of cooperation with other fields of study, apart from human and animal health. Lack of interdisciplinarity and the lack of human, cultural, and social cooperation and VBD studies in Finland and globally was brought up. Two of the interviewed stakeholders discussed the importance of understanding human activity and mindset related to vector-borne diseases and their management. In addition, actors from the field of ecology specifically emphasized the neglect of wild animal disease ecology compared to domestic and farm animal disease studies in Finland. The stakeholder comments below further illustrate these findings.

"And this is fine in a way that veterinary medicine and human medicine… but maybe what really, when we speak about this kind of disease ecology, where then these are understood to a T, such actors as biology, ecology and this type are particularly important. Easily maybe these can be a bit neglected there." (respondent 3)

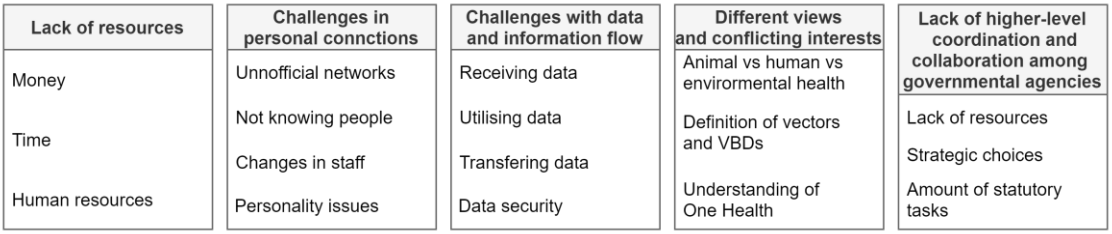
"If we think about it on a very practical level, we have great natural science and clinical research. – In other words, at the university level there is the natural science and medical research, but then what about all the rest? However, ticks and certainly others [vectors] too if we talk more generally about vector-borne diseases. Then okay, it's one thing that we understand their origins and mechanisms and how they can be prevented or how they can be treated. But then, nevertheless, at the very practical level how do people act in the end. Do they vaccinate themselves against TBE or do they protect themselves against ticks or how do they for example react to mosquitoes?" (respondent 8)

In addition, stakeholders with potentially an important role in the VBD/OH scene in Finland, which were very seldomly mentioned in the expert interviews as collaborating actors, were for example: scientific associations and international research institutes, pharmacists, animal diagnostic laboratories, the national occupational health care, independent national and international agencies and national authorities. In this research, actors from the sector of Ministries and policymakers, did not reach the status of key stakeholders at all.

5.5 Category 4: Challenges and hindering factors for stakeholder collaboration

Based on the interviews a number of issues were identified to cause challenges for stakeholder collaboration. The five subcategories emerging from analysis were: lack of resources, challenges in personal connections, challenges with data and information flow, different views and conflicting interests, and lack of higher-level coordination and collaboration among governmental actors. The factors identified to cause challenges for stakeholder collaboration are presented in Figure 3 and discussed in text in more detail.

Figure 3. Five main factors and sub-factors causing challenges for stakeholder collaboration



5.5.1 Lack of resources

When inquired about challenges in stakeholder collaboration and factors preventing collaboration between different actors, all of the ten interviewed actors reported the general lack of resources having a negative effect on stakeholder collaboration. Allocation of resources, lack of money and research funding and the shortage of time were generally reported. Several actors were working with multiple topics, also ones not related to VBDs, so having enough time at hand seemed to be a general problem. Research application processes were also mentioned to be very time consuming and causing a heavy workload.

"Simply put, money always determines how much and what can be done." (respondent 3)

"Whether you get funding, or whether you have to do it [VBD research] alongside other work activities and as a hobby, is a completely different matter." (respondent 10)

"The use of time and what you can do in the end. That is perhaps the biggest challenge. Always, of course, when starting a research project and even writing a project application, they are laborious processes. It requires quite a lot of work and dedication, and yet everyone is really busy in their own ways, so it's definitely a challenge." (respondent 8)

In addition, the lack of human resources and expertise were also seen as factors reducing the possibilities of stakeholder collaboration, the possibility to attend multisectoral VBD and One Health projects and to conduct research. Specifically, there was a reported lack of resources, including VBD experts nationally at higher level institutions such as THL and The Finnish Food authority, in addition to a reported specific lack of research entomologists in Finland related to vector surveillance. Generally, the SARS-Cov-2 pandemic was also mentioned several times as one of the main limiting factors, causing declined resources in epidemiologic expertise, surveillance, and treatment of all other infectious diseases, including VBDs.

"Unfortunately, I'm also very aware of that right now, we are lacking enough experts here. We definitely need at least one more national expert of vector borne diseases, here at the Institute [THL]." (respondent 2)

"We would like to do collaboration with the Finnish Food Agency, there we maybe run into a problem, that they have very little time and resources for research (. . .) even the Food Agency, they would just need more resources in order to have time for something else than doing their statutory tasks." (respondent 6)

"In Finland, the actual entomological know-how is perhaps lacking at the moment (. . .) that it is in the examination and screening of mosquito materials. And in a way, if you want to do something like [vector] surveillance type of things, it is often such a bottleneck." (respondent 4)

5.5.2 Challenges in personal connections

Since stakeholder interactions and being able to collaborate with other actors relies heavily on personal connections, several of the interviewed actors brought up, that not knowing the right people was an issue for building more interactions with different actors. The networks between actors were mostly unformal, hence long-lasting cooperation was in some cases difficult to maintain. Staff changes and retirements could end up ceasing previously formed collaboration between actors. Though, mostly actors felt that it was easy to interact with other stakeholders and people were generally seen willing to participate in collaborating activities, if asked. Still, some felt that personality factors could also have a severe negative impact on building collaborations if a person was seen as difficult to work and interact with. In addition, the SARS-Cov-2 pandemic was

reported to have limited the possibilities to meet face-to-face, which in many cases was seen as something pivotal for proper interactions and collaborations to form between actors.

"Well, maybe the side of The Finnish Food Authority has perhaps been a bit left behind, maybe it's just the fact that I personally don't know those people there now, so I don't have such good connections there." (respondent 4)

"I don't know about these more leading people at THL, I don't know exactly who is there anymore, since the staff has changed. I don't know any more who is there and who have already retired." (respondent 7)

"Mostly, they are based on the personal connections of individual researchers or research projects. Having a unifying idea of where the expertise is in all these different parties... it has been a bit difficult to find." (respondent 9)

5.5.3 Challenges with data and information flow

Interviewed stakeholders reported some difficulties in receiving, using, and transferring different data between stakeholders regarding VBDs. Researchers working with patient samples were especially frustrated with the tough and bureaucratic process of receiving samples from human diagnostic laboratories and data from national registries, for research use. Data security processes were seen as slow and sometimes even preventing research from happening. In addition, there was a lack of knowledge of the potential existing data and projects, which stakeholders saw could also be beneficial for their field of work regarding VBDs. Some differences in data collection methods, different platforms and ways of reporting data were also mentioned to cause minor issues in collaboration between different stakeholders and institutions.

"And then what has sometimes been a problem, but luckily that problem has been reduced a little with these joint projects, that there are different projects and not everyone really knows what the others are doing." (respondent 7)

"Out there is some other research, but that project also produces [as a by-product] other information. Understanding that maybe something else is born from this and finding that connection can be challenging as well." (respondent 9)

"But what I think has become more difficult and is becoming more difficult all the time. It is the siloing of these data protection matters, the merging of registers. (. . .) [Data] from the infectious disease register, which can then finally be combined with these sequences. So, it's absolutely insanely difficult, this license circus is partly within institutions and especially between institutions, so that HUS and THL can share some information. It's heavy, slow and expensive, and above all, stupid. In my opinion that's the biggest problem here. I know for a fact that research is not done because this is so difficult." (respondent 3)

5.5.4 Different views and conflicting interests

The identified key stakeholders seemed to have different interests and priorities concerning VBDs and One Health. Apart from the general division of actors to animal, human and environmental health, some stakeholders were more interested in the health of pets rather than farm animals or wildlife, human health and hospital capacity, medicines and vaccines, fighting disease or doing risk assessment. This conflict in interests was brought up by the interviewees as something possibly complicating cooperation and networking between stakeholders, if one actor is more eager to work on the topic than another because of the varying goals. Different viewpoints were not only seen as something negative, though often they were recognized as an important factor which might cause challenges in collaboration. The interviewed stakeholders also expressed varying views of what is fundamentally seen as a vector-borne disease and what can be counted as a vector.

"Here, right away, we need to define what is vector mediated. There really is a bit of variation here. Some people think that vectors are only arthropod insects, mosquitoes, ticks, fireflies, and the like. But more widely it might be understood that also these kinds of animals, small mammals, etc. rodents, bats that transmit, perhaps belong to this same category. "(respondent 3)

"However, on the veterinary side, the priority is in those animal diseases and easily contagious diseases, which can be seen important to animal production and the preservation of food security and self-sufficiency and the economy of the entire sector, and they are not necessarily zoonoses. On the other hand, the zoonosis side can be largely such, that they are much more dependent on the ecological changes including these vector populations and the changes of host populations, which we have to react in some way, and we cannot influence them. In that sense, perhaps the perspectives and things that are sought and searched for are different... the fact some common interests are definitely found, not everyone may have the same interest. (. . .) Finding that compromise or where the cooperation would be most beneficial for everyone may be the most the most challenging thing to find." (respondent 9)

The same comprehension difference of the key definitions and topics applied to the understanding of the stakeholders concerning the broader One Health approach. In general, the One Health approach and its importance to the management and control of VBDs was better known among animal health and ecology stakeholders, than actors in the field of human health. In human health the One Health approach was mostly understood as a tool or concept used for the prevention of antimicrobial resistance. Some of the stakeholders also brought up the lack of knowledge around the One Health topic among politicians, decision makers and the general public, complicating a broader discussion of the One Health approach and how to utilize it for managing VBDs.

"Well, at the Faculty of Veterinary Medicine, One Health is a familiar concept to everyone and everything... it's an essential part and everyone knows it, but when I'm coming here to the human medicine side, I have to remember to start by telling what One Health is. There's still a lot to do here on the medical side to make One Health familiar." (respondent 6)

"From the ordinary persons side and I think also for politicians, it's difficult to immediately understand what it [One Health] means. Everyone can understand it in their own way, but if you went to the parliament and asked what One Health means, I would think that half of the politicians would be mouth open." (respondent 7)

5.5.5 Lack of higher-level coordination and collaboration among governmental agencies

Currently there seems to be a lack of national higher-level coordination and lack of collaboration among Finnish governmental agencies and other stakeholders, reported by the lower-level stakeholders themselves. This was explained by the higher-level stakeholders, to be caused by the lack of resources and strategic choices made, based on what is seen as important in society at the moment. Two out of three of the listed expert agencies, The Finnish Food Authority and LUKE, brought up their renewed strategies to be part of the issue, where VBD topics are not currently seen as their topmost priority. For THL this information was not available from the interview transcripts. Also, a broader national zoonotic strategy and its priorities were brought up. Statutory tasks with other national agencies were prioritized, leading to less time and resources for activities and cooperation with lower-level stakeholders regarding VBDs.

"Be as it may, that model of One Health, the strategy that has been built, quite a lot of those resources have perhaps been transferred from these activities to others... everything else has come into society since then, hence little thought has been given to it. They are so well in hand, maybe somewhat with that illusion, that it was no longer possible to invest in them in the same way, rather sometime in the early 2000s, when those strategies [zoonotic strategy] were made." (respondent 9)

"But that kind of thing [coordinating joint VBD related projects] is unlikely to be possible anymore based on Luke's new strategic approach. (. . .) perhaps this was not perceived as important in Luke's strategy. "(respondent 5)

5.6 Category 5: Perceived need and promoting factors for a VBD network in Finland

A variety of perspectives were expressed when discussing the formation of a potential VBD/OH network in Finland. To assess the need for a network and the factors to promoting it, the interviewed stakeholders' perceptions were further analyzed. Four broad subcategories were identified based on the responses: (1) a need for multisectoral collaboration and higher-level coordination, (2) need for enhanced data management and information sharing, (3) need for vector surveillance and enhanced preparedness for future risks, and (4) other promoting factors. Stakeholders also provided important personal recommendations for the possible future VBD/OH network.

5.6.1 Need for multisectoral stakeholder collaboration and higher-level coordination

Each of the ten interviewed stakeholders emphasized the need for multisectoral collaboration regarding the management, control, surveillance, and treatment of VBDs. When asked about forming an official VBD/OH network to Finland, the ten participants were unanimous in the opinion that the network would be a good idea and could work as a possible solution to enhance the collaboration between VBD and OH actors in Finland, suggesting that the new network would be able to group all related actors from different fields and levels (from research to administration) related or interested in the topic of VBDs. All actors (n=10) supported the idea of forming an official network to Finland, if it was broad and interdisciplinary enough, instead of being exclusive to only a few. In this regard, one interviewee discussed problems regarding the current Zoonotic center having a too narrow point of view, which should be avoided if an official VBDs group were to be formed. Another interviewee expressed that it could be beneficial to broaden the network to include zoonoses in general, rather than only having a network for VBD experts, while one respondent defined the network between wildlife zoonosis and domestic zoonoses.

"And on the other hand, what's funny about these vector-borne diseases is that they are very multidisciplinary, that no field can cover alone everything there is to be done. That in short, absolutely, it would be useful to bring this group together on a larger scale." (respondent 3)

"Well, the only thing is that it [potential VBD network] is so extensive that it would include administration, so not only researchers, but people related to the administration of zoonosis research. I feel it's important that all is said. We have some fields where there are not many people doing research, but they can do high-quality research in them. So, not to forget them. So, it's comprehensive then. That we will find out exactly what is being done and all these important sectors would be involved in it at some level." (respondent 7)

"Yes, if care is taken to avoid the same problem as with the Zoonosis Centre. In other words, that it would not be just a coalition of research of those [zoonotic] diseases, but the whole thing would be viewed holistically. It would be necessary to also study the ecology of the vectors and the factors affecting the distribution and abundance of vectors, which most often are the host species of the vector. If so, yes for sure." (respondent 7)

"Well, I would actually see it more broadly, in my opinion it [potential VBD network] should then include the whole zoonosis, that there then as one part would be vector-borne diseases. In the end, we are such a small country and so many people do the whole zoonosis work, that in the same process all zoonoses would go, then as subdivided sector could be these vector-borne [diseases]." (respondent 6)

Higher level coordination of the potential VBD network was suggested so that connections between actors would no longer be strictly reliable on personal relations. It was hoped that if there was an official organizing body, the network would be able to gather more resources and funding and to have more power in it. One of the interviewed stakeholders suggested THL for this organizing task. Attendance of higher-level actors and administrators in the potential network were also proposed for more effective implementation of research information to actual actions. Since some unofficial networks/groups related to VBDs already existed (VECLIMIT and unofficial Åland, Turku, Helsinki tick-borne infections network), these were also seen by the interviewed stakeholders as something which could be useful as a base for forming an official network. In addition, it was expected by the stakeholders that a well-coordinated official VBD network would be able to efficiently gather knowledge and resources together and help relevant stakeholders to better know who does what in relation to VBDs in Finland, and hence enhance stakeholder collaboration.

"If there was a clear network, that would not depend only on individual people's willingness to cooperate, their ability to cooperate, and their own interests." (respondent 10)

"That's why if it could be a national network about vector borne diseases, it may be easier if it could be created from THL, then maybe we could have some money also otherwise it's really not easy, how do you get the money for those meetings, okay on teams it's for free absolutely but if you would make a workshop or-, another things that are needed, then I think you need to have somebody else in the group too and that's what they did in Norway, they have a platform but they get funding from the government so that's much easier if you have a platform like that." (respondent 1)

"If there would be some kind of coordinated central network, which would contribute to the fact that those who need to know, also know, what is being done in Finland. (. . .) If it [VECLIMIT] could be formalized and expanded in the direction, let's say the administrative side related to the vector disease work would also be included in this network. That the information from the research would then also go to the administration and thus into practice." (respondent 7)

5.6.2 Need for enhanced data management and information sharing

Apart from the need to gather all the relevant stakeholders together in one network to strengthen interactions and resource use, the interviewed stakeholders also emphasized the need for an official VBD network to enhance data management and information sharing related to vectors and VBDs. The potential network was seen as a channel for sharing experiences and knowledge, in addition to sharing research results and data. This was noted as particularly important since academic publishing was perceived as slow in contrast to the need for rapid sharing of data, observations, and different signals between VBD experts in real-time. Additionally, the potential network was suggested as a place for pitching new research ideas and funding applications.

"We learn from each other, that's also the fact that we get to know the research that is done in different fields, and we also get to know the researchers. And then also the dialogue and reciprocity, which is really important. That we wouldn't just do the research that is interesting to us in our own research chambers. But (we would) share it especially more widely." (respondent 8)

"Already the fact that if these meetings were organized more regularly, it would bring people together and it would be better known what research is going on and from those [research] results a little context for what others and myself are doing. (. . .) It would be necessary also to know, what data there is in general. There may be certain variables affecting these vector-borne diseases somewhere, data collected somewhere, that is not necessarily known about." (respondent 3)

"It would be really important, that we could communicate about our research results even before they were published as a scientific publication, (. . .) isn't it funny that science and official bodies haven't talked to each other so directly before. There would definitely be [information] and we would gladly share our information to support decision-making and operations even before it is in the form of a publication. In the end it is a slow process, the academic publishing process that is (. . . .)" (respondent 6)

The potential VBD network was also identified as an important operator for combining together the currently separate and siloed data and knowledge on VBDs in Finland to: gain a better understanding of what is currently done in Finland, put to best plausible use the already existing data, and to promote concrete actions in society. Several of the interviewed stakeholders also mentioned the network could potentially have an important role in VBDs data and knowledge sharing to the media and the general public in an

comprehensible way, rather than only spreading scientific knowledge to experts in the field. Furthermore, the two interviewed clinical doctors pictured that the official VBD network could be used for preparing and producing currently lacking official clinical guidelines, especially for Lyme disease treatment and diagnostics, at a national level.

"The goal would be to be able to combine all the scraps of knowledge together and thereby to use the best possible understanding socially and especially to those preventive measures, maybe apply them as well in that sense. (. . .) Creating an overall picture and a map, so maybe this would be some division of labor point of view, so it would probably be good to have such a network." (respondent 9)

"An important part of this kind of network's operation, apart from research, science, and observations, would be also the raising of better knowledge and awareness. Especially nowadays, it is emphasized a lot. Not all social media experts are experts." (respondent 6)

5.6.3 Need for vector surveillance and enhanced preparedness for future risks

In addition to the general need of real-time information sharing, four of the interviewed stakeholders explicitly discussed the importance of an official VBD network for enhanced vector and VBD surveillance and risk preparedness when enquiring about the need for collaboration. Stakeholders felt that preventive actions and preparedness were essential for effective management of VBDs and well-known interactions and collaborations through an official network would promote preparedness for future risks such as climate change and the emergence of novel VBDs and vectors in Finland.

"Well, I see that we have to be prepared for the fact that vector-borne diseases will spread in Finland, both in animals and in humans, and will cause more and more disease, and we will be threatened in the future by novel mosquito species that will come here first, but then there are also new tick species that are coming to Finland, because of climate change. We should have such an operating model ready, that we have surveillance both in patients, animals, and to some extent also in those ticks or mosquitoes. There must be that monitoring, and that information is shared and reacted to, if something new starts to be seen. This kind of thing cannot be done without such a cooperation network." (respondent 6)

"I would see it as a kind of preparation for those future scenarios and the like, so that if something new appears or some old, familiar disease starts to become more common, it still requires action and may require agile movements even from the diagnostic laboratory to keep up with it. (. . .) So in a way, there are aspects that, if there was such a network of actors, who would meet now in a peaceful time, maybe only once a year and update what is up. So, it would still exist then, if something were to happen, you wouldn't spend much time wondering." (respondent 4)

5.6.4 Other promoting factors

Other identified promoting factors for forming an official VBDs network to Finland were the clear interest and enthusiasm from the interviewees to join a novel expert network, and the reported eagerness of other stakeholders to connect and attend unofficial collaborations. In addition, the current Finnish zoonotic strategy from 2013-2017, for the Minster of Social Affairs and Health and Ministry of Agriculture and Forestry in Finland, promotes multisectoral collaboration of different stakeholders in the prevention of zoonotic diseases in Finland. In addition to the COVID-19 pandemic, making the topic of infectious diseases, One Health and multisectoral collaboration even more topical than ever before.

"This is one of the tasks for which there is a clear regulation in the Zoonosis Centre's regulation. It specifies that the task of the Zoonosis Center is to ensure that experts in human health, animal health, and food safety cooperate, and then it specifies what the issues are, what the cooperation is for, and who are those that do both the risk management work and the risk assessment work. (. . .) Behind it is the EU zoonosis directive." (respondent 9)

"I feel that at the moment there is more need and opportunity for it [One Health] than ever, thanks to Covid, now it interests why we have new infectious diseases, where they come from and where they spread from. And now there is an opportunity to speak for environmental health, because I see it as a really important issue if we want to ensure the health of people and animals, now if ever we have to take care of the health of the environment." (respondent 6)

5.6.5 Stakeholders' recommendation for a network

Each of the interviewed stakeholders (n=10) made some concrete recommendations on how to develop and operate a potential network in the local Finnish context. Yearly meetings were most often suggested to be a sufficient interval for getting people together face to face. Some ad hoc meetings were also suggested if something interesting or of great importance would occur in between. One of the stakeholders also emphasized the need of more frequent meetings in the beginning for the core organizing of the group within the network. It was then suggested that the network would be divided into different working groups according to topic. Another stakeholder presented the idea of a student/PhD section within the network, to enhance collaboration of people in the early phases of their careers.

“An annual meeting in itself might be more reasonable. But probably in the beginning, when this is to be planned, then of course there should be a little closer pace of these kind of gatherings. That's it, but this way, when there are meetings for a large group, it cannot be more rarely than once a year.” (respondent 3)

“But probably such, on the one hand, ad hoc meetings when there are some emergent-type things or so, or on the other hand, some working groups.” (respondent 3)

“If this vector network is meant to be formed in Finland, then this kind of study, a post-graduate study section, could be involved in some way. So, that the future researchers of the field who are doing their dissertation can get to know each other at an early stage. That way they know what other guys are doing, and then at a later stage all this kind of knowledge, the already existing cooperation can help in all matters. Regardless, if they will become researchers, administrators or whatever, but they know the groups, the industry, and that is important.” (respondent 7)

Stakeholders mostly wished for live and/or remote meetings, workshops, webinars, small conferences and seminars. A group dinner (n=1), a zoonotic day/zoonotic strategy day (n=1), a web page (n=1), blog texts (n=1) and public events (n=1) were also proposed. Moreover, stakeholders emphasized a need for a platform, where the network would be able to connect and discuss between yearly meetings. Email lists were also suggested, although one of the stakeholders specifically ruled out the use of emails as a form of informing due to spam and information getting lost in the inbox.

“It would be enough for a larger network like this to meet once a year, and then the rest of the discussion would take place on some platform. So, that if there is something really interesting, you can always call a meeting to say that now we would like to tell you about this. But for such maintenance, once a year would be enough, but that there would then be a platform where you could say "hey, now we have this really cool discovery, do you want to hear more about it" or "hey, this kind of subjects are coming, yeah"... as long as it's not an email, because that's where they get lost.” (respondent 6)

“Yes, I think that once a year, a virtual or live meeting could be functional, and there also could be just some mailing list, so that if something interesting… then it would go to a certain distribution or something. No, I don't know. Maybe there could be other ways, but in a way, I don't think it would require miracles.” (respondent 4)

“You can do that in many different ways. Of course, popular publications are one way, but then also public events or something like, “come and talk in a café”.” (respondent 8)

6 DISCUSSION

In this chapter the main findings of the study, its bias and limitations, and recommendations for further research are discussed. Synthesis is presented where comparisons are made with the previous limited number of studies available in the global context. As earlier indicated, there are no stakeholder analysis studies conducted on VBD/OH stakeholders in Finland. Stakeholder networks, information and resources sharing and how different VBD actors and stakeholders interact in Finland has not been studied before. In review, the objectives of this study were the following:

1. What/whom are the current key stakeholders/actors related to vector-borne disease research, management, surveillance, control and prevention in Finland. To what extent are these stakeholders interdisciplinary, multisectoral and multi-leveled?

2. What kind of connections and interactions take place between different stakeholders? How and to whom is knowledge and data shared? What are the main challenges for collaboration between the key stakeholders?

3. What kind of stakeholder collaboration do the different VBD stakeholders wish for in the future and what are the needs for a multidisciplinary vector-borne disease expert network in Finland?

6.1 The main results of the study

The results of this study indicate the importance of multisectoral and multi-leveled stakeholder collaboration related to vector-borne disease research, management, surveillance, control and prevention in Finland. The most obvious finding to emerge from the analysis is that currently VBD/OH networks in Finland are mostly built upon unofficial personal connections based on individual researchers own activity and eagerness to connect with other colleagues in Finland or globally. Interestingly VBD collaborations and networks rely heavily on a few Finnish individual key experts and research projects with external funding, resulting in uncertainty in the longevity of collaborations.

Another important finding in this study is that there seems to be a lack of higher-level coordination of VBD/OH collaboration activities in addition to the lack of collaboration between Finnish governmental agencies and lower-level stakeholders, mainly due to lack of resources. The results of this research also show that stakeholder collaboration with the private sector, in addition to independent agencies, NGOs, professional and scientific associations and other foundations in Finland is very limited. The stakeholder mapping conducted in this research further revealed that the fields of human health (with the biggest emphasis), animal health and environmental health (in this case ecology) were more often represented among the VBD/OH stakeholders, compared to other fields such as social sciences and humanities. Furthermore, all ten interviewed stakeholders unanimously supported forming a formal VBD/OH network in Finland in order to enhance stakeholder collaboration, information sharing and data management related to vector-borne diseases in Finland.

6.2 VBD and OH stakeholders in Finland

According to previous literature, identifying and engaging a diversity of stakeholders from various sectors and geographic levels of society is critical to successfully implementing the One Health approach. However, identifying all One Health stakeholders can be challenging (Mazet et al., 2014). With respect to the first research question in this study, a total of 139 potential direct and indirect VBD and One Health stakeholders were successfully identified from various sectors and levels in the Finnish setting. Further analysis revealed 20 key stakeholders from the fields of research, health care, expertise agencies and other collaborating actors. Interestingly, no actor under the category of ministries/and policymakers was identified as key stakeholders in this study. Instead, the field of research had the biggest representation among key stakeholders. The key stakeholders identified representing research were: three Finnish universities, several researchers, international research projects and one national research network (VECLIMIT). This result may be partly explained by the fact that over half (n=6) of the study participants were researchers themselves, of whom 5 were attending the same VECLIMIT consortium.

Fields of human health, animal health, and environmental health (in this case ecology) were more often represented among the actors of the research category, while other fields

such as social sciences were significantly underrepresented. In total, out of the 20 key actors, 14 represented the domain of human health, 10, animal health, 10 environmental health (ecology), and 3 other domains, such as social sciences. These findings are in line with previous studies, since traditionally, One Health stakeholders related to the public and veterinary health sector have been easier to identify in comparison to those related to wildlife and the environment, whom, until recently, have been under-represented (Mazet et al., 2014).

In this study, clinical doctors, especially infectious disease doctors, veterinarians, human diagnostic laboratories and patients were identified as key stakeholders in the category of health care. Noteworthy, veterinarians were the only animal health actors in this category, while all other key health care actors represented human health. Interestingly, for example animal diagnostic laboratories and private, both human and animal, pharmacology and diagnostic companies were not identified as key stakeholders in this research. This combination of findings provides some support for the conceptual premise that VBD/OH stakeholders in Finland are interdisciplinary and multisectoral, but the biggest emphasis still remains in human health, resulting in the neglect of other fields of study, especially social sciences. It is also surprising that, actors from the Ministries and policymakers' sector, such as the Ministry of Social Affairs and Health or the Ministry of Agriculture and Forestry in Finland, were not noted as key stakeholders in this research. Instead, three governmental agencies, The Finnish institute for health and welfare, Finnish Food Authority and Natural Resources Institute Finland were identified as key stakeholders and expert agencies, in addition to the general public and the Finnish media as other collaborating key actors.

These findings have important implications for developing VBD/OH networks in Finland toward an even more interdisciplinary, multisectoral and multi-leveled group of experts, as previous studies clearly indicate the need for an integrated health approach, such as the One Health approach, and enhanced collaboration among a wide range of different fields and stakeholders, in order to effectively tackle health problems like VBDs, emerging at the human-animal-ecosystem interphase (Destoumieux-Garzón et al., 2018; Roger et al., 2016).

6.3 Stakeholder interactions and challenges in collaboration activities

The second question in this research was to explore different stakeholder connections and interactions, and the possible challenges in stakeholder collaborations in Finland. It is interesting to note that the most obvious finding to emerge from this research is that VBD/OH networks in Finland are mostly built upon unofficial personal connections. Interestingly VBD collaborations and networks rely heavily on a few Finnish individual key experts and research projects with external funding. Mostly VBD/OH collaborations in Finland do not have official organized activities, apart from the current VECLIMIT consortium. Primarily collaborations and interactions are based on individual researchers' own activity and eagerness to connect with other colleagues in Finland or globally, resulting in uncertainty in the continuity of collaborations. These results are likely to be related to the lack of resources and the lack of a formally organized VBD/OH network in Finland.

Another important finding of this study is that there seems to be a lack of higher-level coordination of VBD/OH collaboration activities in addition to the lack of collaboration between Finnish governmental agencies and other lower-level stakeholders. The current study did find some interactions between academia and governmental institutions in Finland, but they were limited and more activities were wished for. This is explained by the general lack of resources and renewed agencies' strategies with less emphasis in topics related to VBDs. These results are likely to be related to each other; limited resources of governmental institutions may have caused a neglect on topics related to VBDs in their strategies. These findings are somewhat unanticipated, since previous literature indicates the most common form of collaboration between different stakeholders to be either between academia and governmental bodies or between academia, governmental bodies and NGOs (Khan et al., 2018; Mazet et al., 2014). No collaborations between researchers, governmental institutions and NGOs were identified in this research. In addition, VBD/OH stakeholders' collaboration with the private sector, other independent agencies, professional and scientific associations and other foundations in Finland were very limited.

In conclusion, these findings are significant and help us to understand why lower-level stakeholders are struggling to build VBD/OH collaborations with higher level

stakeholders, and why ministries and policymakers were not reported as key stakeholders in this study. These findings are critical, since previous literature has already stated that important stakeholders in One Health networks are ministries, government research and development institutions, public and private universities, non-governmental stakeholders, such as non-governmental organizations (NGOs), local communities and the private sector (Mazet et al., 2014).

With respect to the main challenges in collaboration between key stakeholders, this study discovered that lack of resources was the main hindering factor for stakeholder collaboration. In accordance, previous research highlights the need for sustainable monetary investment, governmental support and political will in order for a regional-level One Health network to be successful in its efforts (Mazet et al., 2014). The current study documented that the lack of money, time and human resources particularly caused problems in building and sustaining collaborations between actors. It is especially interesting to note that there is a reported lack of VBD expertise especially among higher-level institutions in Finland. In this study, challenges in collaborating were also found to be caused by problems in personal connections, such as not knowing the right people and due to conflicting interests and varying goals. These findings support previous literature indicating the need for understanding the different mandates of each sector in addition to the attempts of unifying One Health terminology, since currently siloed approaches with varying goals and interests scattered across the playing field, makes it harder to accomplish sustainable developments in human, animal and environmental health management (De Garine-Wichatitsky et al., 2021; Destoumieux-Garzón et al., 2018).

Lastly, this study reported challenges with data and information flow regarding difficulties in receiving, using and transferring data between different stakeholders, in addition to the lack of knowledge of the potential availability of data and the existence of different VBD/OH projects. These findings have important implications for developing enhanced ways of networking and sharing knowledge and data between VBD/OH stakeholders in Finland and to enhance VBD management and stakeholder collaboration in the future. The lack of collaborating activities and challenges in interactions between stakeholders indicate that VBD management approaches in Finland are currently fragmented between different sectors and institutions. In the upcoming future disciplinary

boundaries need to be crossed, as no single discipline can address all the issues related to VBDs, nationally and globally. In line with previous studies, VBD management strategies must be holistic and inclusive of human, animal and ecosystem health and have a broad stakeholder attendance to succeed in future policy creation and VBD risk evaluation (Zortman, 2020).

6.4 Potential VBD expert network and the way forward

The third research question in this study was to determine the kind of stakeholder collaboration that the VBD stakeholders wish for in the future, as well as whether there is a need for a multidisciplinary vector-borne disease expert network in Finland. It is interesting to note that all ten interviewed stakeholders of this study stressed the need for better multisectoral collaboration and unanimously supported the formation of an official VBD/OH network in Finland. This finding is in line with previous literature where multidisciplinary communication and co-operation is essential for the surveillance, early detection, warning, prevention and control of vectors, hosts and VBDs. (Braks et al., 2019; Gyles, 2016)

The results of this study indicate that stakeholders wish for the potential network to enhance data management and information sharing, including sharing of topical research results to enhanced vector and VBD surveillance and risk preparedness, especially related to climate change and the (re)emergence of vectors and VBDs in Finland. As mentioned in the literature review, climate change and changing environmental conditions, such as temperature, rainfall and snowfall, can all affect the prevalence and distribution of vectors, pathogens, hosts, and more generally, VBDs, as well as their prevention and control (Rocklöv & Dubrow, 2020; THL, 2020). Together different multisectoral and multidisciplinary stakeholders can share their information and tools, build knowledge, promote health issues to the general public and produce feedback from the field to higher level stakeholders i.e. ministries and multilateral organizations (Mazet et al., 2014).

Some of the issues emerging from the findings of this study relate specifically to the concrete formation of an official VBD/OH network in Finland. Higher-level coordination, adequate resources, broad attendance from different fields and levels, in addition to utilizing current national networks, such as the VECLMIT and/or unofficial Åland-Turku-

Helsinki tick-borne infections network, as a base for a new official national network were suggested. Yearly meetings and ad hoc meetings when needed, in addition to a platform for VBD discussion for the network was also wished for. The present results are significant and raise the possibility that an official VBD network of actual power and meaning could be formed in Finland based on this study's findings.

6.5 Bias and limitations

There are some limitations and possible sources of bias in this study. However, as this study focused on a very specific research area: vector-borne disease stakeholders in Finland, and not a topic that must be generalized for the whole population of Finland, the impact of sampling bias and small sample size was minimized. Still, there was a risk that the interviewed stakeholders would name only other experts of similar work fields as their own, which could have had an effect on the diversity of the study population. This risk was acknowledged when identifying and choosing new stakeholders for interviews. Finally, even though the sample size of this study was relatively small, the scope of the gathered data was very broad and in depth. Over 140 pages of transcribed interview text was analyzed for this report and saturation of findings could be noticed in the results.

Generally, limitations and bias may also appear in studies due to data collection procedures. A well-designed interview guide enhances the quality of data collection and the trustworthiness of research (Kallio et al., 2016). Proper development and pilot testing of the interview guide are key aspects to successful qualitative research (Chenail, 2011; Krauss et al., 2009; Majid et al., 2017). The semi-structured interview guide of this research was pre-pilot tested by internal experts of our research group, and specific attention was given to question formatting. The aim was to keep the questions as broad as possible without being too leading, while still being able to receive all the information needed. Additionally, the interview guide was field tested in an exploratory interview for other possible limitations. Subsequently the guide was altered accordingly to enhance its quality before implementation. These procedures limited potential bias and limitations on the quality of the study related to failures or inaccuracies within the interview guide. As far as interview data transcription as a source of bias is concerned, interview transcripts were done by professionals from an outside language company to minimize any mistakes

in the data. Thorough records of the conducted interviews and detailed documenting on the analysis process enhances the reliability of this master's thesis study.

In qualitative research the researcher/interviewer is the key person and research instrument for obtaining and analyzing data (Poggenpoel & Myburgh, 2003). It takes time to learn to become a skilled interviewer, to format open-ended questions and follow-up questions, based on the participants responses in order to gain more detailed data on the discussed topic (Chenail, 2011). Hence, being a student trainee with limited interviewing experience, I could have possibly been a limitation in this study. To minimize the plausible limitation caused by lack of previous interview and data collection experience, I recorded the interviews both as video- and audiotapes for backup. Recording the interviews enabled subsequent analysis to be done for each interview, thus enhancing the reliability of my analysis (Mays & Pope, 1995). I also held the first round of exploratory interviews together with one of my supervisors to help with the learning process for conducting interviews. This enabled me to practice interviewing with my supervisor and to receive immediate guidance if needed. Prior to interviews, I also familiarized myself on the topic of VBDs in Finland and then chose the study methodology by conducting the literature review of this study.

Data availability and data access was not a limitation to the project; although, the COVID-19 pandemic did affect the method of gathering interview data. Majority of the interviews were held remotely, however, apart from minor internet connection and other IT-issues, the remote interviews worked in my favor. Remote interviewing enabled me to interview stakeholders geographically distant around Finland in an easy and time-efficient manner. Analyzing the interview data was not repeated by other researchers apart from myself. Better reliability regarding the analysis of qualitative data could have been achieved if another qualified researcher had also independently gone through the transcripts for analysis (Mays & Pope, 1995). Unfortunately, there was no time or resources to do this.

Despite the previously discussed limitations in this research, this study significantly adds to our understanding of VBD/OH stakeholders and their interactions in Finland and succeeds in offering valuable insights into stakeholders' perceptions on information sharing and stakeholder networking in Finland.

6.6 Recommendations

In absence of previous studies on stakeholder networks and VBD stakeholder interactions and collaborations in Finland, the findings of this study have a number of important implications for future practice. Firstly, there is a definite need for the establishment of a formal multidisciplinary and multi-leveled vector-borne disease expert network in Finland. Greater efforts are needed to ensure that the currently neglected fields of study and stakeholders are also included in this future network. All fields (human, animal, environmental health, social sciences and humanities) should be present and have a representation of all key governmental institutions and other key stakeholders. Secondly, higher level coordination and formal cooperation between stakeholders should be organized within the network. Particular consideration should be paid to the formation of a clear and shared agenda within the network and the unified understanding between stakeholders of the One Health approach.

Moreover, adequate resources should be made available for research, management, surveillance, control and prevention of vector-borne diseases in Finland. Especially enhanced fiscal and skilled human resources related to VBD expertise in governmental institutions, such as THL, are recommended. All in all, a key policy priority should be the planning and implementation of a formal long-term VBD/OH network to Finland with sufficient resources to enhance national and global stakeholder collaboration and data sharing.

Despite the promising results of this research, some questions still remain to be answered. Further research should be conducted into how to operationalize the recommendations suggested in this study to realistically begin putting in place a formal national-level VBD/OH network, considering the limits that have been discussed earlier. Future investigations on formal One Health networks in other EU countries, such as the Netherlands and France, could be useful benchmarks and models for the Finnish network at hand. Also, future investigations on private actor engagement and public-private partnerships in strengthening VBD management in health systems, in addition to studies

on the (re)emergence of vectors, vector-borne diseases and climate change in Finland are still needed.

7 CONCLUSIONS

The overall aim of this master's thesis was to map the current and missing stakeholders/actors and their interactions related to vector-borne diseases and their management in Finland, within a One Health context. In addition, the objective was also to discuss and reflect on the future of a possible VBD/One Health-network and what would be the likelihood, challenges and means of establishing one in Finland.

In total 139 potential direct and indirect VBD and One Health stakeholders were identified in this research. Twenty stakeholders, from the fields of human-, animal- and, environmental health (notably ecology), in addition to other domains, such as social sciences, were recognized as key VBD/OH actors in Finland. Various research fields were most represented among the key stakeholders, while no actors under the category of ministries/and policymakers were identified as key actors. The results in this study suggest that VBD/OH stakeholders in Finland are to some extent interdisciplinary and multisectoral, but the biggest emphasis among different stakeholders still remains in human health, resulting in the neglect of other fields of study, especially social sciences and humanities.

Furthermore, VBD/OH collaborations and networks in Finland are mostly built upon unofficial personal connections relying heavily on a few Finnish individual key experts and research projects with external funding. The results of this research show that stakeholder collaborations with the private sector, in addition to independent agencies, NGOs, professional and scientific associations and other foundations in Finland are very limited. Lack of higher-level coordination and collaboration, the general lack of resources and renewed governmental agencies' strategies with less emphasis in topics related to VBDs result in challenges among stakeholder interactions and collaboration activities. Problems in personal connections and with data and information flow, in addition to conflicting interests were also identified as factors causing challenges amongst stakeholder interactions. In conclusion, all ten interviewed stakeholders of this study stressed the need for better multisectoral collaboration and unanimously supported the formation of an official VBD/OH network to Finland, in order to enhance data management, information sharing and to enhance vector and VBD surveillance and risk

preparedness, especially related to climate change and the (re)emergence of vectors and VBDs in Finland.

The findings of this study provide novel perspectives on VBD and OH stakeholder interactions in Finland, helping one better understand why stakeholders succeed or struggle to make collaborations with each other. Previous studies have focused more on vector, host and disease epidemiology, especially regarding changes in disease occurrence and distribution of hosts and vectors at a national level. Hence, this study provides new information on previously neglected topics of VBD research. This information will be useful for several stakeholders, researchers and decision-makers alike. The research outcomes will play an important role in society and amongst policy makers by addressing an expanding concern for vector-borne diseases nationally and globally, in addition to having important implications for developing enhanced ways of networking and sharing knowledge and data between VBD/OH stakeholders in Finland.

The findings of this research strongly suggest establishing a formal multidisciplinary and multi-leveled OH vector-borne disease expert network in Finland with higher level coordination and sufficient fiscal and skilled human resources. However, further investigation is still needed to gain a deeper understanding of formal One Health networks in other European countries, private actor engagement and public-private partnerships in strengthening VBD management. In addition to investigating the (re)emergence of vectors, vector-borne diseases and climate change in Finland, further research is also needed in how to operationalize the recommendations suggested in this study to realistically begin putting in place a formal national-level VBD/OH network in Finland.

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APPENDICES

Appendix 1:

Interview Guide

Theme 1: Expertise and knowledge

Q1: Can you introduce yourself and tell briefly about your position, education and background?

- Follow up questions, if not answered already in the introduction:
- *What is the workplace/institution/structure you are working for?*
- *Can you give an overview of your activities and tasks?*

Q2: What are the leading stakes/themes/questions you are working on?

- Potentially adding a follow-up question specific to vector-borne diseases if not explicitly mentioned in the response: *How important are subjects relating to vector-borne diseases in your mandate/research questions/themes?*

Theme 2: Partnerships/Collaboration between stakeholders

Q3: On what projects related to VBDs are you working on at the moment and what kind of data/information do you produce about VBDs?

Q4: In your opinion, which type of actors/stakeholders should be involved in the management of vectors and vector-borne diseases in Finland? (Is there some missing at the moment?)

Q5: What kind of co-operation do you have with other institutions regarding VBDs and have you ever encountered any difficulties related to VBD collaboration?

- Follow-up questions, if not answered already:
- *Whom are you co-operating with regarding VBDs?*
- *What kind of information are you sharing/have shared regarding VBDs?*
- *How is the information and communication and sharing of data handled with other institutions/ organizations?*
- *What is preventing the collaboration between different actors and stakeholders?*
- *And on the other hand, in your experience, which types of actors/stakeholders seem to form successful collaborations/partnerships?*

Theme 3: The need for network of experts working with VBDs

Q6: Are you aware of any existing networks of experts working with vector-borne diseases? If so, what kind of networks?

Q7: Do you see that there would be a need for a network of experts working with VBDs in Finland? If, so what kind of co-operation between stakeholder would you prefer to have?

- Potential follow-up questions:
- *Do you wish there was more co-operation and projects between different experts working with vector-borne diseases?*
- *Have you observed a need for sharing information/communicating your work/research/observations related to vector-borne diseases to other organizations/ institutions?*
- *What kind of information you would want/need regarding vector-borne diseases?*

Q8: How would you like to co-operate/connect with different stakeholders and what would be the best way of sharing information regarding VBDs?

- *Eg. webinars, training, e-mailing list, regular meetings with experts working with VBDs, something else?*

Theme 4: Integrated approaches to health and the One Health (OH) approach

Q9: Have you heard of integrated approaches to health/are you aware of these topics? If so, how would you define/describe it? Do you have any opinions about the One Health approach and how it's related to your work?

If needed: Do you see that there is a or could be a connection between One Health and vector-borne diseases and their management.

Q10: In what ways have you already implemented it in your work or would like to implement it in the future? *(In your opinion, are the collaborations you have already mentioned you work in, One Health collaborations…?)*

- *Do you find it easy to implement a OH/integrated approach to health in your work?*
- *Are there aspects of the OH approach that you find inadequate or difficult to implement?*

Conclusion

Q11: Is there anything else you would like to add? Any other question to ask?

Q12: Who would you recommend for us to interview in the future? (snowballing)

Appendix 2:

Haastattelurunko

Teema 1: Asiantuntemus ja tietämys

Q1: Voisitko esitellä lyhyesti itsesi? Mikä on nykyinen työsi/virkasi, koulutuksesi sekä taustasi?

- Jatkokysymykset, mikäli eivät tule ilmi jo esittelyssä:
- *Missä työpaikassa/instituutiossa työskentelet? (esim. yksityinen vs. julkinen, sairaala tms.)*
- *Voitko antaa yleiskuvan työtehtävistäsi?*

Q2: Mitkä ovat pääkysymykset/asiat/teemat, joiden parissa työskentelet?

- Jatkokysymys vektorivälitteisistä taudeista, mikäli haastateltava ei mainitse niitä: *Kuinka tärkeitä ovat vektorivälitteiset tartuntataudit sekä niihin liittyvät aiheet ja teemat työssäsi?*

Teema 2: Kumppanuudet ja yhteistyö eri sidosryhmien välillä

Q3: Missä/minkälaisissa projekteissa liittyen vektorivälitteisiin tartuntatauteihin olet mukana työskentelemässä tällä hetkellä sekä minkälaista tietoa/informaatiota ja dataa tuotatte vektorivälitteisiin tartuntatauteihin liittyen?

Q4: Sinun mielestäsi, minkä tyyppisiä toimijoita/sidosryhmiä tulisi olla mukana vektorivälitteisten tartuntatautien hallinnassa Suomessa? (Puuttuuko tällä hetkellä jokin toimija?)

Q5: Millaista yhteistyötä sinulla/teillä on muiden instituutioiden/toimijoiden kanssa liittyen vektorivälitteisiin tartuntatauteihin ja oletteko koskaan kohdanneet jonkinlaisia vaikeuksia yhteistöissä vektorivälitteisiin tartuntatauteihin liittyen?

- Jatkokysymykset, mikäli niihin ei tullut vastauksia jo aikaisemmin:
- *Kenen kanssa teette yhteistyötä liittyen vektorivälitteisiin tartuntatauteihin?*
- *Minkälaista tietoa/informaatiota jaatte/olette jakaneet liittyen vektorivälitteisiin tartuntatauteihin?*
- *Kuinka/millä tavalla olette kommunikoineet sekä jakaneet tietoa ja dataa eri instituutioiden ja organisaatioiden välillä?*
- *Mikä mielestäsi estää yhteistyötä eri toimijoiden ja sidosryhmien välillä?*

- *Kokemuksesi mukaan minkä tyyppiset toimijat/sidosryhmät näyttäisivät muodostavan onnistuneita kumppanuuksia ja yhteistoimintaa?*

Teema 3: Tarve vektorivälitteisten tartuntatautien asiantuntijaverkostolle

Q6: Oletko tietoinen mistään jo olemassa olevasta asiantuntijaverkostosta vektorivälitteisiin tartuntatauteihin liittyen? Kertoisitko mitä/millaisia ne ovat?

Q7: Näetkö tarvetta vektorivälitteisten tartuntatautien asiantuntijaverkostolle Suomessa? Jos kyllä, minkälaista yhteistyötä eri sidosryhmien välillä mieluiten haluaisit?

- Mahdollisia jatkokysymyksiä:
- *Toivoisitko enemmän yhteistyötä ja projekteja eri asiantuntijoiden välille, jotka työskentelevät vektorivälitteisten tartuntatautien kanssa?*
- *Oletko kohdannut tarvetta kommunikoida/ jakaa tietoa omasta työstäsi/tutkimuksestasi/havainnoistasi vektorivälitteisiin tartuntatauteihin liittyen muille organisaatioille/instituutioille?*
- *Minkälaista tietoa/dataa haluisit tai tarvitsit vektorivälitteisiin tartuntatauteihin liittyen?*

Q8: Miten haluaisit tehdä yhteistyötä ja olla yhteydessä muihin sidosryhmiin/toimijoihin, ja mikä olisi mielestäsi paras tapa jakaa tietoa/informaatiota liittyen vektorivälitteisiin tartuntatauteihin?

- *Esim. webinaarit, koulutukset, sähköpostilista, säännölliset tapaamiset eri asiantuntijoiden kanssa, jotain muuta, mitä?*

Teema 4: Integroidut lähestymistavat terveyteen sekä One Health (OH)

Q9: Minkälaisista integroiduista lähestymistavoista terveyteen olet kuullut tai oletko tietoinen kyseisistä lähestymistavoista? Miten kuvailisit/määrittelisit niitä? Minkälaisia mielipiteitä liittyen One Health-lähestymistapaan sinulla on ja miten One Health mahdollisesti liittyy työhösi?
Tarvittaessa: Näetkö, että One Health-lähestymistavan sekä vektorivälitteisten tartuntatautien ja niiden hallinnan välillä on jonkinlainen yhteys? Millainen?

- Anna *One Health*- lähestymistapa esimerkkinä, jos haastateltava ei itse tuo sitä esille

Q10: Millä tavalla olet toteuttanut tai käyttänyt työvälineenä omassa työssäsi integroituja lähestymistapoja terveydestä ja/tai miten haluaisit käyttää niitä tulevaisuudessa työssäsi? *(Ovatko mielestäsi jo mainitsemasi yhteystyöprojektit toteuttaneet One Health-lähestymistapaa?)*

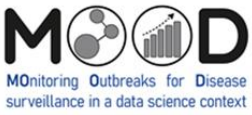
- *Onko mielestäsi yksinkertaista/helppoa implementoida OH/integroituja lähestymistapoja terveydestä työhösi/työssäsi?*
- *Mitkä asiat ovat mielestäsi vaikeita tai puutteellisia liittyen OH/integroitujen toimintatapojen täytäntöön panoon ja toteuttamiseen työssäsi?*

Lopuksi

Q11: Onko mitään muuta mitä haluaisit lisätä tai kysyä?

Q12: Ketä asiantuntijoita suosittelisit, että haastattelisimme jatkossa?

Appendix 3.



Funded under the H2020 programme

Suostumus tutkimukseen osallistumiseen ja aineiston käyttämiseen vektorivälitteisten tautien toimijaverkoston kartoitus- tutkimushankkeessa (haastattelut)

Olen saanut riittävästi kirjallista ja suullista tietoa tutkimushankkeesta "**Vektorivälitteisten tautien toimijaverkoston kartoitus**" ja haluan osallistua siihen. Samalla annan suostumukseni siihen, että kerättävä aineisto voidaan liittää osaksi yllä mainitun hankkeen tutkimusaineistoa.

Olen tietoinen, että osallistuminen on täysin vapaaehtoista ja, että voin keskeyttää osallistumiseni milloin tahansa syytä ilmoittamatta. Tällöin minulta jo kerättyjä tietoja ei käytetä enää tutkimustarkoituksessa. Tehtyjä analyysejä ei peruta.

Annan suostumukseni haastatteluiden ääninauhoittamiseen:

kyllä ____ en ____

Otteita haastatteluistani saa näyttää esimerkkiaineistona hankkeen opinnäytetyössä ja mahdollisissa työpajoissa:

kyllä ____ ei ____

Tästä suostumuslomakkeesta on tehty kaksi (2) samanlaista kappaletta, joista yksi (1) jää tutkittavalle ja yksi (1) hankkeen tutkijalle.

Paikka _____ Aika _____ / _____ 2021

Allekirjoitus _____

Nimenselvennys _____

Organisaatio _____

Sähköposti _____

Vastaanottajan allekirjoitus _____

Nimenselvennys _____

Appendix 4.

Funded under the H2020 programme

TIEDOTE TUTKIMUKSEEN OSALLISTUVALLE

Tutkimus- ja kehittämishanke: Vektorivälitteisten tautien toimijaverkoston kartoitus- asiantuntijahaastattelut

Olet kutsuttu mukaan ***Vektorivälitteisten tautien toimijaverkoston kartoitus-*** tutkimukseen, joka toteutetaan osana EU:n Horisontti 2020-ohjelman rahoittamaa MOOD-hanketta, Terveyden ja hyvinvoinnin laitoksella (THL). Sinut on valittu osalliseksi haastattelututkimukseen, koska sinulla on arvokasta asiantuntemusta vektorivälitteisiin tartuntatauteihin liittyen ja/tai työskentelet vektorivälitteisten tartuntatautien tai niiden hallinnan parissa Suomessa. Sinua haastateltavaksi on voinut suositella myös jo joku edellä haastatelluista asiantuntijoista tähän projektiin liittyen.

Terveyden ja hyvinvoinnin laitos on sosiaali- ja terveysministeriön alaisuudessa toimiva itsenäinen tutkimuslaitos. THL tutkii ja seuraa väestön hyvinvointia ja terveyttä ja kehittää toimenpiteitä niiden edistämiseksi. Keräämme ja tuotamme tutkimukseen ja tietoaineistoihin perustuvaa tietoa. Lisäksi tarjoamme asiantuntemusta ja ratkaisuja, joita sidosryhmämme voivat käyttää päätöksenteossa ja työnsä tukena.

Tässä tutkimustiedotteessa saat tietoa tutkimushankkeesta ja sen osana toteutettavista haastatteluista. THL on yhteistyökumppanina EU:n Horisontti 2020-ohjelman rahoittamassa MOOD-hankkeessa. Hanke toteutetaan 1.1.2020 - 31.12.2023 välisenä aikana. Terveyden ja hyvinvoinnin laitoksen lisäksi mukana hankkeessa on 25 eri tutkimusorganisaatiota 12:sta eri maasta. MOOD-hanketta johtaa ranskalainen French Agricultural Research Centre for International Development (CIRAD). Projekti vektorivälitteisten tautien toimijaverkoston kartoittamisesta Suomessa tapahtuu 1.6.2021 - 31.1.2022 välisenä aikana Terveyden ja hyvinvoinnin laitoksella osana laajempaa MOOD-hanketta. Projektin toteuttaa allekirjoittanut korkeakouluharjoittelija osana lopputyötään Tampereen yliopistolle. Tutkimuksessa kerättyä ainestoa käytetään siten myös Pro gradu- tutkielman teossa lukuvuoden 2021-2022 aikana.

Lisätietoja sekä MOOD-hankkeesta, että Vektorivälitteisten tautien toimijaverkoston kartoitus- hankkeesta löytyy Terveyden ja hyvinvoinnin laitoksen verkkosivuilta.

Hankkeen tavoitteet ja menetelmät
MOOD- hankkeen tarkoituksena on kehittää EI (Epidemic Intelligence) - työkaluja epidemioiden varhaisempaan havaitsemiseen, tautien seurantaan sekä sen arviointiin ovatko havaitut signaalit merkityksellisiä Euroopalle ja Euroopan kansanterveys- ja eläinterveysorganisaatioille.

Osana tätä hanketta käsitelemme myös alueellisia toimijoita ja heidän osuuttaan vektorivälitteisten tartuntatautien seurantaan sekä riskiviestintään. Projektissa on tarkoitus toteuttaa yksittäisiä haastatteluja paikallisten toimijoiden kanssa, sekä mahdollisesti järjestää työpajoja useiden eri toimijoiden kesken. Kerätyn haastatteludatan avulla pyrimme tunnistamaan miten tiedonkulkua, tiedon hallintaa ja riskiviestintää voitaisiin parantaa sekä alueellisella että kansallisella tasolla Suomessa. Haastatteluja ja niiden nauhoituksia voidaan hyödyntää myös työpajojen suunnittelussa

Haastattelujen kohderyhmänä ovat vektorivälitteisten tartuntatautien asiantuntijat sekä vektorivälitteisten tautien ja niiden hallinnan parissa töitä tekevät. Tavoitteenamme on toteuttaa yhteensä noin 20 haastattelua.

Haastattelujen tarkoitus
Haastattelujen tarkoituksena on kartoittaa eri toimijat, jotka ovat mukana työskentelemässä vektorivälitteisten tartuntatautien sekä niiden hallinnan parissa Suomessa. Haastatteluissa pyritään selvittämään näiden toimijoiden keskinäisiä vuorovaikutussuhteita ja pyritään ymmärtämään paremmin yleisiä ongelmia, jotka liittyvät tiedonkulkuun ja tiedon hallintaan eri toimijoiden ja sidosryhmien välillä.

Haastattelussa käsiteltäviä teemoja ovat esimerkiksi:

- Yhteistyö ja vuorovaikutussuhteet eri vektorivälitteisten toimijoiden välillä
- Tarve vektorivälitteisten tautien toimijaverkoston perustamiselle Suomessa
- Integroidut lähestymistavat terveyteen, kuten One Health lähestymistapa

Haastattelujen toteutus
Haastattelut toteutetaan yksittäishaastatteluina koronatilanteen mukaan kasvotusten joko THL:n tiloissa, haastateltavan työpaikalla tai Microsoft Teamsin välityksellä/ puhelinhaastatteluna. Haastattelutilanteessa on mukana ainoastaan haastattelija ja haastateltava ja tulemme noudattamaan haastatteluissa ajankohtaisia koronaohjeistuksia.

Haastattelu vie työaikaasi noin yhden tunnin.

Osallistumisen vapaaehtoisuus
Haastatteluun osallistuminen on vapaaehtoista. Osallistuminen perustuu kirjalliseen suostumukseesi ja sinulta pyydetään myös lupa haastattelujen nauhoittamiseen. Voit peruuttaa suostumuksesi ilman syytä milloin tahansa. Tällöin sinusta kerättyjä tietoja ei käytetä enää tutkimustarkoituksessa, mutta siihen mennessä tapahtuneen käytön pohjalta tehtyjä analyysejä ei pystytä peruuttamaan. Sinulla on myös oikeus pyytää pääsyä sinua koskeviin henkilötietoihin sekä pyytää kyseisten tietojen oikaisemista, poistamista tai käsittelyn rajoittamista. Sinulla on myös oikeus tehdä valitus tietosuojavaltuutetun toimistoon.

Osallistumisen luottamuksellisuus ja tietosuoja
Antamasi vastakset ja tiedot käsitellään THL:n tietoturvakäytäntöjen mukaisesti ja täysin luottamuksellisesti (lukitut kaapit, kulunvalvonta, suojatut tietokannat). Henkilötietoja ei

luovuteta THL:n ulkopuolelle ja tutkimusaineisto hävitetään hankkeen päättymisen jälkeen.

Nauhoitukset puretaan tekstiksi ulkopuolisessa yrityksessä, joka noudattaa vaitiolo- ja salassapitosopimusta. Teksteistä poistetaan kaikki tunnistamisen mahdollistavat tiedot. Tämän jälkeen aineistot ovat ainoastaan hankkeen työryhmän käytössä, eikä niitä luovuteta muille. Myös aineistoa käsitteleviä tutkijoita koskee salassapitovelvollisuus.

Tutkimusjulkaisuissa ja esitelmissä käytetään lyhyitä asiasisältöjä haastatteluista, joista kaikki osanottajien tunnistamisen mahdollistavat tiedot on muutettu tai poistettu. Tekstikatkelmia käytetään luvallasi myös korkeakouluharjoittelijamme opinnäytetyössä sekä mahdollisesti järjestettävissä sidosryhmätyöpajoissa havaintoaineistona. Tulokset julkaistaan sellaisessa muodossa, ettei yksittäistä henkilöä voida tunnistaa. On kuitenkin mahdollista, että läheiset työtoverisi saattavat tunnistaa sinut näistä katkelmista tietojen muuttamisesta huolimatta.

Tutkimukseen liittyvät hyödyt
Haastatteluun osallistuminen tarjoaa sinulle tilaisuuden tarkastella yhteistyötä ja vuorovaikutussuhteita eri vektorivälitteisten tautien ja niiden hallintaan osallistuvien tahojen välillä sekä näiden tahojen mahdollisuutta osallistua laajempaan vektorivälitteisten tartuntatautien verkoston perustamiseen Suomessa. Saat olla myös mukana tuottamassa uutta tietoa vektorivälitteisten tautien tiedonkulusta ja tiedon hallinasta eri toimijoiden sekä sidosryhmien välillä.

Hankkeen tuotokset
Haastattelujen tuloksisia hyödynnetään hankkeen eri toiminnoissa: Hankkeessa tuotetaan ensisijaisesti korkeakouluharjoittelijan Pro gradu tutkielma sekä mahdollisesti THL:n työpaperi vektorivälitteisten tartuntatautien toimijaverkoston kartoittamisesta Suomessa. Hanketta ja siitä tuotettua työpaperia käytetään tekemään suositus vektorivälitteisten tautien toimijaverkoston perustamisesta Suomeen. Tuloksia voidaan viestiä myös ammatillisissa ja tieteellisissä aikakausilehdissä. Mahdollisiin myöhemmin järjestettäviin sidosryhmätyöpajoihin voidaan nostaa haastatteluissa käsiteltäviä aiheita sekä havainnollistavia esimerkkejä.

Osallistuminen tutkimukseen ja suostumuksen antaminen
Luettuasi tämän tiedotteen sinun on mahdollista esittää kysymyksiä. Suostumuksen antaminen tapahtuu allekirjoittamalla erillinen suostumusasiakirja.

Lisätietoja tutkimushankkeesta antaa

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Contact in English/French language

Appendix 5.

Steps for conducting a scoping review and literature search

I conducted a scoping review in order to gather all related data and literature needed for this master's thesis literature review. A scoping review is justified as a methodology for my literature review because my purpose was to clarify the key concepts and theories related to my research question and to have a general overview on the published literature and the existing data. I also identified possible knowledge gaps related to my study topic and examined the key characteristics and methods for conducting a semi-structured interview research (Munn et al., 2018). I focused on articles published after the year 2000 to identify current and relevant literature. I used parts of the PRISMA statement and guidelines for proper reporting of systematic reviews and meta-analyses, in reporting my literature search (Liberati et al., 2009).

The literature review for this study was conducted mainly with the help of different search engines and electronic databases: PubMed, BioMed central, ProQuest and Web of Science. Google Scholar and the Tampere University Library's *Andor* search were also used to search appropriate books, journals and articles on the topic. English and Finnish language documents were identified. I independently scanned through article lists by titles and abstracts in order to select appropriate full texts to scan and include for further reading. In addition, with the help of my supervisors, we identified additional articles on the topic. I gathered additional suitable publications by analyzing citations and bibliographies from articles that I had already selected as relevant to my topic. I also used the THL, *Duodecim Terveyskirjasto* health library, World Health Organization (WHO) and European Centre for Disease Prevention and Control (ECDC) web pages to collect information on the different vector-borne diseases at hand. Search terms included: Vector-borne disease (VBD), tick-borne disease, Pogosta-disease, Sinbis-virus, Tularemia, Lyme borreliosis AND Lyme disease, (TBE), Finland, Europe, semi-structured interview, interview guide, Integrated approaches to health, One Health, Social-ecological systems (SESs), ARDI and Snowball sampling.

Appendix 6.

Excel sheet template of interviewed and contacted stakeholders

Name of contact	Job title	Work themes	Work institution	Email address	Phonenumber	Reference	Date of interview/reminder

Excel sheet template of initial stakeholder analysis

Stakeholder	Sector	Sub-sector	Mentioned in interviews

Appendix 7.

Full list of all potential direct and indirect VBD and OH stakeholders in Finland divided by sector, sub-sector and number of interviews mentioned in.

Stakeholders	Sector	Sub-sector	Mentioned in nro of interviews
Virologist	Research	Virologists	3
National zoonoses research organization	Research	University research organizations	4
Joint EU-projects	Research	International research projects	5
Medical and veterinary students	Health care	Medical students/veterinary students	1
Patients	Health care	Patients	5
Medical doctor of travel medicine	Health care	Medical specialists in travel medicine	1
Other clinical doctors	Health care	Clinical physicians	6
Finnish Food Authority	Expertise agency	Government agencies	7
Researchers collecting vectors	Research	Biologists/ecologists	1
Univercity of Eastern Finland	Research	Universities	2
Univercity of Jyväskylä	Research	Universities	5
Korkeasaari ZOO wildanimal hospital	Health care	Public wildanimal hospital	1
Other individual researchers	Research	Other researchers	10
Univercity of Turku	Research	Universities	7
Turku University hospital	Health care	University hospitals	1
Finnish Deffencive Forces	Other collaborating actors	National authorities	2
ECDC	Expertise agency	International agencies	3
Helsinki One Health	Research	National research networks	4
Entomologist	Research	Entomologists	4
Natural Resources Institute Finland (LUKE)	Expertise agency	Government agencies	6
Ecologist	Research	Ecologists	6
Agricultural industry	Other collaborating actors	Private and public businesses	1
VECLIMIT research consortium	Research	National research networks	7
Finnish institute for health and wellfare THL	Expertise agency	Government agencies	9
Finnish Zoonosis Centre	Expertise agency	National research networks	3
The general public	Other collaborating actors	Communities	7
European Food Safety Authority	Expertise agency	International agencies	1
Finnish Envirorment Institute SYKE	Expertise agency	Government agencies	3
Veterinarians	Health care	Veterinarians	6
Finnish diagnostic labrotaries (HUSLAB and Turku)	Health care	Human diagnostics laboratories	7
The Nordic Council	Other collaborating actors	International networks	1
World Health Organization WHO	Expertise agency	International agencies	2
Ministery of Social Affairs and Health	ministeries/policy-makers	Government ministeries	2
Ministery of Agriculture and Forestery in Finland	ministeries/policy-makers	Government ministeries	2
Animal diagnostic labroratories	Health care	Animal diagnostics laboratories	1
Assisting professor of emerging infections	Research	University professors	5
University of Helsinki	Research	Universities	8
Postdoc/doctoal/master's thesis-wrighters/interns	Research	Students	4
Private pharma and diagnostics companies	Health care	Private pharma and diagnostics companies	3
Academy of Finland	Other collaborating actors	Funders	4
Finnish Meteorological Institute	Expertise agency	Government agencies	3
MSD Animal Health	Health care	Private animal pharmacology companies	2
Huntsmen	Other collaborating actors	Communities	1
Microbiologists	Research	Microbiologists	4
Avia-GIS	Other collaborating actors	Private businesses	1
Chief physician of HUS Diagnostics Center	Health care	Human diagnostics laboratories	8
Prinsipal investigator of the zoonotic virology research group	Research	University research organization	8
Emerging Viral Diseases-Expert Laboratory Network (EVD-LabNet)	Expertise agency	International networks	1
Other international researchers	Research	International researchers	5
European Union	Other collaborating actors	Funders	1
Jane and Aatos Erkko Foundation	Other collaborating actors	Funders	1
Other foundations and sponsors	Other collaborating actors	Funders	1
Goverment research funding initiatives	Other collaborating actors	Funders	1
HUS Helsinki University Hospital	Health care	University hospitals	2
Geographers	Research	Geographers	2
The Finnish Wildlife Agency	Expertise agency	Government agencies	1
Fnnish hospital districts	Health care	Regional hospital districts	1
Bioinformaticians	Research	Bioinformaticians	1
Statistics Finland	Expertise agency	Government agencies	1
Free scholar (biologist/zoologist)	Research	Free scholars	4
Wildlife paracitologist research professor	Research	Wildlife paracitologists	2
The Finnish media	Other collaborating actors	Media/journalists/social media	6
Politicians/desicion makers/civil servants	Other collaborating actors	Politicians/desicion makers/civil servants	1
Professor of ecology and plant pathology	Research	University professors	1
Senior lecturer of zoonotic microbiology	Research	University professors	1
The Centre for Biothreat Preparedness (BUOS)	Expertise agency	National governmental networks	1
The Ministry of Defence	ministeries/policy-makers	Government ministeries	1
The Centre for Military Medicine	Health care	National authorities	1
Veterinary clinics	Health care	Private veterinary clinics	1

Norway, Denmark and Sweden	Other collaborating actors	The Nordic Countries	2
University of Liverpool	Research	International universities	1
Finnish Institute of Occupational Helath	Expertise agency	Independant agencies	1
Infectious diseases doctors	Health care	Medical specialists in infectious diseases	5
Pharmacists	Health care	Pharmacists	1
Other private businesses	Other collaborating actors	Private businesses	2
Animal Health ETT	Health care	NGO's	1
Animal producers	Other collaborating actors	Private businesses	2
Patovet ay	Health care	Private animal diagnostic labratories	1
IDEXX labratories Oy	Health care	Private animal diagnostic labratories	1
Movet Oy	Health care	Private animal diagnostic labratories	1
The Finnish Medical Association (FMA)	Health care	Profeccional associations	1
The Finnish Veterinary Association	Health care	Profeccional associations	1
The Finnish Medical Society Duodecim	Health care	Scientific associations	1
Finnish veterinary practicioners (Suomen Eläinlääkäripraktikot ry)	Health care	Profeccional associations	1
Finnish Society for Study of Infectious Diseases	Research	Scientific associations	1
Finnish Epidemiology Society (FES)	Research	Scientific associations	1
The Finnish Biosecurity Network	Health care	Regional networks	1
Foundation for Research on Viral Diseases	Other collaborating actors	Foundations	1
Finnish Deffencive Forces epidemiologist and chief physican	Health care	Medical specialists in epidemiology	1
The NordTick	Research	Scientific conferences	1
NorthTick	Research	International research projects	1
The Nordic–Baltic Veterinary Contingency Group (NBVCG)	Health care	International networks	1
The European Scientific Counsel Companion Animal Parasites (ESCCAP)	Health care	NGO's	1
The World Veterinary Association (WVA)	Expertise agency	International agencies	1
The World Small Animal Veterinary Association (WSAVA)	Expertise agency	International agencies	1
Social welfare and health care delegation of emergency conditions (PONK)	ministeries/policy-makers	Government agencies	1
Health security steering group	ministeries/policy-makers	Regional networks	1
Pets and/or petowners	Other collaborating actors	Communities	3
Phizer	Health care	Pharmaseutical companies	1
MSD Human Health	Health care	Pharmaseutical companies	1
Ethnologist	Research	Ethnologists	2
The Finnish Literature Society SKS	Research	Scientific non-profit associations	1
Svenska litteratursällskapet i Finland r.f.	Research	Scientific non-profit associations	1
Åbo Akademi	Research	Universities	1
Envirorment historians	Research	Envirorment historians	1
Social scientist	Research	Social scientist	2
Scientific publishers/papers	Research	Scientific publishers/papers	3
Research assistants	Research	Research assistants	1
Other forein universities	Research	International universities	4
Turku Human-Animal Studies Network (TYKE)	Research	Regional networks	1
Nordic ethnologist Facebook-group	Other collaborating actors	International networks	1
Åland central hospital	Health care	Central hospitals	2
Linköping's University Sweden	Research	International universities	1
Uppsala University Sweden	Research	International universities	1
Jönköping University	Research	International universities	1
Turku, Åland, Helsinki tick-borne infections network (unofficial)	Health care	Regional networks	2
Physiotherapists	Health care	Physiotherapists	1
Åland Group for Borrelia Research (ÅGBR)	Research	National networks	1
Medical expert of THL	Health care	Medical experts	1
Primary health care centers	Health care	Primary health care centers	1
THL labratory	Health care	Diagnostics laboratories	1
Helsinki Uni social media network for clinical doctors (unofficial)	Health care	Regional networks	1
Private actors distributing TBE-vaccinations	Health care	Private healthcare companies	1
Private healthcare clinics	Health care	Private healthcare clinics	1
Natural history museums	Other collaborating actors	Natural history museums	1
Immunologists	Research	Immunologists	2
Cental hospitals	Health care	Central hospitals	1
Forein hospitals	Health care	International hospitals	1
The Finnish government	ministeries/policy-makers	Government	3
Other finnish universities	Research	Universities	3
University hospitals	Health care	University hospitals	1
AI and machinelearning specialists	Research	AI and machinelearning specialists	1
Government official	ministeries/policy-makers	Government officials	2
One Health Finland	Research	National networks	1
Pet stores	Other collaborating actors	Private businesses	1
University of Oulu	Research	Universities	1
Public health experts	Health care	Public health experts	1
Anthropologists	Research	Anthropologists	1