2019 | A Systems Thinking Facilitator Guide

SYSTEMS THINKING APPROACH TO SOLVING ONE HEALTH PROBLEMS

USAID FROM THE AMERICAN PEOPLE | One Health Workforce | OHCEA Championing One Health | University of Minnesota | Tufts University

This is a product of the One Health Central and Eastern Africa (OHCEA) for health professionals' training with support from the United States Agency for International Development (USAID).

Published by OHCEA
Unit 16A, Elizabeth Avenue Kololo, P.O Box 35270, Kampala - Uganda
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First Edition

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OHCEA
8 Countries
16 Universities
24 Institutions

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Preface

This module is One of the 16 One Health Training Modules developed by the One Health Central and Eastern Africa Network (OHCEA). OHCEA is an international network, currently of 24 institutions of higher education in public health, veterinary sciences, pathobiology, global health and environmental sciences. These are located in 16 universities in 8 countries in Eastern, Central and Western Africa regions. The universities currently forming OHCEA are: Universite des Montagnes and University of Buea (Cameroon), University of Lubumbashi and University of Kinshasa (DRC), Jimma University, Addis Ababa University and Mekelle University (Ethiopia), Moi University and University of Nairobi (Kenya), Université Cheikh Anta Diop (Senegal), Muhimbili University of Health and Allied Sciences and Sokoine University of Agriculture (Tanzania), University of Rwanda and University of Global Health Equity (Rwanda), Makerere University and Mbarara University of Science and Technology (Uganda).

The OHCEA network's vision is to be a global leader in One Health, promoting sustainable health for prosperous communities, productive animals and balanced ecosystems. OHCEA seeks to build capacity and expand the human resource base needed to prevent, detect and respond to potential pandemic disease outbreaks, and increase integration of animal, wildlife and human disease surveillance and outbreak response systems. The overall goal of this collaboration is to enhance One Health policy formation and implementation, in order to contribute to improved capacity of public health in the region. OHCEA is identifying opportunities for faculty and student development as well as in-service public health workforce that meet the network's goals of strengthening One Health capacity in OHCEA countries.

The 16 modules were developed based on One Health Core Competencies that were identified by OHCEA as key elements in building a skilled One Health workforce. This network is supported by two United States University partners: Tufts University and the University of Minnesota through the USAID funded One Health Workforce Project.

Acknowledgements

This module was made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of the One Health Central and Eastern Africa (OHCEA) university network under the Emerging Pandemic Threats 2 One Health Workforce Project and do not necessarily reflect the views of USAID or the United States Government. USAID reserves a royalty-free nonexclusive and irrevocable right to reproduce, publish, or otherwise use, and to authorize others to use the work for Government purposes.

OHCEA extends her gratitude to those who participated in earlier works that informed the development of this module as well as reviewers and editors of the module.

Sections/parts of the materials for this course were adopted from RESPOND SEAOHUN One Health Course Modules: https://seaohunonehealth.wordpress.com/ecosystem-health/

Introduction to the One Health Central and Eastern Africa (OHCEA) One Health Course Modules

Training the Current and Future Public Health Workforce Using a One Health Approach

There is abundant evidence that no single sector or department can sufficiently manage the challenges of public health in any country, region or continent. Experiences from the fight against Ebola and the highly pathogenic avian influenza in the past few years demonstrated the effectiveness of multi-sectoral, multi-agency approaches and the need for specific training targeting multi-sectoral and multi-disciplinary public health professionals not limited by national or regional borders in dealing with public health threats. In response to this challenge, the One Health approach has been advocated as the global framework for strengthening collaboration and capacities of the sectors and actors involved in health service delivery.

One Health Central and Eastern Africa (OHCEA) is a network of universities in Central and Eastern Africa which are collaborating to build One Health capacity and academic partnerships between the member institutions in the region and with governments. The overall goal of this collaboration is to enhance One Health policy formation and implementation, to contribute to improved capacity of countries to respond to any emerging pandemics in the region. OHCEA seeks to expand the human resource base needed to prevent, detect and respond to potential pandemic disease outbreaks, and increase integration of domestic animal, wildlife and human disease surveillance and outbreak response systems.

OHCEA has identified One Health core competencies and developed modules based on the identified competencies that are key to delivering knowledge and skills to a multidisciplinary workforce and building a framework on which One Health curricula can be designed and implemented. They combine human health, animal health, infectious disease management with principles of ecology, social and environmental sciences. A total of 16 modules have been developed including One Health soft skills such as communication, culture, leadership, gender and core technical skills such as ecosystem health, infectious disease epidemiology, One Health concepts and outbreak response.

The modules are intended to:

- create a framework for One Health curriculum.
- improve workforce capacity to prevent, detect and respond to threats posed by infectious diseases and zoonosis.

One Health is defined as the collaborative effort of multiple disciplines working together locally, nationally, and globally to attain optimal health for people, animals and the environment

www.AVMA.org

The One Health paradigm emerged from the recognition that the well-being of humans, animals and the ecosystem are interrelated and interdependent and there is a need for more systematic and cross sectoral approaches to identifying and responding to global public health emergencies and other public health threats arising at the human animal ecosystem interface.

- generate a shift in countries workforce culture and training structure.
- enable working across sectors and disciplines for a stronger and more effective public health sector.
- allow universities to be key drivers of the future workforce as they forge partnerships and drive change.
- combine human health, animal health, infectious disease with principles of ecology and environmental sciences.

The modules can be used at both pre-service and in-service levels as full courses, workshops or integrated into course materials for professionals who impact disease detection, prevention and response, allowing them to successfully function as an integral part of a larger, multi-disciplinary team of professionals. This is key to creating a stronger sustainable Public Health workforce.

Each module contains a Facilitator Guide, Student Guide, PowerPoint slides and a folder of resources/ references for users. These modules are iterative and are continuously being revised. For any inquiries, please email: OneHealthModules@ohcea.org or wbikaako@ohcea.org

These 16 modules were developed by collaborative efforts of multiple disciplines and teams of people from eight different OHCEA partner countries with the support of two US university partners namely Tufts University and University of Minnesota. A team of over sixty (60) people were engaged in the development of these modules. All the materials represent contribution by the faculty and leadership of the OHCEA network institutions and the technical and managerial support of the OHCEA Secretariat. The modules were built off previous One Health modules developed by SEAOHUN- network: https://seaohunonehealth.wordpress.com/ecosystem-health/ with addition of more Africa- specific materials, examples and case studies relevant and applicable to the region. Each module was reviewed by OHCEA network faculty including US university partners with technical expertise as well as partners with field experience that allows for OH application and appreciation of the local African context.

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Overview of the Systems Thinking Module

In this 21st Century, we find ourselves facing a myriad of complex health challenges that require multi-lateral and multi-disciplinary approaches to solve. Cross-border disease outbreaks like Ebola, West Nile Virus, tuberculosis (TB) and the like, call for stakeholders all over the world to work together to address other concomitant issues surrounding the outbreaks. This is the One Health guiding principle.

One Health is an important global activity based on the concept that human, animal and environmental/ ecosystem health are interdependent. Therefore, professionals working in these areas can best serve the population by collaborating to better understand all the factors involved in disease transmission, ecosystem health, the emergence of novel pathogens and emerging zoonotic agents, including environmental contaminants and toxins that are capable of causing substantial morbidity and mortality, and impacting on socio-economic growth, including in less developed countries. The solution to One Health problems thus requires a Systems Thinking approach.

Systems Thinking is the use of various techniques to study systems of many kinds. It is the process of understanding how other systems influence one another within a complete entity or larger system. In nature, systems thinking examples would be ecosystems in which various elements such as air, water, movement, plants and animals work together to either survive or perish. In organizations, systems consist of people, structures and processes that work together to make it healthy or unhealthy. In public health and epidemiology, systems thinking approach would involve surveillance and response systems to anticipate and manage an outbreak like Ebola. Such a comprehensive system would ensure that 'hot spots' of Ebola are identified early so that local and national health care systems are quickly mobilized and policy makers are appropriately informed to take relevant action to prevent the spread of the disease. This approach would help the health policy makers build programs and policies that are aware of and prepared for unintended consequences.

Systems Thinking differs fundamentally from traditional analytical or statistical methods which focus on separating the individual components of what is being studied or analyzed. However, Systems Thinking focuses on how the 'thing' being studied interacts with other components and constituents of the system. It therefore looks at an expanded view that considers larger numbers of interacting issues within the system being studied. This is very important in generating relevant information especially when the issue being analyzed is dynamic or complex, and giving feedback from both internal and external sources.

Systems Thinking is a relevant One Health approach to problem-solving designed to help participants develop a broader system of interaction in solving infectious disease issues, increase exposure to and improve cross-sectoral and inter-professional collaboration on key disease surveillance and outbreaks. The approach also provides practical strategies useful for field investigations of disease outbreaks.

This module provides participants with the skills necessary to take a systems thinking approach to emerging pandemic diseases. Knowing that men and women have different roles and perspectives that may impact differently on interventions of emerging pandemic diseases and their outcomes, this module will integrate gender perspectives and issues at all levels of systems thinking strategies and processes that will not only add value to the planned outcomes but also promote gender equality and equity.

Target Audience

This module targets undergraduate and post-graduate learners, middle cadre trainees and in-service personnel from multiple disciplines and sectors (private, NGOs, and civil society), as well as policy makers. It can also be adopted for continuous professional development by health and health-related and professionals such as medical, veterinary, pharmaceutical, nursing, public health, environmental and technology.

Systems Thinking Training Goals

The module is designed to provide participants with capability to demonstrate:

i) systems thinking approaches in mapping One Health issues and provide practical strategies useful for field investigations of disease outbreaks, and create solutions.

ii) the gender dynamics on systems thinking towards One Health interventions in emerging pandemic, prevention, disease control, surveillance and response.

Learning Objectives

By the end of the training, participants should be able to:

i) define systems thinking, describe the core concepts of its theories and characteristics, and their application in One Health interventions.

ii) apply systems thinking skills and tools in mapping One Health problems and create solutions to problems with practical strategies useful for field investigations.

iii) use One Health systems thinking skills to improve inter-professional, inter-discipline and cross-sectoral collaboration on key disease surveillance and outbreaks.

iv) apply systems thinking skills to improve multi-sectoral cooperation among national, regional and international government health officials along with multilateral health agencies in One Health interventions.

v) demonstrate knowledge of gender and gender dynamics by systematically applying gender sensitive skills to One Health interventions in pandemic emergence, prevention, disease control, surveillance and response.

Program

Session 1	Session 2	Session 3	Session 4
Core concepts of systems thinking theories, definitions and characteristics and their application in One Health interventions	Tools and skills in mapping One Health problems Solutions to problems with practical strategies useful for field investigations	One Health systems thinking skills to improve inter-professional, inter-discipline and cross-sectoral collaboration on key disease surveillance and outbreaks	Basic gender dynamics, EPT and systematic application of One Health gender sensitive skills in disease prevention, control, surveillance and response

Module Overview

	Topic (Goal)	Learning Objectives (LO)	Instructional Activities (Mode of Delivery)	Materials	Time (Min)
01	Comprehend the core concepts of systems thinking theories, definitions and characteristics and their application in One Health interventions	1. Learn about One Health and systems thinking. 2. Give terms and definitions in systems thinking.	• Brainstorming using sticky notes to define systems thinking terminologies	Flipchart or whiteboard and markers, sticky notes, computer, LCD projector, screen/blank wall, module, the Internet and video clip	30
		3. Discuss the systems thinking theory and systems thinking characteristics.	• Lecture in PowerPoint presentation to explain theories of systems thinking • Paper reviews in groups		25
		4. Distinguish systems thinking from other forms considered traditional analytical forms of thinking.	• A two-group session to demonstrate the two types of thinking		20

02	Apply systems thinking skills and tools in mapping One Health problems and create solutions to problems with practical strategies useful for field investigations	1. Develop a concept map based on collective knowledge. 2. Understand interactions and feedbacks among the components of the map. 3. Categorize maps. Develop solutions to complex One Health problems using systems thinking tools.	• Documentary/ video clip to show different mapping systems	• Flipchart or whiteboard and markers • Computer, LCD projector, screen/blank wall • Module PowerPoint • Internet access • Video clip	60
03	Exposure to One Health systems thinking skills to improve inter-professional, inter-discipline and cross-sectoral collaboration on key disease surveillance and outbreaks	1. Map the integration points where individual systems elements (social networks, organizations, government sectors and communities) interact in a One Health challenge.	• Lecture in PowerPoint presentation to demonstrate the interaction of different disciplines and factors • Group activity and discussion on mapping different disease outbreak scenarios • Field study • Brainstorming and group activity to identify a One Health scenario and multi-discipline and multi-sectoral players' involvement	• Flipchart or whiteboard and markers • Computer, LCD projector, screen/ blank wall • Module PowerPoint • Internet access • Video clip • Group discussions • Case studies	45

		2. Utilize systems thinking approach in the One Health scenario that would improve intervention and/or surveillance. 3. Integrate information and actions across disciplines and sectors using systems thinking tools to strengthen health systems. 4. Use concepts from 'wicked' problem theory to better understand how to formulate and approach complex One Health challenges.			
04	Have knowledge of gender and gender dynamics by systematically applying gender sensitive skills to One Health interventions in pandemic emergence, prevention, disease control, surveillance and response	1. Identify basic gender principles, concepts and dynamics. 2. Identify and analyze gender roles through systems thinking. 3. Apply gender sensitive approaches in One Health interventions based on systems thinking.	• Brainstorming to identify gender awareness among participants • Group discussions to identify gender roles in disease outbreak problem scenarios • Map out gender roles in a One Health systems thinking intervention	• Flipchart or whiteboard and markers • Computer, LCD projector, screen/blank wall • Module PowerPoint • Internet access • Video clip	60

Time	Activity/ Policy	Facilitator Instructions
15 min	**Registration** 	**(Facilitator notes added at end of session)** **Registration** i) Have participants sign the OHCEA attendance register. ii) Explain logistics (e.g. breaks, meals, etc.). iii) Issue perdiem. iv) If the short course is residential, check on accommodation.
15 min	**Welcome** 	**Welcome** Facilitator's welcome remarks. **Participants' introduction:** i) In pairs, let participants share their: • Name • Where they are from • Type of work and position • The latest research they have been engaged in ii) Let participants prepare a one-minute introduction of their partner to the class. iii) Go around the room and have each pair present their partner to the class.
	Expectations 	**Expectations** **Set up:** Have two flipcharts in the front of the room: one titled "Expectations" and the other "Concerns." i) Give each participant two different colored sticky notes. ii) Ask them to write down their expectations for the short course on one of the sticky notes (specify color) and their concerns about the course on the second sticky note (specify color). iii) Have participants place their expectations sticky notes on a flipchart titled "Expectations" and their concerns sticky notes on another flipchart titled "Concerns". iv) Organize the sticky notes per common theme. v) Explain the agenda for the week and the goals of the short course, highlighting the expectations that would be met over the week and those that would not be met. Comment on and address the concerns.

Goals of the Short-Course

The goal is for the participant to:

i) comprehend the core concepts of systems thinking.

ii) apply systems thinking skills in mapping One Health problems and provide practical strategies useful for field investigations of disease outbreaks, and create solutions to One Health problems.

iii) have increased exposure to One Health systems thinking skills to improve cross-sectoral, inter-professional and inter-discipline collaboration on key disease surveillance and disease outbreaks.

iv) have systems thinking skills for improved cooperation among national, regional and international government health officials along with multilateral health agencies in One Health interventions.

v) have knowledge of gender and gender dynamics by systematically applying the knowledge gained to One Health interventions in emerging pandemic, prevention, disease control, surveillance and responses.

Explain that this course is sponsored by One Health Central and Eastern Africa (OHCEA) network. OHCEA network comprises 24 schools of public health and veterinary from eight African countries and two US partner universities: Tufts University and the University of Minnesota. This project is funded through the USAID - Emerging Pandemics Threat 2 grant.

Vision

OHCEA's vision is to be a global leader in One Health, promoting sustainable health for prosperous communities, productive animals and balanced ecosystems. OHCEA seeks to expand the human resource base needed to detect and respond to potential pandemic disease outbreaks.

30 min

Guest Speaker and Pre-test

Guest Speaker

In advance, be sure the speaker is prepared to address the group. Share with him/her the goals of the short course, the desired outcomes and what you would like him/her to emphasize in her/his address.

Introduce the invited guest speaker to "officially open the course."

Pre-test

Distribute copies of the pre-test to the participants and inform them that they have 15 minutes to complete it. Explain that a pre-test is used to gauge how much they will have learned from the pre-training reading material and that a post-test will be administered at the end of the course. Results from the two tests would be compared. There is no grade associated with the pre-test. When participants finish, they can begin their break.

Break

120 min

Pre-Training Reading Material

Distribute the following 2 documents to participants to read before they come to the training.

The Application of Systems Thinking in Health: Why use Systems Thinking? By David H. Peters

https://health-policy-systems.biomedcentral.com/articles/10.1186/1478-4505-12-51

One Health: Interdependence of People, other Species and the Planet by Meredith A. Barret and Steven. A. Osofsky

https://rmportal.net/groups/one-health-students-online-platform/one-health-interdependence-of-people-other-species-and-the-planet/view

Session 1: The Core Concepts of Systems Thinking Theories, Definitions and Characteristics and their Application in One Health Interventions

This opening session provides participants with an overview of systems thinking, its terms, definitions, concepts, theory and characteristics. Systems Thinking is relevant to One Health approach in problem-solving as it will help participants develop capacity to think in a broader system of interaction in solving infectious disease issues.

Learning Objectives

By the end of this session, participants should be able to:

i) define the core concepts of One Health, system and systems thinking.

ii) discuss the systems theory and systems characteristics.

iii) distinguish systems thinking from traditional analytical forms of thinking.

iv) describe the elements of complex problems through systems thinking.

v) evaluate the advantages of a systems thinking approach in health systems.

vi) apply systems thinking skills in mapping One Health problems and provide practical strategies useful for field investigations of disease outbreaks, and create solutions to One Health problems.

15 min

Discovery Activity: What is One Health?

Facilitator Instructions

Begin the session by having participants watch the following videos:

One Health: From Concept to Action by CDC

https://www.youtube.com/watch?v=TG0pduAYESA

One Health: From Idea to Action:

https://www.youtube.com/watch?v=gJ9ybOumITg&t=4s

Briefly discuss with participants the two videos.

20 min

Have each participant take 5-7 minutes to think about and write down on separate sticky notes the answers to the following questions:

1. Define One Health approach.
2. Identify two examples of One Health in practice.
3. Identify two to three advantages of multiple disciplines working together to promote One Health.

Have participants display these sticky notes on the wall in the three separate sections. Then in a plenary, review the following:

1. What are the common things identified?
2. What are the differences?
3. Is there anything that surprised anyone?

Come up with a group description of what One Health is.

There are many different definitions of One Health by different health organizations, but for purposes of this course, we will adopt the American Veterinary Medical Association (AVMA) definition of One Health (www.avma.org). AVMA defines **One Health as the integrative (collaborative) effort of multiple disciplines working together locally, nationally, and globally to attain optimal health for people, animals, and the environment.** Together, the three make up the **One Health** triad, and the **health** of each of them is inextricably connected.

The common theme of One Health is multiple disciplines working together to solve problems at the human, animal and environmental interface. Collaborating across sectors that have a direct or indirect impact on health involves thinking and working across silos and enhancing resources and efforts while valuing the role each sector plays. To improve the effectiveness of the One Health approach, there is need to create a balanced and greater relationship among existing groups and networks, especially between veterinarians and physicians. It is equally vital to amplify the role that environmental and wildlife health practitioners, as well as social scientists and other disciplines play to reduce public health threats.

In less than 10 years, One Health has gained significant momentum. It is now a fast growing movement. The approach has been formally endorsed by the European Commission, the US Department of State, US Department of Agriculture, US Centers for Disease Control and Prevention (CDC), World Bank, World Health Organization (WHO), Food and Agriculture Organization of the United Nations (FAO), World Organization for Animal Health (OIE), United Nations System Influenza Coordination (UNSIC), various universities, NGOs and many others.

The One Health movement is an unexpected positive development that emerged following the unprecedented global response to the highly pathogenic avian influenza. Since the end of 2005, there has been increasing interest in new international political and cross-sectoral collaborations on serious health risks. Numerous international meetings and symposia have been held, including major initiatives in Winnipeg (Manitoba, Canada, March 2009), Hanoi (Vietnam, April 2010), and Stone Mountain (Georgia, US, May 2010), as well as four international One Health scientific congresses. The last one took place in Melbourne, Australia, in December 2016.

20 min

Introduction to One Health Concepts

Give a PowerPoint presentation introducing participants to One Health and its core competencies, (PPP No. 1) the interdependence between humans, animals and environment, and the need for disciplines to work together. The presentation answers questions such as: Why One Health? Why One Health now?

Debrief participants after the session by asking them to reflect on:

i) what One Health is.

ii) what they have gained from the PowerPoint presentation.

As part of this presentation, discuss One Health core competencies, and how systems thinking is a key competency required to be effective One Health change makers.

45 min

Discovery Activity: What is Systems Thinking?

To understand and appreciate the relationship within systems, it is important to adopt systems thinking to tackle complex health problems and risk factors. Systems thinking has huge and untapped potential first, in deciphering the complexity of a public health issue; and second, in applying this understanding to design and evaluate interventions that improve health across other areas. Systems thinking can provide a way forward for operating more successfully and effectively in complex real world settings.

Divide participants into two groups. Each group will receive one of the following scenarios:

Scenario 1:

There is a severe drought affecting Kenya, which has driven up the cost of food and fueled inflation, and has become a key issue on the election campaign trail. Food security has deteriorated since the end of 2016 and conditions remain dire in half of the country's 47 counties. The situation has been exacerbated by the impact of climate change, and it is anticipated that some regions could reach emergency levels by September . The consequences of this drought could stretch across many sectors including agriculture, education, livestock, and even cause political instability.

Scenario 2:

In January 2010, a catastrophic 7.0m earthquake struck Haiti with an epicenter near the town of Léogâne, killing anywhere from 100,000 to 316,000 people and displacing an estimated three million inhabitants. Ten months later, the world's worst cholera epidemic in modern times broke out in the rural Center Department of Haiti, about 65 miles north of the nation's capital, Port-au-Prince killing at least 10,000 people and infecting an estimated 800,000 more.

By the first ten weeks of the outbreak, cholera had spread throughout Haiti. In an update, the *New York Times* reported that the UN's "auditors found that poor sanitation practices remained unaddressed not only in its Haitian mission but also in at least six others in Africa and the Middle East." Despite the horrific and shameful lessons learned in Haiti, UN peacekeepers throughout the world are still lax in their adherence to established protocols for waste water, sewage, and hazardous waste disposal.

Let the groups discuss the following questions:

1. In each scenario, can you identify at least 5 consequences of the problem?
2. Can you identify 5 different stakeholders in the problem?
3. Can you discuss the different sectors/disciplines/departments that should be engaged in analyzing the problem and developing solutions?
4. What different ways can you use to solve the crisis?

For example, in the first case, some consequences would include:

i) Drought
ii) Food crisis: maize deficit up to 16 million tons
iii) Malnutrition
iv) Loss of livelihoods
v) Livestock deaths
vi) Water shortage leading to hydroelectric power shortage
vii) Disease outbreaks as water resources are shared
viii) Cholera
ix) Environmental degradation
x) Political instability

The groups should present their findings in a plenary. Use this to generate a discussion.

These two problems cannot be approached unilaterally. They need a systems thinking approach to identify the multifaceted layers and to generate solutions. The solutions will require input from different building blocks including government sectors, communities, financial resources, information and service delivery sector. All these sectors need to coordinate and collaborate effectively to get a satisfactory solution.

Systems are rarely simple and when you begin to learn about a system, its complexity may be overwhelming. Systems thinking approach allows us to begin to understand the complexity and use it to find answers that matter.

15 min

Using Concept Maps to Distill the Problem Further

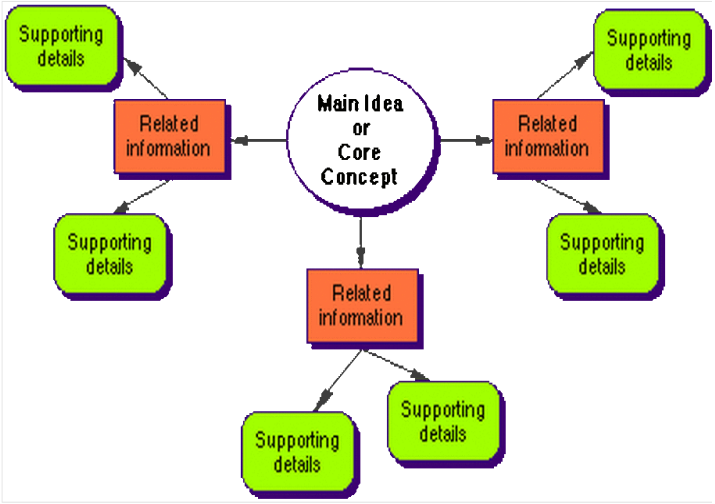
Concept mapping is a technique used to show the relationship of concepts/ideas/facts. The visual representation, usually a web connecting nodes, illustrates participants' understanding of the information being considered from the problem to the solution. Participants create their own understanding through interactions with the things/content/experiences that are part of the problem.

Have participants in their groups create a concept mapping of the problem under discussion and its various consequences by:

i) starting with the "core" of the problem, as a node, typically in the center of a page.

ii) extending lines outward from the center-node to the next levels/elements/components of the problem, to create relationship with and among sub-nodes.

iii) expanding the map/web to integrate and inter-relate all relevant elements of the problem.



Let each group keep drawing as far out as possible to see the levels to which the problems extend. For each problem, participants should identify resources, stakeholders and solutions. Display the concept maps on the wall and do a walk through.

To debrief this section, discuss how participants were able to think through the different levels of the problem, based on the exercises:

i) In a plenary discussion, let each group come up with a description of what systems thinking is.

ii) Have each group define what systems thinking approach means as opposed to traditional analytical thinking.

15 min

PowerPoint Presentation on One Health Systems Thinking

Give a PowerPoint presentation on One Health systems thinking. After this PowerPoint presentation, (PPP No. 2) have participants write on one sticky note two examples of what they would consider One Health complex problems and on another sticky note two ways they would use a systems thinking approach to find solutions to the problem. Put these on the wall and do a quick discussion asking them why they specifically chose those issues and why they chose the solutions they gave.

Time	Activity/ Topic	Facilitator Instructions
20 min	**Video - Cats in Borneo** 	**Watch the following two videos:** **Video clip : Systems Thinking: A Cautionary Tale - Cats in Borneo** https://www.youtube.com/watch?v=17BP9n6g1F0 After watching this video, have each participant take 10 minutes to think and write on separate sticky notes, answers to the following questions from lessons learned in the video clip 1. 1. What started the problem? - *Malaria* 2. Explain the ripple effect of spraying the mosquitoes with DDT? 3. What is the importance of considering the whole? Have each participant take 10 minutes to think about and legibly write down on separate sticky notes, the answers to the following questions from lessons learned in the video clip 2. 1. List as many elements as possible that form and sustain a stable environment. 2. Describe the interconnectivity between the elements of the environment. 3. What practices have contributed to making the environment unstable? 4. What do you understand by the phrase 'unsustainable use of resources'? 5. Can the actions of one sector fix the environment? **Debrief** In concluding this section, have participants write on one sticky note two examples of what they would consider One Health complex problems; on another sticky note, let them write two ways they would use a systems thinking approach to find solutions to the problem. Put these on the wall and do a quick discussion by asking them why they specifically chose those issues and why they chose the solutions they gave.

Session 2: Applying System Thinking skills and tools in mapping One Health problems and create solutions with practical strategies useful for field investigations.

In this session, participants will be able to appreciate systems thinking as the art of making reliable inferences about system behavior by developing a deeper understanding of underlying structures. If you understand the component elements of a system and how they are connected with one another, you can predict the way the system might behave in a given situation. Through discussions, participants will interrogate what system thinking is all about.

Learning Objectives

By the end of this session, participants should be able to:

i) identify the building blocks of a One Health system and essential elements of a One Health challenge/problem and map its components.

ii) identify the skills of a systems thinker.

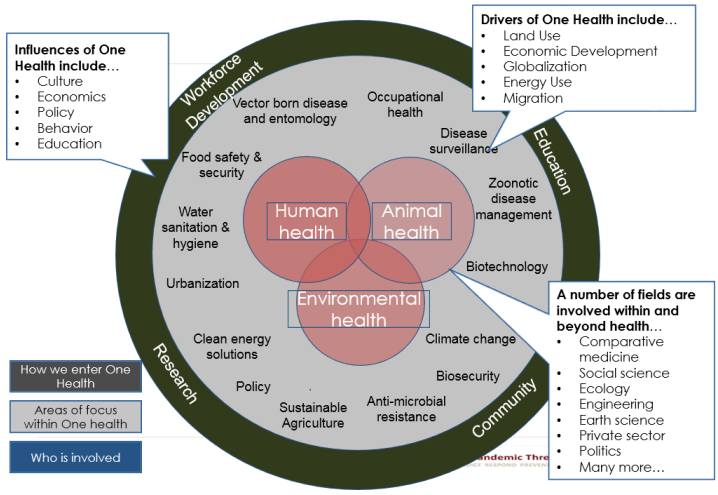
iii) critically think through a complex One Health problem and develop solutions using One Health problem-based learning cases.

Activity/ Topic	Facilitator Instructions
Building Blocks of a One Health System	Systems thinking views problems as part of a wider dynamic system. It involves much more than a reaction to present outcomes or events. It demands a deeper understanding of the linkages, relationships, interactions and behaviors among the elements that characterize the whole system.
 **Group Activity**	**Group Activity** The first step is to analyze the building blocks of a system. The following image shows the building blocks of a standard human health system.

System Thinking For Health Systems Strengthening.
World Health Organization

i) Divide the participants into two groups and ask them to draw what they would consider building blocks for a One Health system.

ii) Let them consider the human, animal and environmental interactions, the drivers of disease emergence, and the different players and stakeholders that should be part of it. The picture might look like the following:



iii) Discuss the different elements in the above image including the inner circle, the middle circle and the outer circle as well as the different drivers and influences of One Health.

Skills of System Thinking

Given the complex relationships and dynamic characteristics of One Health system, applying conventional approaches commonly used to identify problems, create solutions and implement interventions will not take us far enough. We need a radical shift in the intervention design and the use of creative and critical thinking skills.

Group Activity

Using sticky notes, have participants write down at least two skills of systems thinking. Review these in the plenary. Then present the following table and discuss with participants.

Usual approach	Systems thinking approach
Static thinking	**Dynamic thinking**
Focusing on particular events	Framing a problem in terms of a pattern of behaviour over time
Systems-as-effect thinking	**System-as-cause thinking**
Viewing behaviour generated by a system as driven by external forces	Placing responsibility for a behaviour on internal actors who manage the policies and "plumbing" of the system

Tree-by-tree thinking	Forest thinking
Believing that really knowing something means focusing on the details	Believing that to know something requires understanding the context of relationships
Factors thinking	**Operational thinking**
Listing factors that influence or correlate with some result	Concentrating on causality and understanding how a behaviour is generated
Straight-line thinking	**Loop thinking**
Viewing causality as running in one direction, ignoring (either deliberately or not) the interdependence and interaction between and among the causes	Viewing causality as an on-going process, not a one-time event, with effect feeding back to influence the causes and the causes affecting each other

World Health Organization

Problem-Based Learning in Systems Thinking

Developing Critical and Creative Thinking Skills by using Problem-Based Learning in Systems Thinking.

In this session, a Problem-Based Learning case will be used. You need to be conversant with Problem-Based Learning and how it works.

PBL is a system of inquiry where people are trained to become problem-solvers through identification and analysis of the problem. It is commonly used by different disciplines for it allows users to review a problem from multiple perspectives.

PBL requires special teaching techniques in which the teacher facilitates learning by supporting, guiding and monitoring the teaching and learning process. The goals of PBL are to help the participants develop flexible knowledge, effective problem-solving skills, self-directed learning, effective collaborative skills and intrinsic motivation, in addition to domain-specific technical skills and knowledge.

In a PBL model, participants work collaboratively to solve real-world complex problems. To solve these problems, participants create learning plans for how they will acquire the knowledge and skills necessary to develop solutions. In seeking solutions, participants interact with academic and technical experts, as well as a range of stakeholders including business and government, non-governmental and community-based organizations.

In this session, participants will be provided with a One Health PBL case and will use PBL techniques to arrive at a solution. Start the session by making a presentation on what PBL is and the need to use PBL.

Problem-Based Learning — What is it?

Have participants watch the video on what PBL is.

https://www.youtube.com/watch?v=sNhismExIwU

Introduce participants to the different trigger systems used in PBL and then have them work through the One Health PBL case on Rift Valley Fever.

This session will take two hours. Participants will be expected to spend two hours daily to continue working on this PBL case study for a total of 3 days. So, ensure that time is curved out of the daily program for this.

Session 2: One Health systems thinking skills to improve inter-professional, inter-discipline and cross-sectoral collaboration on key disease surveillance and outbreaks

In this session, participants will be exposed to the interrelationships between various disciplines involved in responding to issues that occur at the interface of animal, human and environmental health in any One Health approach. It will be an experiential learning session where participants will work together to document interactions between different sectors when solving a One Health issue like an anthrax outbreak. You need to encourage them to create and use system mapping to deepen their understanding of One Health problems. They will also be able to use concept mapping to explore a complex issue and experientially learn about systems thinking. As an activity, they will identify a One Health challenge and map out its components in a systems thinking approach using relevant sections of One Health Systems Mapping and Analysis Resource Toolkit (OH-SMART).

Learning Objectives

By the end of this session, participants should be able to:

i) Identify the essential elements of a One Health challenge/ problem and map its components.

ii) Map the integration points where individual systems elements (social networks, organizations, governments, communities, ecosystems) interact in a One Health challenge.

iii) Utilize systems thinking approach in the One Health scenario that would improve intervention.

iv) Integrate information and actions across disciplines and sectors using systems thinking tools.

v) Use concepts from 'wicked' problem theory to better understand how to formulate and approach complex One Health challenges.

Activity/ Topic	Facilitator Instructions

Another vital aspect of systems thinking revolves around how systems' stakeholder networks are included in the system. Stakeholders are not only at the center of the system as mediators and beneficiaries, but also as actors driving the system. This includes their participation as individuals, civil society organizations, government ministries, managers, policy makers, stakeholder networks and health care workers.

Each stakeholder may see the purpose of the system differently. This should be considered positive because it brings different perspectives. Divide participants into two groups and present them with the following case studies. Ask them to answer the questions that follow.

Karatu Case Study

(Case studies included at the end of the session)

System Stakeholder Networks:

Questions

1. What is the problem? Who is affected? What are the challenges?
2. What do you see as the social, economic, political problem of this snag?
3. What key One Health issues can be identified?
4. What sectors are involved?
5. Are there any government policy implications?
6. What measures can be done to protect the health of humans, animals and the environment?
7. Can you give similar examples from your own background/ work? How did you deal with it?

Mining in Lake Tshangalele: Environmental and Health Impact Assessment in the Democratic Republic of Congo

http://www.amnesty.org/en/news/chinese-mining-industry-contributes-abuses-democratic-republic-congo-2013-06-19

Questions

1. Given this scenario, what are the One Health issues that arise and who is affected?
2. Identify the multiple stakeholders or players in this scenario.
3. Develop a gender-sensitive intervention strategy for this community.
4. Who would be your key players in the intervention strategy?
5. What do you think could be the possible causes of the health problems affecting the community?
6. How would you investigate the problem? What simple steps can be taken to investigate the problem?
7. What are the main gender considerations in this scenario and how would you address them?

Stakeholder Mapping

Give participants the following instructions:

You have been provided with a set of sticky notes and a plain sheet of paper.

i) On a sticky note, write the name of the stakeholder or player in your case study scenario. Write one name on each sticky note. Write as many stakeholders as you can think of. Identify them by their roles. Consider their gender as well especially at the community level.

ii) Line the sticky notes on the plain piece of paper according to whether they are international, national, regional or local.

iii) Using a red marker, draw a circle around those stakeholders with lots of power and authority.

iv) Draw a square around those players with the most interest in the activity or who are impacted on the most.

v) Using a red marker, draw arrows that show the flow of decision-making (power and authority) from one stakeholder to another.

vi) Using a green marker, draw arrows that show the flow of resources (funding) from one stakeholder to another.

vii) Using a blue marker, draw arrows that show communication flow from one stakeholder to another.

viii) Have the groups discuss the map and the following questions:

1. Who has power and authority?
2. Who do you think should have power and yet does not?
3. Who is being left out of the different arrows and yet considered important? How do you include them?
4. Can you identify any gender differences in power, communication and resource flow?

One Health Systems Mapping

(This tool/activity was adopted from the OH-SMART toolkit developed by the University of Minnesota in collaboration with the United States Department of Agriculture.

https://www.vetmed.umn.edu/centers-programs/global-one-health-initiative/one-health-systems-mapping-and-analysis-resource-toolkit

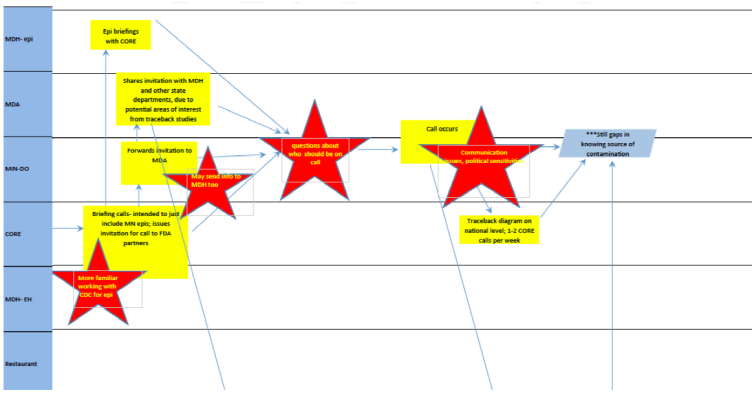
Instructions

Using the two case studies above, draw a table consisting of many rows and two columns. The first column shows the stakeholders involved in the event. The second column shows the timeline of their involvement. The mapping will be done from the left to the right.

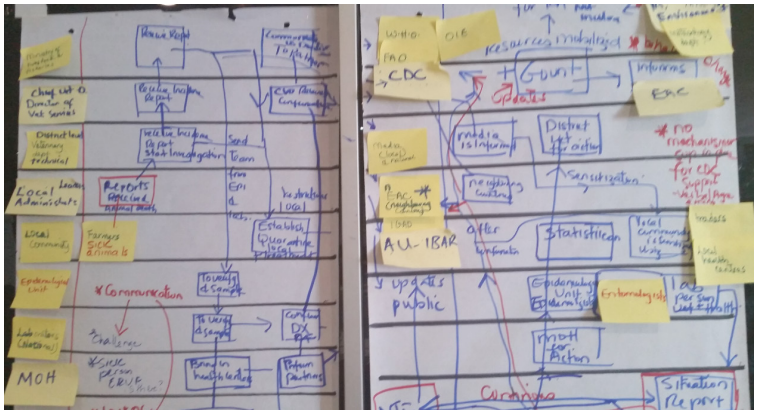
	Over Time
Agency	
Agency	
Agency	
Agency	

Beginning at the center of the table on the left, insert the first stakeholder and the genesis of the public health event: i.e. an animal suspected of having rabies bites a child. Draw a square around this activity. In the left column enter community member as your stakeholder. Using an arrow, link up this activity to what happens next and the stakeholder involved in that next activity. For example, a child goes to local health center and receives first aid. Now enter the second stakeholder in the next row—that would be the local health center. Keep adding activities as they happen in a chronological order and all the stakeholders until you have a map linking up the stakeholders to one another and to the activities happening. If you think there is any missing information, put a question and star it for discussion.

Example of map



Sample systems map for Rift Valley Fever outbreak in Uganda



After Mapping

i) Identify the steps that may not be clearly understood or accepted; show discrepancies or differences in responses noted by stakeholders or duplication of functions.

ii) Note any significant stakeholders not included in the map. For example, in the Rift Valley Fever case, the environment department and entomologists were not included in the mapping, showing a clear gap since these two groups play a major role in the surveillance for RVF.

iii) Mark interactions that are working well and how they might be made more effective.

Groups should present the maps to the rest of the class.

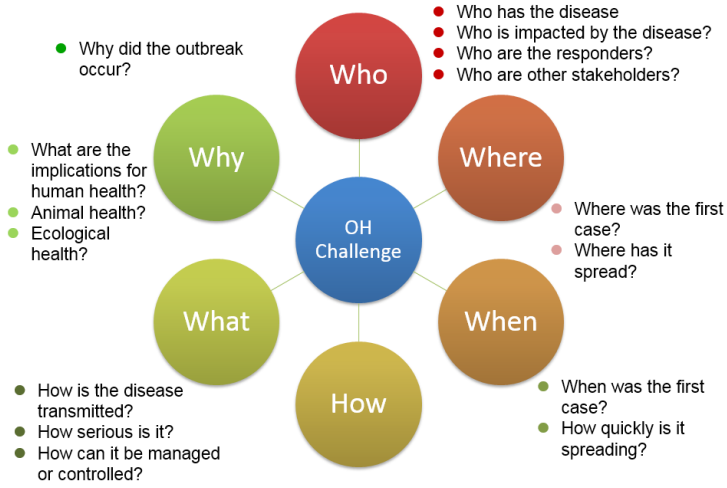
90 mins

One Health Systems Thinking Map

Systems thinking, from a One Health perspective allows us to solve "wicked complex problems" through a simplified process. It provides a means of analyzing the human, animal and environmental interactions and the different disciplines engaged, and how they work together as a system to solve complex health problems. It systematically covers the policies, processes, practices and people, the roles each play and how they interact to function effectively to solve public health threats.

The One Health systems thinking uses the problem-defining approach to identify and solve the problem.

As a next step, each group should use the following systems map to continue to think through engaging stakeholders and analyze the above two case studies based on this.



Groups should present their systems' maps and briefly discuss the questions above. Summarize the session by stressing the need to simplify the problem and solve it step by step.

Session 4: Basic gender dynamics, EPT and systematic application of One Health gender sensitive skills in disease prevention, control, surveillance and response

Men and women have different roles and perspectives that may impact differently in interventions of pandemic emergence diseases and their outcomes. In this session, participants will become more aware of different gender roles, dynamics and perspectives that will enable them to effectively apply gender-sensitive approaches through systems thinking to solve pandemic emergence, prevention, disease control, surveillance and responses. They will also be exposed to gender concepts and dynamics and how to perform a gender analysis in order to systematically integrate gender issues in multi-sectoral, multi-lateral systems thinking approaches to One Health interventions.

The session will culminate in a simulation exercise and evaluation to deepen understanding of complex systems thinking processes, followed by a session on developing brief gender-sensitive case studies that can be used as part of this training.

Learning Objectives

By the end of this session, participants should be able to:

i) identify basic gender principles, concepts and dynamics.

ii) identify and analyse gender roles through systems thinking.

iii) apply gender-sensitive approaches in One Health interventions based on systems thinking.

Activity/ Topic	Facilitator Instructions
Ensuring Gender Sensitivity in a Systems Thinking Approach 	When applying systems thinking approaches, ensure activities are all inclusive. Therefore, considering gender issues, culture and social-economic status of different stakeholders is important. Gender impacts intervention programs. **Divide participants into four groups and have them analyze the following four scenarios.** **Group 1** In this community, there is conflict between the people and the national parks, because the community is collecting medicinal plants and firewood from the national parks — an area that is protected. Wildlife has also been destroying the villagers' crops and killing their domestic animals. The national park management has been having meetings with the village men in the evening at the local men's club to map out a strategy on how to solve the problem.

Expected Response

The meetings are held at the local men's club in the evenings which limits women who are care providers for children from attending. In some communities, women are not even allowed to go out at night. The park authority does not include women in its plans and does not consider the fact that most of the people who collect medicinal plants and firewood are women. For this reason, they should be a key stakeholder in the decision-making.

Group 2

There is an outbreak of avian influenza in this community. The government decides to pass a policy that to completely eradicate this disease, all the poultry will be slaughtered, and farmers with more than 50 birds will be compensated. Backyard poultry farmers are not compensated because most of them do not have more than 50 birds. The disease continues to spread.

Expected Response

In this scenario, most backyard poultry farmers and people who keep less than 50 birds are women. If they are not compensated and yet they have lost their birds, they lose their livelihoods. The policy did not consider the roles and livelihoods of the women. As a result, whenever the women detect any sick birds, they quickly slaughter them and bring them to the markets for sale, thereby spreading the disease.

Group 3

The government in the country you work in wants to target farmers for training in poultry production and on avian influenza prevention and control. To implement this policy, the government has asked the animal health workers in the communities to identify people for training. Since men are the heads of households and the decision makers, they are selected to attend the training.

Expected Response

In most communities that were affected by avian influenza, the poultry caretakers were women. The women should therefore have been a key target for disease prevention training. However, since they are not part of the leadership circle in many communities, they are not involved in identifying trainees and cannot voice their opinion. It has been proven previously that even if the men were trained, they may not deliver the information to their wives and so the disease will still spread.

Group 4

There is an outbreak of brucellosis in this community. Humans have been presented at the health center with undulating fevers. They also have increased abortions among their animals. The disease is transmitted through contaminated milk and milk products. The department of human health decides to create awareness by informing people through the radios that they should boil milk and cook the meat thoroughly. They are puzzled when the outbreak continues.

Expected Response

In this community, women do not generally listen to the radio. In fact, most radios are owned by men, and they usually listen to the news communally when they have men's gatherings between 2:00 pm and 5:00 pm at the marketplace. Women are not allowed in these gatherings. This is also the time when women are busy completing other household chores like collecting firewood. Communicating policy events requires that you know the audience you are targeting.

Ask participants to think specifically about gender issues and share similar experiences. They should think about ways in which a systems thinking approach is gender-sensitive.

Ebola and Gender Case Study

Case Study: Ebola Epidemiology and Gender Issues

Questions

1. Why do you think in the 2001-2002 outbreak of Ebola in Congo and Gabon, more men than women were infected in the early stages of the outbreak?
2. Why do you think the cases of women later outnumbered the cases of men in this outbreak?
3. Why is it that the cases of women exceeded the cases of men for the duration of the outbreak of 2000–2001 in Gulu, Uganda?
4. Explain why in the outbreak of 1976 in Sudan, there were more cases of men than of women.
5. In the 1979 outbreak in Nzara and Yambio, Sudan, why is it that a large proportion of those infected were women?
6. How do you ensure that the scenario portrayed in the case study is avoided?
7. Ask participants to identify the different disciplines represented in the case study.
8. What disciplines are missing?
9. What roles would the missing disciplines have played to improve on the situation?
10. Ask participants if they spotted elements of systems thinking or the lack of it in the case study.
11. Discuss in a plenary what the consequences are of not systematically thinking the problem through.

The case study demonstrates interconnectivity of health challenges and the benefits of a multidisciplinary systems thinking approach to their mitigation.

Key concepts include:

i) Health emergencies are not limited to one sector.

ii) Human activity, agricultural practices and gender roles can contribute to disease transmission.

iii) The benefits of cross-sectoral cooperation and the sharing of resources leads to the prevention of disease at the root, which is economical and can save lives.

iv) Primary health strategies need to include education about disease and disease transmission.

Debrief, Reflection and Conclusion of Workshop

Conclude the workshop by allowing participants time to reflect on the training. They should each state one thing they liked about the workshop and one they think should be added to the training.

Give them time to fill in the post-test and OHCEA evaluation form. If a guest speaker is invited to close the ceremony and give out certificates, then that should conclude the workshop. Any logistics issues should also be dealt with.

OHCEA Event Evaluation – System Thinking Training

Facilitators: _____

Dates: _____

OHCEA supported you to attend the System Thinking training. Please take a few minutes to fill out the following confidential questionnaire. Your responses will help us better understand the value of this event and improve future programs. Thank you!

Please circle your response to each of the following

1. This event met my expectations.
   (a) Strongly disagree
   (b) Disagree
   (c) Agree
   (d) Strongly agree
   (e) Don't know
2. This event was relevant to my personal interests.
   (a) Strongly disagree
   (b) Disagree
   (c) Agree
   (d) Strongly agree
   (e) Don't know
3. This event was relevant to my professional interests.
   (a) Strongly disagree
   (b) Disagree
   (c) Agree
   (d) Strongly agree
   (e) Don't know
4. The information presented was new to me.
   (a) Strongly disagree
   (b) Disagree
   (c) Agree
   (d) Strongly agree
   (e) Don't know
5. The amount of information provided was:
   (a) Not enough
   (b) About right
   (c) Too much
6. This event helped clarify my understanding of "One Health."
   (a) Strongly disagree
   (b) Disagree
   (c) Agree

(g) Strongly agree
(h) Don't know

7. The pre-event logistics were well organized.
   (a) Strongly disagree
   (b) Disagree
   (c) Agree
   (d) Strongly agree
   (e) Don't know

8. The event itself was well organized.
   (a) Strongly disagree
   (b) Disagree
   (c) Agree
   (d) Strongly agree
   (e) Don't know

9. Overall, I found this event to be worthwhile.
   (a) Strongly disagree
   (b) Disagree
   (c) Agree
   (d) Strongly agree
   (e) Don't know

10. I intend to take actions in my work because of what I have learned at this event.
    (a) Strongly disagree
    (b) Disagree
    (c) Agree
    (d) Strongly agree
    (e) Don't know

11. Describe what, if any, actions you will take in your work because of this event.

12. What were the strengths of this event?

13. What can be done to improve this event?

14. What single most important lesson did you learn from this event?

15. Please write any additional comments you may have about this event.

16. Did you present at this event?
    (a) Yes
    (b) No

17. (a) If yes, what was the topic of your presentation?

18. What is your *primary* area of work?
    (a) Nursing
    (b) Human Medicine
    (c) Veterinary Medicine
    (d) Wildlife Medicine
    (e) Public Human Health
    (f) Public Veterinary Health
    (g) Other (please specify): _____

8. Which sector do you represent?
    (a) Government
    (b) Private sector
    (c) Education
    (d) Non-governmental organization (NGO)
    (e) Research
    (f) Other (please specify): _____

7. What is your sex?
    (a) Male
    (b) Female

3. Nationality: _____

Facilitator Notes

Definitions of Different Terms

Global health is the health of populations in a global context and transcends the perspectives and concerns of individual nations. In global health, problems that transcend national borders or have global, political and economic impact are often emphasized. It has been defined as "the area of study, research and practice that places priority on improving health and achieving equity in health for all people worldwide". Thus, global health is about worldwide improvement of health, reduction of disparities, and protection against global threats that disregard national borders. (www.who.org)

- **Environmental Health** is the branch of public health that is concerned with all aspects of the natural and built environment that may affect human health. Other phrases that concern or refer to the discipline of environmental health include environmental public health and environmental protection. Environmental health, being closely related to environmental science and public health, is concerned with environmental factors affecting human health. Environmental health addresses all the physical, chemical and biological factors external to a person and all the related factors impacting behaviors. It encompasses the assessment and control of those environmental factors that can potentially affect health. It targets preventing disease and creating health-supportive environments. This definition excludes behavior not related to the environment, but to the social and cultural environment and genetics.
- **Ecological Health (Eco Health**): The Eco Health approach focuses mainly on the place of human beings within their environment. It recognizes that there are inextricable links between humans and their biophysical, social, and economic environments, and that these links are reflected in a population's state of health (International Development Research Centre). The mission of Eco Health is to strive for sustainable health of people, wildlife and ecosystems by promoting discovery, understanding and trans-disciplinarity. Eco Health Alliance works at the intersection of ecosystem, animal and human health through local conservation programs, and it develops global health solutions to emerging diseases. It is an international organization of scientists dedicated to the conservation of biodiversity. Eco Health Alliance focuses on innovative research, education and training, and accessibility to international conservation partners.
- **Ecosystem Health** is a metaphor used to describe the condition of an ecosystem. Ecosystem condition can vary as a result of fire, flooding, drought, extinctions, invasive species, climate change, mining, overexploitation in fishing, farming or logging, chemical spills, and a host of other reasons. There is no universally accepted benchmark for a healthy ecosystem, but the apparent health status of an ecosystem can vary depending on which health metrics are employed in judging it and which societal aspirations are driving the assessment.
- **Planetary Health**: Planetary health is the newest kid on the block, which is defined as the achievement of the highest attainable standard of health, wellbeing, and equity worldwide through judicious attention to the human systems – political, economic, and social – that shape the future of humanity, and the earth's natural systems that define the safe environmental limits within which humanity can flourish. – (Planetary Health Alliance).

Organizations Operating in the One Health Sphere

i) World Health Organization (WHO)
ii) Food and Agriculture Organization (FAO)
iii) World Organization for Animal Health (OIE)
iv) One Health Initiative
v) United States Centers for Disease Control (CDC)

vi) Eco Health Alliance
vii) United States Agency for International Development (USAID)
viii) One Health Central and Eastern Africa (OHCEA)
ix) Southeast Asia One Health University Network (SEAOHUN)
x) Universities, departments, centers, etc.
xi) Ministries of health, agriculture, environmental resources, etc.
xii) Medical or health professional associations

- The One Health concept is a worldwide strategy for expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals and the environment. The synergism achieved will advance health care for the 21st century and beyond by accelerating biomedical research discoveries, enhancing public health efficacy, expeditiously expanding the scientific knowledge base, and improving medical education and clinical care. When properly implemented, it will help protect and save untold millions of lives in our present and future generations. – *One Health Initiative*
- The One Health concept recognizes that the health of humans is connected to the health of animals and the environment. CDC uses a One Health approach by working with physicians, ecologists, and veterinarians to monitor and control public health threats. We do this by learning about how diseases spread among people, animals, and the environment. – *United States Centers for Disease Control*

Case Study 1: Karatu District, Arusha, Tanzania

Karatu District Arusha Tanzania

Karatu district is located in Arusha region, Tanzania and is known by its agricultural activities. People practice irrigation farming. Among the major drawbacks that farmers face are pests. As a means to overcome such problems, farmers indiscriminately use pesticides to protect their crops. This practice has been reported to be associated with many problems to the people, domestic and wild animals and the environment at large. Cases of abortions in humans and animals are quite high in the district and are associated with pesticide poisoning. Skin diseases and infertility are also rampant especially to people working in horticultural farms. Incidences of fish and aquatic bird mortalities especially lesser flamingoes (*Phoenicopterus minor*) are observed and are all linked with pesticide poisoning.

In 2004, up to 45,000 lesser flamingoes died at Lake Manyara, which is being fed by rivers draining from the agricultural fields in Karatu district. Studies have shown high levels of pesticide residues in milk, beef and eggs of local chickens. A case control study conducted in pregnant women who go to be delivered at Mount Meru Hospital in Arusha showed that they had very high levels of pesticide residues in breast milk and abdominal fats. The newly born babies also had high levels of pesticides in muconeum and umbilical blood. Studies further showed high levels of pesticides in water collected from Lake Manyara and different rivers around irrigated farms.

Efforts have been made by the government to overcome the problem. The Tanzania Ministry of Agriculture has been conducting seminars, extension work and restricting use of pesticides including advocating for the integrated pest control systems. But the problem still exists and is getting worse.

Questions on Karatu Case Study

1. What is the problem? Who is affected? What are the challenges?
2. What do you see as the social, economic and political problem in this?
3. What key One Health issues can be identified?
4. What sectors are involved?
5. Are there any government policy implications?
6. What measures can be done to protect the health of humans, animals and the environment?
7. Can you give similar examples from your own background/work? How did you deal with it?

Case Study 2: Mining in Lake Tshangalele: Environmental and Health Impact Assessment in the Democratic Republic of Congo

Improvised ventilation for a mine shaft at the Tilwezembe site, near Kolwezi, Katanga

http://www.amnesty.org/en/news/chinese-mining-industry-contributes-abuses-democratic-republic-congo-2013-06-19

To provide incentives and attract investors to the mining sector, a new mining code was enacted in the DRC in July 2002. The new code attracted several new mining companies generally of smaller size compared to those operating at the time of the reform. For economic reasons, small mining operations tend to operate closer to large populations creating health and environmental problems. To mitigate the environmental impact of extractive industries, the government of DRC recently enacted an environment framework law. However, this 2011 legislation still needs other implementation measures to guarantee its effectiveness.

The increase in mining operations in Lubumbashi, a city of 1.3 million inhabitants, and surrounding areas has led to air and water pollution directly affecting humans, animals and the food chain. The mines are estimated to provide direct employment to between 200,000 and 280,000 full-time miners and are located only 0.1 km from the edge of the city (see Figure). During the peak season, the total number of miners reaches an estimated 400,000 workers. About 74% of miners are diggers while the rest are sorters and washers.

Miners and their families are exposed to heavy metals through dust inhalation as well as food and water contamination. In Shinkolobwe and Kolwezi, miners are exposed to radiation of up to 24 mSv per year. Poor sanitation conditions in miners' camps also favor epidemics. Recent studies have shown a significant risk of heavy metal contamination in humans, goats and fishes. Massive excavations related to copper mining operations affect the ecosystem such that the natural habitat of rodents and other animal carriers of pathogens may cause known and unknown diseases. These animals are now invading human habitats creating a serious health risk.

In 2011, an outbreak of an unknown disease with hemorrhagic fever-like symptoms caused several deaths and hospitalization in Kapolowe District Health Center, 114 km north-west of Lubumbashi. However, there was no follow-up made as there was generally poor understanding of these exposures and their specific effects. There were also inadequate capacities to study and mitigate these problems. Evidence suggests fish from Lake Tshanga-Lele located in the same district are heavily contaminated. Fish from this lake constitute a main source of protein for the population of the city of Lubumbashi. Illnesses of unknown origin have also been observed in goats within the same area.

These kinds of exposures from mining and its related activities may be associated with significant disease burden. The World Health Organization (WHO) estimates that environmental risk factors contribute to 24% of the global burden of disease from all causes, and to 23% of deaths. It emphasizes that this is likely a conservative estimate because for many diseases, the associations are poorly understood (Prüss-Üstün and Corvalán, 2006).

Questions

1. Given this scenario, what are the One Health issues that arise and who is affected?
   i) Pollution, heavy metal contamination, waterborne illnesses, lung problems, animal /human diseases, dust inhalation, food and water contamination
   ii) Miners and their families, business people and consumers, fishermen and their consumers, animal owners, government, extractive industry.
2. Identify the multiple stakeholders or players in this scenario.
   i) Miners and their families, business owners and private industry, medical, environment, and veterinary professionals, fishermen and other people who rely on the fish, goat keepers or herders and those who purchase the animals for food, government, law and policy makers in regards to mining
3. Develop a gender sensitive intervention strategy for this community.
   i) Scenario can be different but should involve community and government legislation, miners and private industry
   ii) This scenario has particular relevance to inform zoning policies in the Katanga Province, decrees to be issued to accompany the environmental framework law enacted in 2011 and the design of effective emergent and re-emergent diseases surveillance and outbreak response mechanisms. Other regions of DRC and many countries in Africa face the same mining problems.
   iii) It should also help to develop and strengthen environmental and occupational health-related regional research collaborations and to inform nationally and internationally relevant policy development.
4. Who would be your key players in the intervention strategy?
   i) Community of miners both male and female, private industry, professionals vet/medics/ environmentalists, government and policy makers, community leadership whether male or female
5. What do you think could be the possible causes of the health problems affecting the community?

6. How would you investigate the problem? What simple steps can be taken to investigate the problem?
   i) Carry out simple participatory exercises among the community to identify levels of infection in humans, animals and community. Collect samples from water, animals, fish, and humans and test them for heavy metals.
   ii) Perform a risk assessment.
   iii) Perform a rapid gender analysis (in person or desk review).
7. What are the main gender considerations in this scenario and how would you address them?
   i) Identify the gender roles and responsibilities.
   ii) Women in this community have excessive exposure because they are fetching water from the rivers and cooking the contaminated foods.
   iii) Men are mostly exposed because they work in the mines; and therefore, lung diseases would be more common among them.
8. Among those who died, who were affected the most: males or females?

Case Study 3: Ebola

During the early stages of the 2001–2002 Ebola outbreaks that occurred in Congo and Gabon, there were more men than women infected. This situation was, however, reversed during the later stages of the outbreak. In contrast, the number of cases involving women exceeded that of men for the duration of the outbreak of 2000–2001 in Gulu, Uganda. During an outbreak, health officials usually compare the cumulative distribution of cases involving men and women. Cumulative distribution can sometimes mask potentially informative fluctuations in numbers of cases over the course of an outbreak. For the outbreak in Gulu, for example, the cumulative distribution was greater in women throughout; whereas in the outbreak in Gabon, it switched from predominantly men to predominately women.

If only the cumulative distribution had been plotted for the outbreak in Gabon, the switch in incidence from an excess of cases of men to an excess of women would not have been seen until later in the outbreak when the total number of females infected was greater than the total number of males. Interestingly, the outbreaks in Sudan are notable exceptions. Although no published data are available on the proportion of cases of women in a relatively large outbreak that occurred in 1976, it has been reported that males predominated. The 1979 outbreak in Nzara and Yambio, Sudan, was also unusual, in that, despite its small size, a large proportion of those infected were women (69%).

Questions

1. Why do you think in the 2001-2002 outbreak of Ebola in Congo and Gabon more men than women were infected in the early stages of the outbreak?
2. Why do you think the cases of women later outnumbered the cases of men in this outbreak?
3. Why is it that the cases of women exceeded the cases of men for the duration of the outbreak of 2000–2001 in Gulu, Uganda?
4. Explain why in the outbreak of 1976 in Sudan, there were more cases of men than women.

RIFT VALLEY FEVER PROBLEM-BASED LEARNING CASE

Eb and Overflow

Hellen Amuguni, Anne Waweru, Jairus Mdegela,

Expected Learning Time	**6 hours**
Programs of Study	Medicine, Veterinary Medicine, Public Health, Animal Sciences, Environmental Science, Animal Health Sciences, Nursing Health Sciences, Virology, Epidemiology, One Health
Learning Goals	• To understand and appreciate the epidemiology, pathogenesis, clinical signs, transmission, control and treatment of RVF. • To understand the role of the environment in the emergence and re-emergence of diseases. • To understand the policies related to the zoonotic, emerging and re-emerging diseases. • To appreciate the values of identifying partners who are necessary in dealing with a particular outbreak. • To appreciate the values of a good communication strategy, and skills. • To understand culture and gender role differences among pastoralist communities.

Summary

"EB AND OVERFLOW"

Eb, a livestock herder in the northeastern province of Kenya, was hospitalized with a two-day history of fever, vomiting, and blood in the feces. He died two days later. Within a few days, twelve more patients were admitted to the same hospital with similar symptoms, and eleven of the twelve eventually died. Within a period of four months, several hundred additional cases were confirmed in the northeastern province, with case clusters occurring in 18 districts in six out of eight provinces in Kenya. Livestock deaths and abortions were noted in the same provinces.

This case study presents an outbreak of Rift Valley Fever (RVF). RVF is an acute and deadly arthropod-borne, viral disease that is known to affect both animals (primarily sheep, cattle, and goats) and humans. RVF is caused by a three-stranded RNA virus in the *Phlebovirus* genus of the family Bunyaviridae. In ruminants, RVF results in high abortion rates, high mortality in infants, and hepatic necrosis. RVF is of concern to people who raise, transport, and sell animals, as well as those who butcher and consume meat of infected animals. In humans, RVF generally presents as an acute, undifferentiated febrile disease. In rare severe cases (approximately 1% of human infections), these signs progress to hemorrhage, meningoencephalitis, retinopathy, and death. The case fatality rate in patients developing hepatic disease approaches 50%.[1]

Outbreaks of RVF are normally related to climatic changes, and are typically seen where flooding has occurred in otherwise dry areas. Arthropod species (mosquitoes and biting flies) are primarily involved

1 Foreign Animal Diseases: Committee on Foreign and Emerging Diseases of the United States Animal Health Association. 2008 (7th Edition). Pp. 369-375. https://www.aphis.usda.gov/emergency_response/downloads/nahems/fad.pdf

in viral transmission, who uptake the virus by biting infected vertebrate animals. These mosquitoes can then further transmit the virus transovarially and infect humans and ruminants.[2]

However, RVF epidemics transmission also occurs by aerosol routes from the blood of viremic vertebrates, and from contact with viscera of infected animals. Consumption of raw milk has been documented as a route of exposure. RVF virus does not spread from person to person.[3]

This case focuses on an outbreak of RVF in the northeastern province of Kenya. Through this PBL case, participants will have the opportunity to become familiar with mosquito-borne diseases such as RVF, and to better understand their causes, disease epidemiology, prevention, and treatment, while examining environmental factors related to disease distribution. Students will analyze policies applied in transboundary and zoonotic disease outbreaks from a One Health perspective, and will identify the different stakeholders that can be engaged in national surveillance systems for the control and prevention of epidemic-prone diseases.

Learning Objectives

In this case, participants should be able to:

i) describe the causative agent, epidemiology, pathogenesis, clinical signs, transmission, control and treatment of RVF in animals and humans.

ii) identify the role of animals in transmission of RVF to humans.

iii) differentiate RVF from other similar diseases.

iv) describe and explain zoonotic diseases.

v) analyze the role played by the environment (climate, weather, soil types) on the occurrence of RVF.

vi) assess the benefits of a multidisciplinary approach in solving public health threats keeping RVF in mind.

vii) identify, using a system thinking approach, multiple stakeholders that could be involved in an RVF outbreak and describe their role.

viii) explain gender roles and distribution of labor in the pastoralist community and the impact of culture in this outbreak.

ix) evaluate the steps of an outbreak investigation.

x) outline the benefits of a good communication strategy during a disease outbreak.

xi) identify the policies related to transboundary disease and RVF.

xii) illustrate the control measures that can be taken to control RVF.

TRIGGER 1	Bloody Herder and Spreading

A livestock herdsman from the Northeastern Province, Kenya, was hospitalized at the Garissa Provincial Hospital with a 2-day history of fever, vomiting blood, and defecating blood. He died two days later. A 45-year old butcher was later admitted to the Garissa General Hospital that same day. A 12-year-old girl who had been taking care of her parent's goats presented at the same hospital with signs of an acute influenza-like illness with a transient fever, rigor (shivering), headache, severe muscle and joint pain, photophobia, and anorexia, and displaying a petechial rash, nausea, vomiting, and epistaxis. Within a couple of days, twelve other patients were hospitalized with signs of fever and bleeding. Eleven of these individuals died, seven of which were women.

2 Y.B. Kanouté et al. « Epidemiology of brucellosis, Q Fever and Rift Valley Fever at the human and livestock interface in northern Côte d'Ivoire." Acta Tropica 175 (2017) 121–129

3 Foreign Animal Diseases: Committee on Foreign and Emerging Diseases of the United States Animal Health Association. 2008 (7th Edition). Pp. 369-375. https://www.aphis.usda.gov/emergency_response/downloads/nahems/fad.pdf

. Over the next 4 months, several hundred additional cases were confirmed in the northeastern province and additional clusters of cases occurred in 18 districts within 6 out of 8 provinces in Kenya. Tests showed no evidence of malaria in any of these patients.

Key Learning Issues

1. Describe the differential diagnoses for the clinical signs presented by these patients.
2. Describe the steps of an outbreak investigation.
3. Provide a definition of zoonotic diseases.
4. Identify gender role difference in pastoral communities, focusing on caring for animals, and the cultural constraints (social construction) that result in these differences.

TRIGGER 2 Overflowing Christmas

In December of 2006, heavy rainfall, atypical for this hot and semi-arid region, fell in the Garissa District. Severe flooding resulted. Accompanying the flooding in this region was an increased population of mosquitoes and other biting insects. Because of this, sales of mosquito nets were booming and the traders who imported them all the way from Nairobi hiked their prices in response. Most of the people living in this area are nomadic pastoralists, moving around with their animals in search of water and pasture. Despite the flooding, they were excited that they did not have to go far to fetch water for their animals.

Key Learning Issues

1. What diseases are associated with heavy rainfall and flooding?
2. Analyze the role played by the environment (e.g., climate, weather, soil type) on the occurrence of RVF.
3. Who are the nomadic pastoralists and what makes them unique?

TRIGGER 3 Kids, Lambs, and Carcasses All-over

At the same time that patients were being admitted to the hospitals, there was an increase in livestock deaths and abortions. This was especially pronounced among the goats. Many women and girls, who are the ones primarily responsible for the care and birthing of small ruminants in nomadic pastoralist communities, reported seeing an increased number of abortions in the small ruminants. They also reported severe illnesses in newborn lambs and kids, many of which died within hours of infection, rarely surviving more than 36 hours after the onset of infection.

The clinical signs were marked by a high fever which subsided sharply before death. Affected animals were listless, disinclined to move or feed, and respirations were rapid. Mortality reached 90% or higher in animals less than one week of age. Similar signs in livestock were later seen in 6 out of 8 regions of Kenya. Regional veterinarians were informed about the illnesses seen in livestock and humans.

Key Learning Issues

1. Describe the clinical signs and manifestations of RVF in animals and humans.
2. Describe the epidemiology of RVF.
3. Identify the role of livestock in zoonotic disease transmission of RVF.
4. Describe differential diagnoses for RVF.
5. Identify how gender roles can influence the spread of disease in a pastoralist family.

TRIGGER 4 One World, One Medicine, One Health

The Kenya Ministry of Health initiated surveillance and sample collection, initially concentrating on the Northeastern province. Personnel from the Ministry of Agriculture and Livestock embarked on community sensitization programs to educate individuals on personal protective measures. Public awareness programs were essential to keep the public fully and accurately informed, not only to reduce concern and panic, but also to assist in the recognition of disease cases.

An informed press statement was released immediately the disease diagnosis was confirmed. The World Food Program and the Red Cross assisted with rescuing people from the floods and providing food. Residents of the Kenya Field Epidemiology and Laboratory Training Program (FELTP), a One Health program, helped with the outbreak investigation. The Center for Disease Control and Prevention-Kenya Medical Research Institute (CDC-KEMRI) also investigated the outbreak, and the Zoonotic Disease Unit was in the forefront of coordinating all these stakeholders.

Key Learning Issues

1. Identify the benefits of a multidisciplinary approach to solving infectious disease outbreaks, focusing on the example of RVF.
2. List potential stakeholders that could be involved in a RVF outbreak, and describe their role.
3. Identify the benefits of a good communication strategy among stakeholders.

TRIGGER 5 A Sad Day for Kenyans

A public notice was issued saying no slaughter should be carried out in Kenya. Slaughter houses and butcheries were immediately closed, and strict measures were put in place to ensure enforcement. A notice was issued to stop transportation of animals from all affected areas.

Key Learning Issues

1. Describe the role of government and politicians in disease control and public health regulation enforcement, focusing on how they work together with public health agencies.
2. Identify the key policies for successful RVF prevention and control.
3. What are the rules and regulations when a quarantine is issued?
4. Summarize the control measures that can be taken to address an outbreak of RVF.

TRIGGER 6 Diagnosis

The CDC-KEMRI carried out laboratory analyses to confirm the diagnosis of RVF, including enzyme immunoassay (EIA), enzyme-linked immune sorbent assay (ELISA), and reverse transcriptase-polymerase chain reaction (RT-PCR) testing. Analysis revealed high titers for immunoglobin M antibodies to RVF.

Key Learning Issues

1. Identify the causative agent of RVF.
2. Briefly describe the laboratory diagnosis of RVF.
3. Describe the characteristics of the RVF virus.
4. Discuss the One Health approach in the control and prevention of RVF outbreaks.

Facilitator Notes for Rift Valley Fever

(Case developed by Hellen Amuguni, Anne Waweru, Jairus Mdegela)

EB AND FLOW

TRIGGER 1: Bloody Herder and Spreading

What do you know?	• The disease occurred in Garissa, Northeastern province Kenya. • The patient died in 2 days. • A butcher was affected. • A young girl caring for goats was affected. • Other people have died from the disease. • 7 out of 11 dead were women. • Clinical signs: transient fever, vomiting blood and defecating blood, rigor (shivering), headache, severe muscle and joint pain, photophobia and anorexia sometimes with a petechial rash, nausea, vomiting and epistaxis and death • There seems to be some relationship between the disease and the human- animal interactions.
What do you need to know?	• What is unique about Garissa Northeastern province Kenya? • What do these clinical signs mean? • Which diseases present with these signs? • Which diseases present with these signs and are zoonotic? • Why does it seem to be affecting more women in this community?
Hypothesis	• Ebola • RVF • Marburg • Yellow fever • West Nile virus • Malaria • Poisoning

1. **What different diseases present with the clinical signs described in the trigger?**
   Patients in the case presented with signs of an acute influenza-like illness with transient fever, rigor (shivering), headache, severe muscle and joint pain, photophobia and anorexia with a petechial rash, nausea, vomiting and epistaxis which resulted in death in some cases. These signs and symptoms could be associated with viral hemorrhagic fevers such as Ebola and Marburg, mosquito borne illness such as malaria, yellow fever and Rift Valley Fever, and even toxicity from pesticides or aflatoxins.

Differential diagnosis

Ebola Hemorrhagic Fever: The Ebola virus causes an acute, serious illness which is often fatal if untreated. Ebola Virus Disease (EVD) first appeared in 1976 in 2 simultaneous outbreaks, one in what is now Nzara, South Sudan, and the other in Yambuku, Democratic Republic of Congo. The most recent outbreak in the West African countries of Sierra Leone, Guinea and Liberia in 2014 killed over 10,000 people. It is thought that fruit bats of the Pteropodidae family are natural Ebola virus hosts. Ebola is introduced into the human population through close contact with the blood, secretions, organs or other bodily fluids of infected animals such as chimpanzees, gorillas, fruit bats, monkeys, forest antelope and porcupines found ill or dead or in the rainforest. Ebola then spreads through human-to-human transmission via direct contact (through broken skin or mucous membranes) with the blood, secretions, organs or other bodily fluids of infected people, and with surfaces and materials (e.g. bedding, clothing) contaminated with these fluids. The incubation period is 2 to 21 days. Humans are not infectious until they develop symptoms. First symptoms are the sudden onset of fever, fatigue, muscle pain, headache and sore throat. These are followed by vomiting, diarrhea, rash, symptoms of impaired kidney and liver function, and in some cases, both internal and external bleeding (e.g. oozing from the gums, blood in the stools). Laboratory findings include low white blood cell and platelet counts and elevated liver enzymes. It can be difficult to distinguish EVD from other infectious diseases such as malaria, typhoid fever and meningitis. Confirmation that symptoms are caused by Ebola virus infection are made using the following investigations:

- Antibody-capture enzyme-linked immunosorbent assay (ELISA)
- Antigen-capture detection tests
- Serum neutralization test
- Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) assay
- Electron microscopy
- Virus isolation by cell culture

Samples from patients are an extreme biohazard risk; laboratory testing on non-inactivated samples should be conducted under maximum biological containment conditions.

Marburg Hemorrhagic Fever: Marburg hemorrhagic fever (Marburg HF) is a rare but severe hemorrhagic fever which affects both humans and non-human primates. Marburg HF is caused by Marburg virus, a genetically unique zoonotic (or, animal-borne) RNA virus of the filovirus family. The five species of Ebola virus are the only other known members of the filovirus family. The reservoir host of Marburg virus is the African fruit bat, *Rousettus aegyptiacus*. Fruit bats infected with Marburg virus do not show obvious signs of illness. Primates (including humans) can become infected with Marburg virus, and may develop serious disease with high mortality. Further study is needed to determine if other species may also host the virus.

Marburg HF typically appears in sporadic outbreaks throughout Africa; laboratory confirmed cases have been reported in Uganda, Zimbabwe, the Democratic Republic of the Congo, Kenya, Angola, and South Africa. Many of the outbreaks started with male mine workers working in bat-infested mines. The virus is then transmitted within their communities through cultural practices, under-protected family care settings, and under-protected health care staff. It is possible that sporadic, isolated cases occur as well, but go unrecognized. Transmission is mainly human-to-human, resulting from close contact with the blood, secretions, organs or other bodily fluids of infected persons. Burial ceremonies where mourners have direct contact with the body of the deceased can play a significant role in the transmission of Marburg. Transmission via infected semen can occur up to seven weeks after clinical recovery.

The incubation period (interval from infection to onset of symptoms) varies from 2 to 21 days. Illness caused by Marburg virus begins abruptly, with high fever, severe headache and severe malaise. Muscle aches and pains are a common feature. Severe watery diarrhea, abdominal pain and cramping, nausea

and vomiting can begin on the third day. Diarrhea can persist for a week. The appearance of patients at this phase has been described as showing "ghost-like" drawn features, deep-set eyes, expressionless faces, and extreme lethargy. Many patients develop severe hemorrhagic manifestations between 5 and 7 days, and fatal cases usually have some form of bleeding, often from multiple areas. Fresh blood in vomitus and feces is often accompanied by bleeding from the nose, gums, and vagina. Spontaneous bleeding at venipuncture sites (where intravenous access is obtained to give fluids or obtain blood samples) can be particularly troublesome. During the severe phase of illness, patients have sustained high fever. Involvement of the central nervous system can result in confusion, irritability, and aggression. Orchitis has been reported occasionally in the late phase of disease (15 days). In fatal cases, death occurs most often between 8 and 9 days after symptom onset, usually preceded by severe blood loss and shock.

Yellow Fever: Yellow fever is caused by a virus (*Flavivirus*) which is transmitted to humans by the bites of infected *aedes* and *haemogogus* mosquitoes. The mosquitoes either breed around houses (domestic), in forests or jungles (wild), or in both habitats (semi-domestic). Yellow fever occurs in 34 countries in Sub-Saharan Africa and in 13 countries in Latin America. Around 90% of cases reported every year occur in Sub-Saharan Africa. The most recent yellow fever outbreak occurred in Angola in 2016, with more than 450 people infected and 178 deaths – the first epidemic of the disease to hit the country in 30 years.

Yellow fever virus is transmitted by infected mosquitoes, the most common species being *Aedes aegypti* – the same mosquito that spreads the Zika virus. Symptoms include fever, headache, muscle pain, nausea, vomiting, and fatigue. A small percentage of infected people experience a second more severe phase of illness which includes high fever, jaundice and internal bleeding. At least half of severely affected patients who do not receive treatment die within 10 to 14 days.

Illness with yellow fever begins with an 'acute' phase with general symptoms of fever, muscle pain, backache, headache, shivers, loss of appetite, and nausea or vomiting. Most patients show improvement after 3 to 4 days. Around 15% of people with the disease will then go through a second, 'toxic' phase within 24 hours of the initial remission. They will experience high fever, jaundice, and abdominal pain with vomiting and deteriorating kidney function. Bleeding can occur from the mouth, nose, eyes or stomach, with blood then appearing in vomit and feces. Around half of the people who enter the toxic phase of yellow fever disease die within 10 to 14 days.

West Nile fever is a mosquito-borne infection by the West Nile virus. Approximately 80% of West Nile virus infections in humans have few or no symptoms. In the cases where symptoms do occur—termed West Nile fever in cases without neurological disease—the time from infection to the appearance of symptoms is typically between 2 and 15 days. Symptoms may include fever, headaches, feeling tired, muscle pain or aches, nausea, loss of appetite, vomiting, and rash. Less than 1% of the cases are severe and result in neurological disease when the central nervous system is affected. People of advanced age, the very young, or those with immunosuppression, either medically induced, such as those taking immunosuppressive drugs, or due to a pre-existing medical condition such as HIV infection, are most susceptible. The specific neurological diseases that may occur are West Nile encephalitis, which causes inflammation of the brain, West Nile meningitis, which causes inflammation of the meninges, which are the protective membranes that cover the brain and spinal cord, West Nile meningoencephalitis, which causes inflammation of the brain and also the meninges surrounding it, and West Nile poliomyelitis—spinal cord inflammation, which results in a syndrome similar to polio, which may cause acute flaccid paralysis.

West Nile virus is an arbovirus of the Flavivirus kind in the family Flaviviridae. The main way it is spread is by various species of mosquitoes, with birds being the most commonly infected animal and serving as the prime reservoir host. WNV has been found in various species of ticks, but current research suggests they are not important vectors of the virus. WNV also infects various mammal species, including humans, and has been identified in reptilian species, including alligators and crocodiles, and also in amphibians. Not all animal species that are susceptible to WNV infection, including humans, and not

all bird species develop sufficient viral levels to transmit the disease to uninfected mosquitoes, and are thus not considered major factors in WNV transmission.

Malaria: Malaria is a mosquito-borne infectious disease affecting humans and other animals caused by parasitic protozoans (a group of single-celled microorganisms) belonging to the Plasmodium type. Malaria causes symptoms that typically include fever, feeling tired, vomiting, and headaches. In severe cases it can cause yellow skin, seizures, coma, or death. Symptoms usually begin ten to fifteen days after being bitten. If not properly treated, people may have recurrences of the disease months later. In those who have recently survived an infection, reinjection usually causes milder symptoms. This partial resistance disappears over months to years if the person has no continuing exposure to malaria.

The disease is most commonly transmitted by an infected female Anopheles mosquito. The mosquito bite introduces the parasites from the mosquito's saliva into a person's blood. The parasites travel to the liver where they mature and reproduce. Five species of Plasmodium can infect and be spread by humans. Most deaths are caused by P. falciparum because P. vivax, P. ovale, and P. malariae generally cause a milder form of malaria. The species P. knowlesi rarely causes disease in humans. Malaria is typically diagnosed by the microscopic examination of blood using blood films, or with antigen-based rapid diagnostic tests. Methods that use the polymerase chain reaction to detect the parasite's DNA have been developed, but are not widely used in areas where malaria is common due to their cost and complexity.

The risk of disease can be reduced by preventing mosquito bites through the use of mosquito nets and insect repellents, or with mosquito control measures such as spraying insecticides and draining standing water. Several medications are available to prevent malaria in travelers to areas where the disease is common. Occasional doses of the combination medication sulfadoxine/pyrimethamine are recommended in infants and after the first trimester of pregnancy in areas with high rates of malaria. Despite a need, no effective vaccine exists, although efforts to develop one are ongoing. The recommended treatment for malaria is a combination of antimalarial medications that includes an artemisinin.[2][1] The second medication may be either mefloquine, lumefantrine, or sulfadoxine/pyrimethamine.[6] Quinine along with doxycycline may be used if an artemisinin is not available.[6] It is recommended that in areas where the disease is common, malaria is confirmed if possible before treatment is started due to concerns of increasing drug resistance. Resistance among the parasites has developed to several antimalarial medications; for example, chloroquine-resistant *P. falciparum* has spread to most malarial areas, and resistance to artemisinin has become a problem in some parts of Southeast Asia

2. Describe the steps of an outbreak investigation

In an outbreak investigation, the following must be done: preparation for field work coordination with public health competent authorities in case of zoonosis; confirmation of the report triggering the investigation; confirmation of diagnosis epidemiological follow-up and tracing; collection and analysis of data including the animals involved and the spatial and temporal; distribution, implementation of control and preventive measures; documentation and reporting.

There are four main steps in an outbreak investigation, preparation, detection, response and evaluation.

a) **Preparation**

i) Make sure you are optimally prepared, gather information, convene a multidisciplinary team. Form a gender balanced Outbreak Technical Committee (OTC). The team should have at least one member of opposite sex.

ii) All sectors must be represented on the team (Veterinary, Health, Wild life, Security, Media, Community Development/Gender expert, Community leader/Politician, Development partners.

iii) Hold outbreak coordination meetings.

iv) Put in place a surveillance system: weekly reports to Ministry of Health, Ministry of Animal Industry, WHO, OIE and FAO.

v) Develop an outbreak response plan: resources, skills and activities required.

vi) Keep track of required resources: Stockpiles of sampling kits, chemicals, drugs and vaccines.

vii) Develop contingency plans for isolation wards in hospitals, and quarantine of people and animals if involved.

viii) Put in place laboratory support.

ix) Planning for zoonotic disease outbreaks ought to be carried out within the framework of One Health with deliberate efforts to consider.

Components of a coordination team

i) Surveillance

ii) Training/capacity building

iii) Infection prevention and control

iv) Diagnostic laboratories

v) Communication plan

vi) Logistics and finance

vii) Written response plan

viii) Evaluation and post emergency coordination

b) **Detection**

i) From the preliminary laboratory sample reports and circumstantial evidence, the outbreak technical team should recommend the concerned sectors to constitute a field detection team immediately. The field detection team will be directly reporting to the OTC.

ii) The Field detection team is formed consisting of the relevant experts of Veterinarian, Medical doctor, Nurse, Wild life expert, disease anthropologist/socio-economist, laboratory technologist, and communication expert.

iii) The team sets out to the field to collect interview responses and laboratory samples from affected parties whether humans or animals

iv) The team must be gender balanced and must deliberately include female respondents

v) The samples are submitted to the laboratory

vi) Tests carried out and report written and submitted to the OTC

The detection and risk management team should:

i) Establish a Surveillance system

ii) Early warning system

iii) Contact tracing

iv) Who are the key stakeholders?

v) Informal/formal communication channels

vi) Resources and tools

vii) Laboratory resources: regional, international

viii) Timeline for different activities

c) **Response**

i) The outbreak Technical Team recommends formation of a response team

ii) The response team consists of expert members from the relevant sectors (Veterinary, Medical, Nurse, Wild life, Gender/Community Development Expert, Communication expert, Community leader, and international organizations (e.g., FAO and WHO)

iii) The response team must consist of at least a member of opposite sex to avoid gender insensitive conclusions and decisions

iv) The response team studies the reports (both laboratory and field reports) to confirm the outbreak

v) Clinical specimens are dispatched to laboratories for confirmation

vi) The response team counts number of cases and determine size of population to calculate attack rate

vii) Analyze descriptive data to date e.g. time/date of onset, place/location of cases and individual characteristics such as age and sex

viii) Determine the at-risk population (This must be age and gender disaggregated

ix) Formulate hypothesis for pathogen/source transmission

x) Follow up cases and contacts

xi) Produce a report (Results and recommendations for action

xii) Discuss the report with the OTC

xiii) Implement control and prevention measures specific for the disease (press releases, public education messages radio and TV talk shows, memos from the Ministry headquarters to District Directors of health, Commissioner of Veterinary Sciences to DVOs

xiv) Institute quarantine

xv) Produce bio-securities SOPs to be used

xvi) After the disease is seemingly under control, e.g., no reports of new cases, the OTC recommendation for the formation of an evaluation team.

d) **Evaluation**

i) It consists of at least one of the following experts: Veterinarian, Medical Doctor, Nurse, Wild life expert, Community Development Expert, Media expert.

ii) The team assess the appropriateness of containment measures

iii) Assess timeliness of outbreak detection and response

iv) Assesses the preparedness of the country as far as the disease is concerned

v) Assesses the effectiveness of the various teams in terms of gender composition and OH compliance

vi) Writes and disseminates the outbreak report, declaring the status of the disease and recommendations where necessary for future implementation.

The evaluation team should:

i) assess appropriateness and effectiveness of containment measures.

ii) review, monitor and evaluation.

iii) assess timeliness of outbreak detection and response.

iv) change public health policy if indicated.

v) write and disseminate outbreak report.

vi) relay Post Emergency response strategy.

3. Explain what zoonotic diseases are

A zoonotic disease is a disease spread between animals and people. Zoonotic diseases can be caused by viruses, bacteria, parasites, and fungi. Some of these diseases are very common. Scientists estimate that more than 6 out of every 10 known infectious diseases in people are spread from animals, and 3 out of every 4 new or emerging infectious diseases in people are spread from animals. "Reverse zoonosis" or "anthroponosis" are also terms used to describe a human infection transmitted to animals.

4. Identify gender role differences among pastoralist communities (who does what in relation to animals) and what causes its social construction (culture)

In some communities (including pastoralist ones), women and men may care for different livestock, or have different roles in livestock care. Any group that spent more time with goats and sheep, and particularly if they were more involved in the delivery of lambs and kids, would have a much higher exposure to RVFv (see Appendix VII for more details). Similarly, individuals with occupational exposure to bodily fluids of livestock, such as abattoir workers and veterinarians, also have a higher exposure risk ((OIE) 2009).

Gender Roles among Pastoralist Communities

Perception of women in pastoralist communities: Women in pastoralist communities are perceived as:

i) Reproductive actors

ii) Traditional image of mother and wife

iii) Not involved in decision making

iv) Men have full control

v) Women perform the labor, men use the resources

vi) Women provide care for small animals like goats while most men take care of cattle

Role of women in labor provision:

i) Collecting grass

ii) Mudding houses/building houses

iii) Cooking

iv) Fetching water and firewood

v) Cleaning cattle areas /building animal bomas

vi) Milking

vii) Feeding animals

viii) Veterinary care

ix) Nursing new born kids/calves

x) Care of small animals - sheep and goats

xi) Women are providers and caretakers

xii) Extended family: they are responsible for caring for orphans and older people.

TRIGGER 2: Overflowing Christmas

What do you know?	• The time of the year • It is a period of heavy rainfall • There is flooding • There are a lot of mosquitoes and other insects • Increased pricing of mosquito nets • They are pastoralists
What do you need to know?	• What is the geography of the Northeastern province? • Who are pastoralists and what is their lifestyle like? • What are the diseases associated with heavy rainfall? • What is the cause of the flooding? • What are the diseases that are caused by mosquitoes and biting insects? • What is so peculiar about Garissa Northeastern province Kenya? • What is fever? • Which diseases present with these signs? • Which diseases present with these signs and are zoonotic?
Hypothesis	• Malaria • RVF • Yellow fever • Typhoid fever • Leptospirosis • Hepatitis A • Cholera

Key Learning Issues

1. What diseases are associated with heavy rainfall and flooding?

Floods can potentially increase the transmission of the following communicable diseases:

i) Water-borne diseases, such as typhoid fever, cholera, leptospirosis and hepatitis A.

ii) Vector-borne diseases, such as malaria, Rift Valley fever, dengue and dengue hemorrhagic fever, yellow fever, and West Nile Fever.

The only epidemic-prone infection which can be transmitted directly from contaminated water is leptospirosis, a zoonotic bacterial disease. Transmission occurs through contact of the skin and mucous membranes with water, damp soil or vegetation (such as sugarcane) or mud contaminated with rodent urine. The occurrence of flooding after heavy rainfall facilitates the spread of the organism due to the proliferation of rodents which shed large amounts of leptospires in their urine. Outbreaks of leptospirosis occurred in Brazil (1983, 1988 and 1996), in Nicaragua (1995), Krasnodar region, Russian Federation (1997), Santa Fe, USA (1998) Orissa, India (1999) and Thailand (2000). It is likely that environmental changes increased the vector (rodent) population which facilitated transmission. Floods may indirectly lead to an increase in vector-borne diseases through the expansion in the number and range of vector habitats. Standing water caused by heavy rainfall or overflow of rivers can act as breeding sites for mosquitoes, and therefore enhance the potential for exposure of the disaster-affected population and emergency workers to infections such as dengue, malaria, rift valley fever, yellow fever and West Nile fever. Flooding may initially

flush out mosquito breeding, but it comes back when the waters recede. The lag time is usually around 6-8 weeks before the onset of an epidemic.

2. **Analyze the role played by the environment (climate, weather, soil types) on the occurrence of RVF**

Outbreaks of RVF occur generally when particularly heavy, prolonged and, often, unseasonal rainfall favors the breeding of mosquito vectors. Epidemics in most of eastern and southern Africa occur in 5 to 20 year cycles, but, in the dry semi-arid zones of Eastern Africa the periodicity is 15 to 30 years.

Several mosquito species are vectors for RVF virus. The dominant mosquito species vary by region, which in turn, impacts the common transmission cycles of RVFV. Environmental factors, particularly rainfall, seem to be an important risk factor for outbreaks: epizootic events and outbreaks in humans have been observed during years in which unusually heavy rainfall and localized flooding occur. Several factors help explain this process:

- RVF virus can be transmitted from female mosquitoes to offspring via the egg (vertical transmission).
- In the egg, the virus remains viable (infectious) for several years during dry conditions.
- Excessive rainfall enables more mosquito eggs, commonly of the genus *Aedes*, to hatch.
- As mosquito populations increase, the potential for virus to spread to the animals, including humans, on which they feed also increases.
- In epizootic events, there is increased handling of infected animals that then increases risk of exposure for humans.

Risk mapping for RVF was developed to help countries prepare for outbreaks. One strategy used to predict risk takes advantage of the correlation between the growth of vegetation from high rainfall and the proliferation of infected mosquitoes in response to flooding. Another is to use surface sea temperatures and climate models to forecast the effects of El Niño Southern Oscillation (ENSO) events, which again, have been historically associated with RVF outbreaks. These two strategies were combined in the 2000s, and successfully predicted the areas where the 2007-2008 outbreaks in East Africa occurred (Anyamba et al. 2009). Organizations that monitor these signals and publish risk warnings include the United States Department of Agriculture (USDA), the National Oceanic and Atmospheric Administration (NOAA), and the Food and Agriculture Organization of the United Nations (FAO). Future cycles will further elucidate the strengths and weaknesses of these models. Unfortunately, these models are focused on East Africa, and may not be successfully generalized to other areas.

An extremely strong ENSO event emerged in October - November 2015 and continued through April 2016. FAO and NOAA risk mapping models indicated high risk for many parts of East Africa, and a warning was sent out. Guidelines jointly prepared by WHO/FAO/OIE for countries preparing to deal with high RVF risk were available in the risk warning. Generally, recommendations were that infectious disease management through a One Health approach be integrated into national plans and communicated to all stakeholders potentially involved in control (Pittiglioa et al. 2015). Outreach to traditional community leaders was recommended for consideration, to improve the effectiveness of community education efforts.

3. **Who are nomadic pastoralists and what makes them unique?**

Nomadic pastoralism is a form of pastoralism when livestock are herded in order to find fresh pastures on which to graze. Strictly speaking, true nomads follow an irregular pattern of movement, in contrast with transhumance where seasonal pastures are fixed. However, this distinction is often not observed and the term nomad used for both—in historical cases the regularity of movements is often unknown in any case. The herded livestock include cattle, yaks, sheep, goats, reindeer, horses, donkeys or camels, or mixtures of species. Nomadic pastoralism is commonly practiced in regions with little arable land, typically in the developing world, especially in the steppe lands

north of the agricultural zone of Eurasia (Pepin, M et al. 2010). Of the estimated 30 - 40 million nomadic pastoralists worldwide, most are found in central Asia, the Sahel region of West Africa, and the Northern parts of Africa. Increasing numbers of stock may lead to overgrazing of the area and desertification if lands are not allowed to fully recover between one grazing period and the next. Increased enclosure and fencing of land has reduced the amount of land available for this practice. There is substantive uncertainty over the extent to which the various causes for degradation affect grassland. Different causes have been identified which include overgrazing, mining, agricultural reclamation, pests and rodents, soil properties, tectonic activity, and climate change. Simultaneously, it is maintained that some, such as overgrazing and overstocking, may be overstated while others, such as climate change, mining and agricultural reclamation, may be under reported.

RVF epizootics have historically occurred in areas where pastoralism or similar cultural livelihood strategies are prevalent, such as in Kenya, Tanzania, and the Sinai Peninsula. These groups of people may be nomadic or semi-nomadic and often live in remote areas with little access to modern medical or veterinary care. Thus, outbreaks can and have gone unnoticed in these populations, as was discovered during the effort to eradicate Rinderpest near the turn of the last century (Mariner et al. 2012).They also tend to heavily depend upon their animals for their diet and cultural practices. Pastoralists do often contribute significantly to the agricultural trade of their regions, and may sell their livestock to distant buyers. These cultural and social traits mean that these populations are both at higher risk of contracting RVF and highly vulnerable to the effects of RVF epizootics.

TRIGGER 3: Kids, Lambs and Carcasses All-over

What do you know?	• Animals are dying concurrently with humans. • Animals have signs of abortions. • Younger kids and lambs are more susceptible with very high mortality. • The disease is spreading to multiple districts in Kenya. • The disease is affecting both humans and animals.
What do you need to know?	• How many animals have died? • After showing signs, how long does it take before they die? • Who is responsible for the care of kids and lambs in the family? • Are they exposed and how can they be protected?
Hypothesis	• Rift Valley Fever • Other zoonotic arthropod borne diseases

1. **Describe the clinical signs and manifestations of RVF both in animals and humans**

Rift valley fever is an acute and deadly viral disease that is known to affect both animals and humans, and can be of concern to those persons who raise, transport, and sell animals and those who butcher and consume meat. Rift valley fever (or RVF) is a mosquito-borne disease that can cause abortions in pregnant animals and a high mortality in young animals. It is caused by a member of the Phlebovirus genus of the family Bunyaviridae.

In humans, RVF causes a severe influenza-like illness, with occasionally more serious hemorrhagic complications and death. The disease in humans presents most commonly with influenza-like syndrome (fever [37.8–40°C]), headache, muscular pain, weakness, nausea and epigastric discomfort, and photophobia. Most human cases recover within 4–7 days, and complications

can include; retinopathy, blindness, meningo-encephalitis, hemorrhagic syndrome with jaundice, petechia and death. Mild symptoms include hemorrhagic fever, muscle pains and headaches whereas severe symptoms range from loss of sight within weeks of infection to brain inflammation, which can lead to headaches and seizures. Populations at risk include both humans and ruminant animals (goats, sheep, cattle) in areas where the mosquito species known to transmit the virus are found. Human populations at risk are those involved in the raising, care, sale, slaughter and consumption of goats and other ruminants. Animal populations at risk include goats, sheep and cattle, as well as wild ruminant species and non-human primates (e.gs. vervet monkeys, gorillas).

RVF is transmitted from its sylvatic cycle (wildlife) to susceptible animals (and humans, although this is less common) by blood-sucking mosquitoes (aedes or culex). Clinical signs in newborn goat kids (extremely susceptible) include: biphasic fever (40–42°C), which subsides just prior to death, anorexia, weakness, listlessness, abdominal pain, rapid abdominal respiration prior to death and death within 24–36 hours. In older kids and adult goats, clinical peracute disease includes sudden death with no appreciable signs. Acute disease (more common in adult animals); includes fever (41–42°C) lasting 24–96 hours, anorexia, weakness, listlessness and depression, increased respiratory rate, vomiting, bloody/fetid diarrhea, nasal discharge and icterus may be evident in a few animals. In pregnant goats, the disease presents with 'Abortion storms' with rates approaching 100%.

In humans, the main route of infection is through direct contact with fluids from infected animals: direct contact with aborted fetuses (and or blood, secretions) from affected animals, consumption of meat from infected animals, and consumption of raw milk from infected animals. Humans can also be infected via mosquito bites. The first indication of development of an epidemic is frequently the abortion, usually in ruminants, cattle, sheep and goats. Index cases and sporadic cases are usually misdiagnosed. Signs of the disease in animals tend to be non-specific, making it difficult to recognize individual cases of RVF. The simultaneous occurrence of numerous cases of abortion and disease in ruminants, together with disease of humans, following heavy and prolonged rainfall, is characteristic of Rift Valley fever (RVF).

2. **Describe the epidemiology of RVF**

Outbreaks of RVF occur generally when particularly heavy, prolonged and, often, unseasonal rainfall favors the breeding of mosquito vectors. Epidemics in most of eastern and southern Africa occur in 5 to 20 year cycles, but, in the dry semi-arid zones of eastern Africa the periodicity is 15 to 30 years. RVF appears to be restricted to Africa. It was recognized first in the Rift Valley of Kenya at the turn of this century but the agent was not isolated until 1930. The disease was first observed in southern Africa in 1950. Most epidemics have occurred in eastern and southern Africa and, until 1977, the farthest north that the disease was known to have occurred was the Sudan. During 1977 and 1978, a major epidemic occurred in the Nile delta and valley in Egypt. A severe epidemic affected the Senegal River basin in Mauritania and Senegal in 1987 and again in Egypt in 1993. [The periodicity of major epidemics is discussed below in Epidemiological features.]

The epidemics in Egypt indicate that the potential exists for spread to other regions of the world outside the African continent. The East African region has experienced many outbreaks of Rift Valley fever through the 2000 era. In 2006, Kenya had an outbreak, which has become sporadic since then. In 2010, there were persistent sporadic abortions in Rwanda although this was never confirmed. In 2016, there was a RVF outbreak in Kabale a district in western Uganda.

It should be noted that the conditions which precipitate an epidemic of RVF (inter alia, heavy and prolonged rainfall leading to flooding) are also those predisposing to the occurrence of other major disease epidemics which can occur simultaneously. In pastoral areas, the movement of humans and their livestock away from flooded areas and their congregation on higher land favors the transmission of other disease agents including foot-and-mouth disease, contagious bovine pleuropneumonia, contagious caprine pleuropneumonia, capri pox and morbillivirus infections (rinderpest and peste des petits ruminants).

The survival of RVF virus in the environment is limited and it is susceptible to low pH (acid). Areas contaminated with blood spillage can be decontaminated with 2 per cent acetic acid or 5 per cent sodium hypochlorite. Blood, even dried blood, may remain contaminated and infectious for humans for some months at ambient temperature. Pasteurization renders milk safe. Chilled or frozen meat is probably safe to eat after storage and cooking. Hides and skins, bones and manure are rendered safe if sun-dried.

3. Identify the role of animals in transmission of RVF to humans

Humans can be infected with RVFV from bites of infected mosquitoes and, rarely, from other biting insects that have virus-contaminated mouthparts. More commonly, humans are infected after exposure to blood, body fluids, or tissues of RVF-infected animals. This direct exposure to infected animals can occur during slaughter or through veterinary and obstetric procedures such as helping lambs and when they are kids during delivery or handling aborted fetus. Infection through aerosol transmission of RVF virus has occurred in the laboratory environment. No human-to-human transmission has been documented.

4. Differentiate RVF from other similar diseases

Rift valley fever presents signs like other hemorrhagic fevers. The disease in humans presents most commonly with influenza-like syndrome (fever [37.8–40°C]), headache, muscular pain, weakness, nausea and epigastric discomfort, and photophobia. Most human cases recover within 4–7 days, and complications can include; retinopathy, blindness, meningo-encephalitis, hemorrhagic syndrome with jaundice, petechia and death. Mild symptoms include hemorrhagic fever, muscle pains and headaches whereas severe symptoms range from loss of sight within weeks of infection to brain inflammation, which can lead to headaches and seizures. Populations at risk include both humans and ruminant animals (goats, sheep, cattle) in areas where the mosquito species known to transmit the virus are found. Human populations at risk are those involved in the raising, care, sale, slaughter and consumption of goats and other ruminants. Animal populations at risk include goats, sheep and cattle, as well as wild ruminant species and non-human primates (e.g. vervet monkeys, gorillas).

There are 3 main ways to differentiate between RVF and other similar diseases, that is, the environmental component and the fact that it affects small shoats. The best way to differentiate Rift valley fever is through the environmental changes- any heavy rainfall or flooding in the area accompanied by increased number of mosquitoes. The presence of signs and symptoms in animals especially goats and sheep is a key differentiating factor as well, with increased abortions. Most, if not all, infected pregnant sheep, goats, cattle (and most likely domesticated Asian buffaloes) and camels abort affected fetuses at any stage of gestation, usually undergoing autolysis. The most severe reactions occur in newborn lambs and kids which die within hours of infection, rarely surviving more than 36 hours. Onset is marked by high fever which subsides sharply before death. Affected animals are listless, disinclined to move or feed and respiration is rapid. Mortality reaches 90 per cent or more in animals less than one week of age. Older lambs and kids and mature sheep and goats may develop in apparent, peracute or acute disease. In peracute disease death occurs before the development of notable signs. Acute disease is characterized by high fever for 1 to 3 days, anorexia, weakness, listlessness and rapid respiration. Some animals regurgitate ruminal contents and exhibit blood-stained nasal discharge, fetid diarrhea and melena. Jaundice may be evident. Death occurs after about three days of illness. The mortality rate is lower than in week-old lambs but can still reach 50 per cent or more. The disease in calves resembles that in lambs - essentially fever, weakness, inappetence and diarrhea, which may be blood-stained - but jaundice is more frequent. Death occurs in 2 to 8 days and the mortality rate is generally low at around 20 per cent.

One other key way of differentiating RVF from other similar cases is through laboratory diagnosis. The clinical diagnosis can be confirmed by several tests amongst which are:

- Histopathology performed on formalin-fixed sections of liver; lesions are distinctive but immunoperoxidase staining of viral antigen adds specificity
- Virus isolation in cell culture or by intraperitoneal or intracerebral inoculation of weanling mice or hamsters confirmed by immunofluorescent or immunoperoxidase staining
- Detection of viral antigen by immunofluorescent or immunoperoxidase staining of frozen sections, immunodiffusion, complement fixation and ELISA
- Detection of viral RNA by reverse transcriptase polymerase chain reaction (RT-PCR);
- Detection of antibodies by virus neutralization and ELISA (not the haemagglutination-inhibition test which is non-specific); these are used mainly retrospectively to determine the extent of an epidemic. For diagnostic confirmation, recent or current infection must be distinguished from pre-existing immunity. Paired samples collected during the acute phase and again 2 to 3 weeks later provide evidence of recent infection. IgM-capture ELISA allows diagnosis of recent infection to be made on a single serum sample.

5. **Identify the gender roles of animal care in the family**
   In most nomadic pastoralists' homes, women and girls care for the small animals while the men and boys take care of the larger stick. The women and girls are therefore responsible for helping the animals during kidding. RVF causes the largest damage on sheep and goats, thereby creating a bigger risk for women and girls. Most of them get infected through handling aborted fetuses (refer to trigger 1 on gender roles in pastoralist communities). Human populations at risk are those involved in the raising, care, sale, slaughter and consumption of goats and other ruminants. Butcher men are also at risk because of direct contact with animal blood and other body fluids.

TRIGGER 4: One World, One Medicine, One Health

What do you know?	• Several stakeholders are involved. • Lab diagnosis is underway. • There is coordination of the stakeholders. • A common communication message was drafted.
What do you need to know?	• Which tests will be carried out? • Where are these tests being carried out? • Which samples should be taken? • Who should you consult about appropriate testing? • Which preventive measures need to be taken while collecting samples? • How do they make sure they are including all stakeholders in the sensitization process- what mechanisms best reach the women versus the men? • Which measures will be instituted to control the disease?
Hypothesis	• Rift Valley Fever • Multiple stakeholder engagement required

1. **Identify the benefits of a multidisciplinary approach in solving issues regarding infectious diseases, RVF in particular.**
   A multidisciplinary approach means that multiple disciplines are engaged in planning, managing and responding to the public health emergency together. In the case of this RVF outbreak, all different sectors need to be involved; Human health, animal health, environmental health, social departments, entomologists, engineering department, finance and other partners (NGOs),

cultural and political leadership. If they are included in the preparation and planning, they will be able to consolidate resources, harness affected local community support, and save time as well as money. They will share resources such as the same vehicles, equipment, housing and drugs. It will avoid duplication of roles so that different people know their assigned roles and you do not have multiple sectors showing up to do the same thing. A multidisciplinary approach improves communication among the different stakeholders allowing surveillance, sampling to be done systematically; for example: If the medical laboratorians and veterinary laboratorians are working together- they will both receive the diagnosis at the same time and can plan responses together.

2. List the stakeholders that could be involved in an outbreak of RVF response and describe their role.

(a) Local Stakeholders

i) Medical Officers
- Regional Referral Hospital, at local clinics prevention, treatment and control of disease in humans

ii) Local Health Department officials (from the DHO or District Health Office, linked with MOH)
- Epidemiologists - disease ecology and epidemiology
- Entomologists - mosquito surveillance and control
- Logistics-planning and managing outbreak
- Psychosocial experts – welfare of the affected and responders e.g. counseling
- Communications experts-ensure correct information is passed onto the public
- Environmental health-surveillance and community mobilization and sensitization

iii) Veterinary Officers, both senior and junior (work with district headquarters) animal health surveillance and diagnosis aspect

iv) Ministry of Wildlife and tourism: wild animals might be affected

v) Ministry of Environment: climate change impact disease spread

vi) Engineering department - safe disposal of dead (animals or humans), disinfection, drainage systems, and construction of isolation units where need be

vii) Security - enforce quarantine (it should be noted that security in RVF as is for other haemorragic fevers is more of psychological, the security clothes and gun only should make people feel that security is watching; in the event of violation of security by persons moving animals, the security offers should never attempt to use force as they may end up getting infected)District/county level Task Force (DTF)- planning response, control and evaluation
- Including representatives from all above and more
- Interdisciplinary
- Assembles and directs Rapid Response Teams
- The DTF generally oversees the outbreak at district level

viii) Community stakeholders
- Cultural leaders - trusted by their people can mobilize community cooperation,support and trust
- Politicians- respected by community hence help get community cooperation
- Local business people: butchers, meat sellers, dairies, grocers, truckers, tourism/ events

- Community leaders: religious leaders, medicine men- The voice of the people
- Public and community members
- Livestock herders associations-involved in disease spread and control as well as economic impact
- Traders: Both national and international

(b) Non-local Stakeholders

ix) Office of the Prime Minister - Resource mobilization and over sight

- Ministries/Governmental Departments:
  - MOH (Ministry of Health)
  - MAAIF (Ministry of Agriculture, Animal Industries and Fisheries)
  - UWA (Uganda Wildlife Association)
- Laboratories/Research centers: UVRI, NADEC
  - Research Institute- reference laboratory, sent a response team to do initial lab work
  - National Diagnostic Emergency Center), 2016
- International – National collaborations: Emergency Operations Centers, -CDC
- International groups: WHO, CDC, FAO, US Department of Defense
- National Task Force-zoonotic disease unit
  - Reports to Office of the Prime Minister
  - Officially includes representatives from all the above, but not all actually send representatives to meetings regularly
  - Meet monthly for regular or maintenance issues, however, can meet as often as weekly during active outbreak especially at beginning and peak of the outbreak.
  - Holds special meetings to manage public health emergencies
  - The NTF generally oversees the response at national level.

3. Identify the benefits of a good communication strategy

It is important to communicate quickly and effectively with the public when there is an outbreak of RVF to prevent more deaths among humans and animals; ensure a surveillance system is in place; contact tracing and follow up are done systematically; reduce panic among the public; prevent movement of diseased animals from one place to another. A good communication strategy also includes proper targeting of the affected population and ensuring that the means of communication is available to all of them. For example, in this outbreak, women are affected and they may not get information the same way men receive information, therefore a gender sensitive communication strategy has to be implemented to ensure that everyone gets the proper information. Looking at the example of pastoralists environment, radios are commonly listened to by men as graze the bigger animals; the women and children who take care of the smaller animals may not get information passed to them through radio as a communication channel. At the same time the outbreak occurred among the pastoralist community who are constantly on the move. Ensuring that key leaders among the pastoralist community are part of the planning and response teams are kept informed and can therefore share this information effectively with their people is vital. Dissemination of information on RVF can be done through awareness campaigns and educational programmes for affected personnel including livestock handlers,

butchers, veterinarians and community members. Special attention should be paid to gender roles and ensure that both women and men have access to information since they are affected by and exposed to the disease differently. Channels of communication for awareness creation should take into consideration gender roles and cultural context.

4. **Describe how to communicate with the masses in case of an outbreak.**
Communication to the public should be performed by public health agencies most relevant to the scale of the outbreak, be it local (city, county, state) or national. Communication should focus on providing evidence-backed facts (e.g. cause of outbreak, extent of outbreak, risk to individuals, etc.) – while protecting the identities of those affected – so as not to cause an over-reaction or panic, and recommendations for individuals to minimize their risk. There are many possible ways to reach the public, especially given the rapid availability of information on the Internet. Outlets include traditional media outlets, blogs, public health sites, discussion boards, and other websites. Communication should also consider the roles that community members play and their gender and socio-economic status as well as their culture because different levels and cultures have different channels through which they receive and give information. It should also take into consideration the marginalized members of the community who sometimes are unable to get info- such as the homeless, the poor of the poor. When communicating, the following key points should be considered:
    - Consider emotional response to the event
    - Empower audiences to make informed decisions
    - Discourage negative behavior
    - Encourage constructive responses to risk or danger
    - Use appropriate terminology
    - Accept uncertainty
    - Use key messages
    - Provide resources for more information
    - Foster partnerships
    - Remain accessible
    - Always communicate
        - What you know
        - What you don't know
        - What you are doing to address the situation

Trigger 5: A Sad Day for Kenyans

What do you know	• Control measures have been put in place
What do you need to know	• Did the control measures work? • What was the reaction of Kenyans • What are the laws governing slaughtering and meat marketing?
Hypothesis	• Slaughter process has something to do with disease transmission

1. **Describe the role of government and politicians in disease control and enforcement. Explain how they work together with public health agencies.**
   The role of the government is often closely intertwined with that of public health agencies when it comes to disease control and enforcement. The two entities should be collaborative in their approach. While public health agencies may have a greater role in the mobilization of resources towards investigation and surveillance, the government may have a greater role in the allocation of those resources to these agencies. In addition, the government functions in a greater regulatory capacity; this entails a responsibility for implementing public health measures and recommendations by public health agencies, including information dissemination to the public, mosquito control via aerial or space spraying, and other public health interventions.

2. **Identify the policies related to Rift Valley Fever Prevention and Control**
   Please refer to this document for policies to prepare and respond to Rift Valley Fever in Kenya:
   http://steps-centre.org/wp-content/uploads/Rift_Valley_fever_in_Kenya_briefing.pdf

3. **Measures for Rift Valley Fever prevention and control should include active disease surveillance,** an early warning system for outbreak detection, targeted vaccinations in high risk areas, and improved coordination between livestock and public health teams. Pastoralists also need stronger incentives from the authorities if they are to provide active surveillance, prompt reporting and compliance with movement restrictions. The primary goal of a national policy on RVF is to control and prevent spread of the disease to the human population. Thus, the policy should clearly describe methods and procedures for prompt detection and diagnosis of infections in patients and animals. Treatment of human or animal patients must be appropriately instituted under supervision of medical practitioner or veterinarian until full recovery. There should be a section on contact-tracing and surveillance. RVF control procedures must include effective infection control strategies. The full commitment of the Government and adequate funding are keys to a successful RVF control program and this must be included in the policy. The policy must clearly state the organizations, sectors and personnel to be involved in the periodical review of the control and prevention of the disease and response to outbreaks. Among new strategies to be included in the policy are risk analysis and screening programs using current methods and awareness campaigns. Since animals transmit disease to humans, the policy must include disease control in the animal population, with provisions for compensations to owners when forced culling of animals is necessary.

What are the rules and regulations when a quarantine is issued

Isolation is the separation of infected persons or animals during the period of communicability to prevent direct or indirect transmission of infectious agents whereas quarantine is the limitation of the freedom of movement of contacts be it persons or animals which have been exposed to a communicable disease. A quarantine notice is often issued when an infectious or communicable disease has been confirmed and most countries have established laws and regulations relating to quarantines: These are specific to different diseases. The steps involve isolation of the sick party whether humans or animals from the non-sick, control of issue of movement permits for animals and sale of animals, as well as control of movement of people from the area affected. It further involves establishment of a care control center to cater for those in quarantine, ensuring proper cleaning and disinfection of equipment and personal protective equipment, proper disposal of dead, monitoring and logistics.

OIE quarantine regulations:

http://www.oie.int/fileadmin/Home/eng/Our_scientific_expertise/docs/pdf/A_Guidelines_for_Animal_Disease_Control_final.pdf

For Rift Valley fever, immediately on suspicion of the disease, an infected area should be designated extending at least 10 km from known infected animals. The area at risk is also determined with respect to geographical features, prevailing winds, and the presence of possible vectors and the

density of prospective hosts. Movements in and out of the area are prohibited.

After introduction of RVF to a new area, effective quarantine and movement controls are essential to reduce spread, even if the virus has become established in an insect vector population. Initially stringent, these controls can be relaxed a little in favor of zonal restrictions, centered on the infected area, once the extent of infection has been assessed.

4. Illustrate the control measures that can be taken to control RVF

The limits of an area for control activities may be determined by prior knowledge of the distribution of RVF in earlier epidemics in the country and of potential vector species. Theoretically, measures taken could include, inter alia:

- chemical control of vectors by, for example, ultra-low volume spraying of insecticides and application of systemic insecticides to target species
- movement of stock from low-lying areas to well-drained and wind-swept pastures at higher altitudes
- the confinement of livestock to mosquito-proof stables
- control of livestock movements
- slaughter and disposal of all infected livestock

However, such measures are usually impractical, instituted too late and at best palliative in the face of a RVF epidemic. Immunization remains the only effective means of protecting livestock.

Vaccination in the face of established RVF epidemics has usually been applied too late to avert them or prevent considerable losses from occurring. Nevertheless, vaccination of large numbers of animals could ultimately have contributed to the abatement of epidemics and has been beneficial in reducing losses through its impact on herd immunity.

The fact that epidemics of RVF occur at long, irregular intervals of many years and that outbreaks tend to occur simultaneously across an extensive area makes it difficult to advocate, and justify the expense of repeated prophylactic vaccination of susceptible livestock species during the long inter-epidemic periods. A promising approach to resolving this dilemma is the prediction of RVF epidemics. Monitoring of meteorological and remote sensing data, inter alia, Cold Cloud Duration (CCD - a measure of rainfall) and Normalized Difference Vegetation Index (NDVI - a measure of vegetation density/soil moisture), within a geographic information system can indicate when conditions suitable for high vector multiplication are developing and sero-monitoring of livestock can indicate periods of increased viral activity. Prophylactic immunization of livestock could then, conceivably, be applied in time to avert the most serious consequences.

Control and Elimination of Outbreaks in Newly-Infected Countries

Activities undertaken should attempt to contain the virus at the site of introduction (by movement controls) and then eliminate it (destruction of infected and potentially infected livestock). It is very important that the timing and sequence of operations give the greatest chance of eliminating the virus before it becomes widespread in an insect vector or animal populations, including wildlife.

Quarantine and Movement Controls

Immediately on suspicion of the disease, an infected area should be designated extending at least 10 km from known infected animals. The area at risk is also determined with respect to geographical features, prevailing winds, and the presence of possible vectors and the density of prospective hosts. Movements in and out of the area are prohibited.

After introduction of RVF to a new area, effective quarantine and movement controls are essential to reduce spread, even if the virus has become established in an insect vector population. Initially stringent, these controls can be relaxed a little in favor of zonal restrictions, centered on the infected area, once the extent of infection has been assessed.

Sanitary prophylaxis

Control of animal movements (extension of disease); controls at slaughterhouses (exposure to disease); draining of standing water to eliminate or reduce vectors; disinfestations of low depression accumulations of water where mosquitoes may reproduce by (in Africa known as 'dambos') use of methoprene spraying or controlled burning. Hygiene and vector control may have limited effect during widespread outbreaks.

Surveillance and tracing

Infected humans can play an important role in the transmission of RVF and it will be necessary to trace both animal and human movements. Close collaboration between human and veterinary medical staff is called for to trace both the source of infection and possible secondary cases. Surveillance involves clinical examination of livestock at risk and serological monitoring of a statistically significant sample at short intervals to determine if virus transmission is occurring. Vector studies may also be needed. Vector and serological surveillance will need to be continued for at least one year to start to demonstrate freedom from infection. The actual or potential role of wild ruminants must be assessed early.

Vaccination

All ruminants in herds within the infected area should be vaccinated immediately with an inactivated RVF vaccine and revaccinated after 2 to 4 weeks. The use of live attenuated vaccines should only be considered if RVF spreads outside the initial area affected.

Medical prophylaxis attenuated virus vaccine (Smithburn strain), one inoculation confers immunity lasting 3 years, residual pathogenicity for pregnant ewes (abortion) and pathogenic for humans. Inactivated virus vaccine requires two inoculations and annual revaccination; Live-attenuated mutant vaccine - MV P12 Vaccine safe and efficacious for use in pregnant or lactating bovids; non-pathogenic in young lambs; colostrums from vaccinated ewes induces temporary protective immunity.

Vector Control

A realistic assessment of the feasibility of vector control must be made at the earliest possible time in discussion with locust and other plant pest control personnel. Aerial or ground ultra-low volume application of insecticides or thermal fogs or mists generated on the ground could be considered. Treatment of livestock with a systemic insecticide (e.g. an avermectin) or a topical insecticide (e.g. a synthetic pyrethroid) over a wide area could assist in reducing the populations of potential vectors. Biological control systems using Bacillus thuringiensis or hormones suppressing larval development are more acceptable alternatives.

Public Awareness

Public awareness programmes are essential to keep the public fully and accurately informed, not only to reduce concern but also to assist in recognition of disease cases. An informed press statement should be released immediately once the disease diagnosis is confirmed.

Trigger 6: Diagnosis

What do you know?	• Tests carried out and results are out • ELISA tests were carried out • RT-PCR tests were carried out
What do you need to know?	• Which treatment was given to the humans? • Which treatment was given to animals? • Is there a vaccine for animals or humans? • What are the long-term effects of this disease? • What mosquito control mechanisms are used?
Hypothesis	• Rift Valley fever

1. **Identify the causative agent of RVF**

Rift valley fever is an acute and deadly viral disease that is known to affect both animals and humans, and can be of particular concern to those persons who raise, transport, and sell animals and those who butcher and consume meat. Rift valley fever (or RVF) is a mosquito-borne disease that can cause abortions in pregnant animals and a high mortality in young animals. It is a negative-sense, single-stranded RNA virus of the family Bunyaviridae within the genus Phlebovirus. Only one serotype is recognized but strains exist of variable virulence.

Resistance to physical and chemical action: Temperature: Virus recoverable from serum after several months at 4°C or 120 minutes at 56°C.

pH: Resistant in alkaline environments but inactivated at pH <6.8.

Chemicals/Disinfectants: Inactivated by lipid solvents (i.e. ether, chloroform, sodium deoxycholate), low

concentrations of formalin and by strong solutions of sodium or calcium hypochlorite (residual chlorine should exceed 5000 ppm).

Survival: Survives in freeze dried form and aerosols at 23°C and 50–85% humidity. Virus maintained in the eggs of certain arthropod vectors during inter-epidemic periods. Can survive contact with 0.5% phenol at 4°C for 6 months.

2. **Briefly describe the laboratory diagnosis of Rift Valley Fever**

The clinical diagnosis can be confirmed by a number of tests amongst which are:

- histopathology performed on formalin-fixed sections of liver; lesions are distinctive but immunoperoxidase staining of viral antigen adds specificity
- virus isolation in cell culture or by intraperitoneal or intracerebral inoculation of weanling mice or hamsters confirmed by immunofluorescent or immunoperoxidase staining
- detection of viral antigen by immunofluorescent or immunoperoxidase staining of frozen sections, immunodiffusion, complement fixation and ELISA
- detection of viral RNA by reverse transcriptase polymerase chain reaction (RT-PCR)
- detection of antibodies by virus neutralization and ELISA (not the haemagglutination-inhibition test which is non-specific); These are used mainly retrospectively to determine the extent of an epidemic. For diagnostic confirmation, recent or current infection must be distinguished from pre-existing immunity. Paired samples collected during the acute phase and again 2 to 3 weeks later provide evidence of recent infection. IgM-capture ELISA allows diagnosis of recent infection to be made on a single serum sample.

Samples: Heparinised or clotted blood, Plasma or serum Tissue samples of liver, spleen, kidney, lymph node, heart blood and brain from dead animals or aborted fetuses. Specimens should be submitted, preserved in 10% buffered formalin and in glycerol/saline and transported at 4°C. Liver or other tissue for histological examination may be placed in formol saline in the field for diagnostic purposes; facilitates handling and transport in remote areas.

Procedures: Identification of the agent

- Culture – primary isolation is usually performed in hamsters, infant or adult mice, or on cell cultures of various types. The virus may also be detected by immunofluorescence carried out on impression smears of liver, spleen and brain.
- Agar gel immunodiffusion – useful in laboratories without tissue-culture facilities
- Polymerase chain reaction used for rapid diagnosis for antigen detection and used to detect RVF virus in mosquito pools.
- RT-PCR followed by sequencing of the NS(S) protein-coding region has been used in phylogenetic analysis.

- Histopathology – examination of the liver of affected animals will reveal characteristic cytopathology, and immunostaining will allow the specific identification of the RVF viral antigen in infected cells.
- Serological tests; Virus neutralization (the prescribed test for international trade) – microneutralization, plaque reduction neutralization (PRN) and neutralization in mice cannot differentiate presence of antibodies of naturally infected animals from animals vaccinated with RVF vaccine; detects antibodies against RVF virus in the serum of a variety of species highly specific and will record the earliest response. These tests can only be performed with live virus; thus, not recommended for use outside endemic areas or in laboratories without appropriate biosecurity facilities and vaccinated personnel.
- Enzyme-linked immunosorbent assay: can be performed with inactivated antigen and can therefore be used in RVF-free countries. Cross-reactions may occur between RVF virus and other phleboviruses, use of inactivated whole virus or mouse liver antigens has recently been replaced by recombinant nucleocapsid (N) protein as antigen commercially available kits.
- Indirect ELISA with pre-coated plates using a nucleocapsid protein (NC) recombinant antigen and Protein G peroxidase conjugate is described in OIE Terrestrial Manual
- IgM-capture ELISA allows diagnosis of a recent infection
- Haemagglutination inhibition can be performed with inactivated antigen and can therefore be used in RVF-free countries employed with great confidence in non-endemic areas. **Note:** sera from individuals that have had previous infections with phleboviruses other than RVF may result positive.

3. Describe the features of the RVF virus

Rift Valley fever virus (RVFV) is a *Phlebovirus* of the Bunyaviridae family. It is characterized by a three-segmented genome of negative/ambisense strand RNA in viral nucleocaspid protein and enveloped by a lipid bilayer containing two viral glycoproteins, Gn and Gc like all members of the virus family. In livestock, particularly cattle, sheep, and goats, it causes many abortions and close to 100% mortality rates among young animals which results in a significant economic loss. The virus is replicated in domestic ruminant animals resulting in high mortality and abortions. Infection in humans can cause acute illness and even neurological disorders, blindness, hemorrhagic fever and thrombosis. The capability of the virus to cause major epidemics among livestock and humans makes infection with this pathogen a serious public health concern.

RVFV is spherical shaped, enveloped virus, has a negative-sense single-stranded RNA genome made up of 3 segments The genome segments of bunyaviruses encode four structural proteins; the large (L) segment encodes for the viral RNA-dependent RNA polymerase while the medium (M) segment encodes the external glycoproteins (Gn and Gc) and the nonstructural protein (NSm). The small (S) segment is ambisense, coding for the nucleoprotein (N) in the antigenomic sense and the non-structural protein (NSs) in the genomic direction. The two non-structural proteins play a role in pathogenesis in vivo. The virus is likely to have an icosahedral symmetry.

4. Discuss "One Health" approach in the control and prevention of RVF disease outbreaks

One Health is a public health management approach involving people, animals, and the environment. One health approach is a coordinated multidisciplinary and multi-sectoral local, national and international collaboration to detect, prevent and control emerging and re-emerging diseases at the animal-human-ecosystem interface. Thus, the success of One Health approach in the monitoring and control of public health threats lies in the full cooperation of the physicians, veterinarians, environmental experts, policy makers, and the community. This can be achieved by understanding the mode of disease spread among people and animals and in the environment. Outbreak of RVF virus infection implicates animals, humans, and the environment. Thus, the stakeholders responsible for the control and prevention of RVF outbreaks include the Department of Veterinary Services, Department of Wildlife, Ministry of Health, Ministry of Housing, and

Ministry of Environment. Among the functions of these stakeholders is to restrict entry of unauthorized people into the area where the outbreak is occurring. The stakeholder must also formulate and execute the safe disposal of animal carcasses. A carcass burial grounds is assigned after due consideration is given to water seepage from the burial grounds into ponds and waterways. If burning is the choice of carcass disposal, it must be done with due consideration for dioxin emission. The public must be informed of the status of the outbreak and if necessary the authorities can declare a state of national emergency/crisis for the outbreak. The following stakeholders should be involved:

- Department of Veterinary Services
- Ministry of Health
- Department of Wildlife
- Community members: women and men separately
- Ministry of Environment
- Ministry of Information
- Local politicians/community elders
- Any local NGOs and CBOs.

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