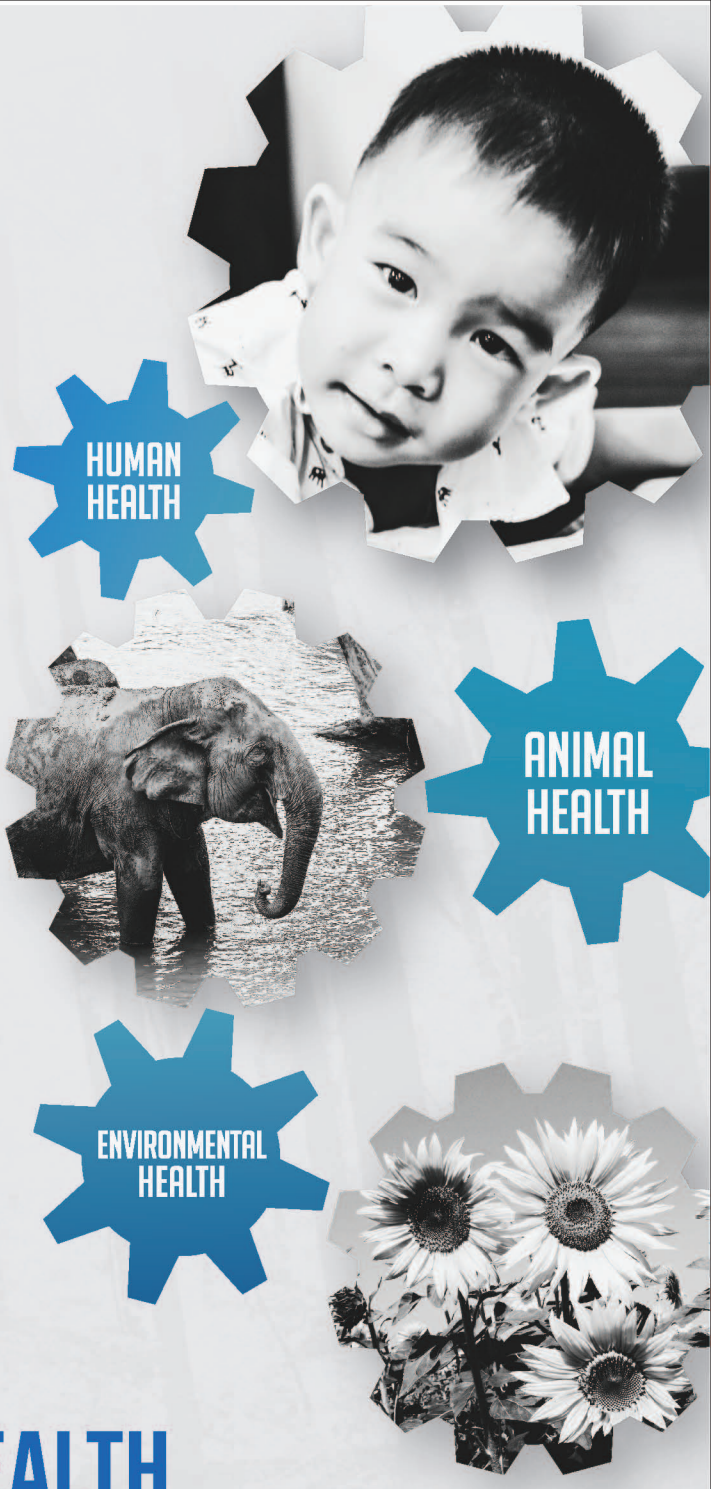

THAILAND ONE HEALTH UNIVERSITY NETWORK:
ONE HEALTH IMPLEMENTATION 2017

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THAILAND ONE HEALTH UNIVERSITY NETWORK: ONE HEALTH IMPLEMENTATION 2017

INTRODUCTION

The Thailand One Health University Network (THOHUN) was established in August 2012 in Bangkok, Thailand. The network was formed under the Emerging Pandemic Threats (EPT) launched by the United States Agency for International Development (USAID) through the RESPOND project. The program seeks to build regional, national and local One Health capacities for early disease detection, prevention, rapid response and containment, and risk reduction. The One Health is a global strategy for expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals and the environment.

THOHUN focuses on pre-service workforce training and strengthening outbreak response capacity through collaboration with Tufts University, University of Minnesota and the South East Asia University One Health Network (SEAOHUN) to conduct activities promoting the One Health approach. SEAOHUN is composed of 10 universities and 14 faculties from Indonesia, Malaysia, Thailand, and Vietnam. These institutions jointly exchange academic resources and advanced innovative teaching methodologies, as well as sharing professional expertise.

Thus far, THOHUN comprises of two founding members, Mahidol University and Chiang Mai University, and six university members from each region of Thailand, namely, Chulalongkorn University, Kasetsart University, Khon Kaen University, Mahasarakham University, Prince of Songkla University, and Thammasart University. In addition, THOHUN National Coordinating Office (THOHUN-NCO) was established to facilitate and assist THOHUN members in conducting activities to foster One Health concept and approach.

Vision

"Strong and sustainable One Health Thai University Network throughout the country by 2020"

Mission

- Build, develop and expand One Health University Network of Thailand.
- Develop and exchange skilled One Health professionals among member universities and involved agencies.
- Support trans-disciplinary collaboration within and among universities and involved agencies.
- Promote research employing One Health strategy to promote the health of humans, animals and the environment.
- Coordinate with other related One Health Networks in the Southeast Asian region.

THE ONE HEALTH WORKFORCE PROJECT

The One Health Workforce (OHW) project is a part of the USAID EPT 2 program, which focuses on disease surveillance, training and outbreak response. The recent emergence of Ebola virus in West Africa, and the far-reaching global threat to humans and animal health, as well as national security and economic prosperity, has brought to the forefront of global politics the limited capacity of health workforce to prevent, detect and respond to infectious disease threats. Coordination and collaboration across human, livestock and wildlife health sectors are essential and is highlighted in the U.S. government Global Health Security Agenda (GHSA), which aims for "a world safe and secure from global health threats posed by infectious diseases."

The One Health program recognizes that the health of humans, animals and the environment are inextricably linked. OHW supports two regional university networks that embrace the One Health strategy, namely, the One Health Central and Eastern Africa (OHCEA) University Network and SEAOHUN.

These One Health university networks support local governments by identifying and addressing knowledge and skills gaps in the current health workforce and transforming future health workforce to address the complex problems according to One Health transformation pathways/levels (Fig), trans-disciplinary and multi-sectoral One Health challenges in their countries and regions. OHW supports OHCEA and SEAOHUN networks to achieve these goals through a wide set of collaborative activities, including field-based training, faculty development and networking, curriculum development, and organizational development.

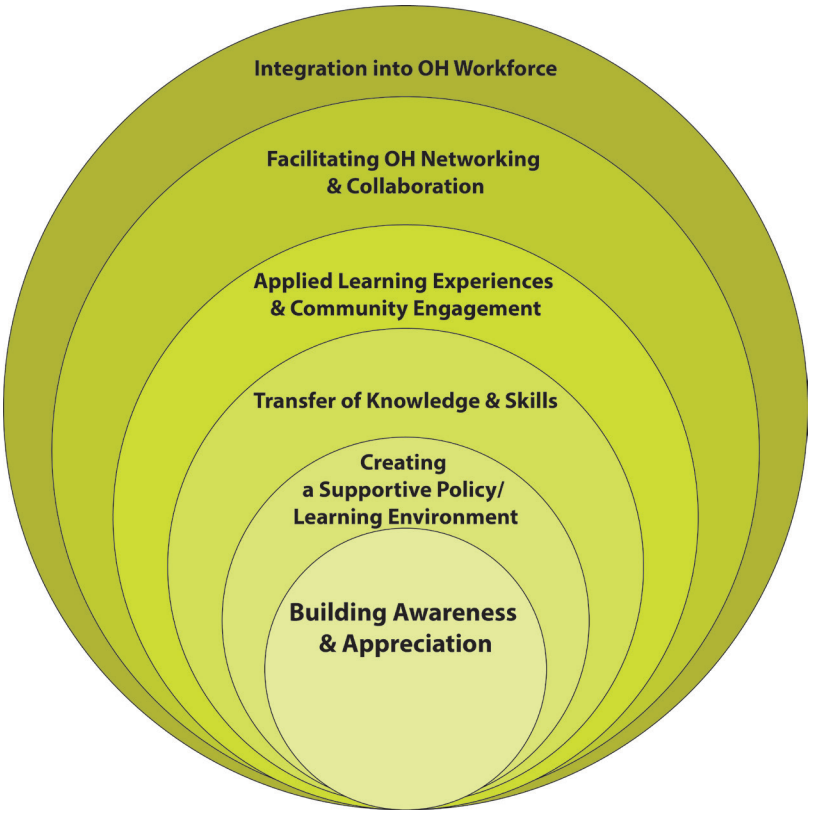
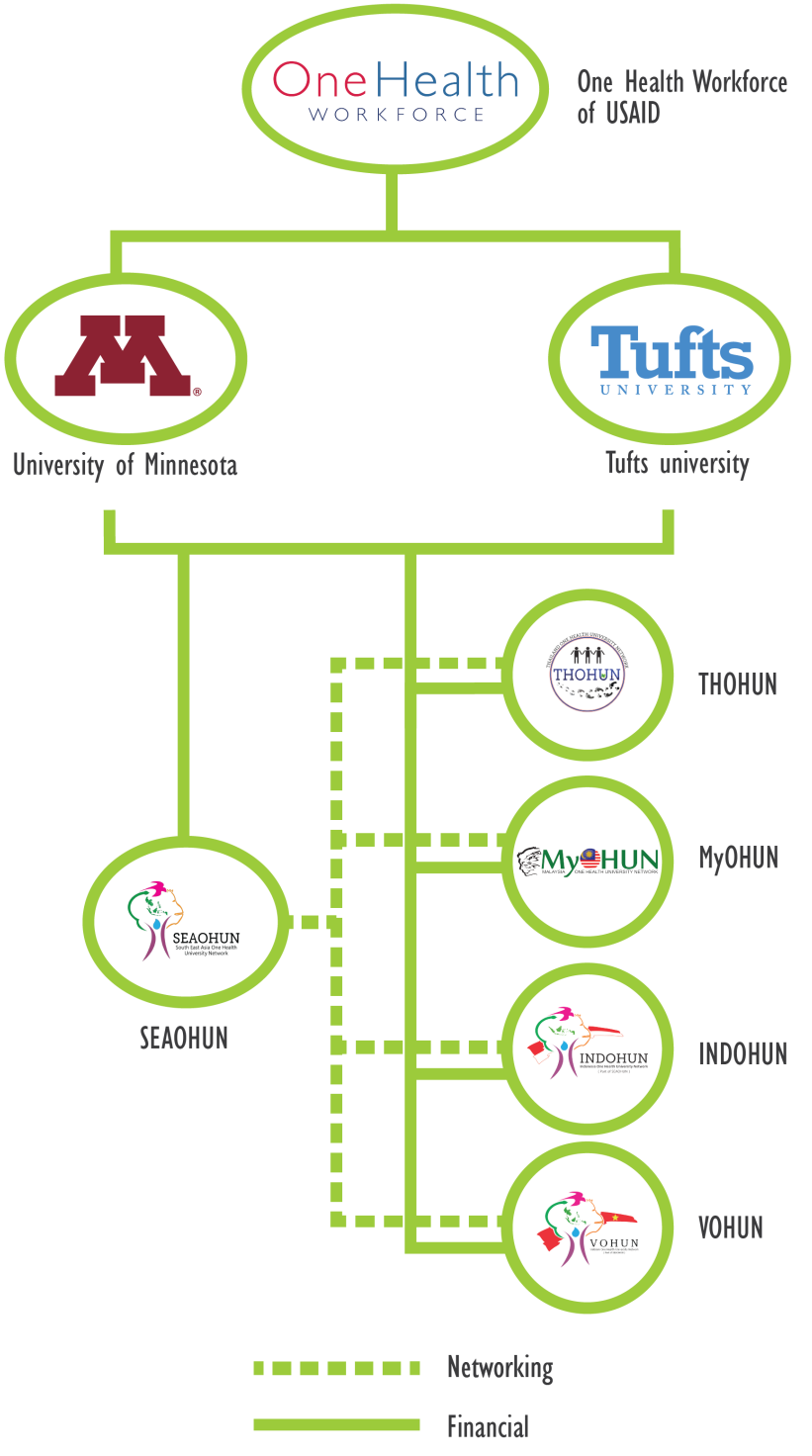
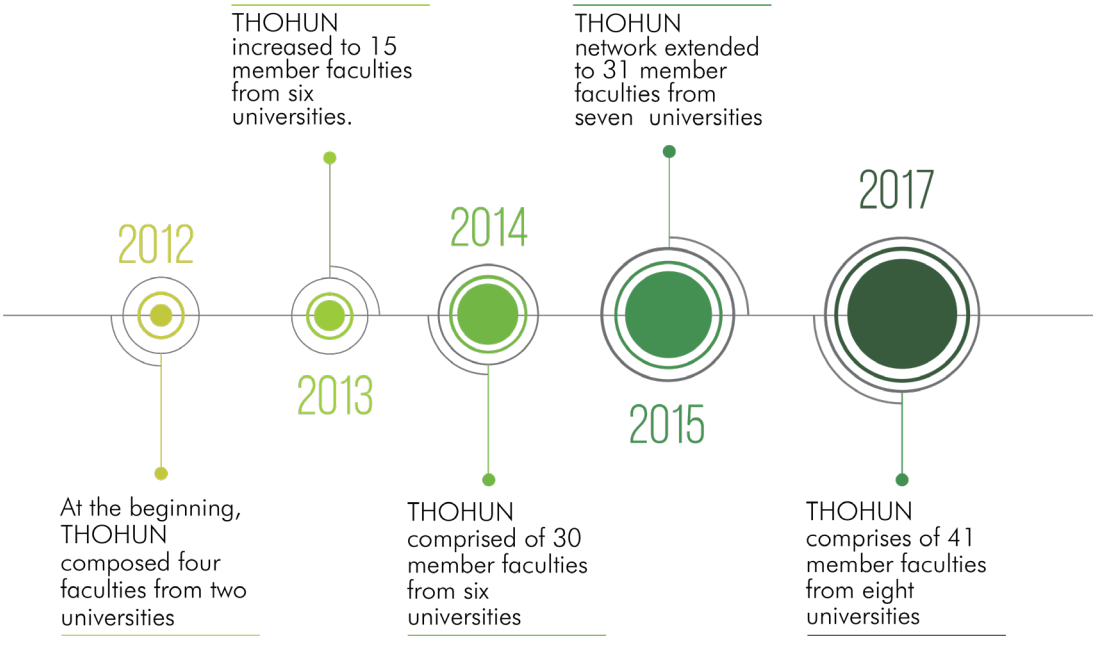


Fig – One Health transformation pathways/levels.

ORGANIZATIONAL STRUCTURE



Collaborative Network



University and Faculty Members

As of August 31, 2017 THOHUN comprises 41 faculties and colleges from 8 Thai universities as shown:

Thailand One Health University Network

Chiang Mai University	Kasetsart University	Prince of Songkla University	Mahidol University	Chulalongkorn University	Khon Kaen University	Thammasat University	Mahasarakham University
- Faculty of Associate Medical Sciences - Faculty of Economics - Faculty of Medicine - Faculty of Nursing - Faculty of Pharmacy - Faculty of Social Sciences - Faculty of Veterinary Medicine	- Faculty of Environment - Faculty of Veterinary Medicine - Faculty of Veterinary Technology - Faculty of Education	- Faculty of Environmental Management - Faculty of Veterinary Science - Faculty of Nursing - Faculty of Pharmaceutical Sciences	- ASEAN Institute for Health Development - Faculty of Medicine Ramathibodi Hospital - Faculty of Environment and Resource studies - Faculty of Nursing - Faculty of Public Health - Faculty of Veterinary Science - Faculty of Tropical Medicine	- College of Public Health Sciences - Faculty of Nursing - Faculty of Pharmaceutical Sciences - Faculty of Veterinary Science	- Faculty of Associate Medical Sciences - Faculty of Dentistry - Faculty of Nursing - Faculty of Public Health - Faculty of Pharmaceutical Sciences - Faculty of Veterinary Medicine	- The School of Global Studies - Faculty of Public Health	- Faculty of Veterinary Medicine - Faculty of Architecture, Urban Design & Creative Arts - Faculty of Informatics - Faculty of Public Health - Faculty of Medicine - Faculty of Nursing - Faculty of Pharmacy

THOHUN Steering Committee

Assoc. Prof. Dr. Parntep Ratanakorn
Faculty of Veterinary Science, Mahidol University
Chairman

Assoc. Prof. Dr. Pratap Singhasivanon
Faculty of Tropical Medicine, Mahidol University
Consultant

Asst. Prof. Dr. Saengduen Moonsom
Faculty of Tropical Medicine, Mahidol University
Coordinator

Chiang Mai University

Prof. Dr. Phongtape Weewattanadate
Faculty of Medicine

Asst. Prof. Dr. Khwanchai Kreausukon
Faculty of Veterinary Medicine

Assoc. Prof. Dr. Lertrak Srikitjakarn
Faculty of Veterinary Medicine

Chulalongkorn University

Prof. Dr. Surasak Taneepanichskul
College of Public Health Sciences

Prof. Dr. Roongroje Thanawongnuwech
Faculty of Veterinary Science

Kasetsart University

Prof. Dr. Apinun Suprasert
Faculty of Veterinary Medicine

Assoc. Prof. Dr. Patamabhorn Amavisit
Faculty of Veterinary Medicine

Khon Kaen University

Assoc. Prof. Dr. Chuchart Kamollert
Faculty of Veterinary Medicine

Assoc. Prof. Dr. Sunpetch Angkititrakul
Faculty of Veterinary Medicine

Mahidol University

Assoc. Prof. Dr. Pratap Singhasivanon
Faculty of Tropical Medicine

Asst. Prof. Dr. Witthawat Wiriyarat
Faculty of Veterinary Science

Prince of Songkla University

Assoc. Prof. Dr. Banjong Witthayawirasak
Faculty of Environmental Management

Assoc. Prof. Dr. Aranya Chaowalit
Faculty of Environmental Management

THOHUN National Coordinating Office

In 2013, THOHUN National Coordinating Office (NCO) was established to conduct and facilitate THOHUN activities to promote the One Health strategy. THOHUN-NCO current staff are:

Assoc. Prof. Dr. Pratap Singhasivanon
Consultant

Asst. Prof. Dr. Saengduen Moonsom
Coordinator

Mr. Irwin F. Chavez
Assistant for International Collaboration

Dr. Veerada Raksanoh
Networking and Communications Manager

Mr. Kittikorn Khunratch
Program and Event Manager

Ms. Tanaporn Panyaniphon
Project Coordination and Management

Ms. Wiriya Kongcharoen
Administrative Manager

Ms. Waroon Boonyaudomsart
Publicity Manager

Ms. Sukanya Kaewkanrai
Finance & Office Manager

THOHUN IMPLEMENTATION ACTIVITIES

Objective 1: OHW Assessment, Planning and Policy Communication

DEVELOPMENT OF ONE HEALTH CORE COMPETENCY DOMAINS FOR THE CURRENT WORKFORCE

Saengduen Moonsom[1]*, Irwin F. Chavez[1], Katherine Waters[2], Stanley Fenwick[3] and Pratap Singhasivanon[1]

[1]THOHUN-National Coordinating Office, Tranakchit Harinasuta Building,Faculty of Tropical Medicine, Mahidol University, Ratchawithi Road, Bangkok 10400, Thailand; [2]School of Public Health, University of Minnesota, Minneapolis, MN 55455, USA; [3]Department of Infectious Disease and Global Health, Cummings School of Veterinary Medicine at Tufts University, 200 Westboro Road' North Grafton, MA 01536, USA

In order to formulate an effective goal-oriented One Health workforce development program for the government sector, current needs and gaps need to be accurately identified to leverage existing strengths and improve weaknesses. The Thai current Workforce from Public Health sectors and stakeholders are key components in the identification of different levels of their One Health Core Competencies (OHCCs). These activities served as a crucial precursor to soundly define the 5-year goals for the ministry workforce development. Authorities from the target ministries were presented their respective organization's position under the One Health framework to allow identification of their future roles and potential contributions during the OHW project. This activity aimed to identify One Health Core Competency domains of Thailand current workforce that will be used for further development of specific competencies and of training packages to improve skills, knowledge and attitudes of the current workforce to effectively prevent, detect and respond to future infectious disease outbreaks in Thailand.

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The workshop was held on March 23-25, 2016 with approximately 50 participants representing six Ministries that are partners under The One Health Collaboration Network comprising Ministries of Agriculture and Cooperatives, Education, Natural Resources and Environment, Public Health, Social Development and Human Security, and Labor, together with the Thai Red Cross Society and representatives from THOHUN university members.

A set of six OHCC domains, namely, (i) One Health professionalism, (ii) communication and informatics, (iii) culture, values, ethics, and beliefs, (iv) collaboration and partnership, (v) leadership, and (vi) planning and management, was developed and agreed upon by all participants (Fig). The final definitions of the six OHCC domains for the current Thailand workforce.

This workshop was the first step in a process to identify OHCC domains for the Thai current workforce. The workshop results were circulated widely in the ministries concerned and to other relevant stakeholders for comments and feedback. Once high-level approval is received, these competency domains will be utilized by the ministries in partnership with the universities to develop specific competencies within the six domains, and to use these to develop training packages to improve the skills, knowledge and attitudes of the current workforce to effectively prevent, detect and respond to future infectious disease outbreaks in Thailand.

Objective 1: OHW Assessment, Planning and Policy Communication

บันทึกข้อตกลงความร่วมมือ
เรื่อง การดำเนินงานด้านสุขภาพหนึ่งเดียวเพื่อความมั่นคงทางสุขภาพของประเทศ
ระหว่าง
กระทรวงเกษตรและสหกรณ์ กระทรวงทรัพยากรธรรมชาติและสิ่งแวดล้อม กระทรวงมหาดไทย
กระทรวงการพัฒนาสังคมและความมั่นคงของมนุษย์
กระทรวงแรงงาน กระทรวงศึกษาธิการ กระทรวงสาธารณสุข และสภากาชาดไทย

บันทึกข้อตกลงฉบับนี้ทำขึ้น ระหว่างผู้แทนจาก ๘ องค์กร คือ กระทรวงเกษตรและสหกรณ์ กระทรวงทรัพยากรธรรมชาติและสิ่งแวดล้อม กระทรวงการพัฒนาสังคมและความมั่นคงของมนุษย์ กระทรวงมหาดไทย กระทรวงแรงงาน กระทรวงศึกษาธิการ กระทรวงสาธารณสุข และสภากาชาดไทย ซึ่งต่อไปนี้จะเรียกว่า **"องค์กรความร่วมมือสุขภาพหนึ่งเดียว"** ได้ตระหนักถึงความสำคัญในการสร้างความร่วมมือของทุกภาคส่วนเพื่อ"สุขภาพหนึ่งเดียว" ที่พึ่งพิงกันของคน-สัตว์-สิ่งแวดล้อม ในทุกระดับของสังคมไทย และเพื่อแก้ปัญหาด้านโรคติดต่ออุบัติใหม่และโรคติดต่อระหว่างสัตว์และคนที่มีความสัมพันธ์กันอย่างซับซ้อน และมีผลกระทบต่อการสูญเสียทางเศรษฐกิจ สังคม และสิ่งแวดล้อมรุนแรง โดยอาศัยกรอบแผนยุทธศาสตร์เตรียมความพร้อม ป้องกันและแก้ไขปัญหาโรคติดต่ออุบัติใหม่แห่งชาติ พระราชบัญญัติโรคติดต่อ พ.ศ.๒๕๕๘ พระราชบัญญัติที่เกี่ยวข้องและมติสมัชชาสุขภาพแห่งชาติ

ดังนั้น องค์กรความร่วมมือสุขภาพหนึ่งเดียว มีเจตจำนงที่จะร่วมมืออย่างเต็มที่ ในด้านการประสานงาน การบริหารจัดการ วิชาการ และทรัพยากร เพื่อบูรณาการแผนงานหรือโครงการ เรื่องสุขภาพหนึ่งเดียว ส่งเสริมให้มีการจัดทำแผน เรื่อง สุขภาพหนึ่งเดียว

ข้อ ๑ พัฒนากลไกความร่วมมือระหว่างกันเพื่อพัฒนา แลกเปลี่ยนองค์ความรู้ ข้อมูลข่าวสารที่จำเป็นในการค้นหา ตรวจสอบ และแจ้งเหตุการณ์ผิดปกติของโรคติดต่ออุบัติใหม่ โรคติดต่อระหว่างสัตว์และคน และความผิดปกติที่อาจส่งผลกระทบต่อสุขภาพ

ข้อ ๒ เพิ่มประสิทธิภาพการทำงานอย่างบูรณาการในระดับนโยบาย และระดับปฏิบัติ เพื่อส่งเสริมการป้องกันการแก้ไขปัญหา และการควบคุมโรคติดต่อระหว่างสัตว์และคน โรคติดต่ออุบัติใหม่ อย่างมีประสิทธิผลและทันเวลา โดยคำนึงถึงผลกระทบต่อการอนุรักษ์สัตว์ป่า และสิ่งแวดล้อม

ข้อ ๓ สนับสนุนการสร้างบุคลากรรุ่นใหม่ และพัฒนาศักยภาพบุคลากรในการทำงาน โดยใช้แนวคิดสุขภาพหนึ่งเดียว

ข้อ ๔ ปลูกฝัง เผยแพร่ความรู้ ข่าวสาร และสร้างความสำนึกของสังคม ชุมชน เรื่องแนวคิดสุขภาพหนึ่งเดียว

บันทึกข้อตกลงความร่วมมือนี้ ทำขึ้น ๘ ฉบับ มีข้อความถูกต้องตรงกัน มีผลบังคับใช้นับตั้งแต่วันที่ ๒๗ มกราคม พ.ศ. ๒๕๕๙ เป็นต้นไป ทุกองค์กรในความร่วมมือสุขภาพหนึ่งเดียวนี้ พิจารณาข้อความโดยละเอียดตลอดแล้ว เห็นว่าตรงตามเจตนารมณ์ทุกประการ จึงได้ลงนามไว้เป็นหลักฐาน ต่อหน้าพยานและต่างฝ่ายต่างถือไว้หน่วยงานละ ๑ ฉบับ

ลงชื่อ.....
(นายธีรภัทร ประยูรสิทธิ์)
ปลัดกระทรวงเกษตรและสหกรณ์

ลงชื่อ.....
(นายเกษมสันต์ จิณณวาโส)
ปลัดกระทรวงทรัพยากรธรรมชาติ
และสิ่งแวดล้อม

ลงชื่อ.....
(นายกฤษฎา บุญราช)
ปลัดกระทรวงมหาดไทย

ลงชื่อ.....
(นายไมตรี อินทุสุต)
ปลัดกระทรวงการพัฒนาสังคม
และความมั่นคงของมนุษย์

ลงชื่อ.....
(หม่อมหลวงปุณฑริก สมิติ)
ปลัดกระทรวงแรงงาน

ลงชื่อ.....
(รองศาสตราจารย์กำจร ตติยกวี)
ปลัดกระทรวงศึกษาธิการ

ลงชื่อ.....
(นายโสภณ เมฆธน)
ปลัดกระทรวงสาธารณสุข

ลงชื่อ.....
(นายแผง วรรณเมธี)
เลขาธิการสภากาชาดไทย

Fig – The memorandum of understanding on implementation of One Health initiative for national health security.

Objective 1: OHW Assessment, Planning and Policy Communication

Fig – One Health Core Competency (OHCC) domains for current workforce in Thailand.

Objective 1: OHW Assessment, Planning and Policy Communication

DEVELOPMENT OF ONE HEALTH CORE COMPETENCY FOR THAILAND CURRENT WORKFORCE

Saengduen Moonsom*, Irwin F. Chavez, and Pratap Singhasivanon

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In 2016, six One Health Core Competency (OHCC) domains for Thailand current workforce/government professionals were identified, namely, (i) One Health professionalism, (ii) communication and informatics, (iii) culture, values, ethics, and beliefs, (iv) collaboration and partnership, (v) leadership, and (vi) planning and management. These six OHCC domains and definitions developed by THOHUN were added into the Operational Plan (2017 – 2021) under the MoU on the Implementation of One Health Initiative for National Health Security as part of the national plan for workforce development. In 2017, One Health core competencies in each of the six OHCC domains were developed in a 2-day workshop attended by the current workforces (Fig). The workshop aimed at identifying the roles of nine target workforce groups [university Master degree teachers and students, businessmen or employers and employees, wild life rangers involved in animal care and breeding center/conservation, Red Cross Society members, livestock personnel, workers and farmers, local governors or administrators trained and worked in disease surveillance, prevention and control, personnel of welfare foster homes and of children and youth councils at provincial and district levels, epidemiology staff, and faculty (derails of latter listed in Table)] with respect to the national health security and to provide details at three levels of OHCCs within the six OHCC domains for Thailand current workforce. These One Health core competencies will serve as crucial frameworks for the Thai ministries involved to serve as guidelines in developing the capacities of their respective current workforce.

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Objective 1: OHW Assessment, Planning and Policy Communication

Table. Faculty and responsibilities.

One Health Professionalism	
➢ **Administrative officer**	
Mid-level:	Apply and integrate One Health knowledge to foster homes and related stakeholders and integrate collaboration within the Ministry of Social Development and Human Security.
➢ **Multidisciplinary team**	
Expert level:	Adapt multidisciplinary knowledge/skills to disease surveillance in foster homes, related centers and stakeholders.
Leadership	
➢ **Administrative officer**	
Mid-level:	Communicate, negotiate and distinguish the importance of each Multidisciplinary sector.
➢ **Multidisciplinary team**	
Mid-level:	- Inspect the infectious disease outbreak within the organization. - Analyze and present the infectious disease outbreak information/situation. - List the choices of decisions to administrator.
Communication & informatics	
➢ **Administrative officer**	
Expert level:	- Justify the information regarding infectious disease outbreak prevention. - Manage the proper communication tools on infectious disease outbreaks across relevant stakeholders and local people to reduce apprehension in the society.
➢ **Multidisciplinary team**	
Mid-level:	- Identify factual information related to infectious disease outbreak for appropriate communication among relevant stakeholders. - Transfer the knowledge of disease prevention and exchange data/information between relevant stakeholders for knowledge management (KM).
Expert level:	- Identify factual information related to infectious disease outbreak for appropriate communication among relevant stakeholders. - Transfer the knowledge of disease prevention and exchange data/information between relevant stakeholders for knowledge management (KM).

Objective 1: OHW Assessment, Planning and Policy Communication

Culture, Values, Ethics & Beliefs	
➢ **Administrative officer**	
Mid-level:	- Understand the workforce cultures within organizations and participate in their social activities. - Evaluate the achievement of One Health understanding and awareness among the local workforces.
Expert level:	- Understand the workforce cultures within organizations and participate in their social activities. - Evaluate the achievement of One Health understanding and awareness among the local workforces.
➢ **Multidisciplinary team**	
Mid-level:	- Apply the One Health knowledge to local centers/community. - Raise the awareness in order to protect the human right of Ministry of Social Development and Human Security's target groups.
Expert level:	- Apply the One Health knowledge to local centers/community. - Raise the awareness in order to protect the human right of Ministry of Social Development and Human Security's target groups.
Collaboration & Partnership	
➢ **Administrative officer**	
Mid-level:	Identify the proper strategies to recruit and work with diverse partners which will achieve the ultimate goals in One Health and a sustainable collaborative network.
➢ **Multidisciplinary team**	
Mid-level:	Promote the cooperation with related partners and organizing One Health networking for infectious disease prevention in local community.
Planning & Management	
➢ **Administrative officer**	
Expert level:	Formulate the goals and objectives including compiling the project and work plan on infectious disease outbreak prevention.
➢ **Multidisciplinary team**	
Expert level:	- Compile the work plan for infectious disease outbreak prevention within Multidisciplinary team. - Efficiently monitor the work plan, follow up and evaluate the results across relevant stakeholders.

Objective 1: OHW Assessment, Planning and Policy Communication

Fig – One Health core competencies training workshop session.

Objective 1: OHW Assessment, Planning and Policy Communication

PROJECT PROPOSAL DEVELOPMENT WORKSHOP

Saengduen Moonsom*, Irwin F. Chavez, and Pratap Singhasivanon

THOHUN-National Coordinating Office, Tranakchit Harinasuta Building, Faculty of Tropical Medicine, Mahidol University, Ratchawithi Road, Bangkok 10400, Thailand

In order to ensure alignment of THOHUN-Year 4 activities with EPT-2 goals and international standards (Global Health Security Agenda, International Health Regulations, Performance of Veterinary Services, and Joint external evaluation tool), a 2-day Project Proposal Development Workshop was organized to create multidisciplinary and high impact activities within three major areas: i) antimicrobial resistance, ii) risk communication, and iii) e-learning development, aimed at identifying and resolving issues, formulating strategic plans, and evaluating and prioritizing THOHUN's Year 4 activities. On the first day, each participating group explained their proposal of streamlining to obtain more efficient and robust projects, of identifying the roles and responsibilities of the affiliated university and of employing multidisciplinary teamwork. The groups also specified the objectives of their respective projects and formulated strategies to achieve the objectives. On the second day, the groups worked on their proposal strategies, justifications and time lines. Nine proposals covering all three areas were submitted for review and approval by the THOHUN Steering Committee.

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Objective 1: OHW Assessment, Planning and Policy Communication

Objective 2: Education and Pre-Service Training of One Health Students (Future Workforce)

INTEGRATIVE ONE HEALTH MODULES FOR CURRENT AND FUTURE ONE HEALTH WORKFORCES

Khwanchai Kreausukon*

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A number of One Health-associated activities have been implemented in the northern region of Thailand, but only a small subset of One Health workforce in the region has been trained. The majority of trainees are students and academic staff. Thus, technical modules to develop One Health skills for other professionals of the One Health workforce should be promoted. In 2015 a number of new One Health modules were developed with collaboration of THOHUN members, stakeholders and students with the aim of increasing the number of available One Health modules, and it was deemed desirable to produce in 2016 other technical modules for other professions of the One Health workforce.

The project entitled "Integrative One Health Modules for Current and Future One Health Workforces" was launched. In order to achieve a sustainable program, an attractive academic curriculum would be developed and evaluated by Chiang Mai University to encourage participation by both undergraduate and graduate students and One Health workers from other professional sectors, especially in the northern region of Thailand. The developed curriculum can serve as a model for other academic institutions in Thailand and thereby ensure the quality and quantity of One Health Workforce in the country.

With these goals in mind, a number of workshops/training courses were conducted in northeastern Thailand as follows. 1) A One Health Workforce Needs Brainstorming Workshop was held in Chiang Mai during 17-18 March, 2016. This activity was conducted to identify the challenges and the needs in the current One Health working areas. Three areas, namely, communication and informatics, knowledge and awareness, and integration and collaboration, were identified by various professionals in

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THOHUN stakeholders, and other professional sectors. 2) One Health Modules I & II Development Workshop was held in Chiang Mai during 19-20 April and 18-19 May, 2016. The activities were conducted to develop two new One Health modules: module A (knowledge and collaboration) and module B (communication and informatics). 3) One Health New Modules Training was held in Chiang Mai during 7-8 July, 2016. This activity was conducted to ensure quality and quantity of the developed modules to be used by the target sectors. 4) An Evaluation Workshop for New Modules Implementations was held in Chiang Mai during 18-19 August, 2016 to assess the effectiveness of implementations of the training course so that adjustments and improvements to the new modules.

Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

DEVELOPMENT OF FUNDAMENTAL ONE HEALTH CORE COMPETENCY COURSE FOR MULTIDISCIPLINARY STUDENTS

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The One Health concept is a worldwide strategy for expanding interdisciplinary collaborations and communications to help solve health problems of humans, animals and the environment. This course is designed to introduce Thailand One Health core competencies to undergraduate students in Kasetsart University, Bangkok using 21st century interactive learning tools. Core competencies are defined as knowledge, behavior and attitude needed by every member of a One Health outbreak team for prevention, disease surveillance and response. This multidisciplinary approach will amalgamate related disciplines, enabling students to better co-ordinate and implement One Health concepts. Students finally will work in their respective professions and be able to join the One Health workforce.

This activity was held on 22 March 2016 and 1 – 5 August 2016, with 50 students out of more than 100 applicants from five departments of Kasetsart University chosen to participate. Core competencies were evaluated before and after the course. Facilitators also evaluated student individually and as a group (Fig) for behavior and homework reports depending on the topic. Every core competencies evaluated improved after completion of the 5-day course.

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Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

Fig – Typical One Health core competencies training workshop session for undergraduate students of Kasetsart University, Bangkok, 1-5 August 2016.

Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

DEVELOPMENT OF ONE HEALTH WORKFORCE OF THAI UNIVERSITY NETWORK FOR COMMUNITY-BASED LEARNING ON INFECTIOUS DISEASES PREVENTION

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Khon Kaen University (KKU) was established as the major university for the north-eastern region of Thailand. The major mission of KKU is to prepare future global citizens to work in a continually changing world.

The majority of Thais living in rural areas work in the agricultural sector. Health problems in humans and animals in the rural areas are current issues, which many organizations participate to try to solve. For example, infectious diseases, such as avian influenza, fasciolosis, foot and mouth disease, hemorrhagic septicemia, melioidosis, opisthorchiasis, and rabies, still cause economic loss, morbidity and mortality in the rural communities.

In order to prevent infectious diseases, it is necessary to educate people and to have collaboration among experts from government, academia and leaders in the community. Thai universities are key pillars in educating the future One Health Workforce build their capacity working in the community. In this project academic staff of six universities (Chiang Mai University, Chulalongkorn University, Kasetsart University, Khon Kaen University, Mahidol University, and Prince of Songkla University) with different backgrounds, disciplines and sectors joined together to form a workforce planning group with the objective of strengthening students' understanding and acquisition of competencies required in the One Health workforce, and also to enable researchers and instructors participating in this project gain a broad view of multidiscipline collaboration that could be integrated into graduate curriculum and teaching. Student preparation phase was conducted during July 10-11, 2016 during which lectures on One Health knowledge were delivered by staff and invited experts (Fig). Students then participated during July 12-22, 2016 with the community of Nong Bua Lam Phu province in on-site activities of building good relationship and productive collaboration with the community, collecting data using questionnaires related to human health, animal health, environment care, and developing plans and activities to implement One Health goals.

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Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

Fig – Typical One Health preparatory session for undergraduate students of Khon Kaen University, Khon Kaen, 12-22 July 2016.

Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

INTERNATIONAL SHORT COURSE ON ECOSYSTEM HEALTH (THOHUN-TELI)

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Due to the increase in the number of emerging pandemic threats, students (future One Health workforce) must be experienced in detection, surveillance, control and response of emerging infectious diseases (EIDs) under real circumstances. In 2016, an International Short Course on Ecosystem Health or THOHUN-TELI was developed to integrate One Health approach into field- and community-based multidisciplinary teaching curriculum of students to prepare them to respond to EID outbreaks.

Students of Clinical Tropical Medicine, Nursing and Public Health (Fig 1), had an opportunity to be exposed to complex health problems, infectious diseases and related public health problems, which originate from interconnections among humans, animals and the environment in the One Health village of Ban Mo Tao, Kanchanaburi province (June 5-23, 2017). At the village students used questionnaires and interviews (Fig 2) and found that there were three major problems villagers faced, namely, human - elephant conflict, water- and food-borne diseases and vector-borne diseases.

At the village site (June 7, 2017), students were given tasks to identify, investigate and come up with practical solutions to manage the infectious diseases and other health problems. As a hallmark of the short course, multidisciplinary teams of students, facilitators and instructors worked together to apply knowledge from their own disciplines and collaborative problem-solving skills.

Samples, such as water (Fig 3) and mosquitoes (Fig 4), were collected and analyzed by the students in the laboratory (Fig 5) for presence of hazardous biological organisms, such as coliforms in food and water, mosquito vectors of malaria and dengue, and pathogens of humans and domestic animals.

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Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

Fig 1 – Multidisciplinary teams of students, facilitators and instructors preparing to visit One Health village of Ban Mo Tao, Kanchanaburi province.

Fig 2 – Typical interview session conducted by students with resident of One Health village of Ban Mo Tao, Kanchanaburi province.

With inputs from the concept of Social Innovation (Fig 6), which focuses attention on ideas and solutions creating social values, students then worked together (Fig 7) to develop a plan for communication to villagers the possible risks of contracting infectious diseases along with proposed solutions and/or suggestions to the identified problems.

Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

Fig 3 – Example of water collection site at One Health village of Ban Mo Tao, Kanchanaburi province.

Fig 4 – Identification of mosquitoes collected at One Health village of Ban Mo Tao, Kanchanaburi province.

Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

Fig 5 – Identification of human and domestic animal pathogens collected at One Health village of Ban Mo Tao, Kanchanaburi province.

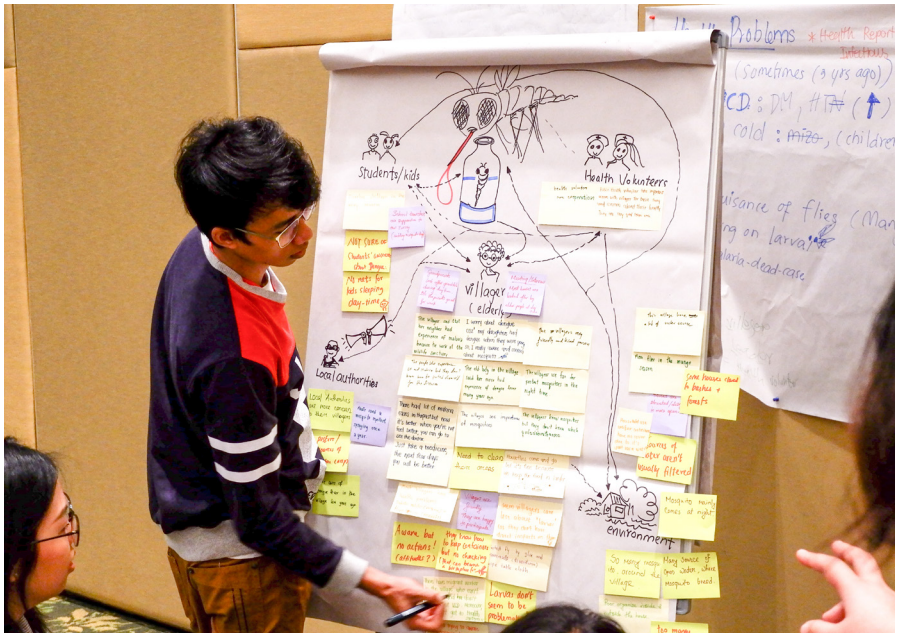

Fig 6 – Mapping the problems, interventions, and social innovation projects.

At the conclusion of the project, more than 30 villagers gathered to listen to presentations as well as to exchange ideas and opinions, and comments on potential solutions provided by the students to the human-elephant conflict, water- and food-borne diseases, and vector-borne diseases.

Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

Fig 7 – Group of students working together using Social Innovation to find solutions to mitigate risks facing residents of One Health village of Ban Mo Tao, Kanchanaburi province.

Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

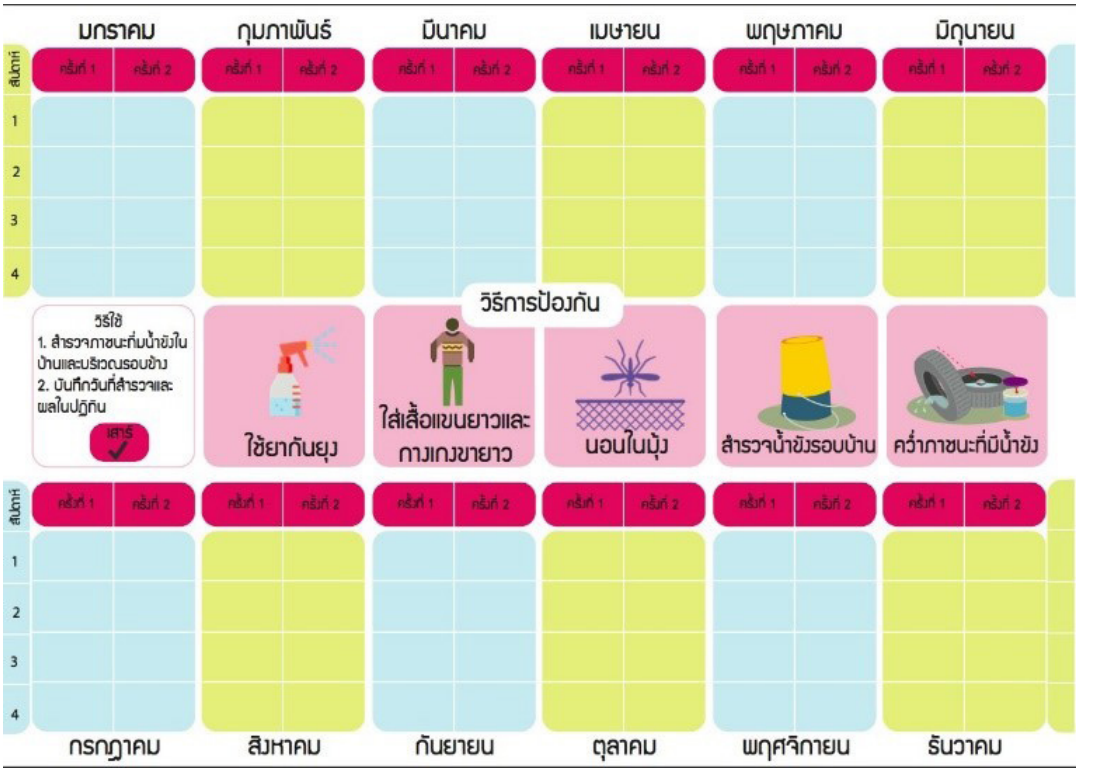

Fig 8 – Solutions for human - elephant conflict, water-borne diseases and vector - borne diseases proposed by participants of THOHUN TELI 2017.

Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

ATTACHMENT OF THAI STUDENTS TO PROVINCIAL ONE HEALTH NETWORK

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In order to develop capacities of future One Health workforce, THOHUN offers scholarships to students for improvement of professional skills and the sharing of related experiences with professional One Health workforces on field. The five students who received the scholarships worked and learned alongside current One Health workforces in livestock offices, public health sectors and local authorities.

Through attending an internship project, students gained experience and knowledge of the One Health Workforce concept, especially collaboration, communication and group participation. During the training period lasting 30 days, students learned how the current workforce applied their knowledge to solve problems particular to a local region. Two students joined the livestock One Health workforce to understand zoonosis control measures (Fig). Another two students who previously had attended the Participatory Oriented Disease Detection (PODD) project in a northern province of Thailand gained further experience in the training and educating people by participating as health volunteers to improve their awareness of disease control. The remaining student attended an internship project at Tha Song Yang Hospital, Tak province. Through the internship project, the students also created a network of multidisciplinary workforces, an important component of the One Health Workforce strategy. Moreover, all students gained increased knowledge and improvement in skill and expertise of importance for their future career. These experiences will help to prepare them to become an effective future workforce. All students presented their experiences during the THOHUN 2017 Annual Meeting, where they were able to receive comments from experts in each field. These comments will help induce students to pursue their chosen career with the added experience and knowledge obtained from One Health Workforce concept. Furthermore, it is hoped some of students may opt to join the One health Workforce as a profession.

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Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

Fig – Students undergoing training with members of the One Health Workforce in a provincial setting in Thailand.

Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

USING ONE HEALTH APPRAOCH TO ADDRESS CHALLENGES OF ANTIMICROBIAL RESISTANCE AND INAPPROPRIATE USE OF ANTIBIOTICS THROUGH TRAINING OF FUTURE HEALTH WORKFORCES

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Antimicrobial resistance (AMR) is recognized over the past few decades as an important, serious and urgent health threat in Thailand. AMR is a complex problem associated with humans, animals and the environment. The common or important AMR bacteria causing infections in Thailand are carbapenem-resistant *Acinetobacter baumanii* (CRAB), *Pseudomonas aeruginosa* and Enterobacteriaceae (CRE), extended-spectrum β-lactamase (ESBL)-producing Enterobacteriaceae, methicillin-resistant *Staphylococcus aureus* (MRSA), and vancomycin-resistant enterococci (VRE). In addition, quinolone-resistant *Escherichia coli* (QREC) and penicillin-resistant *Streptococcus pneumoniae* are among the public health pathogens of concern. In addition, community-acquired infections, such as respiratory tract infections (RTIs) and infectious diarrhea, represent a major burden for every healthcare system, particularly when ineffective or inappropriate antibiotic treatment leads to clinical failure. About half of the antibiotics are prescribed in hospitals where a high prevalence of such antibiotics exists. Moreover, the consumption of antibiotics in Thailand dispensed over-the-counter by community drug stores and retail shops poses major problems of overuse and inappropriate choice of antibiotics for treatment of upper respiratory tract infections (URIs) and acute diarrhea (AD). These subsequently could lead to emergence of AMR in the community.

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Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

One of the Thailand national strategies to control AMR is to strengthen health workforce. Health science students can play a major leadership role in the education of appropriate antibiotic use in primary care settings and community healthcare facilities. Training of future health workforce should aim at increasing awareness and knowledge of AMR and rational use of antibiotics in the treatment of common illnesses related to their future career.

Although, there was an initiative in establishing training modules on rational use of antibiotics (RUA), which in part included the topic of responsible use of antibiotics in treating common illnesses, the modules for health science programs have yet to be fully implemented. Thus, there is no specific course on AMR and rational use of antibiotics offered to health science students so far in Thailand. Hence, a short-course training program was held for health sciences students on One Health strategy to confront AMR challenges and to promote awareness and knowledge of responsible use of antibiotics in the treatment of common illnesses in the country.

We developed concepts and structure of a two-day training course based on (i) One Health core competencies, (ii) Thailand national policies to control AMR and promote RDU, and (iii) the Training Modules on Responsible Use of Antibiotics in targeted common illnesses developed by the RDU Education working group under the national committee on RDU policies. The training course was designed for 3rd-6th year students as a curriculum requirement before their first professional clerkship at community-level healthcare facilities. With training on AMR in ambulatory care settings, students will be able to identify and prescribe antibiotics for common illnesses in an appropriate manner. The short-course training program included brief guidelines for responsible use of antibiotics for four target diseases identified by the Antibiotic Smart Use Project (antibiotic prophylaxis in vaginal delivery of normal term labor (APL), AD, fresh traumatic wound (FTW), and URI), community-acquired antibiotic resistance, control and prevention of AMR using One Health strategy, roles of antibiotic stewardship, and role of multi-disciplinary team in limiting AMR and developing protocols for AMR research proposals (Table 1).

Building on the developed course structure, learning materials and case studies were reviewed by seven experts in health science education and One Health strategy based in the northern region of Thailand and produced for use in a "Short-course Training on Antimicrobial Resistance and Responsible Use of Antibiotics". The short-course

Table 1
Structure and topic content of the short-course training program on antimicrobial resistance (AMR) and rational use of antibiotics (RUA).

Knowledge and skill	Topic
Module 1: General concepts of AMR and RUA	Epidemiology of antimicrobial resistance in Thailand Concept and policy of rational drug use
Module 2: Responsible use of antibiotics in common illnesses in out-patient department (OPD)	Upper respiratory infection (URI) - Pharyngitis - Rhino sinusitis - Acute otitis media - Acute diarrhea - Fresh traumatic wound - Antibiotic prophylaxis in vaginal delivery of normal term labor
Module 3: Team building and communication	Communication skills needed to promote rational use of drugs
Module 4: Integrated care in OPD, in-patient department and the environment using case studies	Principles and importance of RUA in out-patient and in-patient services, and impact of antibiotic use on the environment, organized in five learning stations
Module 5: Health promotion	Alternative care in health promotion and reduction of infection risks

training program consists of five modules. The first module is designed to strengthen awareness of the One Health strategy among health science students from various professional areas, such as medical technology, nursing, pharmacy, and veterinary medicine. Communication and team building skills are developed using role-play and case studies. Students are encouraged to work as a team of different professions so as to obtain One Health core competencies through games and activities. Lectures together

with case study examples help students to improve basic knowledge on responsible use of antibiotics dispensed to out-patients and in-patients. The second module is designed to increase basic knowledge and responsible use of antibiotics for common infectious diseases, such as AD, APL, FTW, and URI, in out-patient department (OPD). The main activities in this module are lectures, presentations of scientific evidence and guidelines of current standard treatment. The third module is designed to strengthen communication and team building skills. The activities include lectures, case studies and assignments. The fourth module is designed to increase knowledge of principles and importance of responsible use of antibiotics in out-patient and in-patient services and to understand the impact of antibiotic use on the environment. This module is organized into five learning stations using case-based learning activities. Awareness of antibiotic use on the environment is conveyed via internet search of evidences for AMR caused by antimicrobial overuse in animal food production and agriculture, along with discussions and debates. The fifth module is designed to increase understaffing of ways and means to promote health using alternative care and reduction in risk of infections. Staff of this short-course program composed of seven faculty members from the Faculties of Associated Medical Sciences, Medicine, Nursing, Pharmacy, and Veterinary Medicine.

A pilot short-course training on AMR and RUA in a primary care setting was held for 53 (35 undergraduate and 18 graduate) students in dentistry, medicine, nursing, and pharmacy from three universities in the northern region of Thailand, with 55% from the latter faculty. Students were exposed to applications of One Health concepts by working in a multi-disciplinary team (Fig 1) to manage AMR through development of (i) communication skills among health care professionals and the public, (ii) multi-disciplinary collaborations on solving problems of overuse of antibiotics and educating public on rational use of antibiotics, and (iii) antibiotic stewardship at every step of antibiotic use based on professional responsibility. The sets of knowledge and skills most likely to be applied in managing AMR and promoting rational use of antibiotics were (i) selection of antibiotics appropriate to the pathogens and corresponding to the standard treatment guidelines, (ii) public education that is simple and easy to understand, and (iii) public communication on AMR and its burden; (iv) dissemination of One Health concept, rational prescribing of antibiotics, (v) active listening, planning and managing AMR, and (vi) development of analytical skills in managing AMR, literature search, communication skills, and multi-disciplinary collaborations; and those requiring further training were (i) analysis of case studies, (ii) antimicrobial stewardship, (iii) skills and attitudes to promote

rational use of antibiotics, and (iv) knowledge and awareness of health care providers to increase perception of AMR and to collaborate in managing AMR problems.

Fig 1 – Typical lecture session and team presentation at the Short-Course Training on Antimicrobial Resistance and Rational Use of Antibiotics.

Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

Feedbacks from 27 health science students attending the short-course training regarding impact of antibiotic use on the environment (station 1), communication skills needed to promote rational use of antibiotics (station 2), principles and importance of rational use of antibiotics in out-patient services (station 3), principles and importance of rational use of antibiotics in in-patient services (station 4), and overall rating of the training course are shown in Figs 2, 3, 4, 5 and 6, respectively.

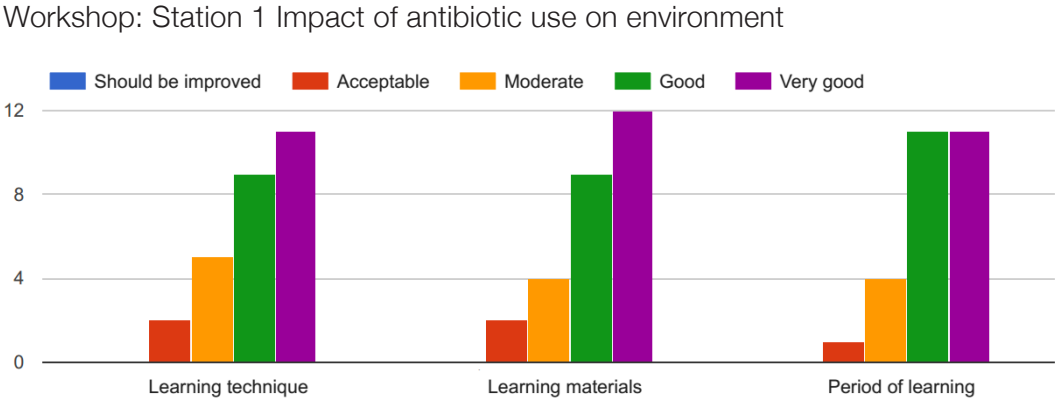

Fig 2 – Number of respondents to workshop station 1.

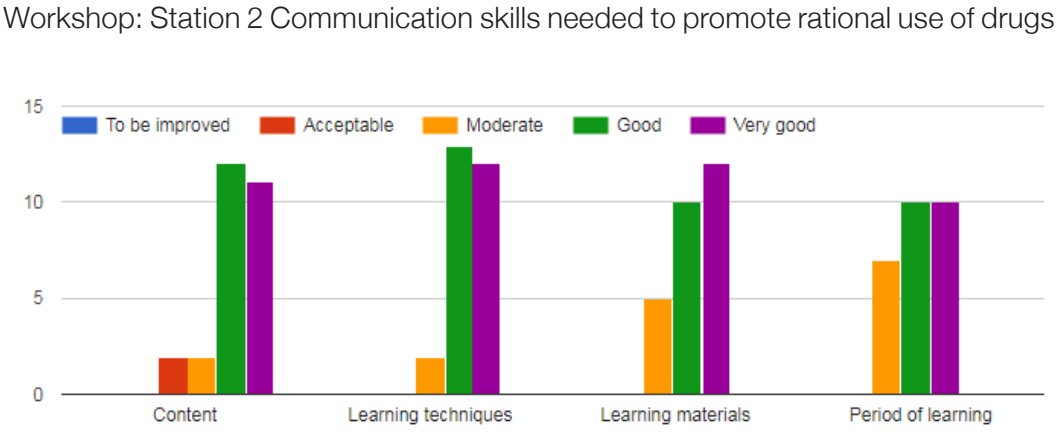

Fig 3 – Number of respondents to workshop station 2.

Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

Workshop: Station 3 Principles and imprtance of rational use of antibiotics in outpatient services

Fig 4 – Number of respondents to workshop station 3.

Workshop: Station 4 Principles and imprtance of rational use of antibiotics in inpatient service

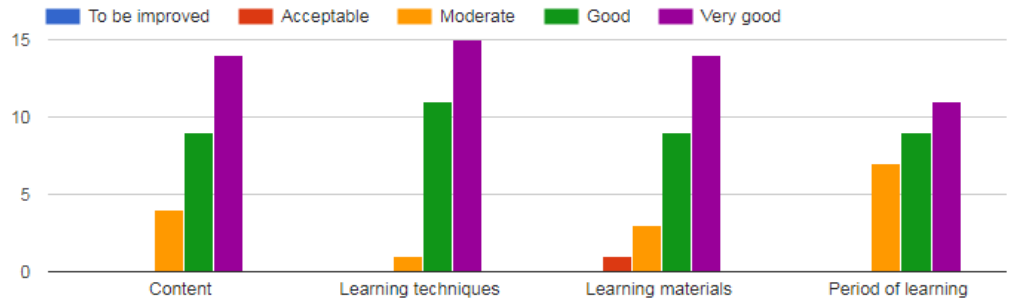

Fig 5 – Number of respondents to workshop station 4.

Health science students will play an important role in attacking AMR problems when they enter into their respective careers. With full understanding and awareness of AMR and responsible use of antibiotics for common illnesses, these trained health science students will have the potential to act in antibiotic stewardship, minimizing overuse of antibiotics in humans and animals, promoting health, and reducing risks of

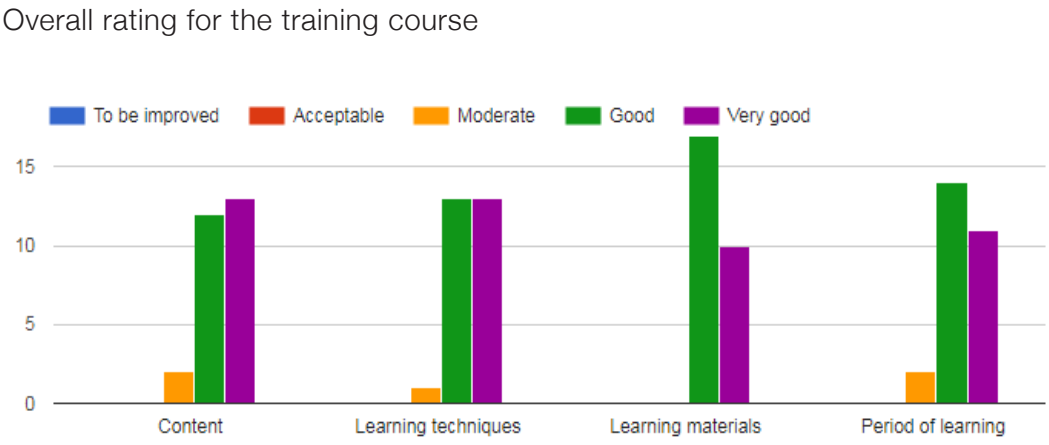

Fig 6 – Number of respondents to overall rating of the training course.

infection, leading to reduced problems related to AMR in the country. Inclusion of the whole short-course training program or some of its learning modules in health sciences curricula should enhance the preparation of future healthcare professions who are capable of contributing to the promotion of rational use of antibiotics and reduction of AMR-related problems.

The pilot short-course training program was conducted with a small number of students because it was arranged during a university break period. Although the participating students came from different health science fields, the majority of the students were from pharmacy. Further training employing in larger groups of students should be considered. Further development of the AMR training program will require consultation and partnership with major stakeholders, such as the Ministry of Public Health, the Ministry of Agriculture and Cooperatives, the Food and Agriculture Organization (FAO), and the World Organization for Animal Health (OIE), to ensure the knowledge and skills of future workforce are in-step with national policies and guidelines on AMR for Thailand and meet the country needs, as well as meeting international standards.

We suggest that short-course training on AMR and responsible use of antibiotics be included in the curriculum of health science degree programs in Thailand. We recommend (i) the training be organized as an inter-professional education course offered students from year 3 onwards to ensure that the students have adequate pre-clinical

and clinical knowledge, (ii) the course be approved by each health science program and a course credit be allocated, and (iii) training modules, manuals and learning materials of each institution be shared among the participating faculties. Attendance of the short-course training program before students enter their first professional clerkship at hospitals and community healthcare centers will enable application of their knowledge of AMR, responsible use of antibiotics for common illnesses and skill in communicating awareness of AMR to other health care professions in their workplace.

Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

TRAINING FOR FUTURE ONE HEALTH WORKFORCE FOR RESPONDING TO EMERGING INFECTIOUS DISEASES IN COMPANION AND EXOTIC ANIMALS

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In the recent outbreaks of various emerging infectious diseases (EIDs) around the world, there were several types of animals infected with the virulent pathogens. Not only livestock and wildlife but also companion and exotic pets can serve as intermediate hosts resulting in an expansion of the extent of human contacts, which poses a serious threat of new emerging zoonotic pathogens infecting humans. In the past, several events showed that companion and exotic pets have risks in contracting EIDs, such as dogs and cats being infected with H5N1 influenza virus in Thailand, prairie dogs infected with monkey poxvirus in the USA, camels infected with MERS-CoV in Middle-Eastern countries, and dogs suspected to be infected with Ebola virus in the USA and Spain. In order to respond rapidly and effectively to new outbreaks of zoonotic EIDs, well-trained workers and a new generation of workforce must be in place. The workforces tackling human, animal and environmental health issues should also have adequate training and skills in handling suspected/infected companion and exotic animals (both legal and confiscated).

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Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

In 2016, we prepared recommendations and provided training for the current One Health workforce in responding to EID in suspected/infected companion and exotic animals, and in 2017, the training was provided to One Health future workforce (university students) in preparing them to become a competent workforce able to handle EIDs suspected/infected companion and exotic animal using the recommendations developed from previous workshop, to respond effectively to future threats, to be aware of biosafety concerns, and how to form networks to assist government ministries in training their respective future One Health workforce. The training program also provided an opportunity for participants to share their experience and discuss future collaborations with One Health activities. Participants were university students and newly-graduated veterinarians from THOHUN member institutions (Chiang Mai, Kasetsart, Mahanakorn University of Technology and Mahidol). Teaching faculty was composed of experts from the current One Health Monitoring and Surveillance Center for Zoonotic Diseases in Wildlife and Exotic Animals (MoZWE) workforce, the FAO Reference Center for Zoonotic and Wildlife Diseases, the Faculty of Veterinary Science, Mahidol University, and collaborating organizations (Department of Livestock Development, Department of Diseases Control, Ministry of Agriculture and Cooperatives and Faculty of Tropical Medicine, Mahidol University).

The four-day training program consisted of lectures and practical demonstrations (Fig) on (i) importance of EIDs in companion animal and exotic animals, (ii) soft skills for One Health strategy, (iii) communication pathways to disease control authority and related law, (iv) disease investigation and rapid response team setting, and (v) recommendations for recognizing and responding to EIDs in suspected/infected companion and exotic animals. Content of recommendation manual consisted of (1) Scope and definition, (2) Characteristics of suspected EID infected animals, (3) Information on risk assessment, (4) Sample collection, packaging and transportation, (5) Animal isolation and quarantine, (6) Criteria for release of quarantined animals, (7) Carcass management and waste decontamination, (8) PPE for use in field work, (9) Risk communications on EIDs and response, and (10) Practicals (PPE don and doff, animal transportation and sample collection, animal health monitoring, care and sample collection during quarantine, sample packaging and transportation, spillover management, carcass management and waste decontamination, and scenario-based practice of response to animals

Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

Fig – Typical training sessions during the four-day training on Responding to Emerging Infectious Diseases in Suspected/Infected Companion and Exotic Animals.

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infected with Ebola virus, MERS-CoV or other highly pathogenic influenza virus).

Data from a survey of participants indicated successful outcomes of the training program: good overall rating of the training, information presented was new to them, informative instructors, useful teaching materials, helpful clarification of their misunderstandings of the One Health strategy, well managed logistics, and intention to implement knowledge acquired from the training program in their workplace. Comments and recommendations from the participants were that (a) awareness of EIDS importance should be promoted among to the practitioners and pet owners, (b) this knowledge should be included in the veterinary curriculum, (c) participants should have opportunity to work with several kinds of the animals, and (d) need to promote a new generation of One Health Workforce.

Objective 2: Education & Pre-Service Training of One Health Students (Future Workforce)

Objective 3: Education and In-Service Training of Health Officers, Practitioners and Professionals (Current Workforce)

DEVELOPING A SHORT TRAINING COURSE ON SURVEILLANCE OF AND RAPID RESPONSE TO EMERGING INFECTIOUS DISEASE OUTBREAKS IN COMMUNITIES FOR PUBLIC HEALTH PERSONNEL IN THAILAND

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Communicable diseases still remain the most common global public health problem. Its high incidence can cause huge social and economic burden and impact on the quality of life of populations in Southeast Asia, including Thailand. In addition, emerging diseases, such as Influenza A (H5N1) and re-emerging infectious diseases (dengue hemorrhagic fever and chikungunya), represent recurrent threats that also cause human suffering and economic loss in the region. Public health administrators need information to prioritize the problems, plan and monitor public health activities to appropriately and effectively use the available limited resources.

Surveillance constitutes an important epidemiological method used to collect public health problems, and health personnel in the public sector needs to have this kind of knowledge and understanding of epidemiology, methods and benefits of disease surveillance and the effective application of such information in their work. The more surveillance information is utilized, the more effective public health problems can be prevented and controlled. Health personnel should be able to apply epidemiology and One Health strategy to prevent disease occurrence in their regions.

A short training course on "Surveillance and Rapid Response of Emerging and Re-emerging Infectious Disease Outbreaks in a Community Using One Health Strategy" was conducted for public health personnel at district and sub-district levels in Khon Kaen and Chiang Mai provinces, and to evaluate the appropriateness and effectiveness of the course including participants' opinions of course content, course duration, training methods and educational materials. Assessment of participants knowledge before and after the training course showed approximately 85% of participants obtained higher scores after completion of the course.

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TRAINING CURRENT ONE HEALTH WORKFORCE TO RECOGNIZE AND RESPOND TO EMERGING INFECTIOUS DISEASES IN SUSPECTED/INFECTED COMPANION AND EXOTIC ANIMALS

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Most emerging infectious diseases (EIDs) are zoonotic and a vast number of microbial pathogens exist in various species of wild and domestic animals. While domestic companion animals, such as pets and exotic animals, may serve as intermediate hosts to expand the extent of human contact, which constitutes an existential threat of new emerging pathogens from these animals. MERs-CoV from camels in Middle-Eastern countries and Ebola virus from bats, suspected/infected pets in Spain and USA and wild animals in Africa are just a few examples. Thus, guidelines, well-trained workers, response teams and a new generation of workforce need to be trained and prepared of the risks involved to ensure that workers can effectively and safely carry out their respective duties.

In order to respond rapidly and effectively to new outbreaks of zoonotic infectious diseases, workers in the field dealing with human, animal and environmental health issues must have adequate training in skills required to handle suspected/infected companion and exotic animals (both legal and confiscated) and to collaborate across other disciplines in charge of responding to EID outbreaks in humans. The outcomes of this training will provide stronger collaboration and communication tools among workers in these fields, especially university personnel and government workers who are experts in human, animal and environmental health problems, and acquaint participants to the activities of One Health workforce services in preventing and controlling the spread of EIDs from infected animals to the community. Moreover, the activities relating to active surveillance of EIDs in exotic animals provide an excellent opportunity for strong collaboration with PREDICT 2 project. This training course aims to support networks to assist government ministries to train their respective current One Health Workforce. This activity was divided into three modules, held during 25-27 May 2016, 7-8 July 2016 and

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26-29 July 2016, respectively at the Faculty of Veterinary Science, Mahidol University.

The guidelines in recognizing and responding to suspected/infected EID in companion and exotic animals were developed based on procedures of Thailand Animal and Human Diseases Control and also adopted from "Interim Guidance for Dog or Cat Quarantine after Exposure to a Human with Confirmed Ebola Virus Disease". The guideline procedures were then tested in three scenario-based simulations: (i) response to EID in companion and exotic pets exposed to similarly infected owners, (ii) response to EID in companion and exotic pets from unknown source, and (iii) response to EID in imported companion and exotic pets. In the last module, participants had the opportunity to apply their knowledge in the actual handling of animals suspected/infected with EID (Fig). Survey data from the participants indicated satisfaction of the workshop.

Fig – Participants applying good practice procedures in handling companion and exotic pets suspected/infected with emerging infectious disease.

Objective 3: Education and In-Service Training of Health Officers, Practitioners and Professionals (Current Workforce)

CAPACITY BUILDING AND NETWORKING OF LABORATORY PROFESSIONALS FOR ZOONOTIC DISEASE CONTROL: INTENSIVE TRAINING IN IDENTIFICATION OF PATHOGENIC BACTERIA

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Bacteria are common causes of zoonotic infections. In Southeast Asia, *Streptococcus suis* infection is a leading cause of death, blindness and hearing loss among infected cases. *S. suis* can be transmitted to humans through close contact with sick or carrier pigs, and by consuming raw or uncooked pork. In Thailand there have been sporadic outbreaks of *S. suis* infection in humans, the first report being in 1987, followed by a series of outbreaks in the north and northeast regions during 1997-2012. Many zoonotic gram-negative bacteria are maintained in human and animal reservoirs and contaminate food supply via excreta causing outbreaks of food-borne illness, e.g. Salmonella.

Although laboratory skills in the detection of bacterial zoonosis have been widely imparted in government sectors under the supervision of the Ministry of Public Health, analysis by THOHUN NCO in Year 1 of gaps and needs revealed laboratory skills are still required as perceived by health professionals of Thailand One Health Workforce. Faculty staff of medical, public health and veterinary schools serve an important role in preparing future workforces for rapid identification of pathogens and reservoirs in mitigating foodborne outbreaks. Therefore, maintaining and improving the One Health Core Competency (OHCC) and laboratory skills of these faculty staff members are crucial for their professional career.

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The intensive training "Networking and capacity building of biomedical personnel in Southeast Asia on clinical laboratory identification of bacteria causing zoonosis and foodborne illness" focused on enhancing OHCC, previous knowledge and laboratory skills for early detection and bacterial identification using standard and advanced techniques. This 2 week hands-on workshop aimed to strengthen faculty staff capacity for effective detection of bacterial zoonosis as well as to create a professional network among professionals from Malaysia, Myanmar, Thailand and Vietnam to ensure sustainable future workforce development. The expected outcomes were that all participants have (1) knowledge regarding One Health strategy, (2) skills and know how in the identification of zoonotic bacteria, food-borne bacteria and others clinically-relevant bacteria, (3) acquired soft skills, and (4) established laboratory networking.

In the first week, on day one, a lecture was delivered in the morning on the One Health strategy and how One Health links to one's health. In the afternoon, participants were informed on zoonotic and specimen handling. On days two to five, participants spent 1.15-1.30 hours on soft skill training in leadership, positive thinking, collaboration and team building, systems thinking and mind mapping, communication and informatics, analytical thinking, communication, and work planning and team working using a number of activities, e.g. NASA moon model, Marshmallow challenge, Blind fold, video presentation and lectures on the concept underlying each skill and how to make summaries of each activity learnt. Then, current knowledge was taught regarding clinically important and zoonotic gram-positive cocci, viz. *Enterococcus* and gram-positive bacilli (*Bacillus, Corynebacterium, Gardnerella, Listeria, Erysipelothrix,* and *Clostridium*), *Streptococcus* and *Staphylococcus,* The lecture also reviewed the properties of zoonotic *S. suis.* This was followed by lectures on biochemical identification of gram-positive bacterial species and a review of antimicrobial resistance in gram-positive bacteria and molecular methods in bacteria detection and identification.

In the laboratory training section, participants were required to identify two unknown gram-positive bacterial samples using techniques starting from streak plating, selecting colonies for staining, selecting colonies for inoculating biochemical test media, and selecting colonies for drug susceptibility testing. One sample was ***S. suis*** and the other gram-positive bacteria closely resembling ***S. suis*** or other clinically important bacteria, e.g. *Streptococcus pneumoniae, Streptococus pyogenes, Streptococcus agalactiae, Streptococcus bovis, Enterococcus faecalis, Enterococcus faecium, Staphylococcus aureus, Staphylococcus haemolyticus,* and *Listeria monocytogenes.* Participants were

required to up date their progress daily and to supply a detailed history regarding the source and origin of their samples based on knowledge from the lectures. Daily questions posed to participants on their laboratory results for Sample 1, which was cultured from blood culture specimen of patient presenting fever, nausea and headache, and had a history of drinking alcohol, were such as (i) on day 1: what is/are the organism(s) in your mind after reading the history of the sample? (ii) on day 2: from the colony morphology and Gram staining, can you guess this organism might be? And (iii) on day 3-4: after identification, what is/are biochemical test(s) you wish to perform?

After all the identification results were known together with their histories, a group discussion was held on such topics as pitfall of each test that would give rise to a false positive or negative result. For instance, cooling the sterile loop by stabbing in blood agar before picking up a colony for subsequent test might produce a false positive result in a catalase test because the blood in blood agar might be the cause of the bubbles indicative of a positive catalase reaction.

In the second week, in the mornings of day 1 to day 3, participants were divided into three groups and each group spent 1.15-1.30 hours discussing the issue of "Capacity building and laboratory professional networking for zoonotic disease control". The following three case studies were presented for discussion.

Case 1. One village in Mae Chaem district (150 km from Chiang Mai) held a special event after the rice harvest, a tradition of this village. They have a special dish known as "Lue" (northern Thai dish using fresh pig blood). After the party, seven men, 35-65 years of age, came down with fever and meningitis from day 1 to day 7. The men said they bought two pigs from a market in Mae Chaem and two more from Chom Thong district (close to Mae Chaem). The patients were admitted to Chom Thong Hospital and referred to Nakhon Ping Hospital (a Chiang Mai central hospital) where CSF and blood samples were cultured and the isolates sent to the Division of Clinical Microbiology, Faculty of Associated Medical Sciences, Chiang Mai University for identification by standard methods and confirmation by PCR. All isolates were identified as *Streptococcus suis* type II. Unfortunately, two patients died, four suffered hearing loss and one lost both hearing and sight.

Discussion topic. Control measures against spread of *S. suis*.

Daily questions were posed for discussion employing the soft skills learnt during the first week followed by presentation.

Objective 3: Education and In-Service Training of Health Officers, Practitioners and Professionals (Current Workforce)

Questions on day 1. (a) Who is/are the stakeholder(s) involved in the control of an epidemic of *S. sui*? (b) How are they involved?

Questions on day 2. (a) What are the responsibilities of each stakeholder involved in the control an epidemic of *S. suis*? (b) What steps should be taken to set up network(s) or working group(s) to control an epidemic of *S. suis*? (c) Who will act as leader of each network or working group?

Questions on day 3. In a network or working group involved in laboratory investigations: (a) Who will act as coordinator or leader? (b) How will collaboration be set up? (c) What is/are activity(ies) that the network or working group should do to serve members?

Case 2. A patient presented with a wound in the left hand and high fever. Pus and blood from the wound were sent for culture before being prescribed the antibiotic ceftriazone. Three days later, laboratory result indicated methicillin-resistant *Staphylococcus aureus* (MRSA). The patient worked at a pig farm and received the wound during the course of his work.

Discussion topic. Control of a MRSA epidemic.

Daily questions were posed for discussion employing the soft skills learnt during the first week followed by presentation.

Questions on day 1. (a) Who is/are stakeholder(s) involved in the control of a MRSA epidemic? (b) How are they involved?

Questions on day 2. (a) What are the responsibilities of each stakeholder involved in the control a MRSA epidemic? (b) What steps should be taken to set up network(s) or working group(s) to control a MRSA epidemic? (c) Who will act as leader of each network or working group?

Questions on day 3. In a network or working group involved in laboratory investigations: (a) Who will act as coordinator or leader? (b) How will collaboration be set up? (c) What is/are activity(ies) that the network or working group should do to serve members?

Case 3. A patient presented with fever, abdominal cramp and diarrhea. The symptoms began 24 hours after consuming a soft-boiled egg from his farm. Stool and blood were sent for culture before being prescribed an antibiotic. After three days, laboratory report indicated the presence of *Salmonella* Enteritidis. The patient had about 1,000 hens, which produce 700-900 eggs per day.

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Discussion topic. Control of an epidemic of *Salmonella* Enteritidis.

Daily questions were posed for discussion employing the soft skills learnt during the first week followed by presentation.

Questions on day 1. (a) Who is/are stakeholder(s) involved in the control of an epidemic of *Salmonella* Enteritidis? (b) How are they involved?

Questions on day 2. (a) What are the responsibilities of each stakeholder involved in the control an epidemic of *Salmonella* Enteritidis? (b) What steps should be taken to set up network(s) or working group(s) to control an epidemic of *Salmonella* Enteritidis? (c) Who will act as leader of each network or working group?

Questions on day 3. In a network or working group involved in laboratory investigations: (a) Who will act as coordinator or leader? (b) How will collaboration be set up? (c) What is/are activity(ies) that the network or working group should do to serve members?

At the completion of each daily discussion topic, each group presented their conclusions. On day 4, each group summarized their conclusions regarding the feasibility of establishing a laboratory network for the control of an epidemic of their respective zoonotic bacterial pathogen.

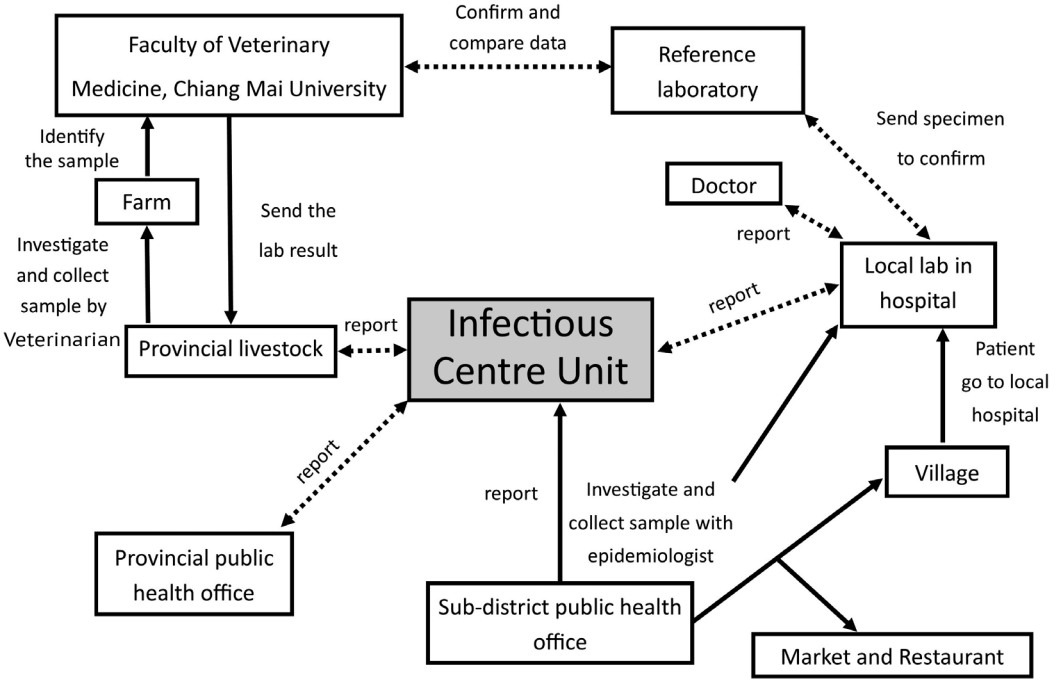
During this period of the training, lectures focused on the clinical importance of zoonotic gram-negative bacteria, such as *Bartonella* especially in family Enterobacteriaceae, e.g. *Eschericial coli, Salmonella, Shigella,* and other coliform group, *Brucella,* and *Francisella*. Lectures also included clinical importance and identification of *Aeromonas, Mycobacterium tuberculosis, Plesiomonas,* and *Vibrio*. There were lectures on drug resistance of gram-negative bacilli, causes and control.

Laboratory training sessions on identification of pathogenic gram-negative bacteria were conducted using the same format as in the first week. One sample was a salmonella specimen (*Salmonella* Choleraesuis, *Salmonella* Enteritidis, *Salmonella* Paratyphi A, or *Salmonella* Typhi) and the other one of the following gram-negative bacilli: *Aeromonas hydrophila, Enterobacter cloacae, Escherichia coli, Klebsiella pneumoniae, Pasteurella multocida, Shigella flexneri, Shigella sonnei, Vibrio cholerae,* and *Vibrio parahaemolyticus.*

A typical power point presentation point presentation from each group is shown in Fig 1.

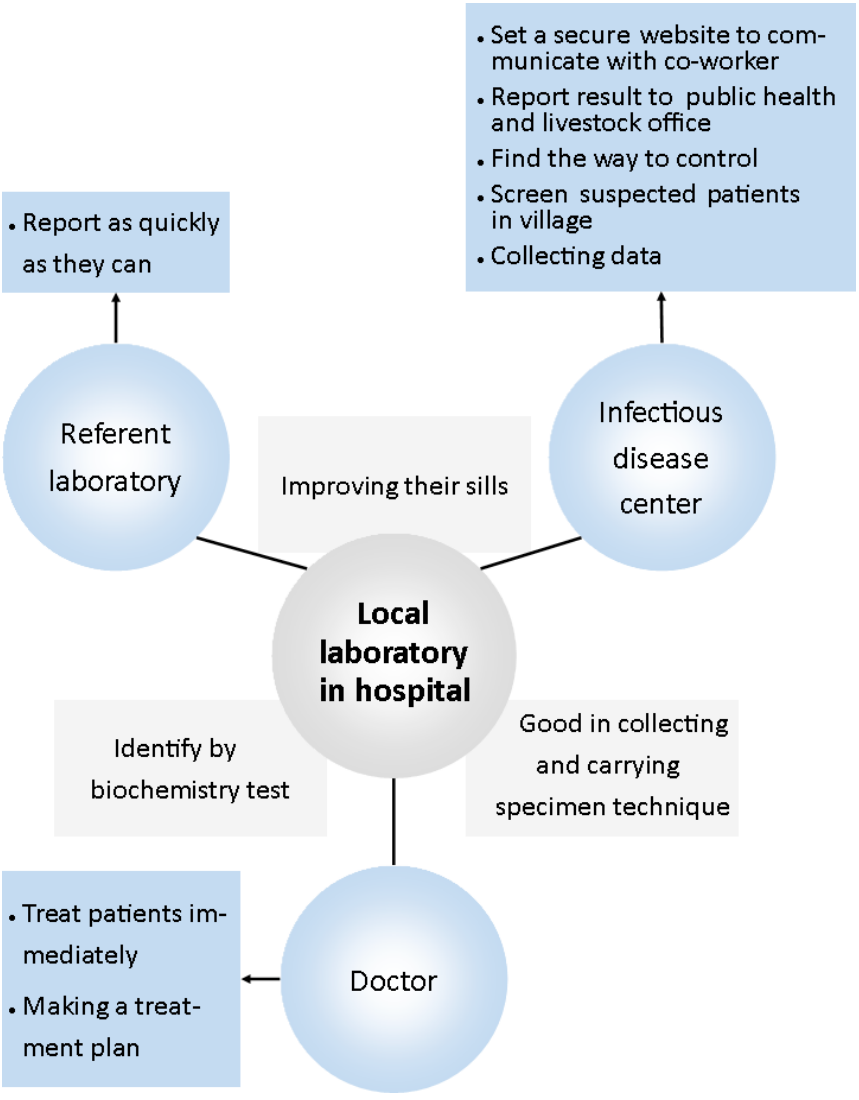
Group 1. Control of *Streptococcus suis* epidemic.

Involvement of Stakeholder or network.



Objective 3: Education and In-Service Training of Health Officers, Practitioners and Professionals (Current Workforce)

Laboratory networking and activity of each stakeholder



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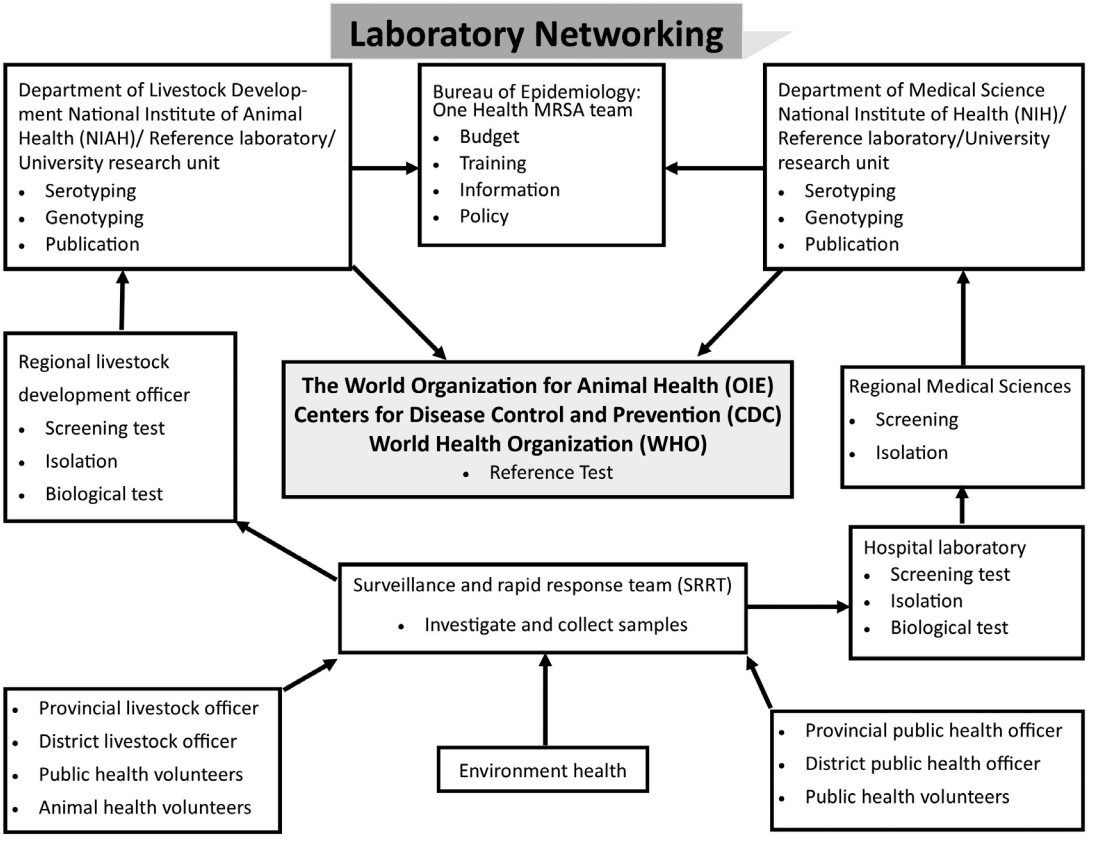
Group 2. Control of an epidemic of methicillin-resistant *Staphylococcus aureus*. Laboratory networking.



Objective 3: Education and In-Service Training of Health Officers, Practitioners and Professionals (Current Workforce)

Group 3. Control of an epidemic of *Salmonella enteritidis*.

Laboratory networking.

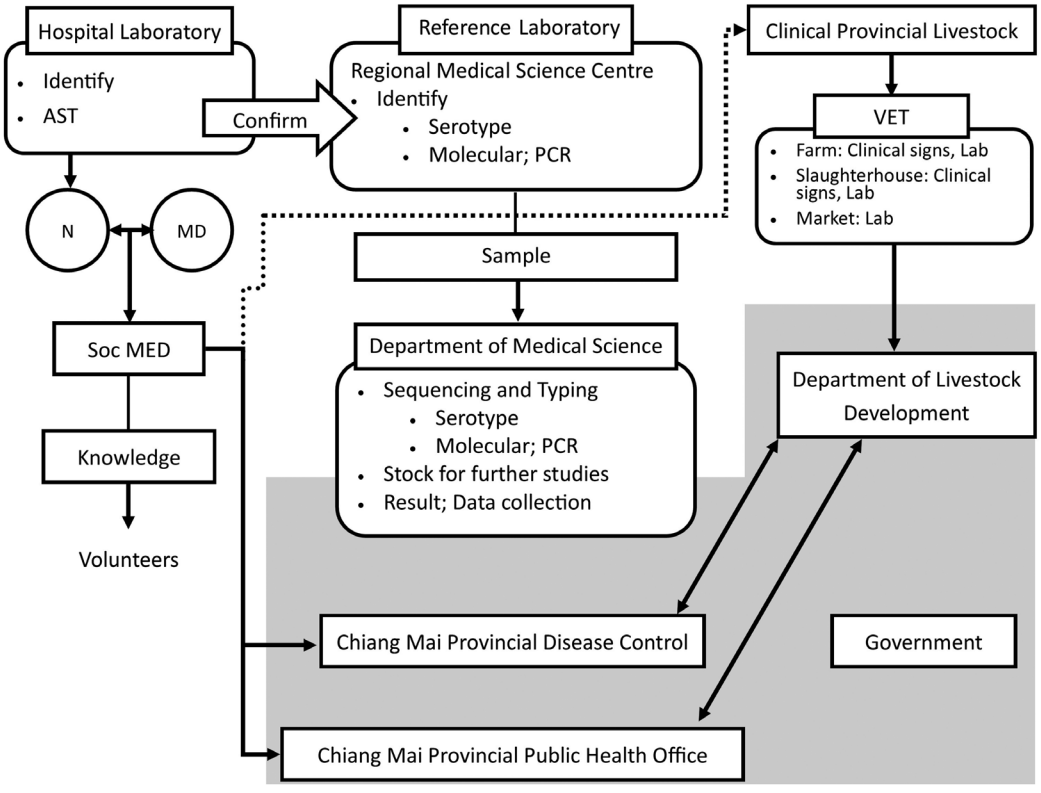


Fig 1 – Typical power point presentations on control strategies of zoonotic bacterial epidemics.

This training workshop emphasized acquisition of both soft and hard skills. Groups composed of participants with different careers and expertise formed a multidisciplinary units that allowed viewpoints from a variety of perspectives and arriving at multifaceted solutions. In the laboratory sessions, participants were diligent in perfecting skills they lacked and in many cases they were helped by fellow participants. Participants' comments on the laboratory training included: (a) "It's very nice learning how to identify unknown samples", (b) "I gained many techniques (in) identification of the unknown bacteria (and) all the facilitators gave good information and help(ed) me a lot during the

lab training", (c) "I need more organism(s) to improve my lab skill, (d) "Got knowledge and technique to do clinical laboratory (tests)", (e) "All staffs were sincere to help us and supported us (via) question, problem, result", (f) "Laboratory training is quite good and interesting", (g) "Excellent", and (h) "Very good laboratory to learn about microorganism and identification".

The consensus of the participants on the control of zoonotic bacterial epidemics a network be established with the Faculty of Associated Medical Sciences acting as the center of collaborating institutions (Fig 2). The network will be divided in two main laboratory groups: one involved in human and the other on animal infections. Each member will help each other and respond immediately to an outbreak through communications via a line group, such as "Zoo Lab Net" and Facebook Laboratory networking for zoonotic disease control (LNZDC) group. In addition, THOHUN should hold similar workshops annually in other regions of the country and ultimately to establish collaborative networks of professionals capable of providing expert training in bacteria identification and in infectious diseases surveillance for future One Health workforces.

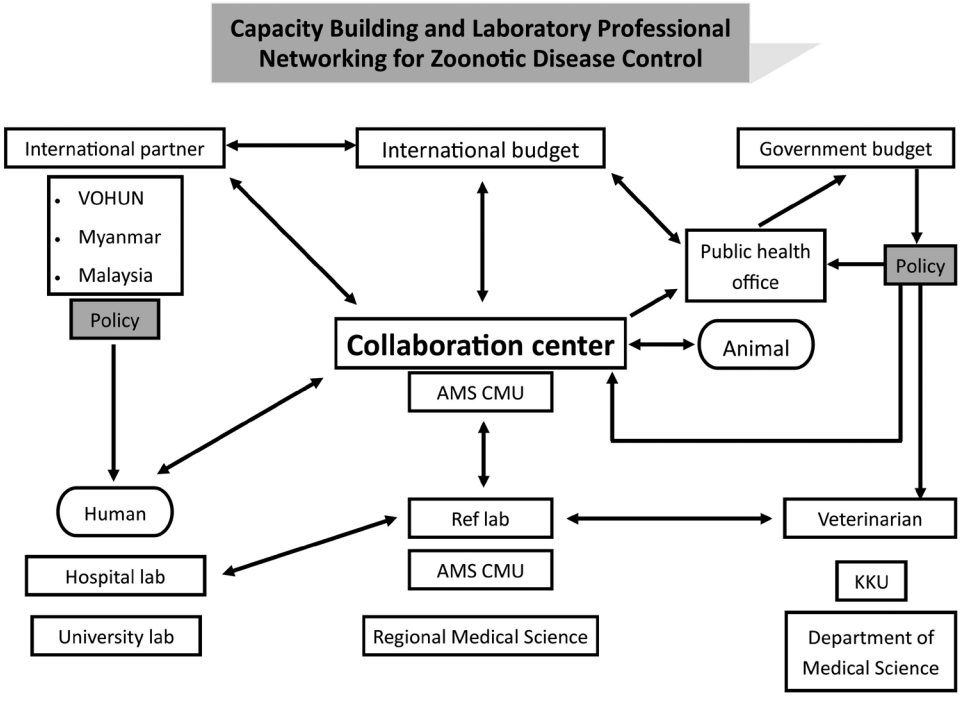


Fig 2 – Thailand network for control of zoonotic bacterial epidemics.

Objective 3: Education and In-Service Training of Health Officers, Practitioners and Professionals (Current Workforce)

STAKEHOLDER CONSULTATIVE AND GAP ANALYSIS FOR IN-SERVICE TRAINING

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The major role of the College of Public Health Sciences, Chulalongkorn University (CPHS-CU) one several academic institutions in health and health sciences, is to produce high quality health and health-related workforce for disease prevention and control, including improving environmental health, health and well-being of people in the region and other areas.

One Health is a worldwide strategy for expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals and the environment. When properly implemented, One Health will help protect and save many millions of lives for the present and future generations. In order to achieve this challenging goal, CPHS-CU in collaboration with our partners worked together to develop a curriculum of short course training program for health and health related professionals on One Health. In 2015, CPHS-CU organized a "Stakeholders meeting for gap and needs analysis" to identify and prioritize the One Health training needs, which suggested the need for a leadership skills curriculum.

Hence, a two-day workshop on Leadership in Health for One Health was organized during 29- 30 August 2016 at CPHS-CU attended by 31 participants from THOHUN network universities (22), Ministry of Public Health (4), Bangkok Metropolitan Office (3) and health staff from government hospitals (2). The workshop was to allow participants to learn and share their opinions and experiences on leadership in health to identify key issues and recommend guidelines for preparing a course curriculum. Participants consisted 1 from the field of education, 1 dentist, 1 health economist, 1 malaria expert, 3 clinicians, 5 administrators, 6 environmental health professionals, and 14 public health officers. The specific goals of the workshop were to (a) instill capacity building in leadership skills for health-related and One Health workforces and (b) apply participants' leadership skills in health-related and One Health areas of concern. For achievement of

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Objective 3: Education and In-Service Training of Health Officers, Practitioners and Professionals (Current Workforce)

Goal (a), participants learnt to (1) understand leadership trails and skills, which included understanding of leadership concept in health-related and One Health contexts and description of leadership qualities and skills desired in health-related and One Health leaders, (2) examine visions of leadership skills through accessing personal leadership styles, and (3) demonstrate role and responsibility of leadership through recognizing role and responsibility of leadership in health-related and One Health leaders. For achieving Goal (b) participants learnt to develop and apply leadership skills through use of case studies, e.g. disease outbreak.

Resource persons were international and national leaders in the health fields. They willingly shared their experiences and guided the participants in group discussions on course curriculum development. All participants actively contributed their expertise to group workshops and meetings (Fig). The workshop came to the conclusion that more One Health stakeholders, viz. private sectors, target participants (e.g. health and One Health-related personnel at the provincial level), should be invited to attend similar workshops.

Fig – Typical discussion group at the workshop on Leadership in Health for One Health, College of Public Health Sciences, Chulalongkorn University, 29- 30 August 2016 .

Objective 3: Education and In-Service Training of Health Officers, Practitioners and Professionals (Current Workforce)

ONE HEALTH IMPLEMENTATION FOR VILLAGE HEALTH AND LIVESTOCK VOLUNTEERS

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Since 1997, One Health was incorporated in the mission of the Faculty of Veterinary Science, Mahidol University, Nakhon Pathom on account of its importance in health management, which should integrate human, animal and environmental health. Thus, a "One Health Village" project was established, with Kang Pla Kod village in Kanchanaburi province chosen as the pilot locale as it is located near the Mahidol University Kanchanaburi campus. The village's problems were identified by a multidisciplinary team with collaboration from the villagers, and activities were established to solve those problems.

The One Health Village project has been initiated since 2014 to help the community of Klang Pla Kod village to solve their complicated problems using the One Health strategy. Our team found that there was a large gap in communication between academics and villagers, especially regarding zoonotic diseases transmitted from livestock and wildlife. Moreover, there are numerous reports of zoonotic diseases in Kanchanaburi province, viz. brucellosis, leptospirosis, tuberculosis, and rabies. In order to educate the villagers of these diseases and of the One Health strategy, it is necessary to alert academics of these challenges. In Thailand, there are around one million village health and livestock volunteers who are in the position to communicate health information to the villagers directly and effectively. Thus, a one-day workshop was held to train health volunteers of Klang Pla Kod village about One Health strategy in dealing with a local outbreak of zoonotic diseases relevant to their community.

In continuation of this important initiative, "One Health Implementation for Village Health Volunteers Workshop I, II and III" was held on 30 March, 17 May and 20 July 2017, respectively attended by 215 human health and 83 village livestock health volunteers from 13 districts of Kanchanaburi province, namely, Bo Phloi , Dan Makham Tia, Huai Krachao, Lao Khwan, Mueang, Nong Prue, Phanom Thuan, Sai Yok, Si Sawat, Tha Maka, Tha Muang, and Thong Pha Phum, were chosen to participate in the workshops.

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Objective 3: Education and In-Service Training of Health Officers, Practitioners and Professionals (Current Workforce)

The participants were informed of the importance of zoonotic diseases, such as avian influenza, brucellosis, leptospirosis, rabies, *Streptococcus suis* and trichinosis. Participants had opportunities via group activities and discussions to update their knowledge of the causes of infections of interest and disease prevention using the One Health strategy. Six booths on different topics were set up manned by specialists to discuss issues and respond to questions (Fig). Depending on the topic of interest, participants were divided into six groups to allow everyone to participate and share their knowledge and experience. Furthermore, participants were encouraged to present strategies to solve their particular human and livestock health problems through One Health. Human and livestock health problems identified and suggested solutions are listed in Table. In addition, participants were encouraged to form collaboration among themselves and links with the experts to create networks to improve efficiency in solving local health problems in man and animal.

Tests were given before and after the workshop to evaluate understanding of One Health and the importance of zoonotic diseases. The increase in test scores cores was reassuring and more importantly, participants enjoyed the activities and felt they obtained a better understanding of One Health and importance of zoonotic diseases on human and livestock health.

Objective 3: Education and In-Service Training of Health Officers, Practitioners and Professionals (Current Workforce)

Table 1
Human and livestock health problems identified and suggested solutions from the Workshop on One Health Implementation for Village Health Volunteers from 13 districts, Kanchanaburi province.

Problems	Tentative solution
Avian influenza	- report suspected case to officer - quarantine suspected animals and use effective disinfectants or detergent for cleaning - do not eat or touch carcass of unknown death birds - not moving unknown carcass without permission - appropriate waste and carcass management - disease prevention by wear protective clothing - building public awareness - network building
Rabies	- disease prevention by pet vaccination, do not contact stray animals - building public awareness - network building
Brucellosis	- disease prevention by vaccination animal, wear protective equipment - appropriate waste and carcass management - building public awareness, do not drink raw milk
Trichinosis	- building public awareness, do not eat raw meat - provide disease information and prevention to related person such as farmer, slaughter house worker, butcher, consumer
Leptospirosis	- disease prevention by wearing boots when fishing - pest control and cleaning house, stables - building public awareness - network building
Streptococcus suis infection	- building public awareness, do not eat raw meat - provide disease information and prevention to related person such as farmer, slaughter house worker, butcher, consumer

Objective 3: Education and In-Service Training of Health Officers, Practitioners and Professionals (Current Workforce)

Fig – Typical booth with a specialist explaining and answering questions from participants attending the Workshop on One Health Implementation for Village Health Volunteers, Kanchanaburi province.

Objective 3: Education and In-Service Training of Health Officers, Practitioners and Professionals (Current Workforce)

Objective 4: Faculty/Staff Development and Improved Academic Offerings

DEVELOPMENT OF A ONE HEALTH ONLINE COURSE FOR ACADEMIC STAFF AND UNIVERSITY STUDENTS

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Avian and swine influenza, dengue fever, food-borne infections, leptospirosis, rabies, seasonal smog, *Streptococcus suis*, and zika virus are only a few of the diseases and complex problems, which continue to affect people of Thailand. Effective surveillance and early detection of the diseases are known strategies to control their spread and to prevent them from reaching outbreak levels. However, these diseases and environmental health problems are multi-factorial and conventional strategies eventually prove ineffective. One Health is an accepted strategy centered on active multidisciplinary collaborations and communications in all aspects of health care, encompassing human, animal, and the environmental.

As good as One Health is, this strategy is still novel to many academics in the health sciences. Thus there is a vital need to promote and advocate One Health in academia. Hence, a "One Health Online Course" was designed to fit the needs and available time for target academic staff and university students. This format would allow optimal delivery of key messages of One Health to those in various disciplines. Twenty academic staff and experts in IT and online course development from the Faculties of Associated Medical Sciences, Education, Humanities, Medicine, Nursing, Pharmacy, and Veterinary Medicine in Chiang Mai University were recruited to develop and provide essential content, teaching materials and strategies for the online course in a two-day workshop.

The objectives of the workshop were to (1) survey the basic knowledge on One Health and needs of academic staff and university students to understand One Health through an online course, (2) create an outline and contents of the One Health Online Course for academic staff and university students, (3) produce teaching materials and teaching strategies to be used in the online course, which include course content, handouts, presentations, homework exercises, and other relevant materials, and (4)

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evaluate the materials used or developed for fulfillment of the goals of the One Health Online Course.

This workshop allowed the sharing of expertise in active learning process from various disciplines to develop outline and contents of the One Health Online Course using group discussion among experts from different disciplines, which was highly appreciated by all participants. Participants agreed a network should be established to allow continuing communication and exchange of ideas in furthering the development and improvement of the One Health Online Course.

Objective 4: Faculty/Staff Development and Improved Academic Offerings

ANALYSIS OF EXISTING E-LEARNING STRUCTURE IN THE COLLEGE OF PUBLIC HEALTH SCIENCES, CHULALONGKORN UNIVERSITY

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Distance education is defined as planned learning structure, which normally occurs in a different place from teaching. Special techniques in course design, teaching techniques and methods of communication and interaction between instructors and learners by digital technology are required to support this mode of education. In this era, distance learning has become an element of "e-learning" because e-learning evolved from a different field of theories and practices. E-learning does not take only course contents into its consideration but also considers face-to-face classroom and interaction between learners and instructors.

In 2002, Thailand introduced a strategy to enhance the quality of higher education by facilitating use of information and communication technology, namely "e-Education". Many universities in the country have adopted e-learning to assist traditional classroom instruction. However, methods and platforms of e-learning in the universities are not well documented. Thus, e-learning in Thai universities needs analysis of current situations to identify weaknesses in the current e-learning platform to enable e-learning to achieve its full potential.

The College of Public Health Sciences, Chulalongkorn University (CPHS-CU) provides a "Learning at the Work Place Program" targeted at public health workforces in Thailand's remote areas and other developed and developing countries. This is a "traditional e-learning" format that uses the internet in a classroom setting and distributes in-class materials. Moving from this mode to an "e-learning system" constitutes one of the goals of CPHS-CU; however, an analysis of the current situation and feedbacks from learners (users) on traditional e-learning did not provide a clear picture.

Hence, a two-day workshop on "Analysis of Existing E-learning Structure at CPHS-CU" was held to document strengths and weaknesses of the current e-learning system from the perspectives of students (users) and stakeholders from within and outside

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Objective 4: Faculty/Staff Development and Improved Academic Offerings

Chulalongkorn University. The workshop was attended by 29 participants, composed of current students, former students, support staff and Chulalongkorn lecturers. The majority came from the public health sector and a number of nurses. Support staff from CPHS-CU were academic service staff who conducted the e-learning and IT staff who provided technical support. In addition, two staff members from the Learning Innovation Center, Chulalongkorn University acted as resource persons providing information related to teaching innovation.

In the workshop, strengths and weaknesses of the current traditional e-learning module were critically examined through discussion among the participants. The following conclusions were reached:

Strengths: (1) Current e-learning mode allowed students to manage their schedule. (2) Lecturers could contact students from abroad. (3) Current e-learning mode economized students' expenses and time. (4) Students could submit comments and suggestions online. (5) Announcements regarding the course were readily accessible online. (6) Several learning platforms could be provided through the e-learning mode.

Weaknesses: (1) This traditional e-learning mode was limited to students with internet access. (2) Learning platform lacked mid-stream testing facility. (3) Lecturers could not know students' learning progress or assess class involvement. (4) Copyright status of illustrations and teaching contents were not clearly indicated. (5) Internet system was not stable in some regions of the country. (6) Current mode lacked a two-way communication system. (7) Evaluation methods were not suitable. (8) Both students and lecturers were deficient in their understanding of the e-learning process resulting in uncoordinated interactions between students and instructors. (9) Library facilities were not accessible to students.

The workshop provided space for sharing and discussion of participants' personal attitude towards traditional e-learning mode. The perception of former and current users were exchanged. CPHS-CU was made aware of the strengths and weaknesses of the current traditional e-learning mode, which will lead to changes and improvements. Data gathered from the workshop already have been incorporated as a part of the development of a questionnaire to survey to take place in the second phase of this ongoing program, which will involve the restructuring of the current traditional e-learning mode into an e-learning system.

Objective 4: Faculty/Staff Development and Improved Academic Offerings

TRAINING THE TRAINERS: INTEGRATION OF ONE HEALTH CORE COMPETENCY FOR MULTI-DISCIPLINE WORKFORCES

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Training the trainers program was a joint collaboration of the Faculty of Veterinary Medicine and the Faculty of Education, Kasetsart University, Bangkok. It consisted of a two-day training program held at Kasetsart University for 39 participants from 13 faculties (Agriculture, Architecture, Economics, Education, Engineering, Environmental science, Food science, Forestry, Humanity, Science, Social science, Veterinary medicine and Veterinary technology) to (1) enable area code from a variety of disciplines to understand One Health strategy and One Health Core Competency (OHCC), (2) improve cooperation and multidisciplinary collaboration among academics interested in One Health, (3) provide practical strategies useful for teaching OHCC, and (4) increase exposure, implementation and application OHCC for undergraduate students enrolled in the general education course "Fundamental OHCC course for multidisciplinary students" of Kasetsart University. Participants were trained through interactive learning activities in professional skills development and harmonization.

From the participants' self-evaluation, they recognized that (i) One Health was useful for daily life in every discipline, (ii) One Health could be applied to better individual health, (iii) active learning skills, such as systems thinking, communication techniques, leadership, collaboration, and partnership were necessary for students in the 21st century, and (iv) One Health should be incorporated into the different disciplines taught at Kasetsart University to spread the concept of "One World, One Health".

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DEVELOPMENT OF E-LEARNING OF ZOONOTIC DISEASES

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Digital learning, i.e., e-learning, encompasses teaching tools , which enable a student to engage in self-learning, in and out classroom through access to a computer, mobile phone or tablet. E-learning can play a significant role in knowledge delivery strategies. Online learning courses available through the internet also appeal to wider audiences who wish to learn about One Health at their own pace anywhere in the world. In order to achieve the learning objectives, a learner is able to repeat lessons as and when required and trace own progress with or without the oversight of a remote instructor.

Knowledge of zoonosis is a fundamental component of veterinary expertise recognized by the World Organization for Animal Health (OIE), the intergovernmental organization focused on global standards for veterinary medicine and the control of animal diseases and zoonoses. OIE recommendations on competencies of graduating veterinarians ('Day 1 graduates') to assure national veterinary services of quality include a specific competency on zoonoses (including food-borne diseases) as well as related competencies on emerging and re-emerging diseases and competencies related to epidemiology, disease management and food hygiene that pertain to zoonoses as well. Current veterinary professionals working in many remote places throughout the world have limited access to traditional face-to-face continuing professional education. E-learning provides an opportunity for up-to-date and relevant continuing education at less cost with reduced time away from the workplace and the need for travel.

Current curricula at veterinary educational establishments (VEE) mostly focus on agents, pathogenesis, clinical signs, prevention and control. The pedagogy for teaching is primarily lectures, with assessments most commonly in the form of multiple-choice or true/false examination questions. From discussions with veterinary teaching staff across

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Southeast Asia, it is clear that an understanding of dynamics of disease transmission, their ecology, determinants for emergence and re-emergence of zoonoses, and policy on associated with zoonoses prevention and control are not covered as thoroughly, if at all.

A number of development projects in the last decade have focused on improving educational programs on zoonoses for veterinarians and other health professionals. The RESPOND project (20xx-20yy), a part of the Emergency Pandemic Threats initiative funded by the United States Agency for International Development (USAID), supported the formation of a regional university network, the South East Asian One Health University Network (SEAOHUN), with one of its goals being the sharing of best practices on teaching and support for strengthening zoonoses-related curricula medical education, including veterinary education. OIE inaugurated veterinary education twinning programs in 2013 with the express purpose of enhancing content and pedagogy of veterinary education related to Day 1 competency recommendations, including zoonoses. Twinning projects to date have joined veterinary faculties in Vietnam and Thailand with veterinary faculties in Australia and the United States, respectively. Recently, USAID's One Health Workforce (OHW) project expanded on the accomplishments of RESPOND and further supported zoonoses education in the health professions. These funded projects supported the authors' use of e-learning through development of animated infographics to explain concepts, such as zoonoses and emerging/re-emerging diseases, and the design of a web-based e-study module that combined different types of resource materials, e.g. Pachyderm®. These projects also supported creation of more traditional learning materials, such as a set of One Health Short Course (OHSC) modules, consisting of seven technical modules and seven core competencies modules designed for face-to-face delivery. The modules are flexible enough to incorporate field experiences with emphasis on One Health.

Our most recent project was to develop an e-learning course on zoonosis with support from THOHUN. Two target audiences were identified for the e-learning course, namely, the current One Health workforce seeking continuing education and the future One Health workforce currently studying at universities. The objectives of this project were to (1) develop an e-learning course to supplement classroom instruction of university students and an e-learning continuing education course fulfilling license renewal requirements for working One Health professionals; (2) to emphasize One Health strategy to zoonoses; (3) design e-learning modules to be compatible with both mobile phones and computers as learning devices; and (4) fulfill requirements for obtaining continuing

education credits of the Center for Veterinary Continuing Education of the Thailand Veterinary Council and also be suitable for incorporation by faculty into a university course for credit.

Development of the e-learning course on zoonosis employed a team approach, composed of veterinarians from the Faculty of Veterinary Medicine (FVM-CMU) and computer graphic design specialists with an interest in e-learning from the College of Arts, Media and Technology (CAMT-CMU), Chiang Mai University. The veterinarians on the team came from several different disciplines and each brought expertise to the project in terms of knowledge of zoonosis and experience working with both animal and human aspects of the disease. The team convened regular workshops to bring together numerous stakeholders including current veterinary students, FVM-CMU staff and veterinarians from both public and private sectors. Their diverse perspectives led to more complete understanding of the complexity of zoonosis in a community. The overall project flow is depicted in Fig 1.

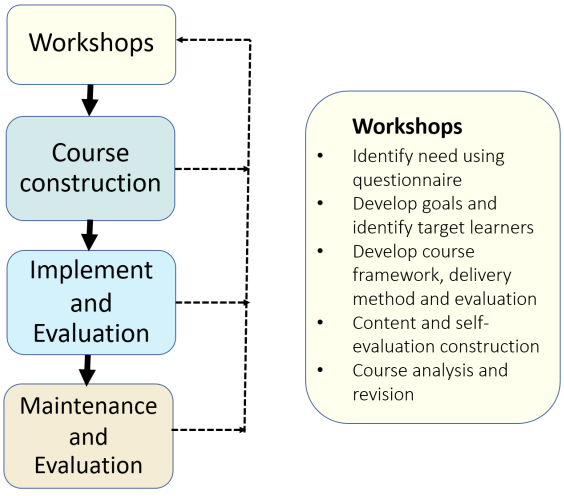

Fig 1 – Flow-chart of e-learning course design and construction program, Chiang Mai University.

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The instructional design of this course followed the classical ADDIE (analysis, design, development, implementation and evaluation) model. Each step was hammered out at 'brainstorming' meetings for course framework, content and delivery methods. The facilitating team of designers from CAMT-CMU shared their experiences in online material construction and delivery methods suitable for new generation of learners. For example, they explained that graphics were easier for younger learners to comprehend. Specific knowledge content, when included, was conveyed most easily through bullets. Workshops were held on every phase of the project, from gathering user needs to design and finally to evaluation of the pilot implementation.

This approach was used to create two separate e-learning courses, one for students who represent future OHW and the other for current OHW professionals. The learning objectives for the future workforce design were gathered from faculty members, while a survey of the current OHW participants revealed that they received basic knowledge of zoonosis during their professional training but limited information of One Health strategy, indicating the need for integration of learning materials on One Health and on zoonosis to demonstrate both relevance and application. The content design, sequence, delivery methods and assessment of the online e-learning courses also were different for adult learners compared to the younger group preparing to join the future OHW.

The course for the future OHW was designed to accommodate an optimal attention span of 30 minutes based on the experience of CAMT-CMU designers. Each 30-minute module emphasized the One Health strategy to zoonosis. Facts on agents, pathogenesis, treatment and control were considered to be better imparted in a classroom setting using classical teaching methods. Contents of the on line course consisted of infographic charts and animated infographic clips, with minimal and concise texts. Infographics exploit the sharing of information through graphics rather than words and are recognized as an effective learning object for the young learners. The infographic helps students recognize the core knowledge and its inter-relationships in the context of One Health. Students were encouraged to seek more information according to their particular interests via the internet. An on line self-test was included with the option to share their scores with colleagues via social media.

Evaluation of e-learning courses and a commitment to continuous improvements are important to enable the e-learning courses to remain up-to-date and interesting to learners. On line evaluations were used to assess learning and gather feedback for course improvement from the learners. The student-focused e-learning course initially

was taught to 60 students who accessed the course from their own devices (laptop, tablet or smart phone). The evaluation confirmed that the time spent on each study module was approximately 30 minutes. The evaluation also collected learner perceptions of their ability to gain knowledge from the course and their satisfaction with the course. A Likert Scale was used to quantify the replies, where a score of 1 reflected strong disagreement and a score of 5 reflected strong agreement. The results indicated most students considered the course improved their knowledge of zoonosis, with 72% agreeing or strongly agreeing.

The evaluation also queried students regarding their use of electronic learning devices. Most students used up to two devices for studying a class, such as a smart phone and/or a computer. Almost an equal percentage of students primarily used a smart phone (46 %) or a personal computer (41%). Interestingly, student use of a tablet (or iPad®) was low (9%). These results suggest that the e-learning course-display design should be compatible both smart phones and PCs.

The course contents for current OHW personnel were based on case studies and problems rather than simply relating fundamental knowledge about zoonosis. The web-based design contained fewer graphics than the course for future OHW (students). Additional links were provided for learners interested in obtaining more details. Current OHW members were more comfortable reading reference papers and other comprehensive literature compared to future OHW learners whose attention span was more limited.

Case-based problems based on actual events and experiences provided better learning material for current OHW. These cases required the learner to make decisions on complicated problems. Current knowledge, such as guidelines for rabies control and vaccination were needed for learners to address problems posed in the case studies. The learner could exit the case, gain the needed information through additional links and then return to the case study with an appropriate solution. The cases reflected the complexity of current issues from a One Health perspective where cultures and beliefs of animal owners and affected people affecting the ways in which problems need to be handled are taken into consideration. The cases also required core competencies in other areas, such as communication skills and leadership to arrive at a solution that benefits the whole community. The cases were built on current OHW experiences to assist the learners make the connection between factual knowledge and the need to consider the situation and solutions in the context of One Health.

Objective 4: Faculty/Staff Development and Improved Academic Offerings

One important target learner group is that of graduate veterinarians as the 2002 Veterinarian Act of Thailand requires all veterinarians to renew their licensing certificate every five years by completing 100 credits (equivalent to 100 lecture hours) of continuing education (CE). This online course provides veterinarians an opportunity to earn CE credits. Online courses could be designed to accommodate the needs of different learners, such as small animal practitioners focusing on individual treatment and livestock practitioner who must consider economic concerns and the population as a whole. Case studies of zoonosis in urban areas can be provided for small animal veterinarians to demonstrate the relevance to their situations, while outbreaks of trans-boundary diseases affecting food animals would be of greater interest and importance to livestock practitioners working in rural areas.

The e-learning mode is best suited for sharing concepts such as the interconnections among agent, host and environment rather than factual knowledge and details. Up-to-date knowledge can be gained anywhere from the internet. Integration of concepts is more difficult to understand simply from using internet search engines or, in some cases, from a series of lectures. Today's generation of learners prefers learning through interactive on line tools such as social networking.

However, ease of student access needs to be balanced with measures that protect student privacy and security. Providing students an opportunity to utilize the e-learning course on an individual basis can be complemented by providing options for sharing their progress with friends and colleagues through social media.

One goal of the course was to convince learners that they can control and manage zoonosis better through One Health. The strategy may be difficult for some learners to understand through a single lecture or reading of a manual. The e-learning platform allows the learner to review materials are not immediately understood and to access supplemental materials that provide more in-depth information. An online teaching platform should supplement face-to-face classroom teaching, as each serves the learner in different ways. Large volumes of factual information usually are too complicated to deliver through an online platform only. The two-way communication between student and teacher is a necessary part of the learning process.

Objective 4: Faculty/Staff Development and Improved Academic Offerings

Objective 5: Organizational Development of Sustainable OHUNs

LEADERSHIP DEVELOPMENT PROGRAM

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In order to ensure sustainability of One Health Workforce (OHW) development and to enhance the capacity of THOHUN trainers to become true multidisciplinary and multi-sectoral One Health leaders in Thailand, such leaders need to be groomed to carry out THOHUN'S goals. Through a Training of Trainers (TOT) platform, THOHUN has created a multidisciplinary group of trainers capable of delivering One Health Short Course and One Health Core Competency (OHCC) Curriculum Mapping workshops. The leadership development program aimed at continuing the success of the TOT platform while strengthening leadership capabilities (including soft skills such as systems thinking, facilitating/training and coordinating) among current THOHUN trainers into true One Health leaders (Fig), while increasing the number of One Health leaders who will facilitate the development of Thailand OHW in both the academic and government sectors. The training was conducted by two private entities: Motivational Training Institute and SGS.

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Fig – THOHUN trainers attending the Leadership Development Program course.

Objective 5: Organizational Development of Sustainable OHUNs

SCHOLARSHIPS FOR ONE HEALTH EVENT PARTICIPATION

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In Year 3, THOHUN provided seven scholarships to support students or faculty staff to present research and One Health implementation output/outcomes at international conferences or hands-on workshops (Fig), mainly requested by THOHUN members. The students and faculty staff had the opportunity to be exposed to broader areas, such as One Health networking expansion, experts' meetings and organization development.

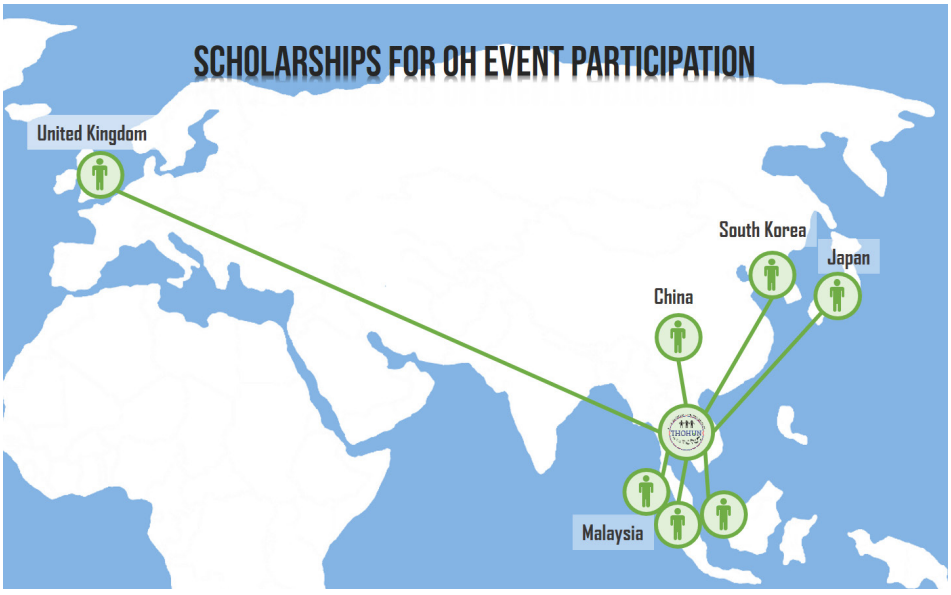

Fig – Locations of conferences/hand-on workshops attended by students/faculty staff supported by THOHUN scholarships.

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Objective 5: Organizational Development of Sustainable OHUNs

WHOLE GENOME SEQUENCING OF EXTENDED-SPECTRUM BETA-LACTAMASE-PRODUCING *ESCHERICHIA COLI* ISOLATED FROM PATIENTS, FARM WASTE AND CANALS IN THAILAND

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Tackling multidrug-resistant *Escherichia coli* requires evidence from One Health studies, which capture a whole host of potential reservoirs in circumscribed geographic areas. We conducted a survey of extended-spectrum β-lactamase (ESBL)-producing *E. coli* isolated from patients, canals and livestock wastewater in Chachoengsao province, Thailand between 2014 and 2015, and analyzed the isolates using whole genome sequencing. The bacterial collection of 149 isolates contained 84 isolates from a single hospital and 65 from the hospital sewers, canals and farm waste water within a 20-km radius. *E. coli* ST131 predominated the clinical collection (29%), but was uncommon in the environment. Genome-based comparison of *E. coli* from infected patients and their immediate environment indicated low genetic similarity overall between the two, although three clinical-environmental isolate pairs differed by ≤5 single nucleotide polymorphisms. Thai *E. coli* isolates were dispersed throughout a phylogenetic tree containing a global *E. coli* collection. All Thai ESBL-positive *E. coli* isolates were multi-drug resistant, including high rates of resistance to amikacin (97%), tobramycin (77%), gentamicin (77%), ciprofloxacin (68%) and trimethoprim (68%). ESBL was encoded by six CTX-M elements and SHV-12. Three isolates from clinical samples (n = 2) or a hospital

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sewer (n = 1) were resistant to the carbapenems (encoded by NDM-1, NDM-5 or GES-5), and three isolates [clinical (n = 1) and canal water (n = 2)] were resistant to colistin (encoded by *mcr-1*); no isolates were resistant to both drugs. Tackling these bacteria will be challenging based on their widespread distribution, but the low prevalence of resistance to the carbapenems and colistin suggests that efforts are now required to prevent these from becoming ubiquitous.

RISK FACTOR IDENTIFICATION, DISEASE SURVEILLANCE AND ONE HEALTH APPLICATION FOR INTESTINAL AMOEBIASIS PREVENTION AND CONTROL IN ENDEMIC AREAS

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Intestinal amoebiasis is a neglected global public health issue causing 100,000 deaths annually. It is prevalent in low socio-economic tropical regions, especially among immigrant and refugee communities. In 2005, the prevalence of dysentery cases in Thailand was of 33.69/100.000 population, with 9.34% being amoebic dysentery. Tha Song Yang district located at Thai-Myanmar border, Tak province has one of the highest prevalence of amoebic dysentery; however data of prevalence and risk factors contributing to intestinal amoebiasis, as well as the presence of its causal agent in domestic animals and environment in villages of Tha Song Yang district are scanty. Hence, this study estimated the prevalence of intestinal parasites and assessed possible contributing risk factors to enable target-specific and sustainable plans involving multi-sectors to be formulated. This study was approved by the Ethics Committee of the Faculty of Tropical Medicine, Mahidol University (FTM ECF-013-05, MUTM 2016-096-01).

In order to determine the prevalence of intestinal parasites and possible zoonotic transmission, human and domestic animal fecal samples during rainy and dry seasons. During the rainy season (August 2017), fecal samples were obtained from 203 individuals (151 villages and 52 hospitals) and 24 domestic animals (one sub-district); and during the dry season (February 2017), from 513 individuals (503 villages and 10 hospitals) and 30 domestic animals (six sub-districts). To assess possible water-borne transmission, 26 water samples were collected from up-, middle- and down-stream sources. Disease-associated knowledge and attitude towards risk factors and prevention were evaluated using questionnaires. Collaboration with the Ministry of Interior (MOI) and Ministry of

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Public Health (MOPH) allowed multi-sectoral 'brainstorming' among villagers, health volunteers, sub-district administrative officers, health care providers, and public health authorities on ways to explore perceptions of important disease-associated risks and solutions.

During the rainy season, microscopic examination of human fecal samples showed *Blastocystis hominis* has the highest prevalence (18%), followed by *Entamoeba histolytica* (12%). Helminth species accounted for 5%. Screening of domestic animal fecal samples revealed the highest prevalence was helminthes species (46%), while amoeba trophozoites ranked fourth (17%). During the dry season, human fecal samples contained *Endolimax nana* (17%), highest prevalence, followed by *E. coli* (12%), *B. hominis* (11%), and *E. histolytica* (4%). Helminth species accounted for 10%. Interestingly, 90% of domestic animal fecal samples contained infective forms of intestinal parasites similar to those of humans. However, correlation of these parasites in human and animal was still inconclusive. From replies to the questionnaire, 71% of the respondents have inadequate knowledge and 38% incorrect perception of disease-associated risk factors and prevention. Multi-sectorial brainstorming resulted in identification of water-related problems as the most prevailing risk, followed by improper waste management, unclean food, and poor personal hygiene.

Target-specific solutions focused on the necessity of obtaining assistance from local authorities to improve water quality and waste management. These suggestions, combined with technical findings, constituted a policy brief and submitted to MOI/MOPH for incorporation into a strategic plan to reduce disease burden. Multidisciplinary and multi-sectoral collaboration and cooperation from academic, public and private sectors are essential elements for successful disease surveillance. Brainstorming proved effective in exploring perceptions of stakeholders regarding disease-related risk factors, thereby aiding the formulation of strategic target-specific control programs. Further studies ought to include species-specific molecular confirmation and subtyping of zoonotic pathogens and their relationship to human and animal one health.

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PREVALENCE AND GENETIC VARIATIONS OF BOVINE AND BOVINE-LIKE ENTEROVIRUSES DETECTED IN CATTLE AND GOAT FECES AND IN WATER SOURCES SURROUNDING ANIMAL FARMS IN KANCHANABURI PROVINCE, THAILAND

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Bovine enteroviruses (BEV), composing enterovirus (EV) species E and F, are non-enveloped RNA viruses of the genus *Enterovirus*, family Picornaviridae. They are commonly found in cattle and previously considered as non-pathogenic. Nevertheless, recent evidences suggest these viruses could be associate with disease in cattle. BEV-like enteroviruses have been increasingly isolated from a wide range of animals, such as deer, goat, goose, horse, possum, and sheep from many countries. There also were reports suggesting detection of BEV in water samples can be used as an indicator of animal fecal contamination to water source. In this study, molecular techniques and phylogenetic analysis were used to determine BEV and BEV-like virus prevalence and genetic variations in feces freshly collected from rectum of cattle and goats in Kanchanaburi province, Thailand. Presence of the virus in water and other animal feces collected around the cattle and goat farms was also determined to investigate possible virus contamination of the surrounding environment and other animals. RT-PCR revealed BEV or BEV-like viruses in 55/157 and 54/117 of cattle and goat fecal samples respectively. BEV sequences were detected in 6/17 water samples and a pool of chicken feces collected in cattle farm areas. Phylogenetic analysis demonstrated presence of EV-E and EV-F in cattle feces, EV-F and BEV-like viruses in goat feces, and EV-F in water and chicken feces. The detection of BEV in water and chicken feces indicates the viruses

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circulating in cattle can contaminate the surrounding environment and be taken up by animals living nearby. These findings suggest that a surveillance of BEV in animals and surrounding environment should be conducted in other regions of the country and an implementation should be put in place to control the spread of BEV among host animals and its contamination of the environment.

DISTRIBUTION, CO-INFECTION AND CLINICAL SIGNIFICANCE OF ARBOVIRUSES IN SOUTHERN THAILAND

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Arboviruses, such as chikungunya, dengue and Zika, are transmitted by the same vector, namely *Aedes* mosquito. There was progressively increasing geographic distribution of this insect vector during the past several decades especially in tropical regions. In general, these viral infections are self-limiting, but in a number of patients the diseases can be life-threatening. There still is a lack of specific treatments and safe effective vaccines. Data on the prevalence and pathophysiological manifestations of co-infection of these three viruses are of importance but lacking. Thus, this study investigated the distribution and co-infection of these three arboviruses during the epidemic season of southern Thailand. Blood serum samples were collected by venipuncture from 242 subjects suspected of arbovirus infection from clinical investigation. RT-PCR was performed to confirm the type(s) of virus and serotyping was conducted in cases with dengue. RT-PCR conformed 88% positivity of arbovirus infection, but no case of co-infection. Among the 157 dengue cases, 64% were Type 2, 24% Type 2, 8% Type 1, and 4% Type 4. One patient with dengue shock syndrome was infected with dengue Type 2 and 0.44% had been classified as secondary infection under their clinical based. A larger cohort of subjects will be needed to identify co-infection of the three arboviruses in circulation in the country and their potential impact in these circumstances.

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A FRAMEWORK DEVELOPMENT TO PROMOTE COLLECTIVE ACTION IN COMMUNITY WITHIN ONE HEALTH HOUSEHOLD ENVIRONMENT PRACTICE TO PREVENT AND CONTROL DENGUE FEVER IN CENTRAL REGION OF THAILAND

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Dengue fever has recently become a major public health concern in the central region of Thailand. The key element of dengue prevention and control is household environment practice among household members and community participation through collective action using the multidisciplinary One Health strategy. This study developed a One Health household environment to prevent and control dengue fever. At the top three endemic areas in the country central region, 422 representative households were selected through a Knowledge, Attitudes, and practices survey for a household environment survey of household (HI), container (CI), and breteau (BI) indices, dengue community-based policies synthesis and One Health development. The majority of respondents were females and had primary school education; and those having a high level of knowledge, positive attitudes towards HEP and One Health, good personal preventive behavior, vector control management skill, social-level support, and community participation were more likely to support household environmental practices (p <0.01). Entomologic survey based on HI, CI and BI indicated three endemic areas were at high risk (urgently needing prevention and control). Key gaps between dengue stakeholders and community-based program exist in most respondents' households were lack of awareness of appropriate practices in household environment management and of the promotion of community participation among stakeholders. Promotion of appropriate community-oriented program based on One Health integrated with risk analysis is a vital step towards a sustainable dengue prevention and control in central Thailand.

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PREVALENCE OF *CRYPTOSPORIDIUM* SPP. INFECTION IN DAIRY CALVES IN KHON KAEN PROVINCE, THAILAND

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In order to determine the prevalence of *Cryptosporidium* spp. infection in diarrheic and non-diarrheic dairy calves (>1-28 days) in Khon Kaen province during December 2016 to January 2017, fecal specimens from non- (n = 63) and diarrheic (n = 137) dairy calves were collected and examined for the presence of *Cryptosporidium* spp. oocysts by modified Kinyoun's acid-fast staining method. Dairy calves were grouped according to their age as follows (50 per group): group I (>1-7 days), group II (8-14 days), group III (15-21 days), and group IV (22-28 days). The overall prevalence of *Cryptosporidium* spp. infection in dairy calves was 52%, 71% in diarrheic dairy calves, and 9% in non-diarrheic dairy calves. Oocysts of *Cryptosporidium* spp. were detected in 25, 44, 64, and 50% of feces from group I, II, III and IV animals, respectively. The intensity of oocysts was higher in diarrheic compared to non-diarrheic dairy calves. There is a significant association between *Cryptosporidium* spp. infection and occurrence of diarrhea (p <0.05). This study indicates that dairy calves aged up to 4 weeks were highly infected with *Cryptosporidium* spp., and the infection mostly occurred in diarrheic dairy calves.

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PREVALANCE AND RISK FACTORS FOR METHICILLIN-RESISTANT *STAPHYLOCOCCUS AUREUS* IN SWINE-PRODUCTION PERSONNEL IN CHIANG MAI-LAMPHUN PROVINCE, THAILAND

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Methicillin-resistant *Staphylococcus aureus* (MRSA) is one of the major human pathogens causing a wide range of infections and is spreading throughout the world. Recent reports of livestock-associated (LA)MRSA in swine production and humans involved have stimulated global public health concern. Carriage of MRSA among swine farm personnel may cause untreatable infection and outbreaks both in humans and animals; however, prevalence and risk factors of MRSA carriage in these professionals in Thailand have been rarely investigated. This study determined the prevalence of MRSA and risk factors associated with MRSA acquisition and transmission in swine-production personnel from 30 farms in Chiang Mai-Lamphun province from October 2016 to July 2017. Nasal swabs and data collection together with MRSA isolation and confirmation were carried out on 153 subjects (67 farm workers, 30 farm owners, 8 veterinarians and animal husbandmen, and 48 veterinary and animal sciences students) participated in this study. A carriage rate of MRSA was 11% and MRSA prevalence in swine farms in Chiang Mai-Lamphun province was 27%. The highest MRSA carriage rate was found in swine farm workers (9/67) and owners (4/30) but to a lesser degree among veterinary and animal sciences students (4/48) and none among veterinarians and animal husbandmen. Being female, working solely on swine production and working in a farm with a high density of swine appeared to be key risk (but not statistically significant) factors for MRSA acquisition. Therefore, MRSA monitoring as well as promoting knowledge on personal hygiene and responsible use of antimicrobials among swine-production personnel are recommended to lessen the dissemination of MRSA among livestock, humans and community (environment).

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PLASMID-MEDIATED COLISTIN RESISTANCE IN SWINE FARMS

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The emergence of colistin resistance among gram-negative bacteria is of serious concern worldwide. Since 2016, colistin was formally prohibited for use as a growth promotor in swine farm in Thailand. The study updated antimicrobial resistance (AMR) profiles of *Escherichia coli* in swine farms with different antimicrobial usage and distribution of plasmid-mediated colistin resistance genes, namely, *mcr-1* and *mcr-2*. Of 343 samples taken from four swine farms in central Thailand, 83% were *E. coli*-positive while 23% were *Salmonella*-positive. Two hundred and one *E. coli* isolates were randomly chosen from each group of samples for MIC analysis of 17 antimicrobial agents mainly used for human therapeutics, together with detection of extended spectrum beta-lactamase (ESBL). The resistance rates were 0% for amikacin, 4% for amoxicillin/clavulanic acid, 21% for cefotaxime, 6% for cefoxitin, 1% for cefoperazone/sulbactam, 19% for cefpirome, 19% for ceftazidime, 23% for ciprofloxacin, 49% for colistin, 0.5% for doripenem, 32% for gentamicin, 0.5% for imipenem, 0.5% for meropenem, 18% for moxifloxacin, 2% for netilmicin, 1% for tigecycline, 53% for trimethoprim/sulfamethoxazole, and 17% for ESBL producers. The MIC of colistin resistance is significantly different among the farms (p <0.01). Of 99 colistin-resistant *E. coli*, 64% carried *mcr-1* and 34% *mcr-2*.

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List of abbreviations

AD	Acute Diarrhea
AMR	Antimicrobial Resistance
CE	Continuing Education
EIDs	Emerging Infectious Diseases
EPT	Emerging Pandemic Threats
FAO	Food and Agriculture Organization
FMD	Foot and Mouth Disease
GHSA	Global Health Security Agenda
H5N1	Influenza A
KAPs	Knowledge, Attitudes, and Practices
LNZDC	Laboratory Networking for Zoonotic Disease Control
MOI	Ministry of Interior
MOPH	Ministry of Public Health
MRSA	Methicillin-resistant *Staphylococcus aureus*
OIE	World Organization for Animal Health
OH	One Health
OHCCs	One Health Core Competencies
OHCEA	One Health Central and Eastern Africa
OHSC	One Health Short Course
OHW	One Health workforce
OPD	Outpatient Department
PCR	Polymerase Chain Reaction
RDU	Rational Drug Use
RT-PCR	Real-time Polymerase Chain Reaction
SEAOHUN	South East Asia University One Health Network
TELI	International Short Course on Ecosystem Health
TOT	Training of Trainers
THOHUN	Thailand One Health University Network
THOHUN-NCO	Thailand One Health University Network National Coordinating Office
USAID	United States Agency for International Development
URIs	Upper Respiratory Tract Infections
VEE	Veterinary Educational Establishments

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