

Combatting liver fluke and bile duct cancer in Thailand: From lab set-up to next-generation sequencing and collaborative science

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FACULTY OF MEDICINE KHON KAEN UNIVERSITY



Brief CV

Education

- 2009-2012 BSc (Hons) Zoology, School of Biological Sciences, University of Bristol
- 2015 Biology of Parasitism Summer School, Marine Biological Laboratory, Woods Hole
- 2012-2017 PhD in Biological Science at Sanger Institute, University of Cambridge

Life in academia @ KKU (Khon Kaen University, Thailand)

- 2017-2020 Department of Biology, Faculty of Science
- 2020-2023 Department of Biochemistry, Faculty of Medicine
- 2023-now Department of Systems Biosciences and Computational Medicine,
Faculty of Medicine



<https://www.redelephantreps.com/khon-kaen-a-photo-essay-through-a-lesser-known-region-of-thailand/>

Liver fluke (*Opisthorchis viverrini*) : A public health problem in Southeast Asia

Opisthorchis viverrini infective stage



Opisthorchis viverrini adult stage



Outline

- Building a career in genomics in Thailand
- Applications of genomics in infectious diseases and cancer - Local problems, wider impact, South-South & global collaboration
- Future prospective

A career in genomics in Thailand

Starting off (2017)

Now a lecturer = many new responsibilities

No lab space for molecular work, or any lab work...

No graduate students

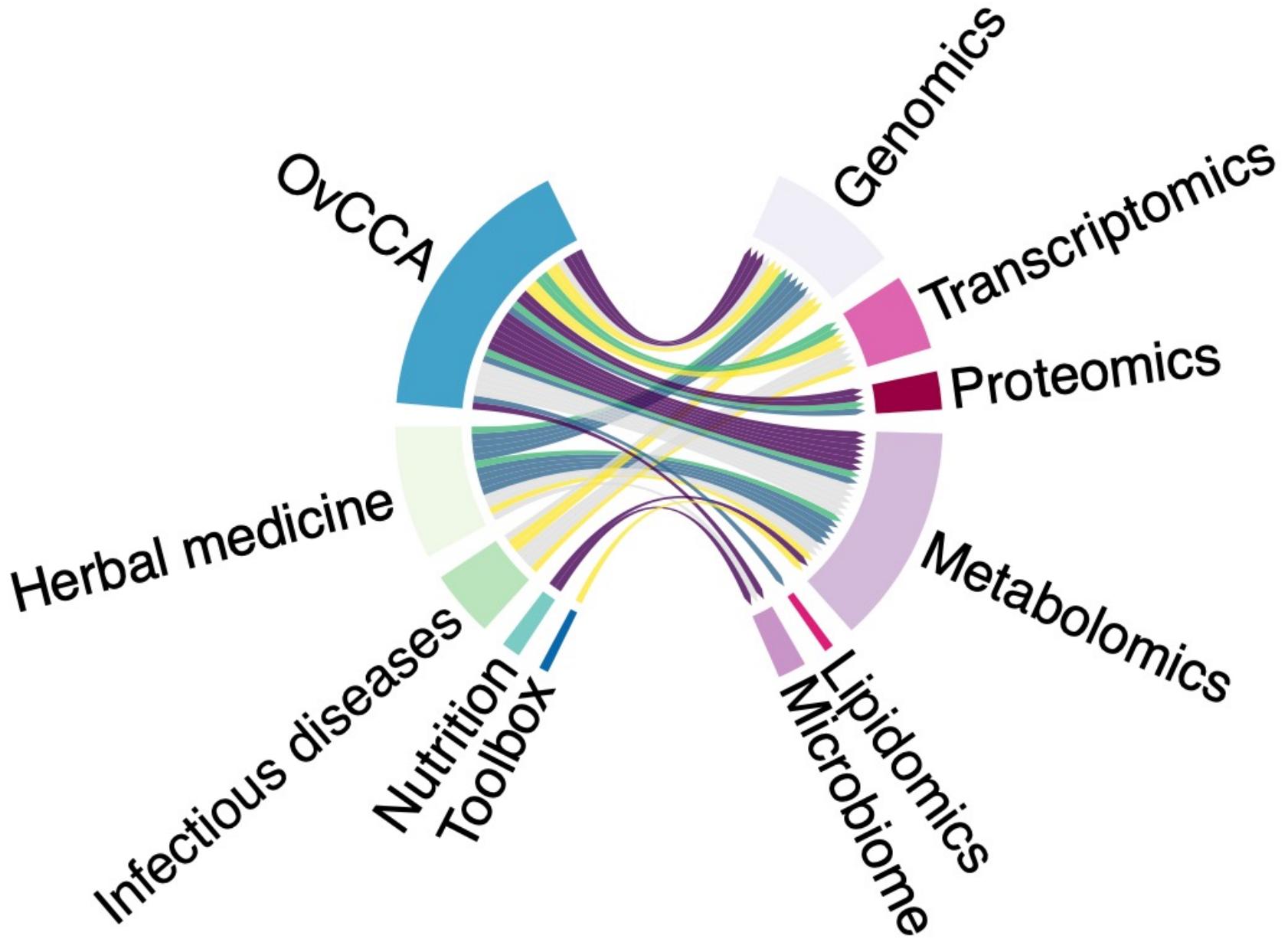
Exploring research questions

Building collaboration

Asking for what needed

A career in genomics in Thailand

Starting off (2017)	Moving on	~ 4 years in	Now
Now a lecturer = many new responsibilities No lab space for molecular work, or any lab work... No graduate students Exploring research questions	Getting starting grant – bioinformatic-focused shipped out for sequencing elsewhere	Formally students Supervise grad students Set up lab space Building grad student trainers/TAs	Local sequencing capacity! (Illumina and Nanopore) = making lab space for genomics Settling computing infrastructure Building grad student trainers/TAs
Building collaboration Asking for what needed	Reconstruct work management system Keep calm	Shifting mindset from <i>do it all myself</i> to <i>supervising and mentoring</i>	Growing a team Developing focused curriculum/internship program



Assoc. Prof.
Watcharin Loilome



Assoc. Prof.
Nisana Namwat

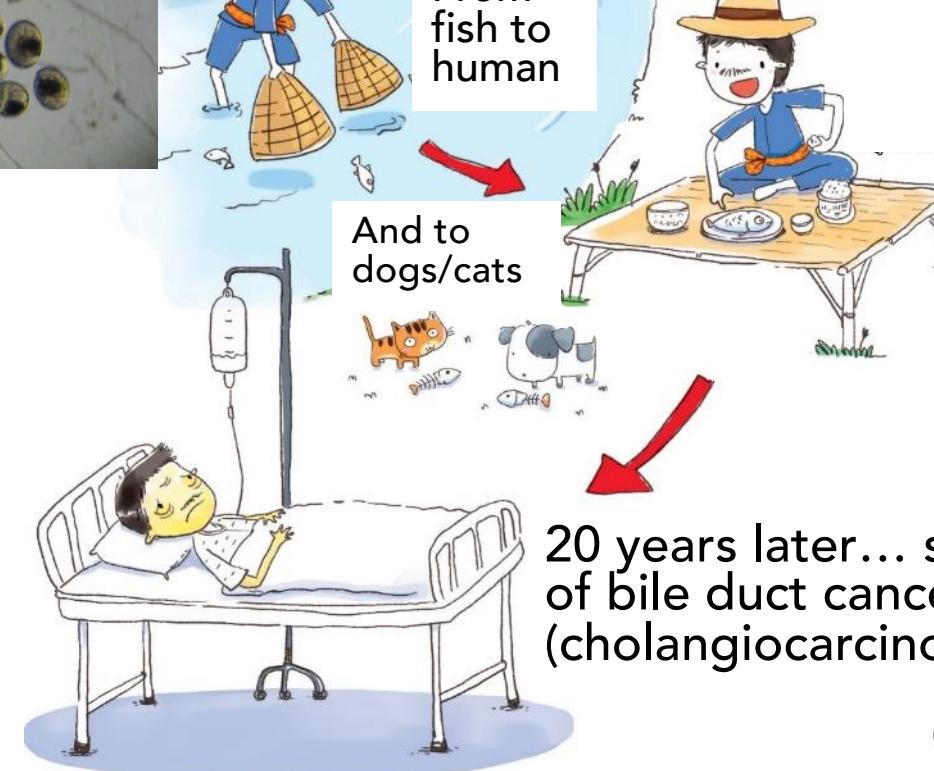
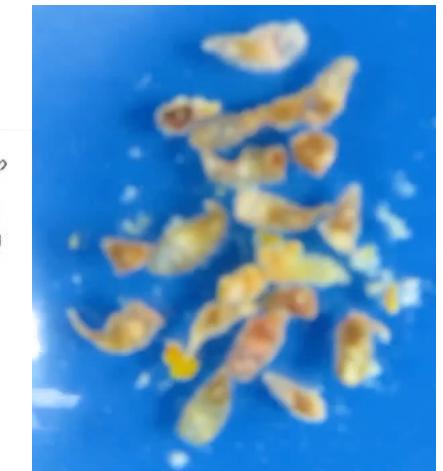
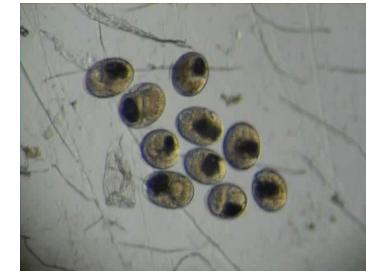
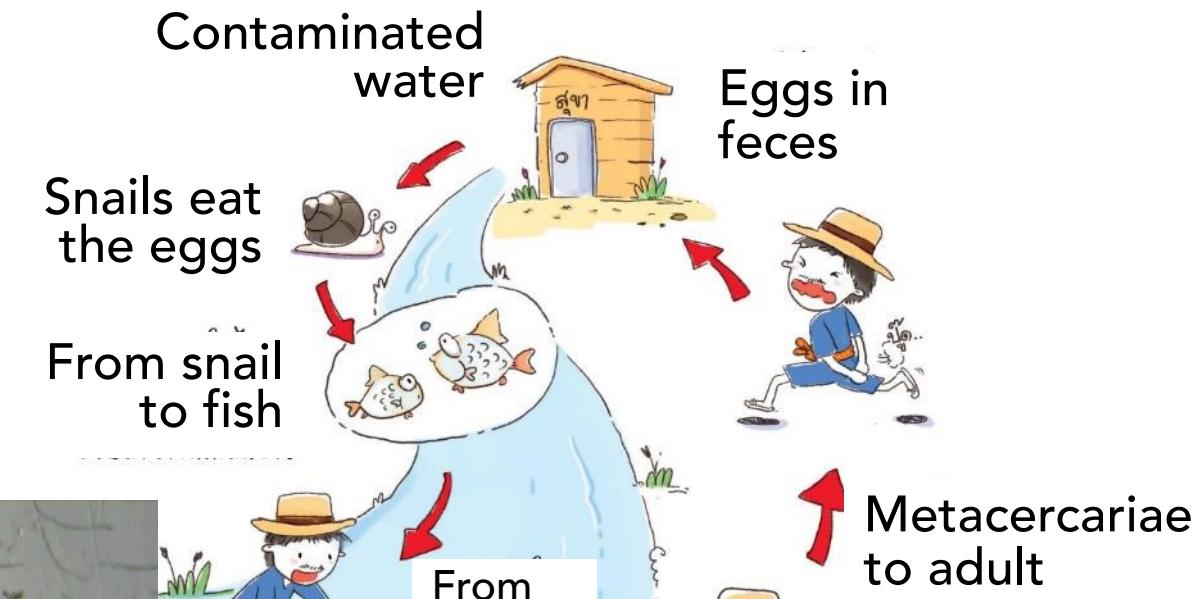


Dr. Poramate
Klanrit



Dr. Arporn
Wangwiwatsin

Life-cycle of *O. viverrini* liver fluke



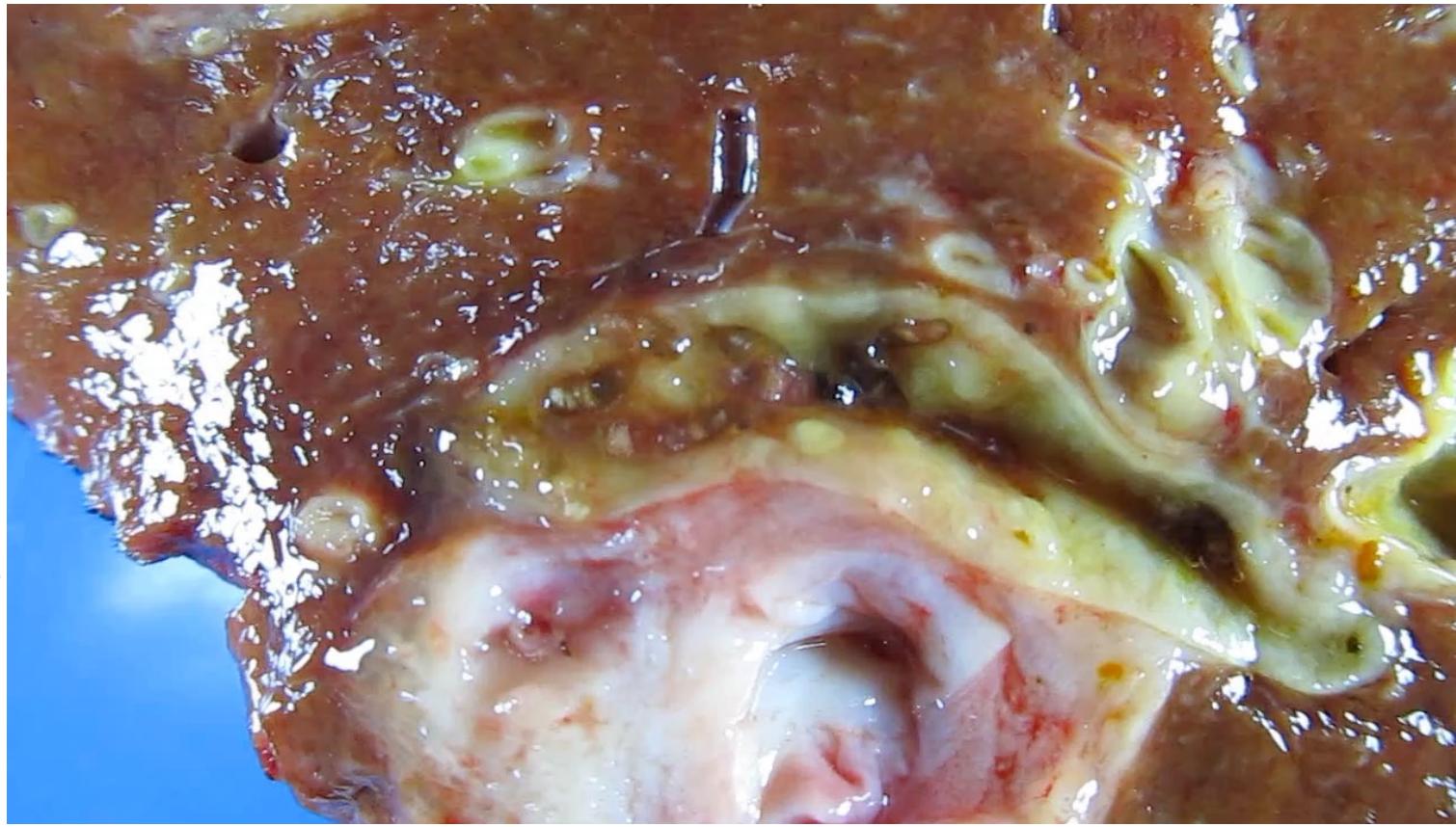
20 years later... symptoms
of bile duct cancer
(cholangiocarcinoma)

Liver fluke (*Opisthorchis viverrini*) : A public health problem in Southeast Asia

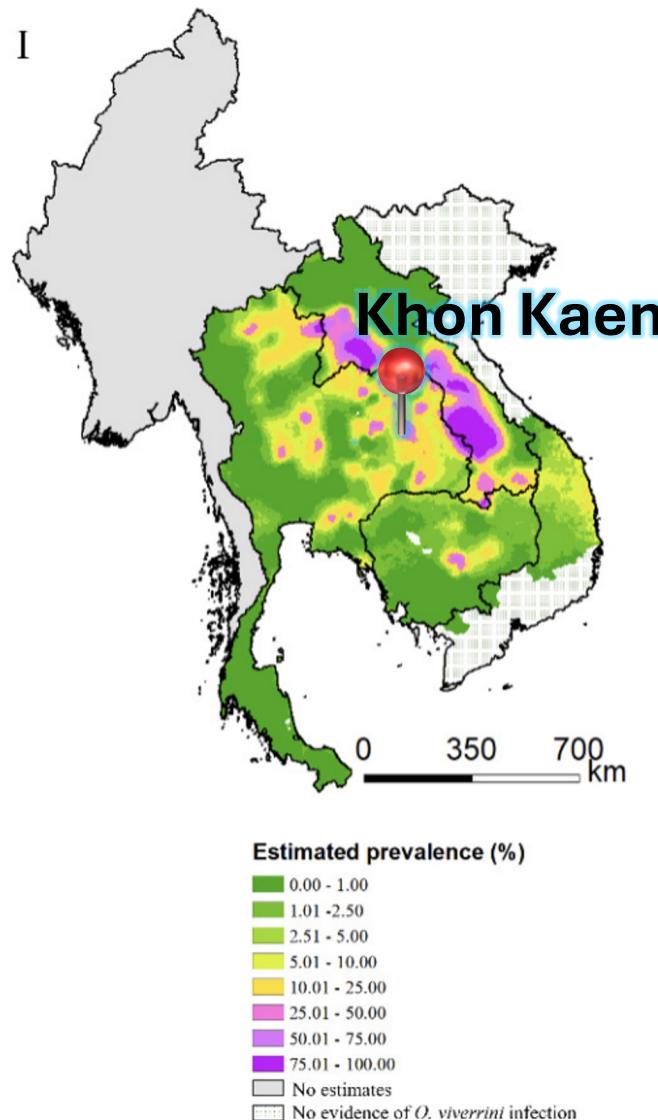
Image credits: International Herald Tribune



VDO credit: Cholangiocarcinoma Research Institute, KKU



Liver fluke (*Opisthorchis viverrini*) : A public health problem in Southeast Asia



- Recent geostatistical analysis estimated that in 2018 there were **12.4 million cases** of *O. viverrini* in Southeast Asia (Thailand, Cambodia, Laos, Vietnam)
Source: Zhao et al. 2021 eLife | *Prevalence map in left Fig.*
- Infection with *O. viverrini* is a **direct cause of bile-duct cancer** (cholangiocarcinoma)
Source: International Agency for Research on Cancer
- Thailand has the **highest incidence** of bile-duct cancer globally, and liver cancer is **most common** type of cancer within the country

Approximately 20,000 new cases/year, in Thailand



In remembrance of a
great man who
dedicated his entire life to combating liver
fluke and cholangiocarcinoma

Professor Narong Khuntikeo (1959-2022)

- Director of Cholangiocarcinoma Research Institute (CARI), Thailand
- President of Cholangiocarcinoma Foundation of Thailand
- Director of Cholangiocarcinoma Excellent Center, Khon Kaen University, Thailand
- Founder of CASCAP (Cholangiocarcinoma Screening and Care Program)

เดินหน้าลุยต่อเนื่อง
การกิจพิชิต
มะเร็งท่อน้ำดี



สถาบันวิจัยมะเร็งท่อน้ำดี มหาวิทยาลัยขอนแก่น
CHOLANGIOPAPILLARY CARCINOMA RESEARCH INSTITUTE

Keep Moving
Forward
to combat
Cholangiocarcinoma

Mission: To enhance national and international collaboration for research, knowledge building, and technology transfer for prevention, diagnosis, and treatment of Ov-CCA in community





One problem, many solutions : multifaceted approach

1

**Food safety
Fluke-free fishes**



2

**Opisthorchiasis treatment
in Cats & Dogs**



4

Sanitary system



5

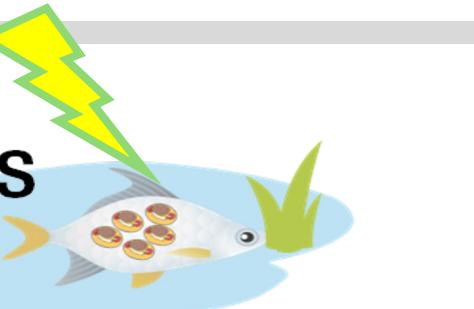
Isan Cohort network system



6

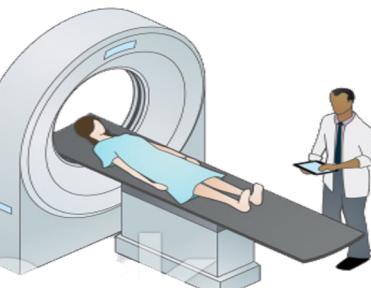
Education

3
**New strategies in
Opisthorchiasis
diagnosis**



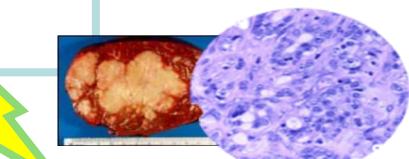
7

**Screening of
CCA risk group
Diagnosis/treatment**



8

Clinical trials



9

Policy research



10

**social sciences &
humanities**



11

GIS system

Groundwork

- Improvement of *O. viverrini* genome and gene annotation
- Updated(?) database of CCA patients genomics (and multi-omics)

Applications

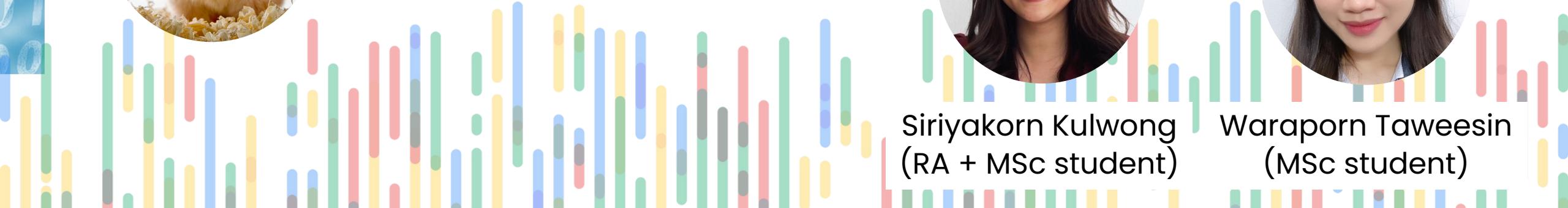
- Profiling molecules of interests – eccDNA, miRNA, cfDNA ..etc
- Tumor microbiome, Tumor heterogeneity

Future prospect

- Policy-guidance – surveillance, population genomics, waste water management
- Molecular profiling and targetted treatment

- Improvement of *O. viverrini* genome and gene annotation
- Updated(?) database of CCA patients genomics (and multi-omics)

Transcriptome of *Opisthorchis viverrini* in hamster model



Siriayakorn Kulwong
(RA + MSc student)



Waraporn Taweesin
(MSc student)

- Utilising database of CCA patients genomics (and multi-omics)

Identifying Target Genes in Cholangiocarcinoma and Treatment Responsiveness for Precision Medicine in *O. viverrini*-endemic area

WORK IN PROGRESS – 80-90% data cleaning, 10-20% data analysis

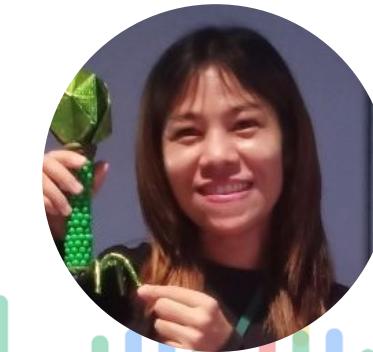
We are here...



Arnut Klangprapun
(MSc student)

- Profiling molecules of interests – eccDNA, miRNA, cfDNA ..etc

Investigation of extrachromosomal circular DNA (eccDNA) in liver-fluke associated cholangiocarcinoma



Zar Zar Win
(MSc student)

And, is looking for a
PhD position !

Groundwork

Applications

Future prospect

- Policy-guidance
 - Surveillance
 - population genomics
 - **waste water management**
- **Molecular profiling** and targetted treatment
 - gene panel
 - miRNA panel
 - cfDNA panel
 - Databases housing multi-omics data x clinical data
- **TRAINING & CAPACITY-BUILDING – human and infrastructure**



LABORATORY, EQUIPMENT, INSTRUMENT AND SERVICES



Instruments

NEXTSEQ 550DX

**PromethION 2 Solo
and MinION**

Chromosome microarray

**TapeStation Automated
Electrophoresis**

Qubit™ 4 Fluorometer

QFX Fluorometer

Services

1. Cancer gene panel
2. Whole exome sequencing
3. Amplicon sequencing
4. Transcriptomics

1. Whole genome sequencing
2. Metagenomics
3. Amplicon sequencing
4. Circular DNA sequencing

1. CNV
2. LOH

DNA/RNA Quantification and QC

DNA/RNA Quantification and QC

DNA/RNA Quantification and QC

BUT THE WORKFLOW AND SYSTEM NEEDS WORK!

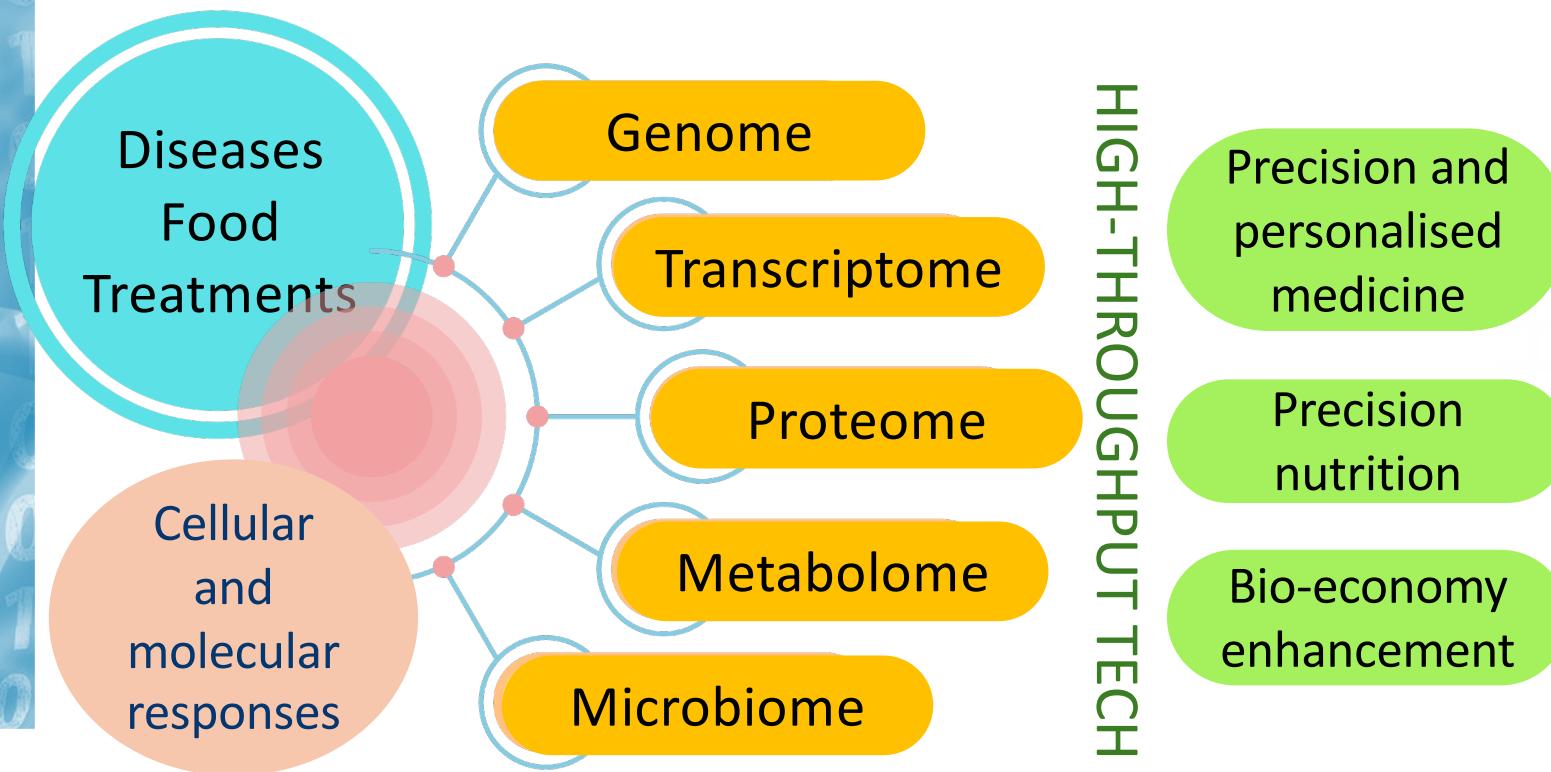
01 Sample preparation



02 Sequencing



03 Individual's laboratory



MSc & PhD SYSTEMS BIOSCIENCES PROGRAMS

(Part of Health & Medical Sciences
Graduate Program)

- Biological Chemistry
- **Laboratory Skills** in Molecular Biosciences
- **Researcher Skill Development**
- **Coding** for Systems Bioscientists
- Molecular Biosciences
- Foodomics
- **Computational Analysis** of Biological Data
- Teaching Skills in Systems Biosciences
- **Upcoming:** Statistics and data sciences

GMS scholarship

Inbound/outbound scholarship for
students and non-student visitors



Helminth Bioinformatics (Asia) (Virtual)

28 June–2 July 2021

Virtual Course



SARS-CoV-2 Bioinformatics for Beginners

31 October–2 December 2022

Distributed Classrooms across Asia, Latin America, and Africa



Helminth Bioinformatics - Asia

21–27 May 2023

Khon Kaen University, Thailand



CAR
Cholangiocarcinoma
Research Institute

COG-TRAIN
COVID-19
GENOMICS
GLOBAL TRAINING



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MDKU
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Lifelong learning



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Application deadline
02 January 2025

Cancer Genome Analysis - Asia

30 March–4 April 2025

Khon Kaen University, Thailand



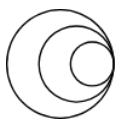
<https://kku.world/cgakku>

Lessons Learned and Future Directions

- Interdisciplinary
- Collaboration, partnership, mutual/fair benefit
- Preference of application-focused research
- Online learning as supplement, not substitute, to face-to-face
- Professional skills development, value addition
- May need to train multiple times / in multiple modes
- You are never too young to mentor and train others
- Content needs are evolving – keep getting feedbacks



- What are everyone doing / wanting to do?
- When to work with existing network or to establish your own track?
- What more can be done of to strengthen capacity building initiatives?
- How to make the effort sustainable?
- How to organise the resources?
- Who should be involved? Who should be driving the initiative?



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MONASH
University
MALAYSIA

a[★]
Genome Institute
of Singapore
GIS

Acknowledgement To co-workers and collaborators



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- Thidathip Wongsurawat
- Piroon Jenjaroenpun
- Zar Zar Win
- Waraporn Taweesin
- Siriluk Nuemaihom
- Siriakorn Kulwong
- Arnut Klangprapan
- Wassana Jamnongkan
- Wichit Taron
- Taweesak Sarnboon
- Autchaisai Siriprayong
- Matthew Berriman
- Gabriel Rinaldi
- Anna Protasio
- Adam Reid
- Thomas Crella
- Stephen Doyle
- WSI Tree of Life Program
- AMMF

Find out more & keep in touch



Liver fluke and bile duct cancer: <https://www.facebook.com/Carikhonkaen>
Graduate program: <https://www.facebook.com/systemsbiosciences>
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