YOUNG RESEARCHER FELLOWSHIP
ASEAN-EU AMR SURVEILLANCE MASTERCLASS
Profiles & Proposals
Table of Contents

A. Introduction

B. Proposed Projects
   i. Situational Assessment of AMR Surveillance in linked European and Southeast Asian Countries
      Zaw Myo Tun, Lucy Lahrita, David Singleton
   ii. Proposal for A Research Link on AMR/AMU in Europe and SEA
      Kshitiz Shrestha, Lucie Collineau and Michael Pietsch
   iii. Qualitative Analysis of Antimicrobial Usage in Crocodile Farming
      Lucie Collineau, Dieu Linh Tran, David Singleton, Mai Chun Wai
   iv. National AMR Surveillance of enterobacteriaceae Isolated from Humans in Hospitals: Pilot Study in a Southeast Asia Country
      Dieu Linh Tran, Katherine Henderson, Mai Chun Wai
   v. Surveillance of Multi Drug Resistant (MDR) Zoonotic Pathogens in Thailand
      Narong Jaturas, Lucy Coyne and Ha Huynh Ngan
   vi. Quantitative questionnaire of farmers and their antimicrobial use in crocodiles
      Lucy Coyne, Lucy Lahrita, Katherine Henderson, Narong Jaturas

C. Fellows Profiles & Report
   i. Alejandro Dorado García
   ii. David Singleton
   iii. Daniel Thomas-Lopez
   iv. Huynh Ngan Ha
   v. Katherine L Henderson
   vi. Kshitiz Shrestha
   vii. Lucie Collineau
   viii. Lucy Coyne
   ix. Lucy Lahrita
   x. Chun-Wai Mai
   xi. Michael Pietsch
   xii. Narong Jaturas
   xiii. Tran Dieu Linh
   xiv. Zaw Myo Tun

D. Coordinator’s Profiles
   i. Prof. Nicola J Williams
   ii. Assoc. Prof. Rungtip Chuanchuen
   iii. Asst. Prof. Walasinee Moonarmart
Introduction

The SEA-EU-NET II project aims to foster greater ASEAN-EU cooperation, especially in the thematic areas of Food Safety and Security, Health and Water Management. Activities by the project include expert workshops, networking events and mobility grants. One key focus area highlighted by the project is the development of scientific talent. The project provides travel grants to young scientists to undertake missions to other regions and develop bridges that would support research collaboration.

The ASEAN-EU AMR Surveillance Masterclass was created to ensure a more comprehensive network was constructed through this effort. As a result, 12 young researchers from across the globe were selected from various disciplines to train together on the topic of AMR Surveillance. They participated in a series of workshops conducted during Summer 2016 by senior experts in AMR from the University of Liverpool, Chulalongkorn University and Mahidol University.

In Liverpool, participants were exposed to the wider context of the topic, linking various disciplines, the policy interface, new technologies for better research outputs and potential funding sources. The talks were also structured to allow fellows to understand their current position in the wider context of the field, before going into discussion to allow them to flex and expand their thoughts into multidisciplinary research and multilateral collaboration. This was complemented by the sessions in Bangkok which provided a more practical view of the research through workshops and field trips. Areas that were covered included industry partnerships and how research could support better animal husbandry. Discussion sessions were more focused towards establishing potential research projects highlighted in this report, of which fellows could explore in future.

Due to the selection process, fellows came from a variety of backgrounds. The fellowship has been a platform for young researchers to understand the landscape of the topic and also a good time to network with their peers and discuss the complementarities of their respective expertise and research topics. The proposed projects highlighted in this report would serve as a catalyst for the fellows to engage and collaborate among themselves, and a range of other stakeholders they are not normally exposed to. Fellows may tap into this network of collaborators to create more comprehensive research projects, and bid for established and upcoming funding opportunities and programmes. It is the intent of the project that the linkages and networks established extend beyond the life of the project itself.

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Proposed Projects

Situational Assessment of AMR Surveillance in linked European and Southeast Asian Countries

Zaw Myo Tun, Lucy Lahrita, David Singleton

Background

Antimicrobial resistance (AMR) is a major health threat globally. The recent O’Neill review estimated over 10 million mortality attributable to antimicrobial-resistant infections annually by 2050, surpassing mortality of cancer. Surveillance of AMR and antimicrobial use (AMU) under the ‘One Health’ framework, encompassing human, animals and environment, is key to AMR control. Differences in AMR/AMU surveillance system implementation and its progress globally mean that it is difficult to make comparison between countries and regions, monitor global trend, and quantify global burden of AMR. Lack of communication on AMR, differences in culture, seasonal practices and population dynamics between countries further complicates the situation. European (EU) region has attempted to address this problem by forming the EU Antimicrobial Resistance Surveillance System and EU Surveillance of Antimicrobial Consumption Network (ESAC-Net) which drive the political commitment for change through between-country comparison. On the other hand, setting up an AMR surveillance network in Southeast Asia (SEA) faces more challenges. The majority are low and middle-income countries (LMIC) with weak health and agricultural systems, multiple competing health priorities, limited workforce and infrastructure for data collection, and poor laboratory capacities. As a result, the evidence base for appropriate and cost-effective strategy for AMR/AMU surveillance remains very weak. Therefore, we propose a pilot project to assess the progress and gaps on AMR surveillance in two linked EU and SEA countries with the eventual aim of setting up a sustainable global One Health AMR surveillance network.

Specific objectives are:

1. To review the existing AMR/AMU surveillance activities in selected EU and SEA countries
2. To identify and compare the facilitators and barriers of sustainable One Health AMR/AMU surveillance system implementation between selected countries
3. To independently assess existing AMR/AMU surveillance systems
4. To formulate recommendations on improving AMR surveillance

Methods

A multi-disciplinary team, consisting of at least an epidemiologist, microbiologist, economist, and health system expert, will select one country each from EU and SEA regions based on certain criteria of interest (e.g., two countries with high volume of trade). The study team will use multiple methods and data sources with iterative process of hypothesis formation and testing. The methods include (1) Key informant interview, focus group discussion or participant observation as appropriate among key stakeholders, including doctors, veterinarians, policy makers, pharmacists, farmers, patients, volunteer health workers, etc; (2) Systematic review of literature; (3) Review of secondary data and reports.

After data collection is completed, the study team will form an international board of experts to develop methods to assess and compare existing AMR surveillance systems between selected countries. Multiple workshops, bringing together the experts and key stakeholders, will be convened to disseminate study findings, and to formulate recommendations for improving existing system or devising novel surveillance strategies under the One Health framework.

Impact

Not only will this pilot study identify knowledge gaps of AMR/AMU surveillance in selected countries, it will also inform stakeholders on the existing system. The study findings may also be useful in advocacy for change in national AMR/AMU surveillance policy. Assessing and comparing AMR surveillance systems of selected EU and SEA countries using the same methodology will facilitate the interpretation of study findings in broader perspectives. Finally, this study will serve as a preliminary work to ultimately expand to all countries in EU and SEA to achieve the coordinated AMR/AMU surveillance networks in both regions.
References


Proposal for A Research Link on AMR/AMU in Europe and SEA
Kshitiz Shrestha, Lucie Collineau and Michael Pietsch

The discussion of the group led to the position that, to mitigate the current antimicrobial resistance (AMR) threat in Asia or other parts of the world, the reduction of antimicrobial usage (AMU) is crucial. If adequately implemented, it can reduce AMR, especially in livestock industry, eventually in humans. To address and evaluate the AMR risk and amount of AMU in South East Asia (SEA), studies monitoring the use and resistance rates, taking into account the regional specificities, should be implemented.

The developed project proposal focused on the evaluation of measures for AMU and AMR reduction in the SEA context, and is designed as a pilot study. A basis for the assessment of risk of transmission of AMR can be built only by linking detailed information on isolate properties with data of epidemiological and experimental studies. The study consists of three main packages: (I) a pilot study to monitor AMU and AMR at a community level and (II) an intervention study, aiming to reduce the AMU in animals and humans. Furthermore in a third package (III) a follow-up of the intervention tools will be conducted.

Section I: AMU/AMR monitoring

In this section, tools for AMU and AMR monitoring at regional level will be developed. A small-scale pilot study will be implemented in a selected community in South-East Asia. First, monitoring of AMU in poultry (taking it as a basis) will be conducted at farm-level in collaboration with local veterinarians and suppliers. Further, since Enterobacteriaceae have been shown to play a crucial role in the transmission of AMR, resistance rates and distributions will be analyzed at molecular level. In parallel, on human side, monitoring of AMU in humans will be determined using prescriptions and sales data from local health service providers, pharmacies and doctors. More detailed AMR data will be collected from farmers and relatives and locals from the same community to obtain data on molecular level for comparing studies to pinpoint to possible transmission pathways (e.g. human-animal transmission).

Section II: Intervention study

An intervention study will be conducted in the same local community where the monitoring tools will be implemented. Main goal of this package will be to train and educate farmers and veterinarians (a) and healthcare workers (b) about alternative measures, biosecurity and prevention in relation with the use of AM, as well as to focus on good practice in AM treatments. By recruiting multiplicators, a train-the teacher system will be installed.

Section III: Impact assessment

AMU and AMR monitoring tools, as well as educational material developed as part of the pilot study will be assessed and adjusted to inform future AMR risk assessment and risk management activities at national and regional levels.

Expected impact of the project:

The proposed project will provide a basis to inform future activities on how to best monitor AMU and AMR in the context of SEA. This appeared as an important requisite for initiating a risk management strategy for the mitigation of AMR in the region. Indeed, the monitoring of AMU and AMR is not harmonized globally. Developing standards for appropriate AMU and AMR monitoring will certainly also benefit other regions initiating or improving monitoring activities, including Europe.

In addition, the project will provide a better understanding of the relationships between AMU and AMR in humans and animals, and describes the status of AMR spread at a community-level in SEA. Methods for communicating on the risk of AMR at a community level will also be developed, and could inform future awareness and communication campaigns. The proposed pilot study will therefore provide critical input to inform future risk assessment and management strategies of AMR, in SEA and elsewhere.
Qualitative Analysis of Antimicrobial Usage in Crocodile Farming

Lucie Collineau, Dieu Linh Tran, David Singleton, Mai Chun Wai

Crocodile farming is a lucrative industry in Southeast Asia, especially in Thailand. Livestock and wildlife farming have been identified as an area of unregulated antimicrobial use and perhaps, misuse, which could be contributing to the development of antimicrobial resistance (AMR)\(^1,2\). Moreover, antibiotics are easily purchased without prescription from many pharmacies in Thailand. Unfortunately, the extent of antimicrobial use in crocodile farming is almost entirely unknown. A search in PubMed using the following keywords “crocodile” AND “farm” AND “antibiotic” or “antimicrobial” (August 2016) resulted in only 4 articles; only 2 were slightly related to antimicrobial resistance surveillance in crocodile farms. Therefore, a study that captures the antimicrobial usage (AMU) could provide a pivotal role in building a foundation to combat AMR in crocodiles and by association, build part of the ‘one health’ framework necessary to combat AMR in all species. In view of the lack of scientific evidence on this topic, we propose to develop a qualitative analysis targeting crocodile farmers. In Phase-1 of this study, we will develop a framework to inform in-depth interview with experts in livestock and wildlife farming via a written questionnaire. Topics would include farm production systems, AMU, biosecurity, feeding protocols, crocodile health status, disease treatment strategies, treatment failures, and farmer’s perceptions towards crocodile welfare.

Once the questionnaire has been analysed appropriate questions and topics will be formed for in depth face-to-face interview (Phase-2). Farmers will be provided with specific drug bottle containers at time of interview designed to collect empty antibacterial containers. The data will be collected and independently analysed by at least 2 researchers. Potential interventions such as education protocol, biosecurity, management systems or diagnosis intervention will be planned based on findings in Phase-2.

For education interventions, farmers will be randomly enrolled into instructive or conversive groups (phase-3) which will be delivered “6 months into the study course. At this time the drug bottle containers will be collected, and they will be provided with a new drug bottle container. Six-months after the intervention, face-to-face interviews will be repeated and the drug bottle containers will be collected for the final time. It is hoped that we would be able to assess the impact of these interventions on perceptions, attitudes and antimicrobial use of crocodile farmers.

This study will be able to capture AMU in crocodile farming and also the perception of farmers in AMU. Ultimately, this study will provide the evidence for strategy planning to combat AMR. Global surveillance using quantitative questionnaire can be implemented based on the finding from this study.

References


National AMR Surveillance of enterobacteriaceae Isolated from Humans in Hospitals: Pilot Study in a Southeast Asia Country

Dieu Linh Tran, Katherine Henderson, Mai Chun Wai

Enterobacteriaceae are a large family of Gram-negative bacteria that includes pathogens causing serious bacterial infections in humans, such as Salmonella spp, Escherichia coli, Klebsiella spp. and Shigella spp. (along with many harmless symbionts). Lestari ES et al. highlighted that antimicrobial resistance (AMR) in bacteria is on the rise in Southeast Asia (SEA)\(^1\). Since 2005, enterobacteriaceae are recognised as a major contributor of AMR bacteria in SEA. Although SEA is yet to be an endemic area for carbapenem resistant enterobacteriaceae (CRE), the rate of CRE detection has been increasing\(^2\). Unfortunately, there is no conclusive surveillance of enterobacteriaceae in SEA to monitor the situation since AMR is inconsistently reported by different hospitals, and are therefore not comparable. There is also no national central automated database that can collect data for analysis to inform effective AMR interventions.

In Phase-1 of this pilot project, we aim to develop standard antimicrobial susceptible testing (AST) guidelines with all the stakeholders, namely directors, heads of microbiology, ministry of health, World Health Organization and European Union (EU) consultants. Each participating hospital will collect blood, urine and faeces samples from all patients with suspected infection. We aim to invite EU consultants to conduct train-the-trainer workshops once the AST guideline developed. On-site technical assistance will be provided and external quality assessment on the AST will be conducted.

In the Phase-2 of this pilot project, the participating hospitals will log the findings on an online portal that will automatically collect the data on the national, central database. The aggregated hospital data in comparison to their region and national data will be automatically fed back to each hospital on a weekly basis. This will ensure any endemic outbreak will be captured immediately and necessary measures can be implemented. The Phase-3 of the pilot project focuses on AMR notification and planning of interventions to reduce the burden of AMR by discerning information from the data gathered in phase-2. With collaboration from EU consultants to support the analytical methods, we would perform in-depth epidemiological data analysis to:

- determine the national prevalence of AMR in enterobacteriaceae isolates
- identify hospital outliers (e.g. hospitals with much higher proportions of AMR)
- discern differences by age, sex, geographic region, hospital type and causative organism
- devise a sustainable action plan for an intervention (e.g. to develop national antibiotic guidelines)

Funding is a key challenge to initiate the foundation IT framework and employ IT consultants to maintain the automated portal system. However, we have adapted other components of the project to create a sustainable and low cost input such as train-the-trainer sessions. This project requires commitment from the hospitals to provide data, enforcement from local authorities to ensure the data is accurately reported and a strong collaborative EU-SEA project management team to drive the project.

Future development

Building on the pilot study, the effectiveness of interventions as a result of the gathered data could be conducted (via prospective/retrospective studies). The addition of other organisms and samples from other healthcare facilities would enhance the national surveillance of AMR, and the model could be used to facilitate the creation of an equivalent veterinary surveillance system with continued collaboration between the EU and SEA countries.

References

Surveillance of Multi Drug Resistant (MDR) Zoonotic Pathogens in Thailand

Narong Jaturas\(^1\), Lucy Coyne\(^2\) and Ha Huynh Ngan\(^3\)

\(^1\)Medical Science Academic Service Centre, Faculty of Medical Science, Naresuan University, Thailand
\(^2\)Antimicrobial Resistance Team, Veterinary Medicines Directorate, Liverpool, United Kingdom
\(^3\)Zoonoses Research Group, Oxford University Clinical Research Unit, Ho Chi Minh City, Vietnam

Background

Salmonellosis is one of the most common and widely distributed foodborne diseases, with tens of millions of human cases occurring worldwide every year (WHO, 2013). In addition, in the European Union (EU), over 100,000 human cases are reported each year and European Food Safety Authority (EFSA) has estimated that the overall economic burden of human salmonellosis could be as high as EUR 3 billion a year (EFSA, 2015). Resistance in Salmonella has been detected in humans and animals (especially broilers and turkeys) and derived meat products. Multi-drug resistance was high (in humans 31.8%, in broilers 56.0%, in turkey 73.0%, and in fattening pigs 37.9%). The continued spread of particularly multi-drug resistant clones reported in both human and animal (broilers, pigs and cattle) isolates is of concern. In addition, *Escherichia coli* is a frequent cause of life-threatening bloodstream infections and other common infections, such as urinary tract infections. Drug-resistant *E. coli* are readily acquired via the diet (food and water), and there is a major turnover of drug-resistant *E. coli* each day. *Campylobacter* bacteria are also a major cause of foodborne diarrhoeal illness in humans and are the most common bacteria that cause gastroenteritis worldwide (WHO, 2016). Resistance to commonly used antimicrobials in *Campylobacter* isolates detected in humans and animals (especially broilers, pigs and cattle). *Campylobacter jejuni* (human; 54.6, broiler; 54.5%, cattle; 35.8%) were resistant. In addition, *C. coli* two thirds of humans; 66.6%, broiler; 68.8% and pig; 31.1 were resistant.

Thailand, agricultural and food industries are crucial and Thailand’s aim to be the “kitchen of the world”. Thailand was the world’s 12th largest food exporter last year, with total shipments of 90bn baht (US$2.9bn) according to the National Food Institute. Over the past few decades, antimicrobial resistance (AMR) has been recognized as an important, serious and urgent health threat in Thailand.

Objectives

- To investigate the prevalence of MDR isolates of *Salmonella*, *E. coli* and *Campylobacter* from chicken, high risk cohorts and the environment at farm and slaughterhouse level
- To investigate the attitudes and knowledge of farms and slaughterhouse workers on zoonotic pathogens, antimicrobial use, antimicrobial resistance and hygiene practices.

Methods for Laboratory Study

Sampling Methods

Identifying farms and slaughterhouses for inclusion in the study:
### Regions of Thailand

<table>
<thead>
<tr>
<th>Regions of Thailand</th>
<th>Percentage of chicken population in different regions of Thailand</th>
<th>Number of farms</th>
<th>Number of slaughterhouses</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>7.9%</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Northeast</td>
<td>14.4%</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Central</td>
<td>71%</td>
<td>35</td>
<td>5</td>
</tr>
<tr>
<td>South</td>
<td>6.9%</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>50</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>

### Samples required:

<table>
<thead>
<tr>
<th></th>
<th>Chicken</th>
<th>High risk cohort – farmers/slaughterhouse workers</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm</td>
<td>Boot swab</td>
<td>Faecal samples</td>
<td>Pond/effluent water</td>
</tr>
<tr>
<td>Slaughterhouse</td>
<td>Carcass swab</td>
<td>Faecal samples</td>
<td>Effluent water</td>
</tr>
</tbody>
</table>

### Testing

- Culture isolation of *E. coli*, *Salmonella spp.* and *Campylobacter*
- Antimicrobial susceptibility testing (AST) by disk diffusion. Interpretative criteria based on the CLSI standard.
- Whole genome sequence (WGS) of isolates found to exhibit MDR

### Methods for Qualitative Study

Semi-structured qualitative interview study with chicken farmers and slaughterhouse workers to explore perceptions on zoonosis, antimicrobial use, antimicrobial resistance, risk perceptions and hygiene practices. Purposive sampling will be used to try and get a range of farmer/slaughterhouse workers from different sized farms/slaughterhouses, with different levels of experience and from different geographic regions. Analysis will be conducted using a thematic analysis approach.

### Purposive sampling:

<table>
<thead>
<tr>
<th></th>
<th>Percentage of chicken population</th>
<th>Number of farmers from each region</th>
<th>Number of slaughterhouse workers per region</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>7.9%</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Northeast</td>
<td>14.4%</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Central</td>
<td>71%</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>South</td>
<td>6.9%</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

### Potential Collaboration for the Study

- Collaboration between the Chulalongkorn University, Bangkok, Thailand and the University of Liverpool, UK
- Chulalongkorn University would conduct the sample collection, conduct bacterial isolation and AST in a central laboratory for samples from farms/slaughterhouses within the region and carry out quality assurance for partner laboratories in Thailand.
- Partners within Thailand – regional government laboratories would carry our AST on human samples, regional veterinary university laboratories would conduct AST on environmental and chicken samples.
- University of Liverpool – WGS expertise on MDR isolates, training researchers from Thailand on WGS and on social science methods.
## Time frame

<table>
<thead>
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<th>Activity</th>
<th>Time (month)</th>
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<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24</td>
</tr>
<tr>
<td><strong>1. Quantitative research</strong></td>
<td></td>
</tr>
<tr>
<td>1.1 Survey</td>
<td></td>
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<tr>
<td>1.2 Sampling &amp; Isolation</td>
<td></td>
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<tr>
<td>1.3 Molecular analysis</td>
<td></td>
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<tr>
<td>1.4 Data analysis</td>
<td></td>
</tr>
<tr>
<td>1.6 Writing up</td>
<td></td>
</tr>
<tr>
<td><strong>2. Qualitative research</strong></td>
<td></td>
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<tr>
<td>2.1 Training</td>
<td></td>
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<tr>
<td>2.2 Interview</td>
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<tr>
<td>2.3 Data analysis</td>
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<tr>
<td>2.4 Writing up</td>
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</tbody>
</table>
Quantitative questionnaire of farmers and their antimicrobial use in crocodiles
Lucy Coyne¹, Lucy Larhita², Katherine Henderson³, Narong Jaturas⁴

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Thailand has the largest crocodile farming industry in the world and is a very important economic market to the country. To maintain high yields, antibiotics are frequently used in unknown quantities as growth promoters, prophylactically and for treatment, with the aim of keeping the crocodiles healthy whilst at the farm (3-4 years) before they are slaughtered for their skin, meat and blood. However, the antibiotics are often administered without a prescription from a vet, by a range of different delivery methods (e.g. in the water, in the feed) and are poorly recorded and regulated.

Before any interventions can be put in place, it is crucial to capture a baseline of how antibiotics are being used at a farm level and the reasons behind those decisions. We propose to conduct quantitative questionnaires, in a face-to-face approach, with the crocodile farmers from a representative geographic sample across Thailand. Our aim is to establish information about:

- The type of crocodile farm (half-circuit, full-circuit farming)
- Individual ponds or group ponds
- Where the hatchlings are supplied from
- Water waste management on site
- Are any biohazard approaches considered around the site (e.g. restricted areas, disinfectant)
- What antibiotics are used, in which groups of animals, how frequently, what dose and for what purpose (growth promoters, prophylactic use, treatment use)
- Is any antimicrobial sensitivity testing (AST) carried out
- Length of time between antibiotics stopped and slaughter
- Assess knowledge of crocodile farmers on antibiotic resistance, public health concerns from antibiotic use in animals, antibiotics considered critical to human medicine and antibiotic residues

Outcomes:

- To obtain baseline data on antimicrobial use in crocodile farms in Thailand and to gauge crocodile farmers knowledge on the current issues of antimicrobial resistance and public health concerns
- Incentive to improve antibiotic stewardship: earn “stamp of quality” on skin, meat and blood products in a similar way to the farm assurance schemes operated in European livestock species
- Education of crocodile producers on responsible use of antibiotics and the potential public health implications from antibiotic use. The existing industry Crocodile Farming Association may be a route through which this can be done by forming regional discussion groups to cover issues such as disease surveillance, antibiotic use, production methods etc.
- Identify areas for future research for example; there may be a need to look at antibiotic residues in effluent water from farms.
### Profiles & Reports

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https://www.researchgate.net/profile/Alejandro_Dorado-Garcia

**Interests:**  
One Health, antimicrobial resistance, evaluation of intervention strategies

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Alejandro Dorado García was born on February 17, 1984 in Madrid, Spain. He graduated as Doctor of Veterinary Medicine in 2008 from Complutense University of Madrid. From 2009 to 2011, he worked in the pharmaceutical industry as Veterinary Pharmacovigilance Technician and as Clinical Research Associate, and obtained his MSc in Monitoring of Clinical Trials from the European School of Pharma Studies and Alcalá de Henares University.

In September 2011 he moved to the Netherlands after receiving a grant from “La Caixa” Foundation to study the MSc in Veterinary Epidemiology and Economics at Utrecht University (UU). He joined the Institute for Risk Assessment Sciences (IRAS) at UU as part of the major research project of his MSc. He continued working at the IRAS and obtained his PhD in June 2016. His PhD thesis aimed to gain further understanding on the epidemiological drivers for development and spread of antimicrobial resistance (AMR) from food-producing animals to humans by putting the spotlight on methicillin-resistant Staphylococcus aureus (MRSA) and extended-spectrum β-lactamase (ESBL)-producing Escherichia coli.

Personal research interests include the evaluation of intervention strategies, the role of antimicrobial drugs and potential public health risks posed by the AMR emergence in the main animal production sectors. His expertise is grounded on the generalist “One Health” concept and is being further developed by his current job position as postdoctoral researcher in the AMR topic under several research consortiums.
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Tel:  +447904 111125

Project: National surveillance (UK) of antimicrobial prescription and resistance in companion animals

I qualified with distinction as a veterinary surgeon from the University of Liverpool in 2015, having also completed an intercalated Master’s Degree in Veterinary Science in 2013. Shortly before qualifying I was offered the opportunity to embark on a PhD, again at the University of Liverpool, exploring the potential to establish a national (UK) antimicrobial prescription and resistance surveillance system in companion animals, primarily dogs and cats.

I discovered an interest in research early on in my undergraduate training, completing a BBSRC-funded summer studentship exploring bluetongue epidemiology in 2011. Following this, I gained distinction in my undergraduate research project analysing the faecal helminth burden of dogs and red foxes in Liverpool, the results of which were presented at the 3rd angiostrongylosis conference in Italy. I continued this interest into my Master’s Degree project which focused on developing surveillance tools for angiostrongylosis in dogs and red foxes in the UK, this was presented at the 4th angiostrongylosis conference in Budapest and also allowed me to work with the Small Animal Veterinary Surveillance Network (SAVSNET, www.savsnet.co.uk). Subsequently, I was offered the opportunity to work with SAVSNET for another summer studentship focusing on dog, cat and rabbit vaccination trends. I presented results of this project at BSAVA Congress 2015.

My PhD project involves working with clinical practice data from over 250 veterinary practices amounting to 1.5 million< electronic health records and diagnostic laboratory antibiotic sensitivity test results (100,000s) and thus far I have developed my skills primarily in the areas of epidemiology; big data handling and statistics. A further exciting aim of the project will be to identify bacterial isolates of particular interest and develop a workable methodology to gain these isolates for further pheno/genotypic study. Since embarking on my PhD I have enjoyed some success. I have again presented my research findings at BSAVA Congress 2016 (abstract published 2016, JSAP), and was also an invited speaker. I was also the lucky recipient of the Postgraduate International Canine Health Award presented by The Kennel Club Charitable Trust and supported by The Metro Bank. This involved a competitive process to gain further funding to support the laboratory-based aims of my project. I am keen to explore the area of AMR surveillance further, particularly opportunities for collaboration.

Outside of academic life I am a keen hiker, love music and am an occasionally fortunate supporter of Swansea City FC.

REPORT

Firstly I would like to thank SEA-EU-NET 2 for the opportunity to attend this masterclass, it was an invaluable experience and I hope that the outcome will involve the development of professional relationships and potential research collaborations in the future. AMR surveillance is an increasingly important area and it is exciting to know that my chosen research field is gaining this level of support. I sincerely hope this continues to
tackle the very real threat of global AMR development and spread. I would also like to thank the British and Thai organisers of the respective legs and particularly KC Liew for ensuring continuity between legs and encouraging relation building throughout the masterclass. I’m sure the masterclass wouldn’t have happened without his input! I will now detail below a few thoughts about the masterclass including a personal reflection and areas that I would be particularly interested in for future collaboration.

Personal reflection

I applied for this fellowship with the primary aim of increasing my level of knowledge surrounding AMR surveillance in humans and animals, and to learn more about ongoing research on a more international scale. As a first year PhD student I am acutely aware of the huge breadth and scale of current AMR research, and the personal challenge of becoming sufficiently well-informed in this area to contribute meaningfully to research. As I am particularly interested in epidemiology and disease surveillance I therefore welcomed the opportunity to attend a masterclass focused on AMR surveillance. I was also interested in developing new contacts and in exploring the potential for future international collaboration – both features I was glad to see were a focus of the workshop. I will now provide a brief summary of my experiences from both legs of the masterclass.

Liverpool

As a current student at the University of Liverpool I was pleased to be able to help show other participants what I consider to be a great city – this was rewarding and I hope helped foster friendships within the group. The workshop programme itself I felt was intensive and focused on AMR surveillance, this was great as considering the broad aims of my PhD project I felt that almost every talk had a relevance to my project. I was also pleased to see that a significant period of time was given to participants to present their research; this most certainly sparked conversations and was a good opportunity to practice presenting in front of a knowledgeable audience, but of a similar level to myself. I believe the selection process was successful – I felt able to contribute, and also all other participants contributed which certainly built towards the success of this masterclass. In this regard I particularly enjoyed the structured group discussions. I felt these were productive and that each in some way built upon the last.

In terms of improvements, I felt this leg was focused on learning; however, it perhaps could have included a discussion on collaboration ideas. This was a focus of the Thailand leg so I didn’t feel it was missing from the overall masterclass, but an initial discussion might have been good to allow people to start thinking of ideas ahead of the Thailand leg. On a practical level, as this leg was so talk/discussion-focused I found the quality/enthusiasm of discussion tended to drop off in the afternoon due to tiredness – changing the location of talks on some of the afternoons might have helped “freshen things up”, but this is really a minor point.

Thailand

As mentioned, I was keen following the Liverpool leg to more directly discuss potential research collaborations, I was therefore happy to see that a key focus of the Thailand leg was just such an area. As this was my first visit to Thailand I experienced a level of enjoyment beyond the workshop itself – it was exciting to see a new country and culture, and I was pleased to see the organisers recognise this with plenty of opportunities to experience tourist opportunities, particularly the local cuisine! It was also interesting to see two vet schools and I appreciate the time taken to organise extensive tours of both facilities.

In terms of workshop programme, it felt less structured than the Liverpool leg which I felt helped foster broader discussion having learnt from Liverpool. I enjoyed the experience of both project proposal workshops and I feel that productive research collaborations might come out of both – I think actually more time could have been given to both. With regards to field visits, whilst the visit to Samphran Elephant and Crocodile Show was an interesting experience, I wasn’t sure of its direct relevance to the masterclass. However, the crocodile farm visit was very interesting, valuable and a highlight of the Thailand leg – I imagine organising such a visit was not easy, and I would be curious to see where research goes in the future in this understudied area.
Collaboration interests

Following from this excellent experience, there are a number of areas I found interesting and would be excited to learn about potential research collaborations in the future. In brief, these are bullet-pointed below:

- Review of AMR one health surveillance in Europe and South East Asia – this was a proposal which came out of the proposal workshop at Chulalongkorn University.
- Development of a farming welfare code for crocodiles
- Qualitative & intervention study of crocodile farming impressions of AMU/AMR – this was a proposal which came out of the proposal workshop at Mahidol University
- Linked human-animal AMU/AMR surveillance – within the UK at first with potential to expand to SEA/other EU countries
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Currently I am finishing my PhD under the supervision of Doctor Bruno Gonzalez Zorn in the field of Antimicrobial Resistance. Specifically, I study the connection between hydrogen sulfide (H\(_2\)S), a gasotransmitter connected to many physiological and pathophysiological pathways, and antimicrobial resistance, as it was stated years ago. At the moment we are unraveling the biochemical events behind H\(_2\)S action.

Besides my project, I am involved in science dissemination and management. I am part of the Board of Trustees of the Spanish Molecular Microbiology group, and I collaborate with the Young Researchers group of the Spanish Society for Microbiology.

I am deeply attracted to science policy, project management and international relationships in health and science issues.

REPORT

The AMR Surveillance Masterclass has been a great experience for me, both from a personal and professional point of view. There has been such a great team spirit environment and a huge amount of networking among the participants.

I would like to summarize hereby some of the highlights of this week:

- Lessons learnt: the sessions were very diverse and addressed many different topics. I would like to highlight here a few of them:
  - The One Health sessions talked about different bodies related to the surveillance of antimicrobial resistance, such as the O’Neil Report, the EARS-Net and ESAC-NET, the ESVAC-Net and the GLASS.
  - We also had a chance to discuss the role of wildlife in AMR prevalence.
  - Seamus Fanning showed us how an antimicrobial treatment has consequences on other factors besides bacteria, such as phages, and how this, at the same time, has an impact on the spread of AMR mechanisms.
  - Helen Clough presented a great seminar about how to handle risk analysis data, giving us crucial concepts such as understanding that model outputs will be only as good as model inputs or the difference between uncertainty and variability.
  - Kate Baker’s presentation about the dissemination of azithromycin resistant shigellosis made me understand the importance of knowing the context around the emergence of a pathogen to be able to tackle and handle it.

- Comments on the sessions: one of the best parts of the sessions was the breakout sessions in which we had the chance to know more closely the situation of any of the topics in the different countries in Europe and Asia.
  - I believe we could have skipped a couple coffee breaks and we could have extended some of the most successful sessions.
• Interesting highlights: of course, the most remarkable experience of this week is the great team spirit and international environment that was created during the week among the participants, both at a professional and personal level.

• Areas of interest: I believe that from this Fellowship there could be future collaborations related to international AMR surveillance, consortium funding, science advise, etc.
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Project: Impact of AMU on the emergence of AMR in animal production farms in Vietnam

Ha received her BSc in Biotechnology from Ho Chi Minh International University in 2009 and her MSc in Molecular Biology from the University of Sydney in 2011. Ha’s Master’s research focused on structural studies of MPG1 hydrophobin, a pathogenicity factor of *M. grisea* which is the causal agent of rice blast.

Ha joined OUCRU, HCMC-Vietnam in June, 2012 with research works on bacterial pathogens which cause infections in both animal and human. Her research direction is examining the risk of *Streptococcus suis* – an emerging zoonotic agent transmission from food sources to human consumers. She performed surveillance studies to investigate the prevalence of *S. suis* in different types of pigs products as well as genetic characterization to compare pig and human isolates. Recently, she has expanded her research interest on the impact of AMU on the emergence of AMR in animal production farms in Vietnam.

REPORT

The SEA-EU NET 2 fellowship with the theme of One Health Surveillance in AMR provides a broad, interdisciplinary picture consisting of all aspects of healthcare such as human, animal and environment. The masterclass, which was carried out in Liverpool (UK) and Bangkok (Thailand) allowed participants to listen to different points of view toward AMR, to understand various approaches to identify and respond to urgent AMR issues, to experience AMR stewardships promoted in developed and developing countries. By being one in a mixture of participants coming from different countries with different disciplines e.g Public Health, Veterinary medicine, Sociology, Biology... I have broadened my mind by the necessary and benefit of multi-and inter-disciplinary approaches in combating AMR. In addition, the workshop also offers opportunities for potential collaboration networks as well as applications for research funding.

Lesson learnt from Liverpool, UK

From Liverpool, there were a series of lectures and discussions covering all aspects related to AMR, starting by the very basic but appropriate definition of “One Health - a concept that becomes an approach that becomes a movement” to clear targets and actions in AMR fighting of united collaboration of WHO, FAO & OIE to strategies for AMU surveillance and stewardship. Besides that, lessons and experience were shared based on previous research carried out around Europe for AMR surveillance in human and veterinary sciences, as well as in wild-life and environment. Scopes for collaboration between EU and SEA including both lab capacity strengthening, and potential funding sources such as Newton Fund or Longitudinal Prize were also presented. These talks have encouraged young researchers like me to move forward on the career path, possibly starting by development of similar works or translation of successful example of AMU and AMR reduction campaign in EU countries to Vietnam.

Lesson learnt from Bangkok, Thailand
From Bangkok, we have experienced strategies from Thailand to balance between conservation and economic incentives from wildlife animals through a series of lectures about crocodiles in Thailand and Southeast Asian and a fieldtrip to Sriracha Farm Asia where the whole process of crocodile breeding for both meat and leather production was presented. This is a valuable experience since we also have many crocodile farms in Vietnam and the successful model of Thailand could potentially be applied in my country not only to protect this animal but also to offer economic benefits to farmers. In addition, the issue of AMU in wildlife was deeply discussed. In case of crocodile farming, we all came up with the responsibility of the crocodile distributors to control the use of antimicrobials during breeding duration of their animals in sub farms.

**Lesson learnt from participants**

Mixture of participants coming from different countries with different backgrounds offered different research targets and experience. Through participant presentation sessions, a summary about AMU and AMR situation as well as relevant researches in SEA countries (Thailand, Indonesia, Malaysia, Singapore) and EU (France, Spain, UK) was presented. Those all are important materials providing an up-to-date overview of this global issue in two areas that are very different in climate, culture, drug using practices in public health and livestock production.

Especially, there are two research topics that are really fitting to what I am doing at OUCRU. One performed research to understand AMU and prescribing behaviour by pig vets while another worked on development of strategies to promote pig health from decreasing the need for AMU in pig industry. Those will provide necessary references for us to develop feasible intervention approaches to reduce AMU and AMR in animal farms in Vietnam.

Last but not least, I want to express my sincere appreciation to the SEA-EU NET for the great fellowship and opportunity to attend this valuable master class. I strongly believe that with knowledge and experience obtained, I would contribute positively to the development of my research group as well as the global AMR surveillance through new EU-Vietnam coordinated projects in a very near future.
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Katherine is in the final year of her part-time PhD at UCL, and simultaneously works as a full-time epidemiology scientist in the Department of Healthcare-Associated Infections and Antimicrobial Resistance (HCAI & AMR) at the national Public Health England (PHE) centre in London. She studied her B.A. in Geography at the University of Manchester with a focus on medical geography and the environmental impact on the spread of disease. Since receiving her M.Sc. in Control of Infectious Diseases from the London School of Hygiene and Tropical Medicine (LSHTM) in 2008, her work within the Department of HCAI & AMR has focused on the national surveillance of AMR in England, across a range of bacterial and fungal organisms, for which she has a keen interest. Her current work at PHE is focused on antimicrobial prescribing, contributing towards the annual English surveillance programme for antimicrobial utilisation and resistance (ESPAUR) report and surveillance of AMR for respiratory isolates in relation to pandemic flu preparedness. Her role involves a lot of team-working and collaboration with other institutes and international colleagues.

The focus of Katherine’s PhD is to discriminate between community-acquired, healthcare-associated and hospital-acquired bloodstream infections in children in England (using linked national clinical hospital and laboratory data) to help inform empiric antibiotic treatment in hospital considering the increase in antimicrobial resistant pathogens causing infection are being observed in the community as well as in hospital.

Katherine has been a co-author on 23 peer-reviewed manuscripts, which include 6 first-author articles (manuscripts and letters), and has presented her work both on posters and via oral presentations at national and international conferences (for example ICAAC in the USA, ESCAIDE in Stockholm, ESPID in Greece, Holland and Belgium, and SHIP in Scotland). Her technical skills include quantitative (managing large datasets, data linkage and analysis using STATA and R) and qualitative methods (questionnaires and focus group interviews). She is fluent in both English and French.

REPORT

The AMR Surveillance Masterclass has been an incredible experience, not only for what I have learnt from and contributed to in the workshop, but also for the large network of colleagues that I have had the pleasure to meet and work with.

Learning

The majority of my knowledge surrounding AMR is from a human health perspective, both from a hospital and community context. As a result, this masterclass has offered me the possibility of learning a lot about the veterinary and environmental perspectives of AMR (in addition to the human perspective) via the delivery of lectures about One Health at the University of Liverpool. My knowledge about the diversity of AMR and antimicrobial use (AMU) in different countries has also increased from listening to the introductory presentations of other fellows with a range of expertise, as well as the presentations about South-East Asia
(SEA) at Chulalongkorn and Mahidol universities. For example, it was a revelation to learn about the challenges that SEA countries face with regards to the extent of antibiotic availability over the counter, the black market trade and the unrecorded and often unknown antibiotics that are being introduced into the livestock process. I also felt that I became more confident in vocalising and presenting my ideas to an audience as we all participated in communicating via PowerPoint and flipchart presentations because everyone was keen and engaged in the topic. Overall, I think the balance of group work to lectures was good, where there were more lectures in Liverpool, and more group work in Bangkok.

Networking

Even from the start of the two weeks we were already mixing and contributing well within different exercise groups. Every group, no matter the combination, produced informative work that was fed back to the workshop, and the whole situation provided a great foundation for in-depth discussion and debate amongst peers. I found this very refreshing to be able to talk about a lot of different aspects of AMR and ask questions in a group of students with a keen interest in the topic and with their own knowledge to inform discussions. I think this became evident when we produced our four team presentations in the second week for both project proposals whilst working to tight deadlines.

The networking was not only successful during the programmed day but also in the evenings where we all ate dinner together or explored the respective cities. This provided us with a more informal environment to continue discussions and learn a bit more about each other at an individual and cultural level. I think this was invaluable and enhanced the overall teamwork exercises.

Discovery

Visiting the two cities that the workshop was split between also gave two experiences of AMR and AMU in those countries as well as within the larger continental area. Everyone learnt about the different cultures and gave us all a chance to explore something new. We were also able to explore the reality of different situations in the laboratory or field (e.g. laboratory tours, AMU in crocodile farms) that wouldn’t have been possible if the workshop had been only classroom based.

Challenges

I think the biggest challenge was fitting in enough learning and group work exercises into the two-weeks. There was so much to incorporate that overall I think a good balance was struck although consideration of geographical proximity and length of travel time may help for any future courses. I feel that for the formal group work presentation in Thailand that we needed more than the time given to work on the proposal (particularly the second one) even though every group did manage to produce strong proposals considering the time-frame. However, as a brainstorming and sketching exercise, it really brought the team members together. I really enjoyed working with Mai and Linh at Chulalongkorn; and then with Lucy C, Lucy L and Narong as we had a lot of discussion about our project and good debate on how to hone our proposal; I felt like we approached the tasks in a very positive, targeted and productive manner.

Concluding thoughts

I have learnt a lot more about AMR than I had known previously and I am excited about future collaborations between the group and with other colleagues from the ideas that we compiled. I think data gathering, both from a quantitative (e.g. laboratory results) and qualitative viewpoint (e.g. prescribing perceptions on farms and in healthcare settings) are extremely important to understand what the situation is before any interventions can take place in SEA. I think that some of the lessons learnt in Europe can also help to inform any new projects in SEA, which will be an important attribute of any collaboration, to create more efficient methods that will impact and reduce the global burden of AMR.

I am honoured to have been invited by the organisers of this masterclass to contribute towards this two-week workshop and to have met such an inspiring group of colleagues and lecturers, who I have formed a strong network with. Thank you, kop khun kha.
Kshitiz Shrestha Dr.
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Kshitiz is a Master of Veterinary studies graduate from Institute of Veterinary Animal and Biomedical Science, Massey University, New Zealand and now seeking PhD. Currently, he is associated with One Health InterRisk International Master program.

The complexity of pathogen transmission dynamics in human, livestock/wildlife interface, drivers for the emergence of disease and pathogen spillover, public health, virology, immunology etc. fascinates him. He is passionate about research and diagnosis of emerging diseases and public health problems. He also like to embrace the industry integrated skills combined with comprehensive understanding in a multidiscipline setting. He likes to work on improving animal health, production and welfare as well as broader areas of science, food sustainability and one health.

Other than a vet by education background, he has a Diploma in Global health through Finnish Medical society. He has also received “Young Researcher Fellowship” from SEA-EU-NET for the years 2014, 2015 and 2016. He wants to update himself with the global scientific trends across various research.

REPORT

Bacteria prevail everywhere including commensal bacteria in human. They are just waiting for an opportunity to cause an infection in the human body. The widely prevalent bacteria, E. coli causes many health problems such as pneumonia, wound infection, bloodstream infection, urinary tract infection etc. In order to prevent from infections; we use antibiotics. With the advent of antibiotics, public health interventions have improved. However, bacteria also gradually evolved different mechanisms encoded by ‘resistant genes’ to render the antimicrobials ineffective. Hence, the patient is susceptible to the infections. This is also the case with the animals. This condition which is also referred as “antimicrobial resistance” (AMR) is an emerging global health problem.

There is evidence reported for the transmission of bacteria with AMR on to people through the consumption of food animals, which is called ‘zoonotic transmission’. Any kind of food animals such as poultry, chicken, cattle, goat, including crocodile, which are farmed for the food, are found to have high amount of antimicrobials usage and potentiates to have developed AMR microbial. However, the evidences are inconclusive whether such food sources when consumed will lead to the development of AMR in humans. On this context, several experts from various organizations and universities enlightened us fellows on several topics at this AMR Workshop. These included the sources of AMR, the mechanisms of acquisition of AMR in humans and animals, the fate of antimicrobials after it is drained out into the environment and the cycle back of AMR bacteria back into humans and animals from the contaminated water or farm environment.
Bacterial zoonotic disease expert Prof Nicola J Williams gave a warm welcome at the start of the workshop on 11 July. Other experts then followed it: Prof Malcolm Bennett, Prof Jim Scudamore. Other experts focused on various aspects of AMR like global spread of AMR, AMR detection and surveillance in veterinary and human health, presence of AMR in nature and wildlife, building laboratory capacity etc. There were also information sessions about the Newton Fund, Longitude Prize. Thanks to KC Liew - science and innovation officer from British High Commission Singapore himself provided information on potential opportunities for EU-ASEAN collaborations in Health in Horizon 2020. Brilliant participants from SE Asia and Europe shared their area of research/expertise, experience about antimicrobial usage from their country, joined in various discussions. The tour of the facilities at centre for genome sequencing of University of Liverpool was impressive and highlighted how the modern tool and technique can play role in AMR surveillance.

After having great experience in Liverpool, it was not over yet. The second leg was in Thailand- completely different scenario, culture, place, and people. With typical Asian way of starting a workshop with respective personnel in dais and brief lectures from almost everyone and of course photos, photos and photos (very popular in Thailand), the Thailand leg kicked off at Faculty of Veterinary Science, Chulalongkorn University (CU), Bangkok. The current situation of AMR in South East Asia is worse and the need of networking with non-academic and industrial partners for the prevention and control of AMR in SEA was highlighted in the presentations by the faculty members. The session ended with a tour of vet facilities at CU.

On third day, Mahidol University faculty members welcomed us. They focused on crocodile, their health problems and prevalence of AMR on crocodile. We visited a small zoo with few wild animals and they also exhibited elephant and crocodile show. Honestly, the situation of some animals such as python, non-human primates in their enclosure were horrible and totally against animal welfare. They had no provision of naturalistic enclosures, no drinking water source or any relevant enriching furniture for the animals. Clearly, the animals were used as a showcase for the sole benefit of a few numbers of owners.

The following day, we had a visit to a crocodile farm that was few hours away from Bangkok. It had maintained the farm standard such as biosecurity and produced excellent crocodile leather. Finally, after a group discussion and presentations from the participants on new methodology, tools and concept in epidemiology and risk management of infectious diseases, we ended the workshop.

It was a great experience visiting places, farms and dining wonderful meals together with people from all around the world. We – coming from different disciplines and from different worlds worked together for One Health to achieve common goals and targets. Thanks to the SEA-EU NET who brought this concept into reality. Thanks to KC for all the management and smooth coordination.
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Project/Interests: MINAPIG - Minimizing antimicrobial usage in pig production in Europe

Lucie obtained her Doctor of Veterinary Medicine degree (DVM) in 2012 from the Ecole Nationale Vétérinaire de Toulouse, France. She completed various volunteer project works in international institutions, where she developed a strong interest in veterinary public health and international collaboration.

She completed her final year as an MSc student in Animal Health and Epidemiology in Southern countries within the French Agricultural Research Centre for Development (CIRAD) in Montpellier, France. Her MSc thesis project focused on the qualitative modeling of animal health surveillance and control systems and more especially its application to the HPAI H5N1 in South East Asia.

Lucie is currently a resident of the European College of Veterinary Public Health (ECVPH), and a third-year PhD student. She is mainly involved in the MINAPIG project that works towards the minimization of antimicrobial use in European pig production.

She especially enjoys bringing together various disciplines, such as epidemiology, economy and social sciences in order to improve animal health and especially livestock production.

REPORT

I participated to the AMR Master class as a third year PhD student, originating from Europe and with a veterinary background. I think it was good timing, both to have sufficient understanding of the topic, and to explore potential future collaborations, e.g. as a post-doctoral student.

The course was very well organized with a right balance of lectures, group discussions and group works as well as field visits. Having two one-week sessions, with sufficient time devoted to social activities and networking (e.g. shared lunches and dinners), really contributed to consolidate the group of participants and organizers, who got to know each other pretty well at the end of the course. I am confident I have established closed and sustainable contacts with other participants from Europe and Asia.

From the course content, it appeared very clearly to me that AMR has become a top public health priority in Europe and Asia, at least in human medicine. The health and economic impact of AMR worldwide is now widely accepted. However, major data gaps remain to actually tackle this problem. One of the main data gaps relate to the monitoring of antimicrobial usage; while some countries have started monitoring antimicrobial usage for several years, others still have no information about antimicrobial usage in their country. Even those
countries already monitoring antimicrobial usage are using different approaches as no standardized approach has been proposed so far, especially in veterinary medicine.

I was surprised by the very high levels of AMR prevalence found in human and animals in Asia, including for critically important antimicrobials and extensive farming, e.g. crocodile farming. However, figures should be interpreted with caution as laboratory analyses are hardly standardized. These high levels of AMR are difficult to interpret in the absence of antimicrobial usage data. Additionally, little is known to date, neither in Asia nor in Europe, about the relative importance of the different AMR transmission pathways (e.g. transmission via food, direct contact with animals, and exposure at hospital). Risk analyses approaches are needed to explore this further.

Considering the data gaps mentioned above, I have identified three major areas for collaboration between Asia and Europe: i) capacity building for the monitoring of antimicrobial usage, especially in veterinary medicine, ii) capacity building for AMR monitoring and iii) development of risk assessment approaches to better understand AMR transmission pathways and inform future AMR risk management activities.

Contacts were made with relevant persons at Chulalongkorn and Mahidol Universities, as well as with interested course participants, to develop these ideas further. International organizations (e.g. OIE, FAO and WHO) were also identified as relevant stakeholders to be associated to future projects in these areas. During the course, we were made aware of different funding opportunities to support EU-Asia partnerships. Some of them, e.g. the Fleming fund, appeared very promising in regards of the selected areas of interest, and will be considered in priority for future collaboration projects.
Lucy Coyne  

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**Postdoctoral study:** Writing up Veterinary Medicines Directorate funded PhD project at the University of Liverpool entitled ‘Drivers and motivators of antimicrobial prescribing practices in pigs.’

**Research interests:** Antimicrobial resistance and antimicrobial prescribing practices in food producing animals, zoonotic disease, public health, qualitative research, social psychology, disease surveillance and antimicrobial use surveillance.

I qualified as a veterinary surgeon from the University of Liverpool in 2011 and spent two years working in mixed species and equine first opinion practice. I returned to undertake a PhD at the University of Liverpool in 2012 using a mixed methodology in order to explore the influences behind antimicrobial prescribing practices in pigs. This included qualitative methodology through the use of focus groups and in-depth semi-structured interviews which were analysed using a thematic analysis approach. I followed this up with a quantitative questionnaire study and conducted univariable and multivariable logistic regression analysis on results.

Additionally, I was seconded to the Veterinary Medicines Directorate as a Higher Scientific Officer for a period of 6 months during my PhD. I worked as a contractor in the Antimicrobial Resistance team at the Veterinary Medicines Directorate (VMD) and was responsible for the collection and analysis of veterinary antimicrobial sales data for the UK. In my current role at AHDB Pork I am responsible for the overseeing disease surveillance, antimicrobial use and managing research and development projects relevant to the UK pig industry.

**Publications:**

**Peer reviewed publications:**


**Government publications:**


The wide range of different research areas on antimicrobial use and antimicrobial resistance are vast. From microbiological principles in antimicrobial resistance testing and whole genome sequencing, through quantitative statistical models to the use of sociological principles to explore antimicrobial use. The workshop highlighted the full spectrum of research areas which fall within the area of antimicrobial resistance surveillance. Despite the contrasting research areas it was clear that different workshop participants shared common goals and interests even if the methodologies and paths their own research took were very different.

The shared concerns amongst researchers working within the human and veterinary medicine spheres highlighted the importance of a ‘one health’ approach in antimicrobial resistance research. The workshop showed that it is essential that researchers collaborate and share ideas in order to maximise the success and practical implications from their research areas. The discussion of ideas and knowledge exchange between participants from human and veterinary medicine showed that there is huge potential for a combined and collaborative approach to future research. This shows a potential to override the current status quo where both human and veterinary medicine are known to place blame for antimicrobial resistance issues onto the other one. Thus, the workshop showed the potential for a collaborative approach to tackling the growing issue of antimicrobial resistance.

The majority of the research conducted by the workshop participants was carried out at a regional or country level which was usually within the geographic area of the research institute or University that participants’ were working within. The workshop allowed researchers using common methodologies or researching similar subject matters to converse, compare and contrast challenges and successes in different regions or countries. This was of particular value when comparing European countries, which generally have a high level of regulation and enforcement with regards to antimicrobial use, with Asian countries in which antimicrobial use is largely unregulated and poorly enforced. The need to consider antimicrobial resistance as a global problem was a common trend discussed throughout the workshop. However, a conclusion from the workshop was that it was essential that it is tackled more locally by region or country in order to achieve the goals at a global level.

Participants from European and Asian countries were able to gain essential knowledge and understanding from researchers from the different regions. Asian participants were able to gain a broader understanding of the different antimicrobial surveillance systems already established across different European countries and the policy measures which are in place to collect such data. Equally, participants were able to compare and contrast systems in place in different European countries as well as surveillance across the European Union (EU). Participants from European countries were able to acquire knowledge on current systems of collecting antimicrobial resistance and use data in Asia and to understand the multi-factorial and complicated reasoning behind barriers to improving current systems in many Asian countries. The workshop offered an ideal forum for discussion of these subjects due to the shared interest and common goals of participants.

A highlight of the workshop was the opportunity to learn about the product demand, systems employed and emerging disease concerns of commercial crocodile farming in Thailand and neighbouring Asian countries. The access to initial data on antimicrobial resistance levels on commercial crocodile farms and details of a recent disease outbreak allowed participants to combine their individual knowledge of disease transmission, biosecurity, antimicrobial use and resistance in order to troubleshoot potential areas where further data are required and potential solutions to the disease outbreak. This task allowed participants to share knowledge and draw on their own research areas to present collective ideas and perceptions on the case. For example, it was particularly useful to draw on the experience of some of the participants from a veterinary background with regards to farming practices for participants from a human medicine background who may not be familiar with standard procedures on commercial farms.

The crocodile farm was also of great interest due to the parallels between the farming systems employed and commercial livestock farming. This showed that farming wild animal species results in farmers facing the same disease threats and antimicrobial resistance issues as producers farming cattle, sheep or pigs. These considerations are applicable to wildlife farming whatever the species or country in which these animals are to be kept. The interplay of the conservation of the Siamese Crocodile with the commercial demand for the skin,
as an exclusive and expensive product, was an area of interest and sparked interesting debates between workshop participants.

In conclusion, the most valuable experience from the workshop was the opportunity to share ideas, exchange knowledge and work together with likeminded researchers on antimicrobial use and resistance. The workshop has created friendships and professional partnerships that will form the basis of future collaborations on antimicrobial resistance research.
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Project/Interests: Medicines from natural products

Lucy Lahrita is a PhD candidate at Hokkaido University Japan. Having served as a professional pharmacist in Indonesia, her home country, she untiringly worked to promote natural products-based medicines for self-medication in nationwide scale. She has been awarded research funding from the Japanese Government Scholarship, is pursuing her graduate education at Hokkaido University to investigate natural compounds in traditional medicines for low cost medication purposes.

Her research focuses on bioactive compounds from Indonesian medicinal plants. Her work involves cellular and molecular studies to identify potential species and their mechanisms of actions. Elucidation structure of the responsible bioactive compounds is a part of her drug discovery project. Her recent discovery of dual active plants for chronic diseases has become a groundbreaking discovery in the field of study.

REPORT

Lessons learned from the class:

Listening to a series of lectures at Liverpool University, Chulalongkorn University, and Mahidol University, we realized that antimicrobial resistance (AMR) now constitutes a significant threat against effective treatments for infectious diseases worldwide. Of great concern to clinicians, veterinarians and scientists alike, AMR has also attracted attention to the general public in recent years. This growing public awareness reflects increasing worries over the potential of AMR to cause severe economic loss and compromise human health. This shift in perception is welcome and essential because AMR has become a global and multidisciplinary issue, not only in human health but also in animal health and environment. Therefore, any long-term and sustainable solutions to the problem require not only technological advancement but also introduction of new policies to regulate the use of antibiotics, as what we discussed in various work-groups within the AMR Surveillance Masterclass participants.

Interesting highlights:

A preliminary survey on AMR in 2013 showed that *Escherichia coli* have produced enzymes Klebsiela Extended Spectrum Beta lactamase (ESBL) of about 60%. In addition to that fact, the reports from our colleagues from representative countries in EU and ASEAN regions during the Masterclass, showed dramatic developments of bacteria resistant to antibiotics in their respective countries. Putting together the lectures from university experts and representative participants has inspired us on the application of microbial risk assessment to address societal challenges due to antimicrobial resistance. Discussion and sharing within groups throughout our Masterclass in Liverpool and Thailand, we have created several research proposals as a continuation of our collaboration within ASEAN countries and with the EU region. More things can be achieved in this field when people work together than when they work alone, because in the end, research on AMR and One Health approach are to be an interdisciplinary process that requires collaboration among colleagues beyond national borders.
**Areas of Interests for Potential Collaboration**

Having originated from Indonesia, in the past three years, I have been undertaking bioscience research for chronic tropical diseases. My project is undertaken on the interface between food security and public health by promoting the use of bioactive compounds from Southeast Asian region’s plants for tackling infectious diseases and other chronic diseases. With over 20,000 plant species, Indonesia is rich in biodiversity for medicinal purposes. Following the Amazon rain forests, the region has the second biggest biodiversity in the world, as reflected by a high number of indigenous medicinal plants.

With this in mind, networking with regional stakeholders and discussion on current topics in AMR surveillance will likely promote research collaboration in medicinal plants from the Southeast Asian region. In the framework of SEA-EU NET Project, to ensure success in health research collaborations, we have to promote true partnership where both parties from the region mutually benefit, and manifested as commitment from both partners. In this case, we need to build on one’s strengths and improving on ones’ weaknesses. For this purpose, I plan to undertake research collaboration with some UK colleagues for molecular biology for genes, protein analysis, as well as chemical extraction of bioactive compounds from promising medicinal plants.

This opportunity would enable me to have in depth discussion on the main issue with the colleagues. For example, how to cure patients who have developed resistance to antibiotics? As patients would not be forced to antibiotics, it will be a very long treatment of patients in hospitals. Through this project, we need to put efforts in reducing the rate of antibiotic resistance in the region. If the antibiotic-resistant is not immediately controlled, this could become the biggest killer in the world by 2050. If research collaboration involves technology, there should be sharing and transfer for long term benefits and sustainable impacts on both regions. By the end of the fellowship, I sincerely hope that the SEA-EU NET project can facilitate diffusion of knowledge among young scientists involved and best practices in different areas. More importantly, both academic institutions and young scientists can synergize research strengths in optimizing the potential of one health surveillance for the benefits of public health in Southeast Asian region.
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Project/Interests: Collaborative Drug Discovery Programme that focusing on drug discovery, drug repurposing and rationale of drug usage

Dr Mai Chun Wai graduated with First Class Honours and Dean’s List from the International Medical University (IMU) Bachelor of Pharmacy in 2009. He was the recipient of Sanofi-Aventis Award and Kotra Pharma Award for excellence in research in the graduating class. Dr Mai then graduated with PhD in Medical and Health Sciences (Medicinal Chemistry) from IMU under the joint supervision from IMU, University of Strathclyde (United Kingdom, UK) and UiTM in 2014. Currently he is appointed as Lecturer in School of Pharmacy, IMU.

For the past 2 years, Dr Mai and his research team has published 13 papers (Aug 2016). Our findings also received the Y.S.P. SAH Best Research Paper Award by Taiwan Tien Te Lee Biomedical Foundation. We also received Best Oral Presentation and Best Poster Presentations from several scientific conferences. In 2015, Dr Mai was awarded a Research Fellowship at British Antarctic Survey (Cambridge, United Kingdom) by Sultan Mizan Antarctic Research Foundation (YPASM, Malaysia) to study extremophiles as a source for anti-microbial agents. This study is an ongoing collaboration with Professor Peter Convey and Dr. Kevin Newsham (UK). Our results show that bacteria isolated from Antarctic soils have anti-fungal properties. A joint research proposal by IMU (Malaysia), British Antarctic Survey (UK), Manchester University (UK) and Kew’s Garden Laboratory (UK) has since been made for us to further study this.

Dr Mai was also sponsored by the UK Royal Society of Chemistry to participate in a drug discovery workshop. At the closing of the workshop, he was the inaugural recipient of the 2016 Research Mobility Grant. This grant sponsored his research attachment at the Institute of Protein Biochemistry, National Research Council, Naples. Dr Mai’s team is investigating the bioactive compounds from Antarctic soil bacteria against multi-drug resistance human pathogens. At present, they have identified 10 out of 28 isolates with good inhibitory effects against multi-drug resistance human pathogens namely, Burkholderia cenocepacia, Pseudomonas aeruginosa and Klebsiella pneumoniae. The team is isolating the pure compounds with such promising anti-microbial activities. In Malaysia, his team focuses on antibacterial properties of bacteria isolated from Malaysia mangrove soils. The hypothesis is that bacteria that survive under extreme environment may harbour potential antimicrobial agents. The potential of these extremophiles is still yet to be understood.

His other research interests are in the treatment of complications (eg: chronic inflammation and cancers) related to infections. He believes a patient’s management should be holistic and it should not only rely on antimicrobial agents. Most of the antimicrobial agents are cytotoxic to microorganisms. The dead
microorganism often remains in the host and may induce inflammation. Patients often suffer from the complications as a secondary disease due to the infection. Therefore, his team also designed a high-throughput platform for drug discovery in infection and its complications. His team welcomes all collaborators who are interested to investigate any bioactive compound with potential medicinal properties as well as elucidating biomarkers for these diseases.

REPORT

The training at Liverpool and Bangkok were very fruitful and productive to all delegates because the organiser had invited many eminent speakers to facilitate networking and discussion with regional stakeholders on current challenges and strategies related to antimicrobial resistance (AMR). Unlike other workshops or seminars, the organiser has only selected about 12 participants, which allows maximum interactions among the participants and facilitators. I am fairly new to One Health Initiative and certainly this workshop has connected me to the right people for collaboration as well as broadens my understanding to One-Health Initiative. It is inspiring to learn that developed countries have such systematic health system for their public. There are definitely much room for improvement in Malaysia’s health system.

As a drug discovery pharmacist, I am biased to training related to the technical capacity for One Health. I am very glad the trainings covered the application of cutting edge surveillance technology and research activities by national and regional laboratories. Prof Peter Silley (University of Bradford), one of the panel members in Clinical & Laboratory Standards Institute (CLSI) United States, shared about technical specification in laboratory setting for testing. We were also introduced to cutting edge technology by Prof Mark Fielder (University of Kingston) and Dr Alan Darby, Dr Mathew Ellington (Public Health England) and Dr Kate Baker (University of Liverpool). We also had the opportunity to visit the Next-Generation Sequencing (NGS) Laboratory in Institute of Integrative Biology, University of Liverpool. I always send my samples for NGS and yet this is my first time meeting the machine. Also, we visited the Animal Facilities in Chulalongkorn University and laboratories in Mahidol University.

Nonetheless, I am very grateful to the organiser, who has put in topics such as epidemiology, and qualitative analysis. Being a laboratory based scientist, it is always challenging to facilitate collaboration with epidemiologists and social scientists. I learn their perspective and their great works in AMR. With the expertise from the group members, we have designed proposals to tackle AMR. We proposed 2 potential projects, namely “Qualitative analysis of antimicrobial usage in crocodile farming” and “National AMR Surveillance of enterobacteriaceae Isolated from Humans in Hospitals: Pilot Study in a Southeast Asia Country”. The proposal writing exercise was very productive and certainly an effective way to facilitate discussion.

Overall, it is my honour to participate in this great workshop. I have built new friendships and collaborators across the world. It is certainly only possible through such workshop. Our laboratory welcomes all collaborators who are interested to investigate any bioactive compound with potential medicinal properties as well as elucidating novel biomarkers for these diseases. Our team is having ongoing discussion with researchers from Liverpool Tropical Medicine (Liverpool University), University College Dublin and Chulalongkorn University on AMR related research collaborators.
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Projects/Interests:
- RESET: ESBL and (fluoro)quinolone Resistance in Enterobacteriaceae
- NGS-based molecular surveillance for nosocomial pathogens

I completed my Bachelor and Master studies at the Ernst-Moritz-Arndt-University Greifswald, majoring in the field of environmental research with the main subject in the field of environmental microbiology. I studied on “Influence of matrix stress and osmotic stress to the growth, gene expression and adaption of Arthrobacter chlorophenolicus A6” at the Helmholtz-Center for Environmental Research in Leipzig, Germany.

Currently I am a PhD student at the Robert Koch-Institute, which is a Federal Public Health institute of the Federal Ministry of Health of Germany. The aim of my research-based project is to investigate the molecular epidemiology of extended-spectrum β-lactamases (ESBL)-, AmpC β-lactamases and carbapenemases in Enterobacteriaceae from hospitals, ambulatory settings and the community in Germany. This project is part of the RESET research consortium, which assesses, in an interdisciplinary approach, the impact of different origins, transmission routes and pathogens on the risk for humans being exposed to multidrug resistant Enterobacteriaceae. We especially set focus on Enterobacteriaceae which produce ESBL and carry plasmid-mediated (fluoro)quinolone-resistance (PMQR) genes. For this purpose I am performing both epidemiological and experimental investigations on isolates from human origin on a molecular level together with next generation sequencing and comparative whole genome data analysis, as well as plasmid analysis. Genetic markers identified in this study will be used for evaluating risk factors for the selection, transmission, colonization and infection with and from ESBL-, AmpC and carbapenemase producing Enterobacteriaceae between human and animals.

REPORT

For the Health Fellowship Grant: Antimicrobial Resistance Surveillance Masterclass, 12 young doctoral and postdoctoral participants from Europe and South East Asia (SEA) were selected to participate in both project phases in Liverpool, UK and Bangkok, Thailand. The participants were selected for their interest in carry on research in the scope of EU/SEA scientific collaboration and their field of subject, such as Veterinary Medicine, Public Health, Modeling Science, Pharmacy and Microbiology and came to equal parts from SEA and the EU, as well as the different origin of research. Focus and aim of the project was to strengthen and implement research collaborations and partnerships between SEA and the EU. In the scope of this project the focus for partnerships was set on the topic of AMR and health research on bases of the One Health approach. The project took place in the SEA-EU-NET 2 project and was funded by the European Union’s Seventh Framework Program.

The masterclass was separated into two parts: (i) the Europe leg from 11 – 15th of July and the (ii) Southeast Asia leg from 01 – 05th of August. In both legs the participants were invited to present, network and learn about aspects of AMR surveillance.
(i) The Liverpool leg

The Liverpool leg took place at University of Liverpool and was led by Prof Nicola J Williams. In this first week of the project the participants had the opportunity to present their research related to AMR and AMU and the current situation in their home countries. Together with frequent discussion rounds between the presentations, the attendees were able to comprehend AMR/AMU situations in different regional settings and the political implications. Besides of the participant’s presentations, invited speakers from different scientific backgrounds gave lectures about up to date topics to understand the context of health research strategies and policies. The topics went from One Health and Surveillance in different settings, about AMU, political understanding of AMR to the implementation of state of the art technologies, such as next generation sequencing in AMR surveillance. Each topic complex again was accompanied by discussion rounds, giving the opportunity to get together with the speakers and fellow participants and discuss the topics more detailed. To enable the attendees in further research projects and networking programs, funding opportunities were introduced. Further, the “off-program points” such as coffee breaks and common dinner gave very good opportunities to continue networking on a personal level.

(ii) The Bangkok leg

The project part in Bangkok was separated in to two locations: Chulalongkorn University in Bangkok and at Mahidol University in Nakhonpathom. Main aspect of this week’s masterclass was the focus on AMR situation and surveillance in the SEA region and especially Thailand and a big focus on the aspect of AMR and AMU in wildlife. Furthermore a group discussion with the aim of creating a project proposal for linked research between SEA and EU was hold. This task gave the opportunity to discuss and apply the lessons learnt from the first leg in Liverpool. A very interesting and highlighting point was the visit of a crocodile farm, which was giving detailed insights into the husbandry and production settings of wildlife animals and the problems occurring under these situations.

The workshop “Antimicrobial Resistance Surveillance Master Class” gave the participants many great opportunities to improve their knowledge about the problematic of AMR and AMU and an overview about up to date research on this field. Not only with a focused view of one subject, but with the wider perspective of the One Health approach. This interaction of different fields might have been one of the strongest benefits of bringing people with such a high diverse background together. The discussions in between the sessions clearly emphasized clearly the importance of cross disciplinary working. The offered opportunities to network with the fellow participants and get into interesting discussions with invited speakers about their research was another great chance of this class.
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Interests: Molecular Biology, Tropical Diseases

Narong received his BSc in Medical Science from Naresuan University, Thailand in 2012 and MMedSc in Parasitology from the University of Malaya, Malaysia in 2016. Narong’s Master’s research focused on the detection of malaria parasites in human blood, urine and saliva. His research interests and ideas derive from a number of different fields including genetics, parasitology (malaria, waterborne parasites and soil transmitted helminth), insect diversity and epidemiology.

Narong joined MSASC in Thailand since 2015 with work as science officer. He was also part of the environmental water research team of Southeast Asia countries and he has travelled around in Malaysia, Thailand, Vietnam, Laos PDR and Myanmar. Recently, he has expanded his research interest on DNA barcoding of medically and forensically important insects (i.e. Sandflies, house fly, flesh fly and blow fly) for a vector control and forensic application.

Currently, he is seeking for the PhD opportunity in the topic of host-parasite interaction as well as bacterial and parasite co-infection. Upon completion of his study, he will take up a position as a lecturer at department of Microbiology and Parasitology, Faculty of Medical Science, Naresuan University.

REPORT

I am honoured to be part of the young researcher AMR surveillance masterclass which was held in Liverpool, UK and Bangkok, Thailand. As antimicrobial resistance is a global health issue that is becoming more serious, and impacts on human/animal health, socio-economy growth and trade. Antimicrobial resistance is a complex problem that requires a comprehensive and unified international collaboration. This masterclass was really helpful in bridging knowledge gaps between researchers from two regions (Europe and Southeast Asia). This masterclass was also a platform for young researchers from two regions to share our ideas and experiences on AMR issues in our respective countries.

This masterclass was comprehensive. Speakers gave an overview and insight into One Health on AMR Surveillance in many aspects. I have learned about the history, definitions of One Health. I have also learned about the principle of surveillance. Speakers also talked about national, regional and global AMR surveillance. This gave insight into the current situation on all levels of AMR surveillance and some challenges in the future. The sessions made participants understand all levels of AMR surveillance. Moreover, the session of Antimicrobial resistance in wildlife and environment raised awareness to the participants that the drug
resistance may happen in other areas and not only in human health, livestock or food production. We have learned the background and what happens in practice of susceptibility testing. This topic has raised awareness of the researchers that have to check back to the standard or threshold of susceptibility testing. We have to have the interpretive criteria such as susceptible (breakpoint), resistant and intermediate.

Presentation sessions were also given by the young researchers. This session gave us to understand the context and situation of the antibiotic prescription and use as well as the AMR situation in each countries. Most of the countries from Southeast Asia, it is quite easy to get the antibiotics (such as buying antibiotics over the counters) as compared to the countries in Europe. In some countries, AMR is not the major concern, and more concern was about food security (do we have enough food to consume? is the food clean?).

Besides the scientific presentations, we did have chances to visit the wildlife farming business (i.e. crocodile’s farm) and zoo. This session was useful for young researcher like us. We get to have experience in reality not just study from the text or presentation. Lessons learnt from this session, wild animals may serve as the wild reservoirs of resistance determinants. Moreover, wildlife is an important part that we could not overlook as it could provide a biological mean for the spread of antimicrobial resistant bacteria that might affect humans, companion animals, livestock and environment.

Last but not least, I would like to thank the European Commission under SEA-EU-NET II for sponsoring this invaluable program. I also wish to thanks all organizers, program coordinators as well as speakers.
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Linh graduated from College of Natural Science, Vietnam National University in Biotechnology in 2004. She then worked for a Vietnam vaccine manufacturer. In 2009 she earned her master degree in Animal Biotechnology in Konkuk University, South Korea. During that period she did research on characterization of avian influenza H5N1 human isolates as well as production of pseudo-typed virus for vaccine purpose.

She has started working in National Institute of Hygiene and Epidemiology (NIHE) since 2010. She now is in charge of Laboratory Quality management and Biosafety issues, especially participated in projects for laboratory network strengthening. She is also a lecturer for Hanoi School of Public Health and Hai Phong Medical University, sharing her knowledge and skills on laboratory, quality management and biosafety with undergraduate students.

Since 2012, she has started her PhD working on carbapenem-resistant Enterobacteriaceae in NIHE. Now she joins some projects related to Microbiome, Antimicrobial resistance and Resistome in human, animal and environmental isolates.

REPORT

Antimicrobial Resistance has been emerging as a global and multi-disciplinary concern. AMR being a One Health problem, has crossed the boundaries between human, animal and environment. Its consequences presented in all aspects of life including politics, social, economics and public security problems.

A lot of efforts to control AMR are done by countries around the world e.g. increase of global public awareness, reduction of Antimicrobial use (AMU), establishment of global surveillance of AMR, improve our knowledge on AMR mechanisms etc. Although significant achievements have been gained, there still a lot of gaps need to be addressed.

Obviously, there are big differences among developed and developing country settings. Developed countries e.g EU nations has established a quite good AMR surveillance network, control of AMU as well as increased public awareness on AMR. In contrast, developing countries has no or restricted surveillance network on AMR. AMU seems to be out of control in developing countries (e.g. ASEAN countries), typically the widespread nature of non-prescribed sales of all types of antibiotics. People in poor areas just try to have enough food and do not understand what AMR is. Even rich people now care about chemical-free food rather than caring about AMR in food. Despite this big difference, EU and ASEAN countries have a common shortcoming in AMR surveillance network: the connection, integration between surveillance networks for humans and animals. We all know that there exists close interactions between humans, animals, food, environment and antibiotics. Therefore, all the data should be shared between human and animal sectors to have cross-sector interventions. No efficient and sustainable intervention can be achieved if we only attack one link in the chain. AMR is occurring everywhere, hence cross-borders collaborations need to be set and carried out. It’s the time
to think about helping each other to have a “real” global AMR surveillance network supporting for One Health approach.

Similar things should be done in terms of AMR research. Nowadays, developed countries have advanced techniques and research resources. But are still keen to know what is happening in the other world. On the other hand, researchers in developing countries have to struggle with the limitation of equipment, reagents and techniques. That’s a gap which can easily be filled by collaborative research projects or research grants funded by EU.

One great practical example of setting up collaborations is AMR Surveillance Masterclass funded by SEA-EU-Net. Scientists, researchers, healthcare workers etc. from multiple disciplines were brought together to share information, knowledge, lessons learnt and to seed future collaborations.

As a participant in this class, I learnt a lot and was inspired to start up new AMR projects with the participation of other countries towards a brighter future for global health.

Last but not least, I would like to say thank you to all contributors, organizers, lecturers and other participants to make a practical step forward in AMR control and to give me unforgettable memories and experiences.
Dr. Zaw Myo Tun received his medical degree (MBBS) from University of Medicine, Mandalay, and MSc in Epidemiology from the London School of Hygiene & Tropical Medicine. He has extensive field experience in HIV and TB control, and operational research in Myanmar. He was awarded the Chevening Scholarship (UK) to pursue the MSc Epidemiology. His MSc research focused on the trends of risk factors of HIV acquisition over 16 years in Phnom Penh, Cambodia.

Dr. Tun joined Singapore Social Lifestyle and Infections Networks (SLING) group at Saw Swee Hock School of Public Health (SSHSPH), National University of Singapore as a research associate since 2014. His current research focuses on epidemiology of respiratory viruses and methicillin-resistant Staphylococcus aureus (MRSA) in Singapore. Dr. Tun is also doing a PhD at SSHSPH. His PhD research uses a novel approach to study the role of patient movements on risk of MRSA transmission in a Singapore tertiary hospital using electronic medical records. His research interests are infectious disease epidemiology, antimicrobial resistance, operational research in health program settings, particularly in South-East Asia.

REPORT

SEA-EU-NET II Antimicrobial Resistance Surveillance Master Class was a unique opportunity to gain broader and deeper insights on issues around AMR surveillance under the One Health framework. Discussion with senior scholars and professors from the most prestigious universities in European and Southeast Asia (SEA) regions, showcase of cutting edge AMR research, brainstorming and networking with participants from EU and SEA countries with diverse background, and tours to animal farms, hospitals and diagnostic centers to understand practical issues of antimicrobial use were the highlights of this workshop.

I highlight below a few important AMR issues covered in the workshop and share my learning experience. At the Institute of Infection and Global Health, University of Liverpool, many senior scholars imparted their knowledge and experience on One Health and AMR through a series of lectures and group works over five days. AMR cannot be tackled in a silo – the coordination among stakeholders from human health, animal health, and environment health is essential. Although there have been increasing communication at the international level, as evidenced in the recent joint publication on AMR from World Health Organisation, World Organisation for Animal Health, and Food and Agriculture Organisation of the United Nations, ¹ lack of communication and blaming among the stakeholders at the country level are still a major issue. Some efforts with measurable success in Europe such as the EU Antimicrobial Resistance Surveillance System and EU Surveillance of Antimicrobial Consumption Network (ESAC-Net) are certainly good models to learn from and implement in SEA. Using uniform standards and units in susceptibility testing and measuring AMR use to facilitate the interpretability and comparison across countries over time is also important.

In addition, we learned the current understanding and knowledge gaps in the dynamics of resistance and selection between human, animals and environment at molecular and genetic level, AMR in wildlife, social issues in AMR, methods to conduct risk analysis of AMR, and importance of integrating subtyping and epidemiological information in AMR control. Further, it was eye-opening to listen to participants who shared their AMR research and situations in their countries. Brainstorming in groups with participants on major
knowledge gaps on AMR was very stimulating. It was also very motivating to learn about Longitude prize, Newton fund and other potential opportunities for collaborations.

On the other hand, the faculty of veterinary science from Chulalongkorn and Mahidol universities demonstrated the AMR problem from a different perspective - through a series of field trips and brainstorming sessions. In the beginning of the workshop, Thai senior scholars discussed the extent of knowledge gap of AMR surveillance and control in the region and in Thailand. It is encouraging that Thailand has made its first step by establishing national AMR resistance containment and prevention program. Much more needed to be done in AMR control in SEA countries compared to the progress of the European counterparts. Then, a visit to Chulalongkorn University affiliated small animal hospital, and diagnostic laboratory provided us an overview of practical issues in antimicrobial use in veterinary clinical practice thanks to the detailed explanation the hospital staff. Another interesting field trip was a visit to a crocodile farm organised by Mahidol University where we had a discussion on the process, antimicrobial use, and environmental sustainability in wildlife farming. During the workshop, I teamed up with other participants, and presented two proposals on 1) Situational Assessment of AMR in Linked EU and SEA Countries, and 2) Assessing the Spread of AMR from Animal Farming to the Community. It was also exciting to learn that funding opportunities are available at the regional level from Thailand, EU, and elsewhere to tackle AMR.

I am privileged to be part of the One Health and AMR community thanks to SEA-EU-NET II and workshop organising teams from Liverpool and Bangkok. Special thanks to Prof. Nicole Williams, Assoc. Prof. Rungtip Chuanchuen, Assoc. Prof. Walasinee Moonarmart, Dr. Taradon Luangtongkum and Mr. Kong Cheng Liew for their coordination and experience sharing to make this workshop a success. I hope to contribute to building this community further and to strengthening AMR surveillance and control in SEA and beyond.

References
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Nicola is a microbiologist and Professor in Bacterial Zoonotic Disease and has over 15 years research experience on bacterial zoonoses (including antimicrobial resistance) in wildlife, food and companion animal species, investigating reservoirs, survival in the environment, fitness and transmission between animals and to humans.

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Rungtip is a veterinary professor. She has been engaging in teaching in the area of food safety, zoonotic bacterial agents and antimicrobial resistance at both undergraduate and graduate level. She is currently director of center of antimicrobial resistance monitoring in foodborne pathogens (*in cooperation with WHO*) and Global Infections Network: South-East Asia and Western Pacific region. She is now running Research Unit on microbial food safety and antimicrobial resistance. Her main research projects at present include epidemiology and mechanisms of antimicrobial resistance in commensal bacteria, foodborne pathogens and nosocomial pathogens. The research has expanded to cover the ASEAN region. She is actively involved in surveillance of antimicrobial resistance associated with livestock in the border area between Thailand, Lao People’s Democratic Republic and Cambodia.
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Walasinee is a small animal clinician and Assistant Professor in Small Animal Medicine. She has experienced as a clinicians for over 20 years where she extended clinical work to research on her interests, including cardiology, infectious diseases, antimicrobial usage, antimicrobial resistance, and epidemiology.
Co-organisers

**British High Commission Singapore (BHC)**

The Science and Innovation section in the British High Commission is part of the Foreign and Commonwealth Office’s global Science and Innovation Network (SIN). The Science and Innovation Network promotes and facilitates international collaboration in research and innovation.

Science and innovation are at the heart of government strategy for promoting prosperity and growth. Research and knowledge is increasingly developed and transferred through international collaboration which provides opportunities to work with the best in the world, exchange students and researchers, and gain access to large scale international facilities, leading to mutual benefits for UK and Singapore.

To promote international collaboration the Department for Business, Energy and Industrial Strategy and the Foreign & Commonwealth Office jointly fund the UK Science and Innovation Network (SIN), based in 28 countries around the world.

The Southeast Asia regional SIN team, based in Singapore, working with Embassies and High Commissions throughout the region, develops and supports cooperation on research and innovation with local partners in Southeast Asia and with partners across the UK.


**The National Science and Technology Development Agency (NSTDA)**

NSTDA is Thailand’s national agency for S&T and one of the leading S&T centres in Southeast Asia. NSTDA was established in 1991 under a special law and is governed by an Executive Board appointed by Cabinet and chaired by the Minister of Science and Technology. NSTDA consists of four national technology centres, together with the Corporate Office and Technology Management Centre (TMC). The four national technology centres are the National Centre for Genetic Engineering and Biotechnology (BIOTEC), the National Metal and Materials Centre (MTEC), the National Electronics and Computer Technology Centre (NECTEC) and the National Nanotechnology Centre (NANOTEC).

NSTDA’s main mission is to conduct R&D in the four main technology areas as well as to develop and support R&D in universities and other institutions, using in-house national technology centres and granting mechanisms. NSTDA is also involved in S&T manpower development in Thailand, creating S&T infrastructure and working with the private sector in support of national socio-economic goals.

NSTDA also plays a leading role in a number of regional S&T networks including the ASEAN Committee on Science and Technology (COST) and the APEC Centre for Technology Foresight.

The NSTDA Corporate Office and the four national centres are located at Thailand Science Park (TSP), the first science park in Thailand, which is located about one hour north of central Bangkok. TSP houses 2,000 NSTDA staff and about 50 private companies.

**Website:** [http://www.nstda.or.th/eng/index.php](http://www.nstda.or.th/eng/index.php)