

# Helminth Genomics:

## a team journey on worms and cancer from fundamentals towards applications

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Khon Kaen University Phenome Centre



คณะแพทยศาสตร์ มหาวิทยาลัยขอนแก่น  
FACULTY OF MEDICINE KHON KAEN UNIVERSITY



# Brief CV

## Education

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

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

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

# Outline

- Building a career in helminth genomics in Thailand
- Local problems, global collaboration
- Capacity-building, bioinformatics training, formal education
- Challenges and future prospective

# of publications  
in 2022

Genomics = 1,854,060 results



2022: 103,731

All

103,731

(Thailand[Affiliation]) AND (Genomics) = 6,834 results



2022: 721

Thailand

721

(United Kingdom[Affiliation]) AND (Genomics) = 36,024 results



2022: 2,467

UK

2,467

(Singapore[Affiliation]) AND (Genomics) = 11,608 results



2022: 1,036

Singapore

1,036

# A career in helminth genomics in Thailand

## Starting off

Now a lecturer = many new responsibilities

No lab space for molecular work

No graduate students

Exploring research questions

Building collaboration

Asking for what needed

# A career in helminth genomics in Thailand

Starting off	Moving on
Now a lecturer = many new responsibilities	Getting starting grant – bioinformatic-focused
No lab space for molecular work	Shared lab space / help train grad students
No graduate students	All sequencing materials need to be shipped out for sequencing elsewhere
Exploring research questions	
Building collaboration	Reconstruct work management system
Asking for what needed	Keep calm

# A career in helminth genomics in Thailand

Starting off	Moving on	~ 4 years in
Now a lecturer = many new responsibilities  No lab space for molecular work  No graduate students  Exploring research questions	Getting starting grant – bioinformatic-focused  Shared lab space / help train grad students  All sequencing materials need to be shipped out for sequencing elsewhere	Writing, writing, writing  Formally supervise grad students  Part of a research team/institute  2 NGS projects on Ov liver fluke
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>

# A career in helminth genomics in Thailand

Starting off	Moving on	~ 4 years in	Now
Now a lecturer = many new responsibilities	Getting starting grant – bioinformatic-focused	Writing, writing, writing Formally supervise grad students	Catching up Local sequencing capacity! (Illumina and Nanopore) = making lab space for genomics
No lab space for molecular work	Shared lab space / help train grad students	Part of a research team/institute	Computing infrastructure
No graduate students	All sequencing materials need to be shipped out for sequencing elsewhere	2 NGS projects on Ov liver fluke	More sequencing projects
Exploring research questions			
Building collaboration	Reconstruct work management system	Shifting mindset from <i>do it all myself</i> to <i>supervising and mentoring</i>	Growing a team
Asking for what needed	Keep calm		Survive the tenure track

# Liver fluke (*Opisthorchis viverrini*)

A public health problem in Southeast Asia (amongst many other pathogen!)

Image credits: International Herald Tribune

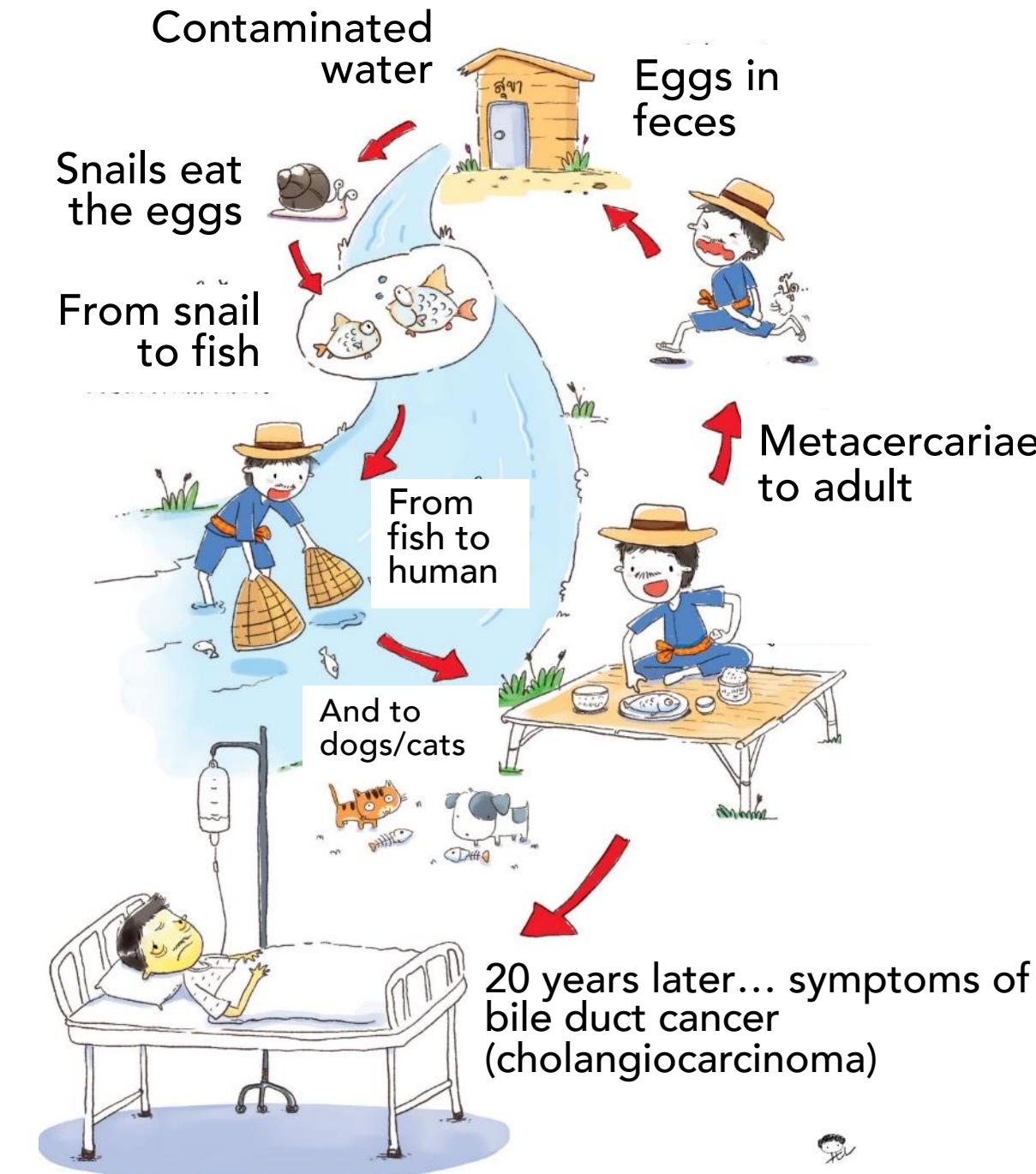


VDO credit: Cholangiocarcinoma Research Institute, KKU



Slide credit: adapted from Thomas Crelle

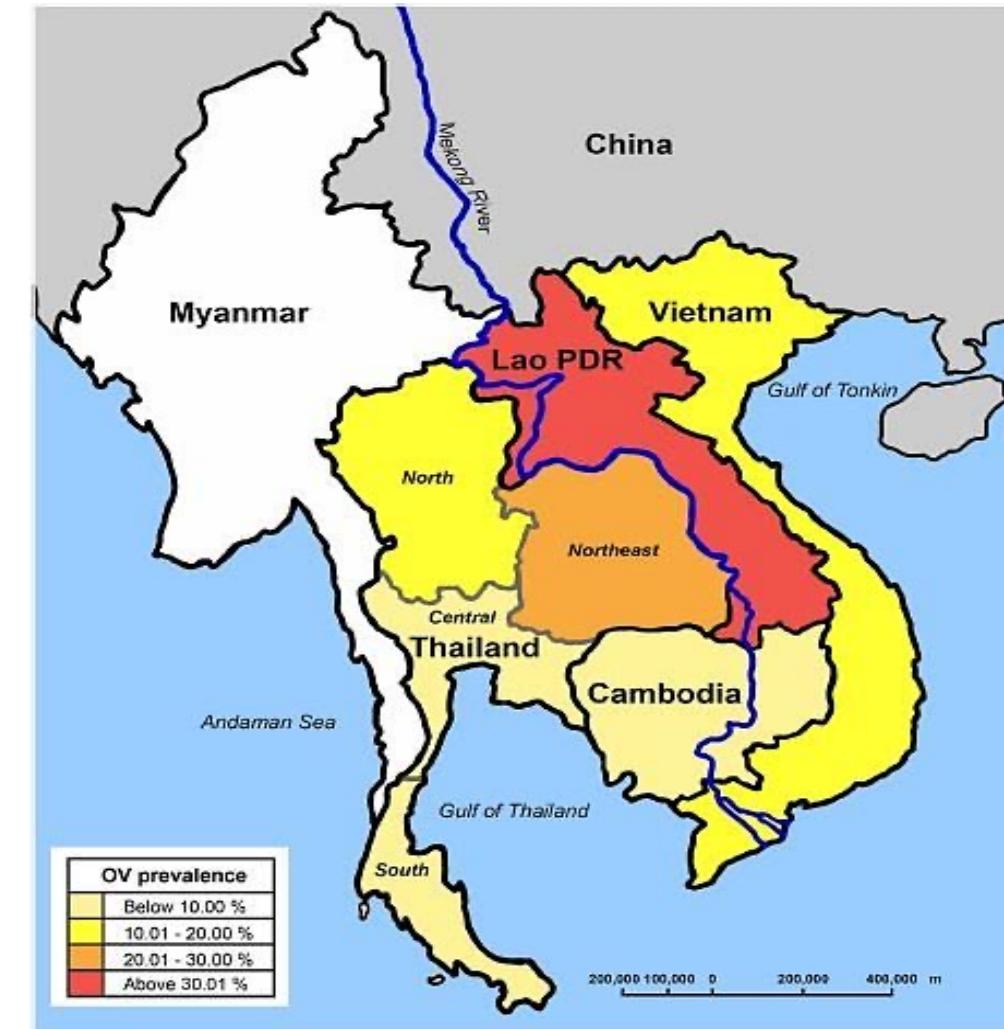
# Life-cycle of *O. viverrini* liver fluke



# Liver fluke in Southeast Asia

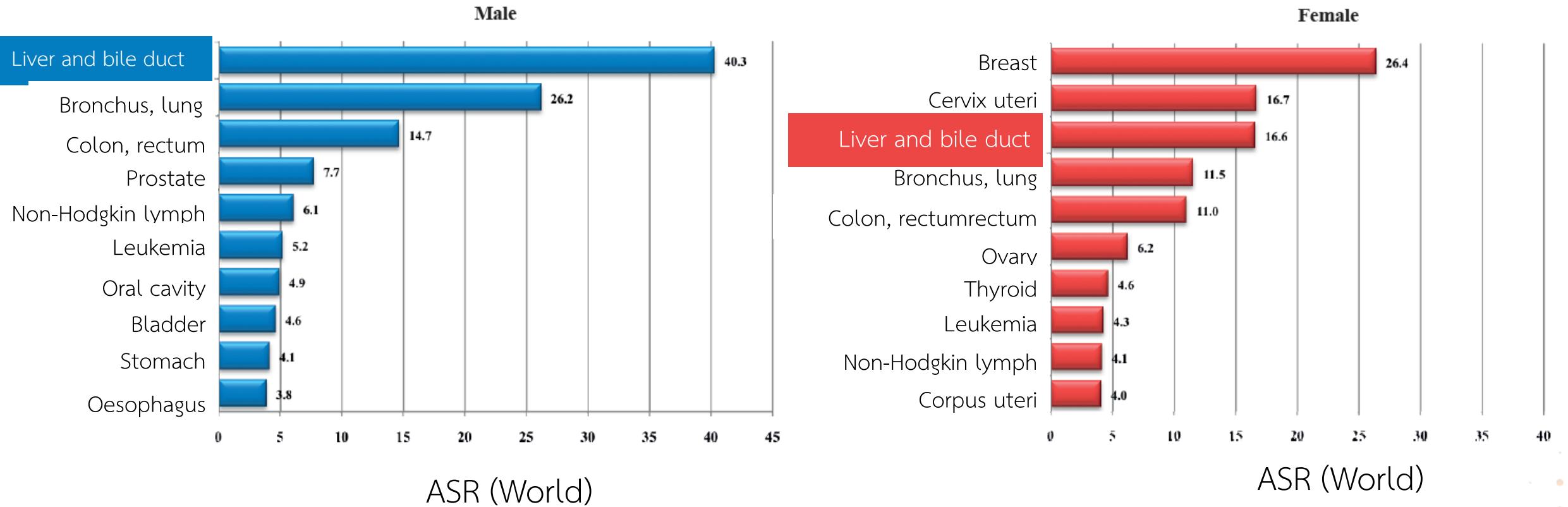


- A.) *O. felineus*
- B.) *O. viverrini* (Ov)
- C.) *C. sinensis*



Prevalence of Ov in Southeast Asia (Khuntikeo et al., 2018)

# Cancer in Thailand (as of 2013)



Source: National Cancer Institute, 2013

เดินหน้าลุยต่อเนื่อง  
การกิจพิชิต  
มะเร็งท่อน้ำดี

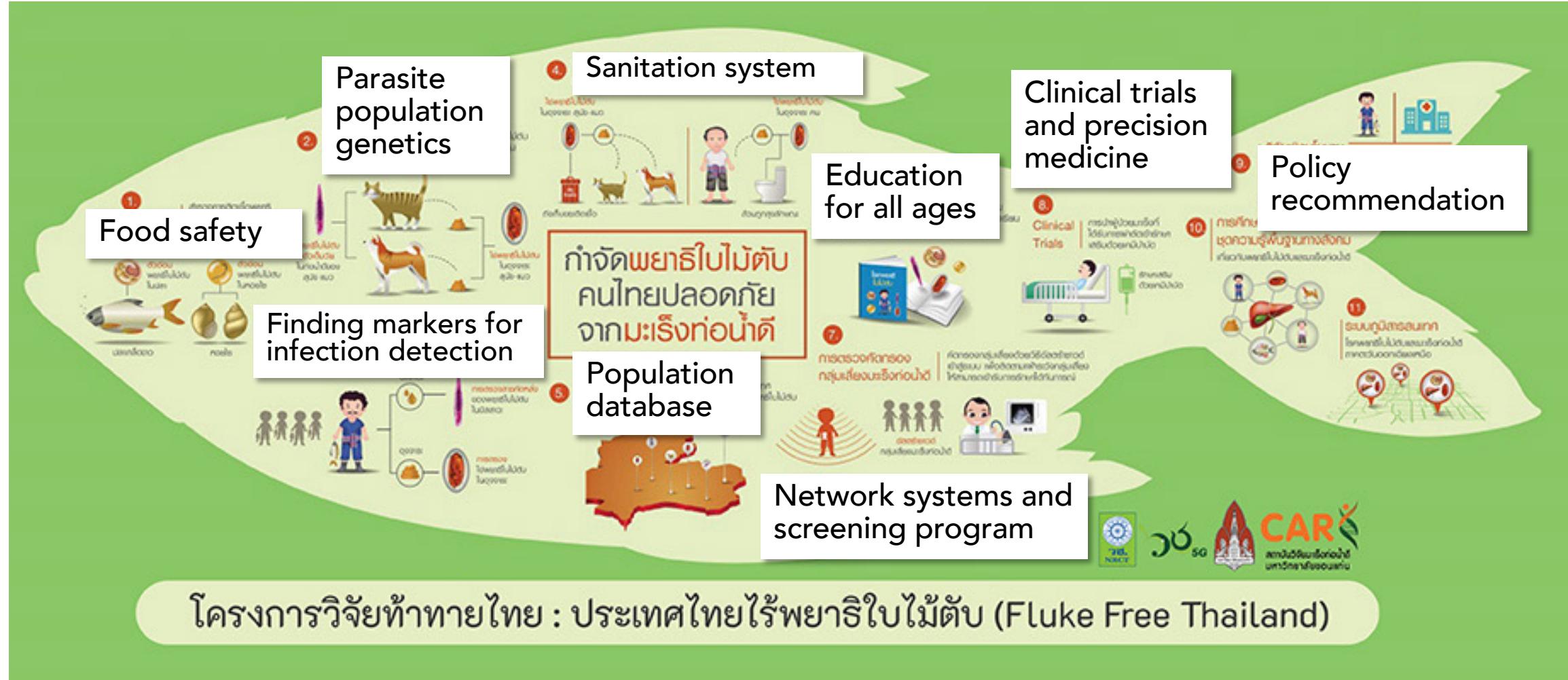


Keep Moving  
Forward  
to combat  
Cholangiocarcinoma

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

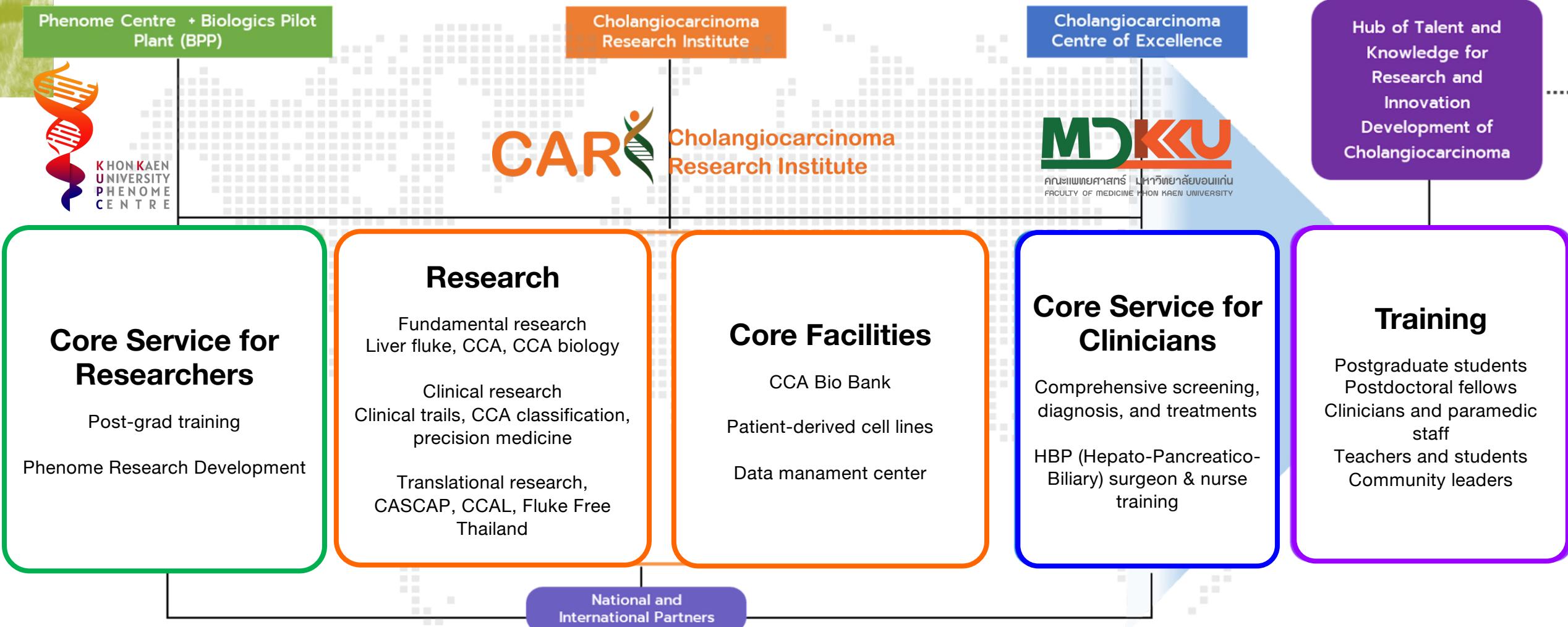


# One problem, many solutions



# Operating structure of CARI : Collaborative forces

Research, Facilities, Clinical and public health service, Frontier research service, Training and technology transfer



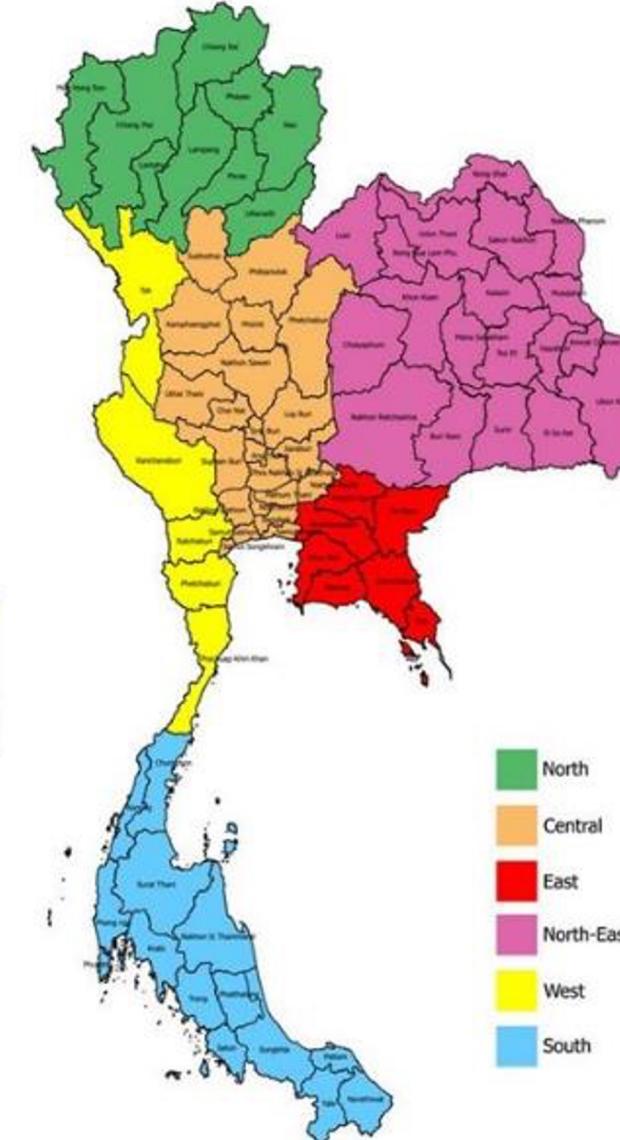
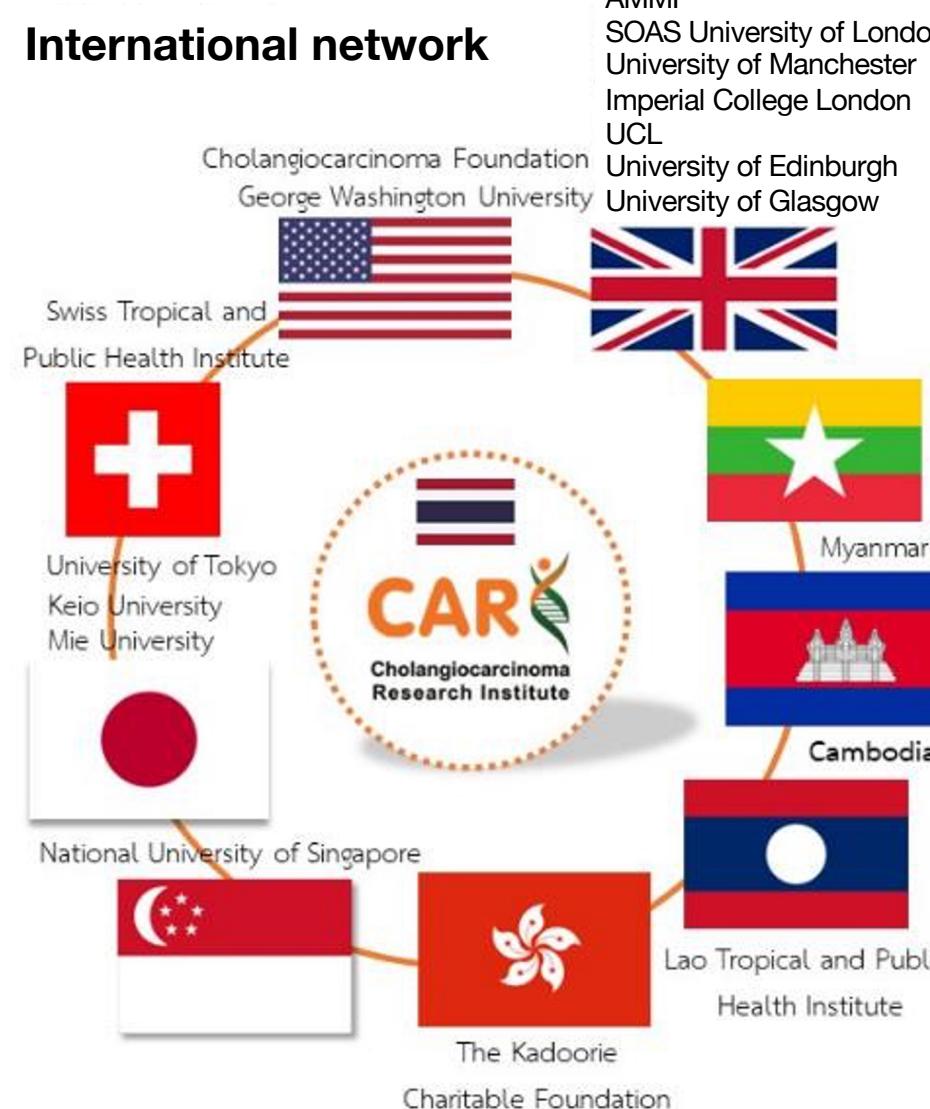
With main sponsorship from: Ministry of Higher Education, Science, Research and Innovation (Thailand),  
National Research Council of Thailand, Office of Thailand Science Research and Innovation

# CARI Network

and expanding – for pathogen genomics too



## International network

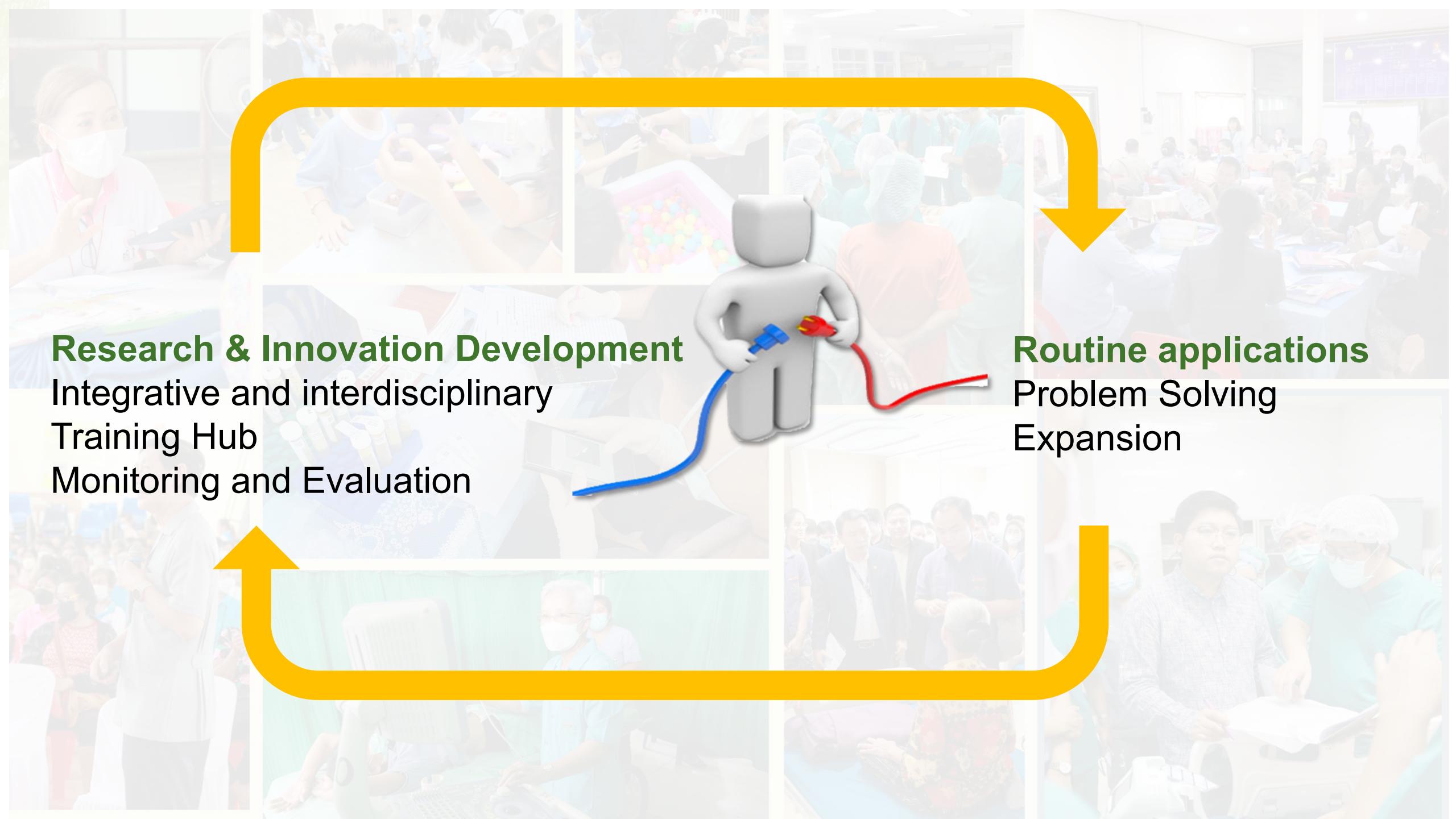


## Domestic network

Ministry of Health  
Ministry of Agriculture  
Ministry of Education  
Local sectors - over 3800 hospitals and 260 health offices)  
Various universities and Faculties (from health science to social science, education to engineer)  
Private sectors (e.g. banks, construction companies)  
Professional communities (surgeon, nurses)  
CCA Foundation of Thailand

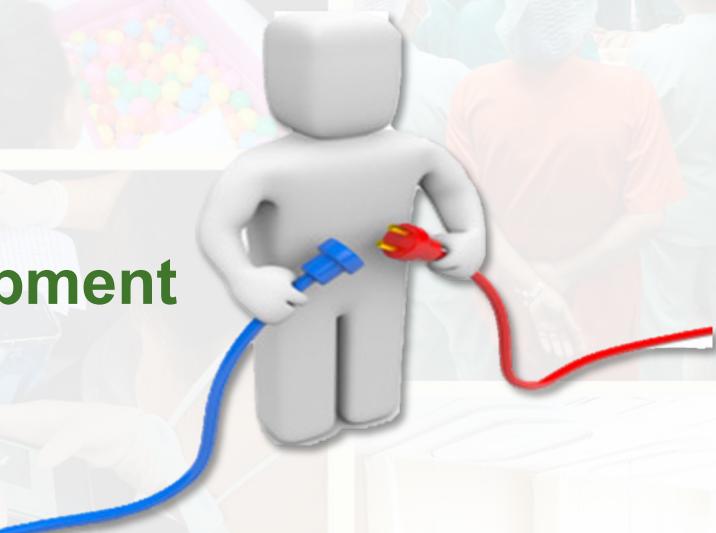
“Everyone can have something to contribute”





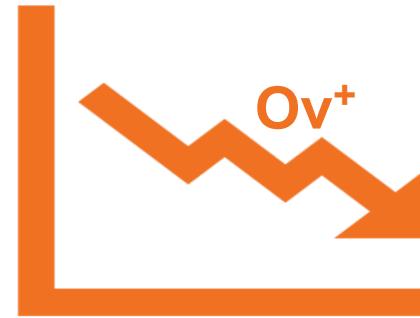
**Research & Innovation Development**  
Integrative and interdisciplinary  
Training Hub  
Monitoring and Evaluation

**Routine applications**  
Problem Solving  
Expansion



# Results since the program started (data as of 2021)

Declining incidents and improved patients' life



Ov infection rate

42% > 13.4% > 7.7% >1%



Early CCA detection

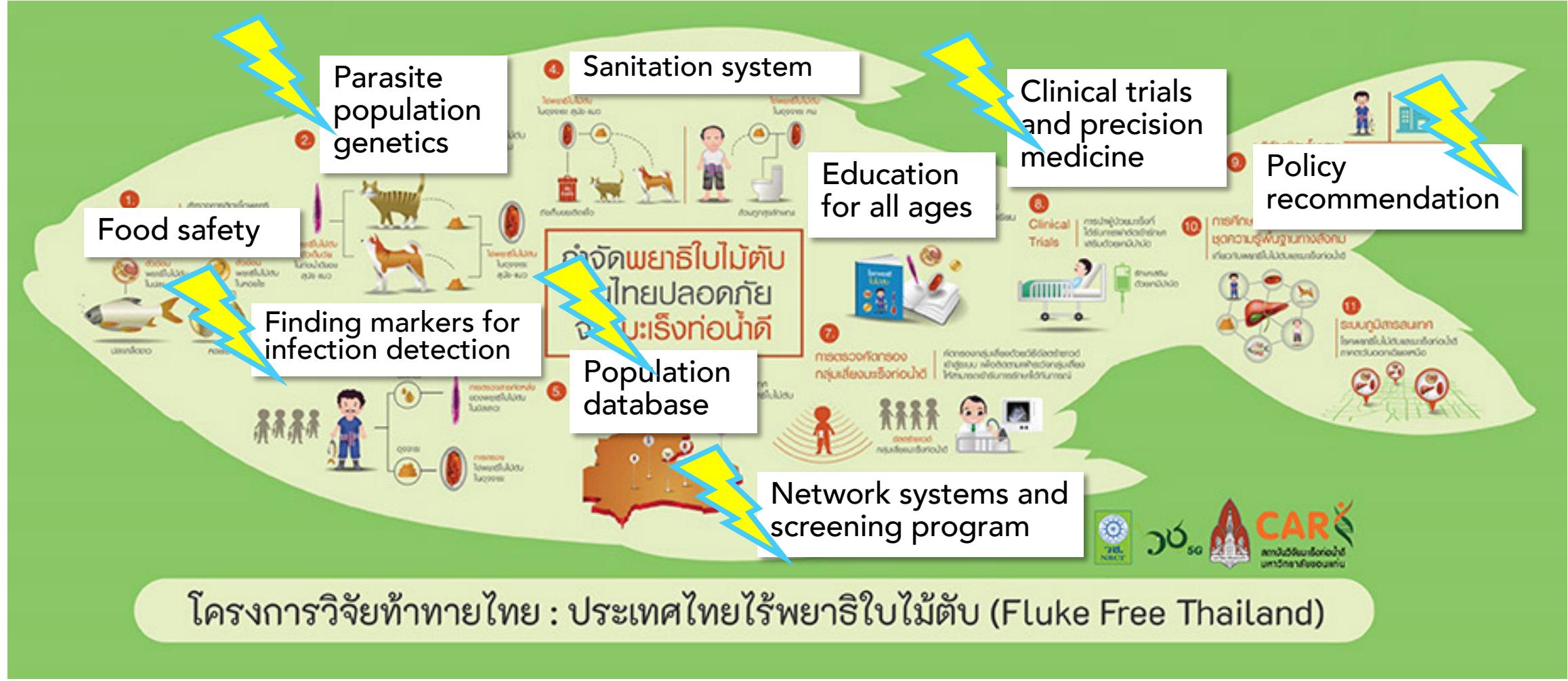
21.8% > 84.5%



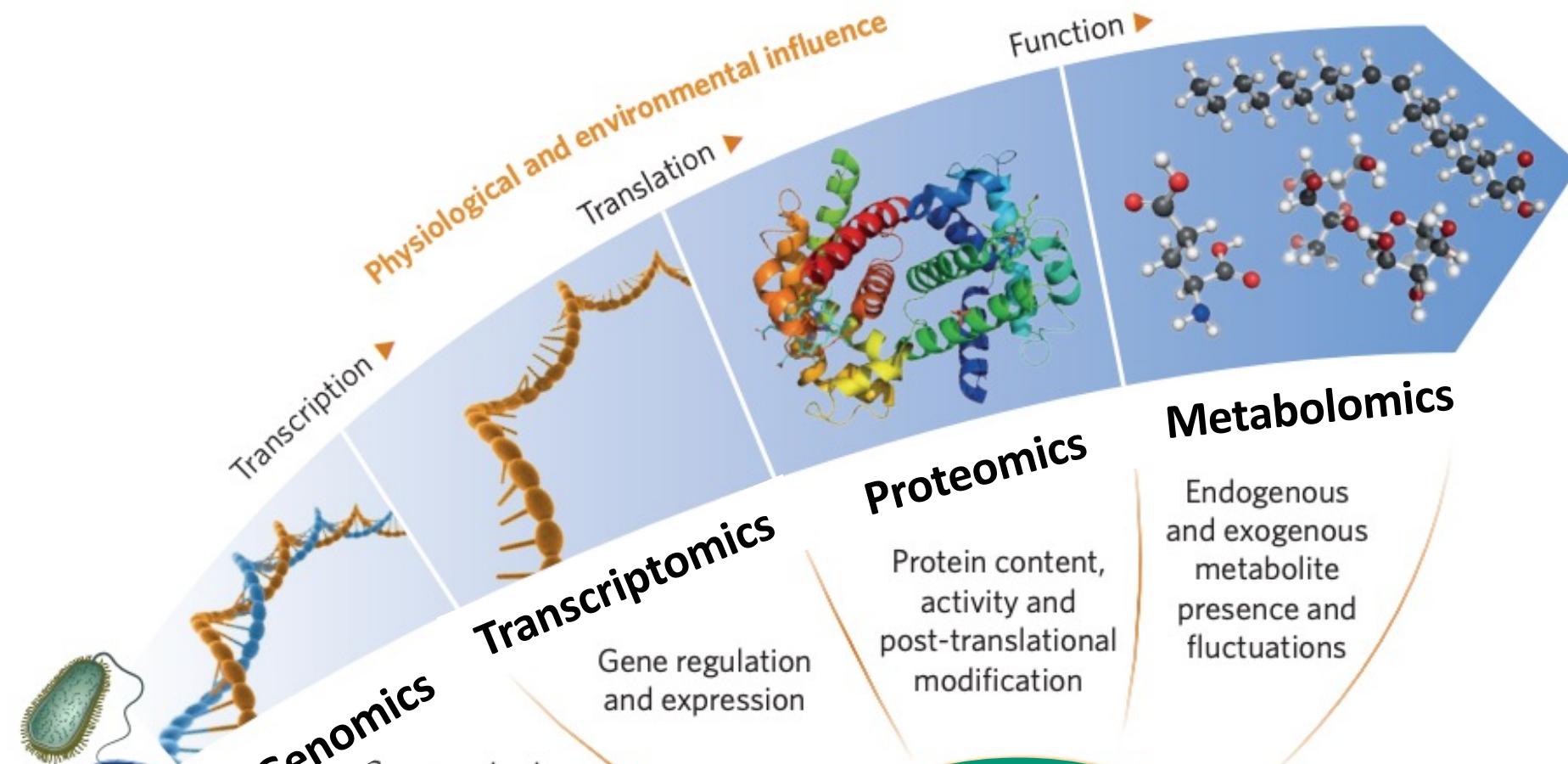
Patients 5 years survival

17.3% > 48.3%

# Integrating multi-omics in healthcare and intervention



## Parasites & Host



## Microbial community

Health and disease states

Environmental perturbations

Phenotypic traits



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UNIVERSITY  
PHENOME  
CENTRE

## Phenome Education and Capacity-building Unit (PECU)

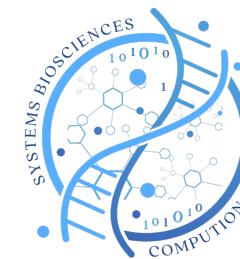
- ✓ Service
- ✓ Training
- ✓ R&D

### Non-degree Programs

- CliNaP-M (Metabolomics short course)
- SARS-CoV-2 Bioinformatics
- Helminth Bioinformatics x 2
- High-throughput Technology and Data Safety (Hi-Tech-DS)

### Degree Programs

- MSc and PhD in Health and Medical Sciences (Systems Biosciences)



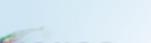
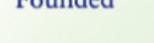
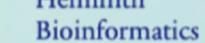
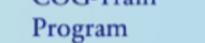
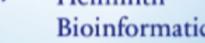
# Local impact, international collaborations

## Training portfolio

# 5 in-house metabolomics short courses

# 3 joint bioinformatic short courses with Wellcome Connecting Science

Both focused on postgraduate students, early career researchers

JUN 2019	DEC 2019	JAN 2020	DEC 2020	APR 2021	JUL 2021	APR 2022	NOV 2022	FEB 2023	MAY 2023
 KKUIPL	 CliNaP-M							 IRURP	
✓ KKUIPL Founded	✓ CliNaP-M Short course #1	✓ UHPLC-QTOF-ESI MS/MS Service Launched	✓ CliNaP-M Short course #2	✓ CliNaP-M Short course #3	✓ Virtual Helminth Bioinformatics	✓ CliNaP-M Short course #4	✓ Virtual SARS-CoV-2 Bioinformatics COG-Train Program	✓ IRURP Symposium 2023	✓ New Service Platforms Launched
 CARs		✓ NMR Service Launched			 wellcome connecting science			✓ CliNaP-M Short course #5	✓ Helminth Bioinformatics - Asia
 MDKU	Imperial College London						 wellcome connecting science	Murdoch University Imperial College London	 wellcome connecting science

# Metabolomics short courses

**ONLINE COURSE**  
INTRODUCTION TO METABOLOMICS  
EXPERIMENT DESIGN,  
PRINCIPLES OF LC-MS AND NMR  
DATA PROCESSING AND ANALYSIS

**ONSITE COURSE**  
HANDS-ON SAMPLE PREPARATION AND  
DATA ANALYSIS WITH HELP FROM  
EXPERIENCED INSTRUCTORS

**ONLINE COURSE OPEN FOR REGISTRATION - EARLY 2022**

**ONSITE COURSE 3-5 APRIL 2022**  
@KKU SCIENCE PARK

**SAVE THE DATE**

**FOLLOW KKUPL AND CLINAP PAGE FOR UPDATES  
ON REGISTRATION OPENING AND OTHER DETAILS**

**SCAN ME**

[bit.ly/CLINAP2022](https://bit.ly/CLINAP2022)

**ClinAPM**  
CLINICAL AND NATURAL PRODUCT METABOLOMICS  
"Phenomics for Precision Medicine"

**This short course will cover:**

- Study design and sample preparation considerations
- Understanding the NMR pulse sequence
- Understanding NMR data acquisition
- Managing NMR data handling and preprocessing
- A crash course in coding
- Working on omics data analysis
- Working on NMR metabolite identification
- LC-MS validation of metabolite assignment
- Understanding gut microbiota profiling
- Understanding gut microbial profile analysis

**February 7-10, 2023**  
Northeastern Science Park,  
Khon Kaen University,  
Khon Kaen, Thailand

**Please note:** All ClinAP-M registrants are eligible for free admission to IRUPR 2023 Symposium on 6 Feb 2023.

**Registration fee**  
Students/Postgraduate students\*  
**6,500฿**  
\*This rate is available for the first 10 seats.

**Standard Registration**  
**8,500฿**

**REGISTER NOW**  
Before January 30, 2023

<https://forms.gle/e4xuEb6U7oE6hXEX6>

**shorturl.at/abgX9** **063-238-9297**  
**@kkupl** **@clinapshortcourseseries**  
**clinapshortcourseseries@gmail.com**





COG-TRAIN  
COVID-19  
GENOMICS  
GLOBAL TRAINING



# Pathogen genomics courses



## Helminth Bioinformatics (Asia) (Virtual)

28 June–2 July 2021

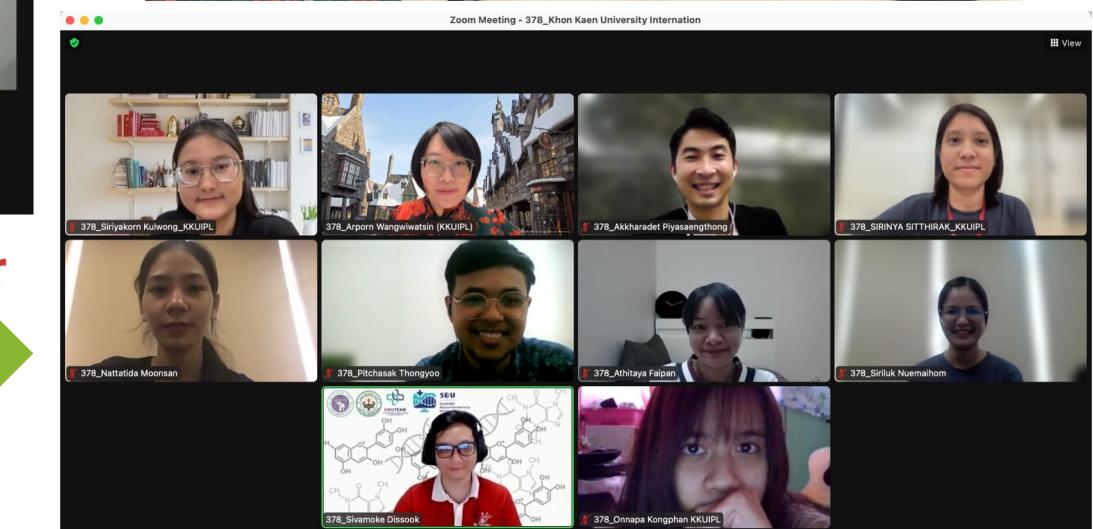
Virtual Course



## SARS-CoV-2 Bioinformatics for Beginners

31 October–2 December 2022

Distributed Classrooms across Asia, Latin America, and Africa



# Bioinformatics AND engagement training



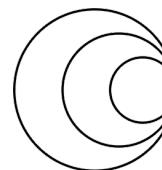
Helminth Bioinformatics - Asia

21-27 May 2023

Khon Kaen University, Thailand



# WCS HELMINTH BIOINFORMATICS AND PUBLIC ENGAGEMENT – ASIA 2023 @ KHON KAEN UNIVERSITY



**wellcome**  
**connecting**  
**science**



**KKU**  
KHON KAEN UNIVERSITY

คณะแพทยศาสตร์ มหาวิทยาลัยขอนแก่น  
FACULTY OF MEDICINE KHON KAEN UNIVERSITY

**CAR**

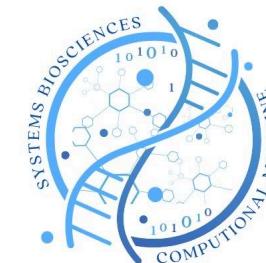


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**Office of Digital Technology**  
University Digital Infrastructure

**MUSEUM & LIFELONG LEARNING CENTER**  
Khon Kaen University  
ศูนย์พัฒนาและเผยแพร่เรียนรู้ด้วยชัด  
มหาวิทยาลัยขอนแก่น



**Parasitology**  
Faculty of Medicine, Khon Kaen University

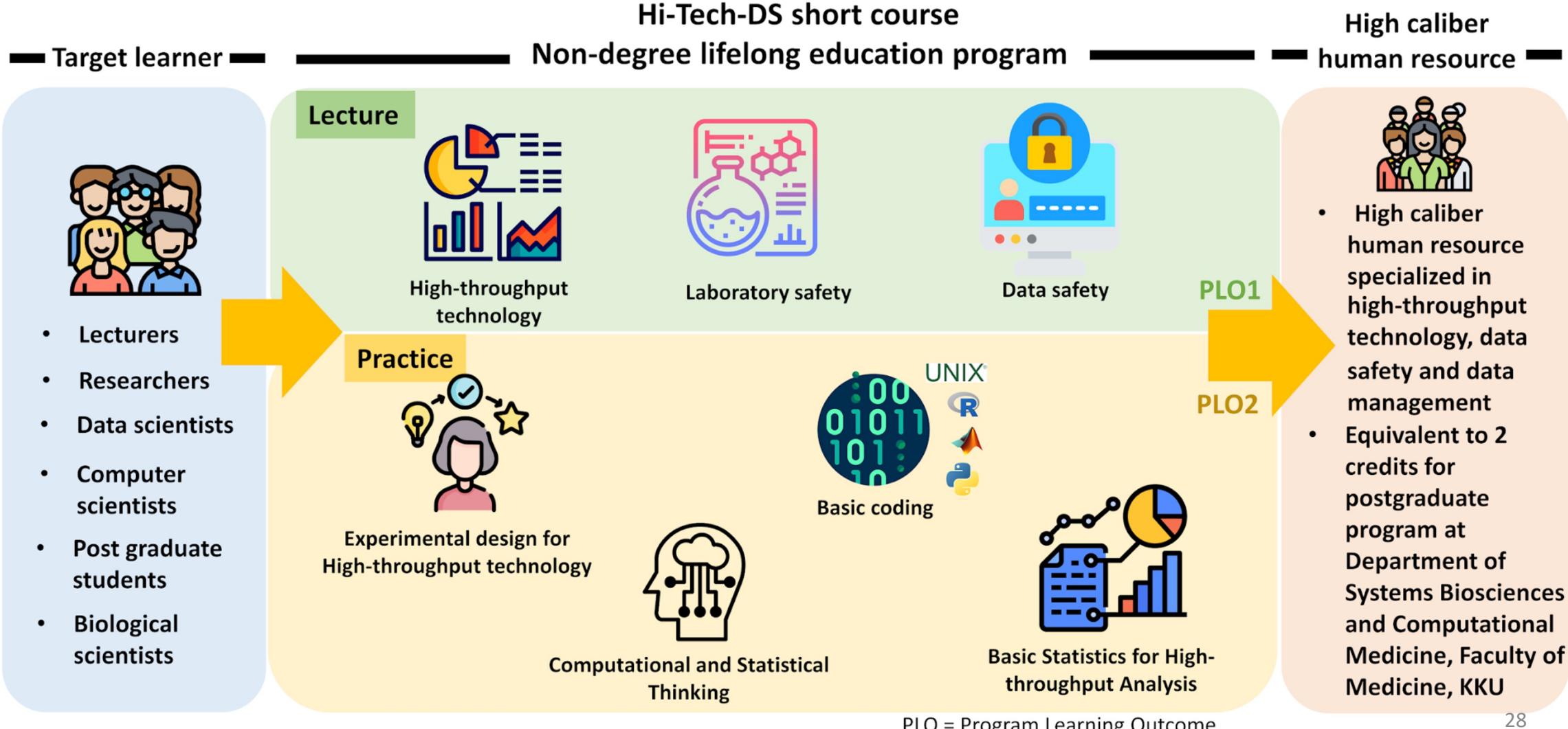
**CPMR**  
COMPUTATIONAL AND PRECISION MEDICINE  
RESEARCH GROUP

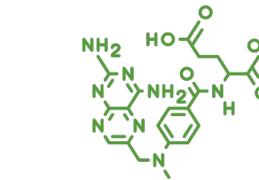


BAYASITA @KKU

# High-Throughput Technology and Data Safety short Course

## Hi-Tech-DS





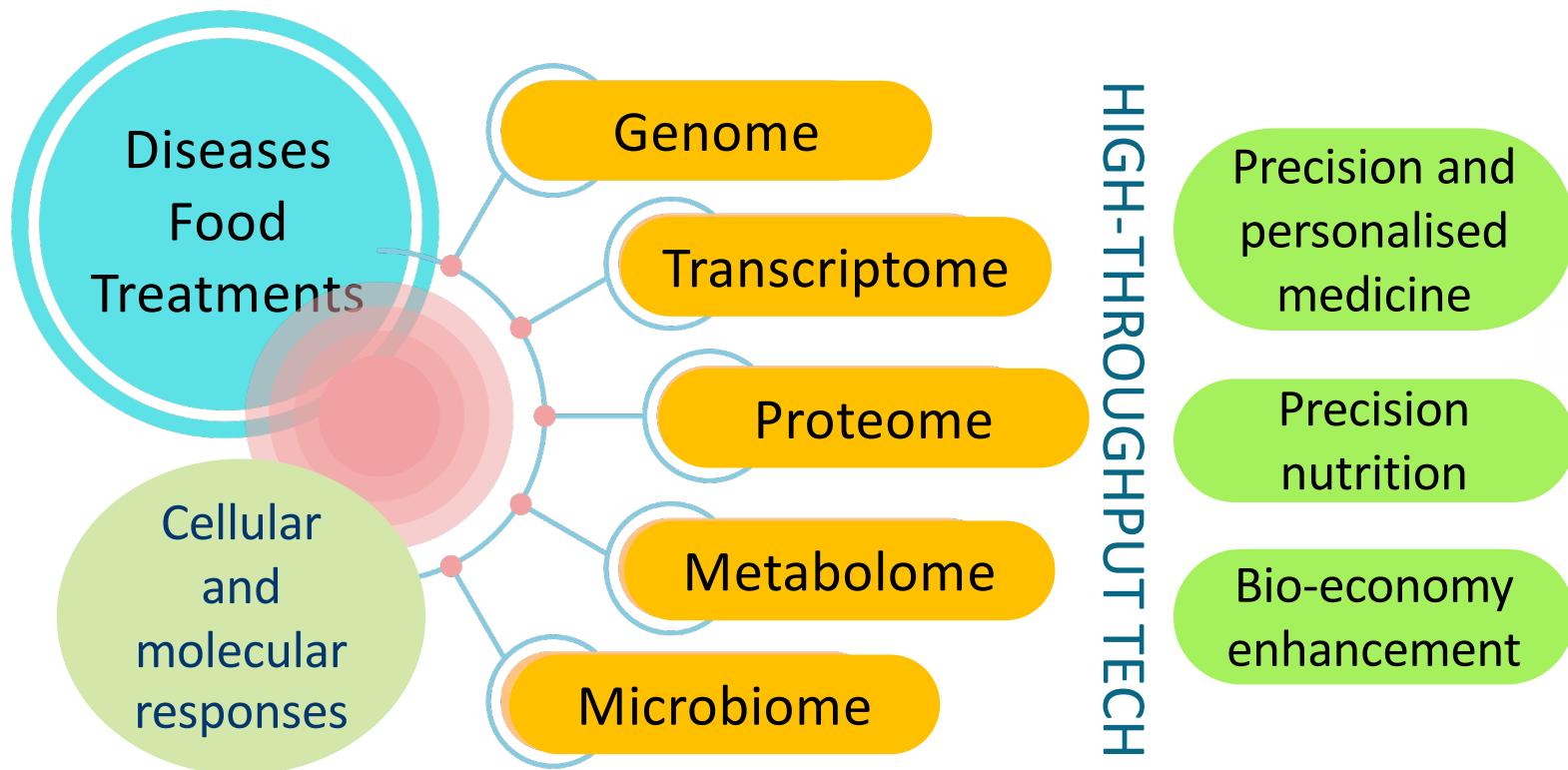
Medical  
Biochemistry

Molecular  
Biology

Data Science

Mathematics

Statistics



# MSc & PhD SYSTEMS BIOSCIENCES PROGRAMS

(Part of Health & Medical Sciences  
Graduate Program)

- Cells and Molecular Biology
- 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
- Technology Creativity and Innovation for Systems Bioscientists

# Something to look forward to



# 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?



# Current limitations and challenges

## HELMINTH RESEARCH

- Specimens can be hard to acquire
- Often available in tiny amount
- Maintaining life cycle is not always feasible
- Specimen quality for high-throughput techniques vs risk & cost
- The variations with environment, climate changes, intervention

## GENOMICS

- Access to capital equipment
- Skills in sample and library preparation
- Cost of sample library preparation
- Cost of sequencing
- Access to computing infrastructure
- Data handling, management, analysis, presentation
- Keep updated with fast-moving trends VS conventional administrative process

**Solution?**

# Find out more & keep in touch



Graduate program: <https://www.facebook.com/systemsbiosciences>

KKU Phenome Center: <https://www.facebook.com/KKUPhenomeCentre>

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

Thai Bioinformatics: <https://www.facebook.com/groups/217299258320806>

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